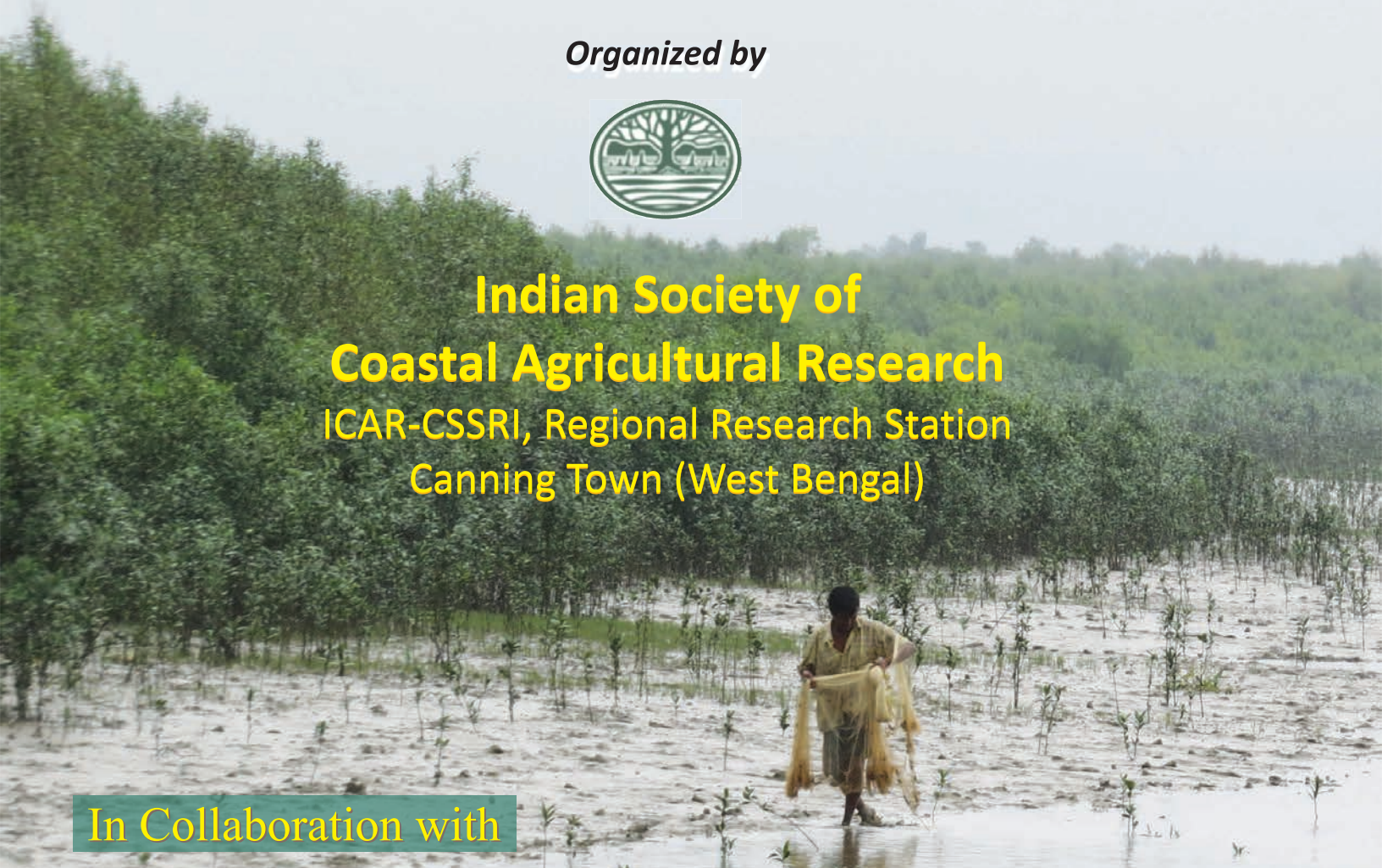
Abstracts

12th National Symposium
on
Coastal Agriculture:
Boosting Production Potential under Stressed Environment

28th September – 1st October 2018



Organized by

Indian Society of
Coastal Agricultural Research
ICAR-CSSRI, Regional Research Station
Canning Town (West Bengal)

In Collaboration with

Inter-disciplinary Society for Advancement of Agricultural Sciences and Technology
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli (Maharashtra)

Dapoli Chapter of Indian Society of Coastal Agricultural Research
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ABSTRACTS

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The society would also like to put on record the painstaking efforts taken by the staff of Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, ICAR-CSSRI, Karnal and its Regional Research Station, Canning Town, West Bengal in organizing the event successfully.

ISCAR is highly indebted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra for providing all the support and logistics for organization of the symposium.

Organizers

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Special Lectures

2nd Dr. J. S. P. Yadav Memorial Lecture

Towards A Green Deal for Coastal Ecosystem with Special Reference to Sundarbans under Changing Climate

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The fact that the Sundarbans, a typical representation of the coastal ecosystem, and a treasure trove of natural resources, is degrading fast under the combined assault of man, nature and climate change, is no longer confined to scientific discussions, but has become a concern in public discourses. The issue at stake being the well being (habitat, health, livelihood and income) of the people, urgent remedial measures are warranted. Amongst the numerous issues seeking solutions, this paper addresses three concerns: i) increasing freshwater scarcity, which is limiting agricultural growth; ii) drainage congestion, causing flooding of farms and farmsteads; iii) and overexploitation coupled with pollution of resources in the coastal waters due to crowding of ventures, leading to fall in provisioning and other ecosystem services. Three innovative approaches are advanced to resolve these critical issues. The first suggestion speaks of closing few identified estuaries by suitable engineering structures, to create fresh water reservoir, and to do away with the need of protection bunds along the closed length on either side of the estuary. The second intervention advocates tidal river management (TRM) to enlarge the estuary sections along the estuary, where beels (large and deep-water bodies) are available. The third intervention is about extending farming in off-coast sea. Unlike land, sea offers the opportunity of practising three-dimensional (3-D) farming in the water column. Several technology models, which enable growing various useful seaweeds, corals, fishes at varying depths, not only offer new areas for farming, but also sequester more carbon, absorbs phosphorous and nitrogen, which are the major pollutants of coastal waters. The planning, design and operationalization of estuary management practices are based on complex hydraulic phenomena. In addition, the built environments always carry the burden of tradeoff, and the suggested interventions are no exception to this rule. Further research is necessary to arrive at balanced decisions as per TEEB AgriFood Framework, for internalization of externalities embedded in the value loss of natural capital. Some of the identified research and data gaps include: estuary regime modelling for design of protection structures, hydro-salinity modelling to settle the competing issues crop *vs* brackish water aquaculture, mapping of coastal ecosystem resources for natural capital accounting (NAC). The suggested interventions, if properly implemented, will turn out to be a green deal – 'minimizing tradeoffs and increasing synergies between enhanced human outcomes (crops, fish, water supply etc.) and the health of the natural environment'.

Special Lecture

'Build Back Better' Coastal Aquaculture Hotspots in India

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Shrimp farms in India generally known as "Aquaculture hotspots" along the coastal belt contributes about Rs.37,871 crores to the export earnings in 2017. 1.2 million ha of coastal area has been found suitable for shrimp farming and out of which about 25% has been already been exploited. In the early years of 2000, when P. *monodon* was facing WSSV and MBV, countries switched to *P. vannamei* and that saved the industry. India was the last on that curve and in 2017, produced an impressive 600,000 tonnes. But *P. vannamei* is now facing huge disease issues. Switching back to *P. monodon* is only a 'band aid' option .In the late nineties, there were serious problems of viral diseases and environmental safety issues, which arose mainly owing to lack of planning and regulation. At present, risk of losing a crop to diseases has increased and profit margins, have decreased due to increased inputs cost and lowered international market price. So there is an urgent need to ensure sustainability of shrimp farming in the country through appropriate technical and policy interventions to ensure economic viability, food safety, environmental soundness, social acceptability, equity and conservation of resources. Building back the better hotspots for the effective aquatic environment management comes in many tiers. The first tier is the pond water and bottom which comes into contact with the shrimp but there is also the second tier such as the outlet canal and the

creek into which sludge and effluent is deposited. Shrimp toilets are excellent disposal systems but where is this waste disposed to? If effluent is undiluted sufficiently, it becomes a "hotbed of disease" instead of "hotspot of production" which will return to haunt the neighbourhood. Diseases whether WSSV, EHP or WFS are affecting the Indian shrimp aquaculture production more than we care to admit. Our low production efficiency has become the new normal. Strenuous efforts from existing players to revive *Penaeus monodon* to create a dual species industry are also seen. Genetics and nutrition have made contributions to the industry but each face their own predicament with farmers. It is too easy to blame poor genetics for all the health and disease issues. Encouraging farmers and hatchery operators to move away from empirical management of the farming ecosystem to more knowledge-based management is the only viable option left in our hand. Community based ecological mangrove restoration can self repair or successfully undergo secondary succession for the revival of coastal aquaculture hotspots in India. Researchable issues on the thrust areas of coastal aquaculture with an integration of agriculture have enormous potential for increasing employment generation and foreign exchange in the country. The above are some items are on the wish list which will be discussed in the presentation to help the industry focus on science in search of a long term solution under stressed coastal environment.

Session I:

Advancement in Natural Resources Management for Sustained Productivity

ANRM 1 (INVITED)

Reclamation and Management of Salt Affected Soils: Issues and Prospects

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The recently unveiled 'Sustainable Development Goals' (SDGs), a set of 17 interconnected global goals, place a critical emphasis on the sustainable management of land and water resources for arresting the land degradation and desertification. Being a signatory to the United Nations Convention on Combating Desertification (UNCCD), India remains committed to achieve land degradation neutral status by 2030. A recent study by ISRO shows that ~30% of the total geographical area (96.40 M ha) of India is undergoing degradation with salinity/alkalinity and associated problems like soil erosion and waterlogging being the major causative factors. Salt-induced land degradation is by no means a new problem; salinity is known to swallow productive farmlands and cause human misery since ancient times. Nonetheless, the problem has attained alarming proportions in the past few decades and the recent salinization trends in the Mediterranean Basin, the Indo-Gangetic Plains and Murray-Darling Basin serve as the grim reminder of the adverse impacts of salinity. Since its inception in 1969, ICAR-CSSRI has made onerous efforts to develop workable solutions for rehabilitating the salt impaired lands with varying extents of success. While some of the technologies like gypsum-based package for sodic lands and salt tolerant cultivars have turned out to be a huge success leading to the productive utilization of over 2.0 M ha degraded salty lands, slow spread of other efficient technologies like sub-surface drainage remains a significant concern. Of late, success has also been achieved in reclaiming waterlogged salt-affected lands in central Indo-Gangetic Plains and the coastal areas through land shaping models. An equal emphasis is being placed to promote resource use efficient integrated farming models and conservation agriculture practices in reclaimed areas for preventing resodification/resalinization, water and energy savings and promoting farm diversification through low water requiring high value crops. All said and done, continual secondary salinization of prime lands despite ongoing reclamation is a cause for concern. Fresh water shortages, rising amendment costs and climate change impacts may further exacerbate the salinity risk with coastal soils likely to be hit hard. While prevention of seawater ingress remains an important goal, every effort is being made to provide immediate relief to the salt-affected coastal communities by developing and popularizing high yielding crop cultivars, promoting rice-fish based integrated farming models and identifying economically important halophyte crops. Tremendous success of land shaping models in coastal West Bengal is a vivid example that efforts underway will shortly culminate into viable technologies for giving a new lease life to the difficult-to-reclaim coastal salt-affected soils.

ANRM 2 (INVITED)

On-Farm Water Management for Enhancing Water Productivity in Coastal Region

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India has 8,129 km long coast line. Its peninsular region is bounded by the Bay of Bengal on the east, the Indian Ocean to its south and the Arabian Sea on the west. In addition, it has two distinct major island ecosystems, the Andaman and Nicobar Islands in the Bay of Bengal and the Lakshadweep Islands in the Arabian Sea. The hinterland of the coastline has varied geomorphic and topographical features of coastal plains, mountains, valley, riverine systems, climatic conditions, soil conditions and water budgets, and a wide range of cultivated crops. The agriculture in coastal area is plagued with adverse land and water conditions. It include (i) intense rainfall at early and prolonged drought spell at later crop stage, and severe surface drainage problem due to non-availability of land gradient, low permeable sub-soils, inadequate field drainage and siltation of river beds causing cultivation of low productive, traditional tall varieties during *kharif* season, and (ii) delay in sowing due to excessive soil moisture and excessive salt accumulation in the soil profile due to tidal waters, lack of assured water supply and poor quality groundwater causing low crop productivity during *rabi* season. Although agriculture in the coastal ecosystem is predominantly rainfed, it is seen as potential areas for bridging the expected national food shortages due to low agricultural productivity and high rainfall. Management of rainwater is, therefore, central and crucial that forms the basis for improvement in the region. Integrated natural resource management is good for planning strategy,

watershed management is good for program implementation and farming system approach is more suiting to beneficiaries. However, looking to the small land holdings in coastal ecosystem, farming system approach seems to be more appropriate. It is an integrated approach on rainwater management dealing with on-farm storage of excess rainwater during monsoon season and recycling the same for irrigation of crops during deficit periods in dry season with the objective to introduce multi-cropping and multiple uses of water in the otherwise predominantly mono-cropped rice areas. Since rice is the main cropping system in the entire coastal region, focus needs to be re-oriented towards an integrated planning for rice-based crop planning which may be compatible with the available land and water resources for improved and sustainable productivity. The various strategies suggested to combat the surface drainage problem are (i) channelization of the catchment and regulated operation of the sluice gates (ii) land and water management through levelling, bunding, land shaping alternatives and improved crop planning, and (iii) adopting improved crop varieties tolerant to high submergence and salinity. Harvesting of excess rainwater through on-farm reservoirs, land shaping alternatives, derelict channels, surface drains and river estuaries during monsoon season would not only provide the means of assured water supply during post-monsoon season but also create the scope of fresh water aquaculture. In addition, instead of saline groundwater alone, conjunctive use of harvested rainwater with saline groundwater through efficient irrigation application techniques like micro-irrigation will be of great use for higher crop productivity and economizing the stored rainwater. However, in this paper, greater emphasis is given on various experiences of on farm water management so as to enhance the land & water productivity, and ultimately towards doubling the farm profitability in the coastal region of the country.

ANRM 3 (INVITED)

Agro-techniques for Enhancing Farmers' Income in the Coastal Salt Affected Soils

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In India, variable estimates (7.0 to 26.1 M ha) of salt affected soils are being reported. Out of the mostly reported area of 6.7 million hectares salt affected soils in the country coastal saline soils is reported to occur in about 1.2 million hectares contributing to 18 per cent, while the inland saline soils and sodic soils contribute to 25 and 57 per cent respectively. By 2025 area projected under salt affected soils in India is about 13 million ha and 20 million ha by 2050. The coastal salt affected soils occur in nine states including Andaman and Nicobar Islands. Out of the1.2 million hectares of coastal salt affected soils around 9 lakh hectares are present in Gujarat (4.61 ha) and West Bengal (4.41 ha). Considering that 75 per cent of the coastal salt affected soils are present in these two states, strong research and development infrastructure has been developed in these two states to work on coastal salt affected soils. In West Bengal, the ICAR-CSSRI, RRS, Canning Town has developed large number of technologies to address the constraints of crop production and suggested ways and means to increase the farmers' income in the coastal area especially, the Sundarbans of 24 Parganas. Some of the major agronomic technologies developed are land shaping and rain water harvesting, *"Ail"* cultivation of vegetables on the bunds, crop diversifications along with their agro-technologies, etc. The economic benefits and socio-economic impact on the adoption of these technologies at framers' levels are discussed in this paper. In Gujarat, the research and development activities on salt affected soils are done through the ICAR-CSSRI, RRS, Bharuch and through special research station for coastal salt affected soils at Danti under NAU, Navsari. To improve the farmers income and socio-economic conditions many technologies have been developed, including introduction of new crops, water conservation and utilization, the bio-reclamation through Gattan panic grass cultivation, farm pond technologies for water conservation and utilization, land configuration, mulching technology for use of poor quality water, advantage of improved irrigation methods and their adoption rate. Further large-scale adoption of micro irrigation systems by the farmers in coastal districts have increased their socio-economic conditions. In addition, the adoption of sub surface drainage technology developed at the Soil and Water Management Research Unit has got a wide acceptance among the farmers in the coastal districts of Bharuch, Surat and Navsari. The relative economics of these improved practices are discussed. The coastal agricultural research station, at Panvel in Maharashtra has concentrated on varietal development especially rice varieties and agro-techniques with special reference to cultural practices and integrated farming systems. Among the different AICRP centres, Bapatla takes care of coastal salinity problems in Andhra Pradesh. The technologies developed, include management and use of poor quality water and use of micro irrigation and sub surface drainage. The improvement in the socio-economic aspect on large scale adoption is presented in the paper. Realizing the need for reclamation of these salt affected soils, the GOI under RKVY has approved a project for

Reclamation of Problematic Soil with a financial assistance of 15000 rupees per hectare for reclamation of salt affected soils. The paper also indicates the thrust areas for research and development for the management of coastal salt affected soils along with some constraints of adoption.

ANRM 4 (INVITED)

Assessment and Management of Natural Resources of Coastal Gujarat towards Enhancing Productivity and Ensuring Food Security

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Salinity of soil and water is a major constraint in enhancing productivity and ensuring food security. The Gujarat State is sharing the longest coastal line in the country *i.e.,* 1600 km. Salinity problems are increasing at an alarming rate, more particularly in the irrigation command areas and coastal area. Out of 67.40 lakh hectares area affected by coastal and inland soil salinity/sodicity in the country, Gujarat has the largest salt-affected lands (21.05 lakh ha) which include 4.62 lakh ha coastal saline soils, 10.98 lakh ha inland saline soils and 5.45 lakh ha inland alkali soils. It is reported that Gujarat, in general received less rainfall during the period 1960 - 1990 compared to 1991 - 2008 and in particular Bharuch district received average annual rainfall of 753 mm during 1975 - 2011 as compared to 895 mm for the period 2000-2011. The average annual rainfall during the period 2000-2011 was increased by 19 per cent over long term average (1975-2011). It is also observed that the intensity of rainfall was more during later period of monsoon for 2000-2011 as compared to 1975-2011. Considering the climatic and edaphic factors, crops traditionally cultivated in Gujarat were highly appropriate. In Gujarat state the soils are ranging from sandy and saline to deep black clayey. Sand to sandy loam and saline soils are confined to the Kutch agro-climatic region and North Gujarat and partly to North Saurashtra. The soils predominantly found in Kutch are sandy and saline and receives the lowest rainfall in the state (346 mm per annum). The crops that have been traditionally cultivated in Kutch include pearl millet and sorghum. North Saurashtra has two dominant soil types: shallow to medium black and shallow to medium black calcareous. The average rainfall is about 633 mm per annum. While parts of North Saurashtra have medium black and poorly drained soils, South Saurashtra is completely covered with shallow to medium black calcareous soils. The average rainfall here is 877 mm per annum. Groundnut, sorghum, and pearl millet are the crops traditionally grown in South Saurashtra. Central Gujarat is covered with deep, medium black to loamy sand and sandy loam to sandy soil and average rainfall has been recorded at 822 mm per annum. The traditionally cultivated crops here are rice and cotton. South Gujarat, along with Southern Hills, characteristically comprises deep black clayey and deep black with coastal alluvial to medium black soils while the northern most region of South Gujarat is home to deep black to medium black poorly drained to loamy soils. The average rainfall in South Gujarat and the Southern Hills is 1207 mm per annum and 1819 mm per annum, respectively. The crops traditionally grown here include cotton, rice and sorghum. Gujarat witnessed an increase in groundwater extraction for irrigation purposes over the past two decades. This has been mainly caused by the shift in cropping patterns towards water intensive crops such as wheat, sugarcane, rice, and cotton. Seawater ingress besides marine influence creates huge salinity in the coastal regions. Salinity in coastal soils, unlike that in inland soils is caused during the process of their formation under marine influence and subsequently due to periodical influence of saline water either through inundation or capillary rise from shallow underground water or saline water irrigation. Dominant salts occur in coastal saline soils are sodium chloride and sodium sulphate with loads of soluble cations with dominance of Na followed by Mg, Ca and K and chloride as the predominant anion followed by sulphate. The coastal land needs protection against tidal inundation through protective embankment like bio-shield for control of sea ingress, soil erosion and salinity. Monsoonal rainfall intensity has been increased during later period of Monsoon in the western coastal region. Unsuitable climatic conditions, soil and water degradation, marine influence in the coastal areas and secondary salinisation in irrigation command areas decreased the productivity of arable farming. Technological knowledge generated till date has helped in solving the problems in large tracts of land in different regions to restore their full productive potential. However, new challenges either due to changing climate or land use anomalies, leading to exponential increase in the area under salinity. With new challenges cropping up, soil salinity related stresses, particularly in coastal area are more pronounced and more damaging to crop production. The productivity of these soils can be restored by management and reclamation using different available technologies. Providing of adequate drainage, leaching out of soluble salts below root zone, cultivation of salt tolerant varieties/ halophytic plants, bio-saline agriculture, plantation of bio-shield including mangroves in coastal area, etc have to be ensured for

enhancing the productivity of these soils and ensuring food security. For management and enhancing the productivity in black soils of Gujarat, the different interventions have been evolved.

ANRM 5

Suitability of Irrigation Water from Palghar and Dahanu Tahsil of Coastal Konkan

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To evaluate the quality status of groundwater for irrigation, hundred water samples were collected from different locations of Palghar and Dahanu Tahsil of Coastal Konkan of Maharashtra in May 2016 (Pre-monsoon) and October 2016 (Post-monsoon). The pH, EC, SAR and RSC values of irrigation water collected in pre-monsoon season were high as compared to post monsoon season which might be due to increased rainwater dilution effect. According to salinity classes, in May 61% and in October 67% water samples were categorized as C_1 class (i.e. safe for use), while remaining 39% in May and 33% in October water samples were categorized as C_2 in May. On the basis of SAR, in the month of May 50% and in October 54% water samples were found safe (S_1) for irrigation; further in May 47% and in October 43% water samples were moderately safe for irrigation, while remaining 3.0 per cent water samples were marginally unsafe for irrigation purpose in May and October. According to RSC, 77% irrigation water samples in May and 79% water samples in October were suitable for irrigation having RSC < 1.25 me L^{-1}. 10% water samples in May and in October were marginally suitable, while 13% water samples in May and 11% water samples in October were unsuitable for irrigation.

ANRM 6

Land Shaping: Technique for Improving Soil and Water Quality and Productivity of Degraded Land in Coastal Region

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Land degradation in coastal region of India is the biggest threat because *of its adverse impact on* food security, livelihood and environment. It leads to a significant reduction of the productive capacity of land. In India, about 8 m ha land in 3 agro-ecological regions (AERs) 18, 19 and 20 which cover major parts of the coastal region are degraded by water erosion, salt accumulation, acidification and waterlogging processes of land degradation. Implementation of sustainable land management practices for arresting land degradation and enhancing productivity is essential for achieving food security of the country and livelihood security of the farming communities living in the vulnerable coastal ecosystems. Land shaping techniques like farm pond (FP), paddy-cum-fish (PCF) and deep-furrow & high ridge (DFHR) where original land has been modified to create high, medium and original low land situations and water harvesting structures provide scope to alleviate salinity and waterlogging problems of coastal land. Studies showed that high land/ ridges created under land shaping were free of water logging during monsoon season. Soil salinity build up in the profile of the different land situations was less compared to control (without land shaping). Among the different land situations, salinity in the root zone was less in high land followed by medium and low land. The pH of harvested rain water was in the normal range throughout the year, however, salinity varied with seasons and it reached a peak value before onset of monsoon and was lowest during monsoon. The quality of harvested water was found to be suitable for agricultural purposes. The organic carbon (OC) and available N and P were higher while available K, Na, Ca, Cl and SO_4 content were lower under different land situations created under land shaping techniques compared to control. The OC content in upper soil layer was higher in high and medium land than in low land. The concentrations of available K, Na, Ca, Cl and SO_4 were less in high land situation. Waterlogging and soil salinity were reduced in the high land/ ridges providing scope for cultivation of diverse multi-crops round the year. The rainwater harvested in pond/furrows created a source of irrigation water which is highly scarce in the region during dry season and also provided a scope for more profitable integrated cultivation of crop and fish and crop and fish separately along with vegetable, fruits and other high value

crops. Financial analyses of FP, PCF and DFHR techniques for assessing long term viability of implementation of these techniques under coastal environment revealed that the Internal Rate of Return (IRR) was 46%, 42%, and 36% under FP, PCF and DFHR, respectively. Similarly, Net Present Value (NPV) was Rs. 285059, Rs. 232450, and Rs. 96817; BCR was 1.58, 1.55, and 1.20 and payback period was 1.41, 1.78 and 2.13 years, respectively under FP, PCF and DFHR land shaping techniques. Financial analysis of all land shaping techniques under study indicated that investment on such interventions were financially viable and attractive proposition for the coastal region.

ANRM 7

Biological Properties of Different Soil Types of Coastal Region as Influenced by FYM Application

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An incubation study was undertaken in glass house at Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri during *Kharif* 2013 to investigate the effect of FYM application on the biological properties of different soil types of coastal region of Maharashtra. The experiment was laid out in factorial completely randomized design with soil types as a main factor and FYM application (with and without FYM) as sub-factor comprising eighteen treatments combinations replicated thrice. Periodical observations were undertaken at 30, 60, 90 and 120 days after incubation (DAI). From the experiment it was observed that, the biological properties like CO_2 evolution, microbial biomass carbon, microbial count of bacteria, fungi, actinomycetes, dehydrogenase activity, urease activity as well as phosphates activity increased with the period of incubation irrespective of the soil type. Application of FYM further resulted in significant improvement in these properties. The CO_2 evolution, microbial biomass carbon, microbial count of fungi and urease activity were increased up to 60 DAI. However, the microbial count of actinomycetes increased up to 90 DAI and there after it decreased gradually. The microbial count of bacteria decreased from 30 DAI to 120 DAI, while dehydrogenase and phosphatase activity showed irregular trends irrespective of the soil type. In the present investigation, the biological properties of the different soil types of Konkan region were modified by FYM application. Further it also resulted in significant improvement in the overall soil quality component.

ANRM 8

Spatial Changes in Physicochemical Properties of Water and Sediment at Selected Places of Sundarban

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Indian Sundarban is an UNESCO World Heritage Site listed as Sundarban National Park. Sundarban Biosphere Reserve encompasses mangrove forest along with reclaimed habitat of 5366 km^2 for 4.1 million people. The Sundarbans contain the world's largest coastal mangrove forest, with an area of about 10,000 km^2, of which about 6,000 km^2 are located in Bangladesh and about 4,000 km^2 in India. Various physico-chemical parameters of river water at five selected places of Sundarban *viz*., Sandeshkhali, Jharkhali, Patharpratima, Frazerganj and Nischintapur (control site) were estimated in different seasons and change patterns were explained. Sediment characteristics of the same stations selected were measured for the purpose of comparison. Significantly lower dissolved oxygen (4.96 ± 1.49) were recorded at Sandeshkhali as compared to other stations especially during monsoon months when DO as low as 3.04 ppm was recorded. Sandeshkhali sampling point recorded the highest total alkalinity value (116.67 ± 5.07) which was followed by the control station, Nischintapur (107.34 ± 12.26). The nutrient parameters (PO_4-P, NO_3-N and SiO_3-SiO_2) followed similar pattern of spatial variation with higher values at Nischitapur and Sandeshkhali, the sampling centres with upstream freshwater discharge. The two sampling centres were characterized by higher freshwater discharge, higher turbidity and lower photosynthetic primary production.

Jharkhali mangrove soils were richer in organic carbon (0.7-0.9%) than the river sediment (0.1-0.3%) indicating significant role of mangrove litters in soil carbon sequestration. A few samples from Sandeshkhali in upper Sundarban zone also measured very high organic carbon (>3%) but for quite different reason, like high anthropogenic activities, as there was almost no or sparse mangrove plants available. Salinization in Jharkhali soil during May was indicated by the very high specific conductivity (9-11 dS m^{-1}) as compared to Nischintapur (1.2-2.5 dS m^{-1}). Total nitrogen in soil at Sandeshkhali has gone up very high during pre-monsoon (0.154%); the river sediment also contained 0.140% N at the same time. Unlike Jharkhali in middle of Sundarban, where a good population of mangrove plants were available and contained 0.07% total nitrogen in the same season, Sandeshkhali had no or very sparse number of mangrove species present. Therefore, enhanced anthropological activities might be a responsible factor for boosting up organic carbon content. On the other hand, soils from Patharpratima and Frazerganj mangrove areas recorded 0.053% and 0.048% total nitrogen respectively, in monsoon in comparison to 0.036% and 0.031% respectively in pre-monsoon. Overall, spatial variations in mangrove population, tidal influence and human population and activities played significant role in changing of water and sediment quality parameters.

ANRM 9

Energy Potential and Properties of Water: A Case Study of Acro - Thermal Hot Spring

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A thermal water spring or hydrothermal spring is a place where warm or hot groundwater comes out from the earth on a regular basis for at least a predictable part of the year, and its temperature is significantly above the ambient ground temperature. Each thermal spring is unique. Even spring that looks same; differ in characteristics such as temperature, flow rate and chemistry of water. This paper described the study of water quality parameters and energy potential of Unhavare (17.98^{o} North latitude and 73.25^{o} East longitude) acro-thermal hot spring containing sulphur. Thermal spring water samples were collected in one litre bottles for chemical analysis. The various physical and chemical properties like temperature, pH, total dissolved solids, EC and sodium, chloride content in the water was measured. The discharge and temperature variation of the outlet spring water was monitored. The energy potential based on yearly discharge and average temperature was estimated using convective heat flow model.

ANRM 10

Microbial and Enzyme Activities of the Salt Affected Soils in West Coast Region of India

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Soil salinization is one of the most important land degradation process. Understanding the microbial and enzyme properties of salt affected soils would help to decide the countermeasure for improving the productivity of these soils. The present study was aimed to investigate the effects salinity under low soil pH (acidic soil reaction) on soil microbial and enzyme activities. Representative soil samples (0-0.15 m depth) from 240 different locations in coastal districts of Maharashtra and Goa were collected. Based on the electrical conductivity (EC), the soils were classified in to five classes as: non-saline (NS, < 2 dS m^{-1}, 0.62 dS m^{-1}), slightly saline (SS, 2-4 dS m^{-1}, 3.42 dS m^{-1}), moderately saline (MS, 4-8 dS m^{-1}, 5.78 dS m^{-1}), strongly saline (STS, 8-16 dS m^{-1}, 11.72 dS m^{-1}) and very strongly saline (VSTS, >16 dS m^{-1}, 20.12 dS m^{-1}).The soil pH in the different salinity levels ranged from 5.17 to 6.40.These soils have co-existence of soil salinity with low soil pH *i.e.*, soil salinity and acidity. As expected, all the exchangeable cations (K, Na, Ca and Mg) studied were found to increase with increasing salinity level. In all the categories, the exchangeable Na was most dominant among all the cations. The soil organic carbon varied insignificantly with salinity level. The soil microbial activity - basal soil respiration (BSR), soil microbial biomass carbon (MBC), soil microbial biomass nitrogen (MBN), MBC as a fraction of SOC and enzyme activities - dehydrogenase, phosphatase and urease decreased significantly ($p<0.05$) with increasing salinity level. On the contrary, metabolic quotient increased with increasing salinity and this revealed the environmental stress on the microbial population. Significant ($p<0.05$) negative correlation of EC with MBC (r= -0.83), MBN (r= -0.83), BSR

(r= -0.92), dehydrogenase (r=-0.78) and phosphatase (r=-0.90) confirmed the depressive effect of salinity on the soil microbial and enzyme activity in salt affected soils of coastal region. Suitable countermeasures need to be taken up to alleviate the depressive effect of high salt content on the microbial and enzyme activity for the sustainable crop production in West Coast region of India.

ANRM 11

Assessment of Quality of Irrigation Water from Ponds of Raigad District of Konkan

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An experiment was conducted to study water quality of 49 ponds in Raigad District, Maharashtra in the pre and post monsoon season *i.e.,* May 2017 and December 2017. The result obtained from investigation revealed that all water samples from Raigad district were neutral in reaction. In case of EC, water samples, were categorized as C_2 and C_3 salinity class. Among all the cations Na^+ was dominant in water followed by $Ca^{++} > Mg^{++} > K^+$. The relative proportion of anions in irrigation water was in sequence of $HCO_3^- > Cl^- > SO_4^{--} > CO_3^{--}$. In all water samples, carbonate was absent; therefore, the quality of water is good. According to SAR, 93.87 per cent water samples were categorized as S_1 class and 6.12 per cent water samples were categorized as S_2 in May, while, in December, 100 per cent water samples were categorized as S_1 class. The pH, EC, cations, anions as well as boron, SAR and RSC values of irrigation water collected in pre monsoon season (May 2017) were high as compared to post monsoon season (December 2017).

ANRM 12

Soil Physicochemical Properties, Primary Nutrients Content and Microbial Activity in Coastal Saline Soils of West Bengal: Effect of Land Use Systems

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An experiment was conducted to study the effect of land use systems on soil physicochemical properties, primary nutrients content and microbial activity in coastal saline soils of West Bengal. Samples were collected from different land use systems viz. land shaping plots (high, mid and low land), zero tillage (ZT), conventional tillage (CT) and reduced tillage (RT) with rice-rice (R-R) and rice–cotton (R-C) rotations, guava orchard and mangrove cultivation. The soil samples were collected in triplicate from two depths (0-15 and 15-30 cm) for this study from the above mentioned land use systems adopting standard procedures. Higher mean pH values were observed in those land uses where no residue was added compared to the residue added site**s.** The pH of Rice-Rice Reduced Tillage site with residue addition (R) was 8.43 and 8.74 without residues (NR). The reduced pH in the latter might be attributed to the acidity developed due to decomposition of crop residues. The EC of the soil in the different land use systems were found to be low might be due to the leaching of salts in the monsoon and little capillary rise of salt rich water in winter. EC values in the studied systems ranged from 0.02 (R-R, RT-R) to 0.1 (R-C, CT-R) dS m^{-1}. The available nitrogen content of the different land use systems was mainly in medium range whereas P and K were medium to high. Low available N might be ascribed to the higher losses of fertilizer nitrogen through denitrification in salt affected ecosystems and/or greater demand of soil microbes for nitrogen. In R-R ZT-R plot the available N content was 478 kg/ha which was much higher compared to the mangrove plantation 232.83 kg ha^{-1} where no fertilizer N was added. The availability of N, P and K was higher in plots where crop residue was added compared to non residue added plot might be due to greater nutrient recycling through increased microbial intervention and less nutrient losses. The P content of the guava plot was higher (21.80 kg ha^{-1}) than mangrove plot (10.47 kg ha^{-1}). This might be due to the better mycorrhizal association in guava compared to mangrove. The microbial biomass carbon was found to be highest in Rice-cotton conventional tillage with residue addition (438 mg kg^{-1}) compared to when no residue was added (387 mg kg^{-1}). MBC in conventional tillage plot was also higher than zero and reduced tillage plot may be

due to better aeration with tillage. A negative correlation was observed between EC and MBC irrespective of the treatments. The FDA activity was found to be higher in all the land use systems when residue was added compared to without residues. This shows that residue addition increases the microbial activity due to better ambient environment as well as energy supply to microbes. The microbial biomass carbon and FDA activity were found to reduce with EC of the soil as higher salt accumulation created a stress condition for the microbial growth. Agro forestry based cultivation was found to be a better option in reclaiming the salt affected soils as they improve drainage by higher evapo-transpiration rate and also addition of organic matter in the form of leaf litters. Land shaping technique was also found to be suitable in coastal saline soils in reducing the salt stress to crops.

ANRM 13

Analysis of Water Resources in Gosaba Island of Indian Sundarban using Remote Sensing and GIS Tool

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Gosaba island of Indian Sundarban comes under the coastal saline zone of West Bengal. Non-availability of quality water for irrigation is one of the major limitations for growing crop during post monsoon season. In order to explore the possibility of increasing cropping intensity of Gosaba region a study was conducted to analyze the distribution and seasonality surface water resources over the island as well as its suitability for irrigation with respect to salinity. Water bodies and agricultural lands distributed over the villages were delineated with help of Quantum GIS using Google earth images and Sentinel-2 images as base maps. The pattern of distribution of water bodies among the villages was studied by overlay analysis. The seasonal variation of water depth (from reference ground level), pH and electrical conductivity (EC) were measured at weekly interval from 19 selected ponds and one canal point. Five piezometers were installed at different land situations to observe the seasonality and quality of ground water as a comparison. The study revealed that the village Uttardanga has the highest area under water body. The seasonality pattern showed that the EC of pond water sharply decreased after the monsoon rainfall and remained low till end of January. It was also observed that the EC varied widely across the ponds. There was strong correlation between the depth of water level and EC of most of the pond water. The results also showed similar seasonal variation of water depth and EC of piezometers under study. The result gives us a fair idea about the distribution of ponds that could be used as potential source of supplementary irrigation to the post-monsoon crops.

ANRM 14

Study of Soil Physicochemical Parameters and Humic Components in Relation to Salinity in Different Landforms in a Coastal Soil of West Bengal

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Soil organic matter (SOM) contains almost all essential plant nutrients and plays a pivotal role in crop production. For sustainable utilization of soil resources, SOM should be maintained at a threshold level. The soil salinity and cropping behaviour under different landforms also have an important influence on soil organic matter. In this study soil samples were collected from three different villages of Gosaba Block (Lat. 22° 09' - 22° 10' N; Long. 88° 47' - 88° 48' E) of South 24 Parganas district of West Bengal (India) coming under three different landforms namely, cultivated deltaic (CD), mudflat (MUD) and depressed low-land (DL). Soil sorptivity and physicochemical characteristics like soil texture, pH, EC, organic carbon etc. were studied. Soil organic matter and its humic components namely, humic acid and fulvic acid for different soils were also analyzed for the coastal Block. The cultivated deltaic (CD) soil observed highest steady state cumulative infiltration (5.0 cm) followed by mudflat (MUD) soil (3.5 cm) and depressed low-land (DL) soil (1.9 cm). The organic carbon content of all soils was medium (0.54%) to high (1.28%), salinity was low to high (3.6 - 13.7 d Sm^{-1}). The steady state cumulative infiltration of deltaic soils was higher than depressed low-land soils because of higher fulvic acid content in deltaic soil (0.14 - 0.15%) than depressed low-land soils (0.09 - 0.1%). The humic acid: fulvic acid ratio decreased with soil depth. The relation between sorptivity and % clay, pH, EC, porosity and humic acid were highly significant, exponential and negative (r = -0.81, -0.89, -0.87, -0.88 and -0.86, respectively).

ANRM 15

Effect of Non-Woven Jute Agro-Textile Mulches on Improvement of Soil Health and Broccoli Production in Coastal Alluvial Soil

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Non-woven Jute Agro-textiles (JAT) are special textiles, which are manufactured by processing the jute fibres through garneting cum cross lapping followed by needle punching loom for mechanical bondage. Jute Agro-textiles used for agriculture varies from 250-750 gsm with thickness 3-6 cm, width 100 ±10 cm. They have very high porosity and absorb 500% water by weight and can retain moisture for long time. It has very high carbon to nitrogen (C:N) ratio. Non-woven JAT of 300 and 500 gsm were applied as mulch in broccoli production system and compared with plastic mulches at coastal alluvial soils of South 24 Parganas district of West Bengal. Steady increase in moisture retention capacity in all the agro-textile mulches was observed over control. However, in case of 500 gsm JAT mulches seedling mortality was found to be higher during crop establishment stages due to excess moisture content in the root zone. Irrigation requirement reduced drastically in case of both the JAT mulches. Weed population was suppressed from 50-80% over control under JAT mulches. Bacterial and fungal population in the root rhizosphere increased significantly over control. Availability of nitrogen, phosphorus and potassium increased in the rhizosphere due to increase in population of *Rhizobium sp*., phosphate and potassium solubilising bacteria in favourable temperature and humid condition. Highest yield of broccoli was observed in 300 gsm JAT mulches compared to other treatments. It was observed that the 500 gsm agro-textile mulches could be used for three seasons, whereas, 300 gsm agro-textile mulches could be used for two seasons. It could be concluded that due its repeated use, environmental benefits and capacity of enhancing crop yield; farmers economic return could be enhanced 2-3 folds with application of JAT in high value vegetable crop like broccoli.

ANRM 16

Delineation of Waterlogged Areas through GIS and Scope for Cultivation of *Typha sp*.: An Emergent Hydrophyte in Coastal Waterlogged Areas

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Adoption of conventional agriculture in waterlogged areas always remains a challenge due to changed physical, chemical and microbiological properties of waterlogged soils. Even under such limitations a number of economically important plants are cultivated under waterlogged condition. Such interventions in low profile play an important role in sustaining livelihood of the people in waterlogged affected areas. The cultivation of aquatic food crops like *Typha*, a clonal species with ability to form monospecific communities in waterlogged areas has commercial importance. With traditional acceptance they have demand in market. Built-in survival mechanisms of extensive tissue porosity to cellular tolerance at biochemical levels endows remarkable resilience to *Typha* to grow under waterlogged condition. These resilient and stable agricultural system provides means to earn and live under excess water scenarios. Growing waterlogging resilient commercial crops like *Typha*, makes the system significantly remunerative. The LISS III data (1:50,000 scale) was analyzed to delineate waterlogged areas for Typha cultivation. The crop was evaluated for their growth performance in delineated area for suitability of their cultivation in similar waterlogged and adjoining areas elsewhere. At N level of 90 kg ha^{-1} plants maintained better chlorophyll level when applied as basal compared to other treatments of 0 and 30 kg N level. The net photosynthesis rate (P_n) at 90 kg ha^{-1} N level was significantly higher at 15.77 μ mol CO_2 m^{-2} s^{-1} in comparison to net photosynthesis rate at 30 kg ha^{-1} and without N fertilizer treatment. Both the fertilizer levels and stage of application had significant effect on net photosynthesis rate. The benefit for farmers can go upto Rs. 87500 ha^{-1} to upto Rs. 203000 ha^{-1} if farmer himself is engaged from cultivation to retail marketing, where as a trader earns about Rs. 115500 ha^{-1} by involving in knitting and marketing after purchasing leaves from farmers.

ANRM 17

Periodical Variations in the Irrigation Well Water Quality of Murud and Dapoli from Coastal Konkan of Maharashtra

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Periodical variations in the irrigation well water quality was studied for 25 wells from Dapoli and 25 wells from Murud of coastal Konkan (M.S.) in first week of December 2016, March 2017 and June 2017. All *rabi* and *rabi* hot weather crops are irrigated with the water from these wells during this period. Dapoli is at a higher altitude (244 m) whereas Murud is at the sea level. These two locations are 7 km apart from each other. There is difference in the quality of ground water at both locations. The properties *viz.* pH, EC, cations (Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}), anions (HCO_3^-, CO_3^{2-}, Cl^- and SO_4^{2-}), boron, sodium adsorption ratio (SAR) and residual sodium carbonate (RSC) were estimated and their respective water quality classes were decided. The result obtained from investigation revealed that the well water samples from Dapoli were within the safe limit throughout the irrigated cropping season. As far as salinity hazard, RSC class and chloride content are concerned, most of the irrigation well water samples from Murud were under moderately safe limit from March. The relative cation contents in well water samples of Murud and Dapoli were $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ and $Ca^{2+} > Na^+ > Mg^{2+} > K^+$, respectively and that of anion from Murud and Dapoli were $Cl^- > HCO_3^- > SO_4^{2-} > CO_3^{2-}$ and $HCO_3^- > Cl^- > SO_4^{2-} > CO_3^{2-}$, respectively. There was no sodicity hazard in water samples from Murud. The pH, EC, cations, anions, boron, SAR and RSC values of irrigation water collected in the first week of June were higher as compared to those during first week of December and March, which might be due to evaporation and temperature increase during first week of June.

ANRM 18

Vetiver Grass Technology- A Bioengineering Solution for Soil Protection in Coastal Areas

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Coastal areas are vulnerable to soil erosion through wave action, winds and storm surges. It creates natural fluctuations of coastlines as the sediment supply is moved along the sea shores and waterways. High tides, winds and storm surges result in abrupt rise of the sea level, which makes beaches and dunes susceptible to the erosive power of incoming waves. This process of the outgoing waves dragging away the loose sand particles in the sea resulted in weakening of the dunes, making them more vulnerable to further erosion. In order to ensure long-term eco-friendly and resilient protection of our coastal areas, we need to identify cost- effective "green" solutions for sustainable management and risk reduction. One such green solution is introduction of vetiver grass technology (VGT). *Vetiver* (*Chrysopogon zizanioides* L. Nash.) or *khus* is a perennial bunch grass with a strong finely structured network of deep penetrating root system that can offer both erosion prevention and control of movement of surface earth mass. Globally, VGT has emerged as a novel, natural, green, simple, practicable and cost-effective tool for preventing erosion and further degradation of river banks and coastal areas. This is due to its unique ability to tolerate extreme weather and soil conditions, wide range of heavy metal pollutants and agrochemicals as well as it can thrive under changed climatic conditions being a C_4 plant. Since the agro-climatic conditions of India are favourable for *Vetiver* cultivation, VGT may be a potential innovative approach for conserving soil as an alternative of hard engineering measures. Considering the facts, various excellent researches and experiments have been done with Vetiver grass, to assess its potentiality as a bioengineering tool for soil conservation, in India as well as other countries. The results so far recorded, suggested that for soil protection of coastal areas, VGT may be a good means. Thus, in near future, *Vetiver* may be considered the most potential bio-engineering tool for coastal areas.

ANRM 19

Prediction of Irrigation Water Quality Parameters in Konkan Region using Artificial Neural Network Technique

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The water quality is expressed in terms physical, chemical or biological state of water. The water quality also influences suitability of water for specific uses and its further application and utilization for drinking, irrigation and industrial uses. Hence, it is essential to decide the suitability of groundwater for the irrigation purpose based on the occurrence of major ions and nutrients in the groundwater. Good quality irrigation water is essential to maintain the soil fertility and crop yield at upper level. Ground water quality in some of the industrial areas of Ratnagiri district is adversely affected by the industrial effluents. The district has a coastline and creeks, agricultural land is reported to be saline due to sea water ingress along the coast and creeks. Ground water quality has become saline therefore rendering it unsuitable for irrigation. Prediction will help to suggest the type of amendment to be adopted or suitable measure to be adopted in that area. Among various conceptual and black box models developed over a period, hybrid wavelet and Artificial Intelligence (AI)-based models have been amongst the most promising in simulating hydrologic processes. In the present study, artificial neural networks (ANN) were used to derive and to develop models for prediction KR (Kelly's Ratio), Percent Na (Percent Sodium), PI (Permeability Index), RSC (Residual Sodium Carbonate), SAR (Sodium Absorption Ratio) and SSP (Soluble Sodium Percentage) as groundwater quality parameters of Khed taluka by using post monsoon season values of existing groundwater quality parameters collected for time period 1999-2014 from Groundwater Surveys and Development Agency, Navi Mumbai as input variables *i.e.*, Na, Mg, K, $CaCO_3$, HCO_3. The ANN model was developed with multilayer feed forward back propagation (MLFBP) with sigmoid transferred function. While developing ANN model for different input parameters, three steps were followed as identification of model structures, evaluate the performance and adopting model for forecasting. The model development data set was further divided into three subsets; training set, cross validation set and testing set in 70:15:15 proportions. The ANN models were developed for prediction KR, Percent Na, PI, RSC, SAR and SSP using neurosolutions. Performance of model was evaluated by statistical criteria included correlation coefficient, Root Mean Square Error, Index of Agreement, Mean Bias Error. The analysis revealed that selected ANN based model shown correlation coefficient ($r>0.95$), RMSE(<0.3438), IA(>0.91) and MBE(<-0.2450) for Model 3-2-1 to predict KR, Model 4-2-1 to predict percent Na, Model 4-6-1 to predict PI, Model 4-4-1 to predict RSC and Model 3-6-1 to predict SAR and SSP during post monsoon season. The results confirmed that developed ANN models found suitable for prediction of water quality indicators used for irrigation purpose. The recommend number of nodes in hidden layer can be used for modeling of water quality indicators under limited data conditions.

ANRM 20

Fractionation of Boron in Soils of Konkan

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The present study was conducted to assess the status of boron fractions in different soils of *Konkan* region. Surface soil samples were collected representing eight soil types namely, lateritic, medium black, manat, coarse shallow, coastal alluvial, coastal saline, reddish brown and acid sulphate soil located in different places of *Konkan* region of Maharashtra. The mean values of readily soluble B (RsB), specifically adsorbed boron (SaB), oxide bound boron (OxB), organically bound boron (OrB), residual boron (ReB) and total boron (TB) were 0.32, 2.30, 58.90, 5.49, 85.72 and 152.73 mg kg^{-1}, respectively. Most of the soils in *Konkan* region showed low to medium concentrations of readily soluble boron which is the plant available fraction of boron. The readily soluble boron ranged between 0.28 ppm to 0.34 ppm in different soils of the *Konkan* region of Maharashtra.

ANRM 21

Nutrient Status and Fertility Capability Grouping of Soils of Sindhudurg District, Maharashtra

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The soils of Sindhudurg district were assessed for available nutrient status and grouped into fertility capability units by collecting soil from surface depth (0-25 cm) in rice and subsurface depth (25-60 cm) in mango and cashew cultivated fields from 8 representative locations. Based on elevation and drainage, the study was divided into three physiographic units *viz.*, uplands, midlands and lowlands. The soils were strongly acidic to moderately alkaline in reaction, low to high in organic carbon, low to medium in available nitrogen, phosphorous and sufficient in available potassium. With respect to micronutrients status the soils were deficient to sufficient in zinc, sufficient in manganese and copper while, sufficient at surface and sub-surface depths in iron. The soils under different physiographic units were grouped into a total 20 fertility capability units based on fertility related constraints and variations in management requirements.

ANRM 22

Assessment of Water Quality along the Mahim Creek in Mumbai Using Water Quality Index Method

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The present investigation along the Mahim creek of Mumbai was performed for the study of water quality variables like pH, dissolved oxygen (DO_2), biochemical oxygen demand (BOD) and fecal coliform using water quality index (WQI) for the evaluation of the deterioration level. To assess this, the National Sanitation Foundation, United States, developed a standardized water quality index (NSFWQI) method that was applied with slight modification in relative weights assigned by Central Pollution Control Board (CPCB) which exhibits single value. Water samples were collected from three stations viz Mahim-Bandra Pipe Line (S1), Bandra-Sion Link Road (S2) and Bandra-Kurla Complex (S3) along the creek for a period of one year from October 2016 to September 2017 in post-monsoon, pre-monsoon and monsoon period. The results obtained were compared with primary water quality criteria under class seawater (SW II) standards as prescribed by CPCB, India. Study reveals that, the creek biotope had the lowest pH values of 7.31, 7.32 and 7.38 for the station S2, S3 and S1 respectively, the highest corresponding values being 7.57, 7.69 and 7.62. The lowest values for DO_2 was observed in station S3, S2 and S1 were 2.60, 2.66 and 2.68 mg L^{-1} respectively, the highest corresponding values were 4.13, 4.24 and 4.32 mg L^{-1}. Similarly, the lowest values for BOD were recorded in S1, S2 and S3 was 8.13, 8.32 and 9.15 mg L^{-1}, respectively, subsequently the corresponding highest values found were 13.53, 13.71 and 14.12 mg L^{-1}. High fecal coliform recorded for station S1, S2 and S3 were 4000, 11000 and 18000 MPN (Most Probable Number) 100 mL^{-1} respectively, the corresponding minimum number being 1100, 1500 and 4200 MPN 100 mL^{-1} were observed. The investigation reveals that, the average WQI derived for S1, S2 and S3 was 44.73 ± 4.56, 43.59± 4.39 and 41.84±4.00 respectively that classify each sampling station into bad, bad and bad to very bad water quality respectively. Mean WQI value computed from three stations were 43.38± 4.37, concludes that the Mahim creek water falls under bad to very bad category that is not suitable for designated use, aquaculture and recreational activities.

ANRM 23

Effect of Various Filtration Media and Layer Thickness on Physical and Chemical Properties of Grey Water

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The effect of various media and layer thickness on physical and chemical properties of grey water for recycling purpose is most essential step before design of any filtration system. Individual media were tested separately for different layer thickness and its combination is useful for design of the efficient filtration system. Hence study was carried out by using media viz. sand (0.42 mm), grit (6-8mm), gravel (15-25 mm), brick pieces (25-30 mm) and charcoal (12-16 mm) along with layer thickness of 15, 30 and 45 cm respectively. The engineering properties of the selected media as bulk density, porosity, voids ratio and hydraulic conductivity were worked out individually by using standard methodology. Sand had highest porosity of 39 per cent and voids ratio 0.63. Finer filtration can be achieved due to greater porosity and void ratio. The highest dry and wet bulk density were found under gravel i.e. 1.12 x10^9 and 1.27 x10^9 Mg m^{-3} which is deciding factor of weight and volume of filtration system. The hydraulic conductivity was found maximum under brick pieces (123 m day^{-1}). The hydraulic conductivity of sand governs the filtration efficiency and hydraulic retention time (HRT). The effective depth of the filtration media were decided after filtering grey water through individual selected media layer of 15, 30 and 45 cm and its effect on physical and chemical properties of grey water were compared with irrigation water quality. The grey water shown most desirable range of pH (6.5-7.5) and bicarbonate after filtration through sand medium at layer thickness of 45 cm, while the potassium, being the beneficial nutrient for plant growth, at layer thickness of 15 cm, respectively. The lowest EC (<0.25 ds m^{-1}) and TDS (<500, mg L^{-1}) of treated grey water were found in grit medium at layer thickness of 45 cm while magnesium at layer thickness of 30 cm, respectively. The nitrogen, being the essential nutrient for plant growth, found in desirable range after filtration through brick medium at layer thickness of 45 cm. However, sodium (<3 me L^{-1}) and RSC (<1.25 me L^{-1}) of grey water found at minimum level at layer thickness of 45 cm while SAR and calcium at layer thickness of 30 cm which adversely affect soil structure and plant growth when in excess. The untreated grey water shown turbidity value 80 NTU while treated water shown drastic reduction up to 30NTU. Reduction of undesirable odour and colour is also substantial after filtration.The effective layer thickness and type of filtration media was decided on the basis of four major chemical parameters *viz.*, pH, EC, SAR and RSC etc. which shown combination of coarse gravel 15 cm, grit 45 cm, sand 45 cm and broken brick 30 cm has reduced undesirable chemical constituents efficiently below acceptable range of irrigation water quality. The combined layer thickness can be used for design of the grey water treatment plant.

ANRM 24

Qualitative and Quantitative Land Evaluation of some Coastal Soils of Guntur District

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Effective soil management requires an understanding of soil distribution patterns within landscape and knowledge of genesis. A systematic approach towards assessing the potentials of a land when used for a given purpose can be achieved only when the properties of a land are studied so as to prepare an inventory competent for suitable planning. Soil site characteristics provide indicators for identifying soil condition. Productivity and potentiality assessments are land evaluation approaches. Productivity is calculated on existing soil condition and potentiality is the future productivity of land taking into consideration the improvements by management practices and the reclamation of limiting characteristics. Suitability is a measure of how well the qualities of a land unit match the requirements of a particular form of land use. Crop suitability assessment is one of the land evaluation approaches for alternate land use planning. Four representative soil profiles were chosen from different sites of Pedapuluguvaaripaalem village. The profiles were selected according to drainage evident from the textural classes. The initial on field inspection of texture was done through feel method. Qualitative land evaluation *i.e.*, soil

suitability classification for rice using weighted means of different land characteristics and the climate, soil and site requirements for rice. Soils represented by profiles 1, 2, 3 were placed under not suitable categories of N_1nfs, N_1nsf, N_1wfs, and profile 4 was placed under marginally suitable category of S_3nf. Quantitative land evaluation indices such as productivity and potentiality were calculated. The productivity ratings index varied from 18.2 to 26.0 for crop, 14.0 to 22.3 for pasture and 4.4 to 7.8 for forest. The soils of P3 were considered under the class 4 (poor) for crop, while P1, P2 and P4 qualified for class 3 (average). For pasture soils of all profiles qualified for class 4 (poor) except P1 which qualified for average class (3). For forest the soils of P1, P2 and P4, were extremely unsuitable whereas for P3, they were poor in suitability. The potential productivity rating index ranged from 30.6 to 58.3 for crop, 27.5 to 58.3 for pasture and 12.9 to 22.9 for forest. Thereby the classes for crop growing ranged from III to II (average to good), for pasture III to II (average to good) and for forest III to IV (poor to average). The coefficient of improvement (CI) varied from 12.4 to 32.3 for crop, 13.5 to 36.0 for pasture, and 8.6 to 15.4 for forest. The highest value of CI was recorded by P1 for crop and pasture, and P1, P3 for forest indicating maximum requirements for improvement of productivity of these soils. The crop suitability index revealed that the main constraints for crops were pH and ESP of soil. These studies helped us to assess the magnitude of improvements required to be done in coastal soils of the research area for sustainable crop production.

ANRM 25

Impact of Organic Mulches in Presence of Termites

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Use of farm wastes as mulches is an age old practice for conservation of water however; most farmers feel that the use of mulches will attract termites leading to damage of fruit trees. The present study on role of termites in breakdown of agricultural wastes has shown that, the presence of termites is necessary for the breakdown of mulch. It was seen that, grass and weeds (70.55%) when used are more readily consumed by the termites as compared to paddy straw (37.83%) or coconut husk (28.0%). The termites also help in the incorporation organic mulches into the soil leading to subsequent improvement in soil characteristics. The breakdown of grass mulch in the presence of termites resulted in raising the pH of the soil from 5.23 to 5.99, which was a rise of almost 15 per cent. Any soil with the pH nearer to the neutral level of 7.00 always shows improved levels of nutrient uptake and hence plant growth. Thus, the presence of termites will aid in better plant growth. The presence of termites in grass mulched plot resulted in a 31 per cent reduction in bulk density of the soil. The reduction in the paddy straw mulched plot was 19 per cent and it was 17 per cent in the plots mulched with coconut husk. While, the soil below the mulches which was treated with chlorpyriphos remained compact and actually in bare plots the soil became more compact as evidenced by a rise in bulk density.

ANRM 26

Recycling of Different Organic Wastes through Vermicomposting

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The experiment was laid out in factorial randomized block design with four treatments (sugarcane trash, soybean straw, vegetable market waste and sugarcane trash + soybean straw) and three replications for both of the method (Normal vermicomposting - M_1 and Modified vermicomposting - M_2). During vermicomposting period, the samples were collected at an interval of 15 days *i.e.,* on 15th, 30th, 45th and 60th day. In normal vermicomposting, black colour in vegetable market waste, very dark brown in soybean straw, dark grey in sugarcane trash and very dark brown in sugarcane trash + soybean straw indicated that the compost was mature. While in case of the modified vermicomposting, black colour of vermicompost in vegetable market waste, very dark grey in soybean straw, very dark grey in sugarcane trash and very dark grey in sugarcane trash + soybean straw indicated compost maturity. The results indicated that the physical properties like temperature and porosity was recorded significantly higher in

normal vermicomposting (M_1) than modified vermicomposting (M_2) at 15 to 60 days. Among the treatments, the maximum reduction of temperature was recorded with vegetable market waste (T_3, 24.83 ^{0}C) over soybean straw (T_2, 27.17 ^{0}C), sugarcane trash + soybean straw (T_4, 27.67 ^{0}C) and sugarcane trash (T_1, 28.67 ^{0}C) at all days. The lower value of porosity was recorded (67.54 to 63.39 %) with vegetable market waste (T_3) at 30 to 60 days of vermicomposting than the other treatments. The high value of bulk density (Mg m^{-3}) was recorded in modified vermicomposting (M_2) over normal vermicomposting (M_1) at 30 to 60 days. In vermicomposting with vegetable market waste (T_3) highest bulk density was recorded (0.97 Mg m^{-3}) at 60 days. Among various biological properties, the result indicated that in vermicomposting process from 15 to 60 days, microbial population (fungi, bacteria, actinomycetes) and CO_2 evolution increasing up to 45th day but after that they showed declining trend. The CO_2 evolution and microbial population in modified vermicomposting (M_2) was significantly higher than in normal vermicomposting (M_1). The vermicomposting with vegetable market waste (T_3) recorded higher CO_2 evolution (250.32, 276.65 and 272.72 mg 100 g^{-1} 24 hr^{-1}), fungal population (56.02, 67.43 and 64.51 x 10^4 CFU g^{-1}), bacterial population (86.66, 92.11 and 87.28 x 10^6 CFU g^{-1}) and actinomycetes population (36.53, 43.28 and 40.72 x 10^5 CFU g^{-1}) as compared to other treatments at 30, 45 and 60 days.

Session II:

Crop Production Technologies for Agricultural and Horticultural Crops under Stressed Environment

CPT 1 (INVITED)

Abiotic Constraints and Opportunities for Agriculture in Coastal Regions of Maharashtra

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Coastal area of Maharashtra is blessed with climate featured by ample rains during monsoon while other parts face frequent drought. However, the excess rains, low radiation and coastal salinity pose major constraints for agricultural crops during the monsoon. In addition, low moisture holding capacity of soil is the impending problem for post monsoon crops. These abiotic stresses are likely to be the major constraints in doubling the farmers' income in the region which traditionally follows the combination of horticulture, field crops dominated by rice, livestock and fisheries as main sources of livelihood. Hence any strategy in the agricultural sector has to include adaptation and mitigation options to deal with abiotic stress management. These options should give due priority to the location specific features. The resource management technologies can be critical for the region as >10 t ha^{-1} yr^{-1} soil lost due to erosion particularly in Raigad (570 t ha^{-1} yr^{-1}), Ratnagiri (540t ha^{-1} yr^{-1}) and Sindhudurg (255t ha^{-1} yr^{-1}). NIASM can join BSKKV and NBSS&LUP to map and develop management options for this abiotic stress issue. Extreme temperatures (high/low) affect mango and cashew the major horticultural crops of the region. Spongy tissue of Mango is one of the effects of abiotic stresses. In addition, high temperature induced nutritional stress is the constraints in improving livestock productivity. Many of these issues can be solved through management options for edaphic stresses imposed by acidic and lateritic soil, costal salinity and water deficit during summer. Though blessed with ample rains the efforts to double the farmers' income should necessarily include the best watershed management approach and water saving technology like drips for horticultural crops. Coastal salinity is the issue where rice cultivation dominates. This issue can be addressed through salt tolerant cultivars of rice which have been developed recently by using locally adapted rice. Technological interventions are needed to improve finger millet as this crop is likely to fetch enhanced income by virtue of high nutritional value particularly with improved post-harvest technologies to evolve value added products. On the other hand, floriculture and agro-tourism can provide additional livelihood options in the region. Flower crops such as Rose, Jasmine, Chrysanthemum, Aster, Marigold, Tuberose, Gerbera, and Gladiolus can provide enhanced remuneration with better market linkage in addition to scientific interventions. Mushroom can be a boon for aspiring agri-entrepreneur as the coastal region provides natural environment with high humidity, relatively cooler temperature and hence less energy cost while the product can reach big cities in short time if internal roads are set right. Konkan specific advantage can also be explored to promote goat rearing in the region which is rich in natural vegetation, region specific breeds and there is ample scope for its integration with existing cropping system. However, nutritional stresses that emerges as secondary stresses on exposure to extreme temperature to be addressed for managing these livestock. In conclusion, updated agro-ecosystem knowledge, integration of technologies, bridging the knowledge and technology gap, creating new opportunities through right mix of agri-enterprises, risk cover, development and addition of value to the agri-products through post-harvest processing, market intelligence and policies and institutional-network development will be the driving factors for improvement of agricultural income in the region.

CPT 2 (INVITED)

Recent Advances in Breeding for Salt-tolerance in Rice

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Rice is the staple food for more than half of the world's population. Salt stress is a major constraint across many rice production areas because of the high sensitivity of modern rice varieties. Salt stress is the second largest abiotic problem, after drought, affecting rice productivity. Huge variations exist in the worldwide estimates of salt-affected areas, but all of them indicate the vast magnitude of the problem. In the climate change scenario, the situation is expected to worsen due to sea level rise and more frequent saline water intrusion into deep coasts because of climate changes. The development of tolerant crop varieties that can withstand such harsh scenarios is considered an economically viable, environmentally friendly, and socially acceptable approach. Salt stress never occurs alone and

is invariably associated with either mineral deficiencies or toxicities; submergence in the coastal areas therefore, multiple abiotic stress tolerance is most appropriate for developing a suitable variety for salt-affected areas. Rice is not very sensitive to salt stress throughout the growing period but the seedling and reproductive stages are the most sensitive growth stages. There is very poor association between these two stages for salt tolerance, suggesting that they are regulated by different processes and sets of genes/QTLs. Reproductive-stage salinity tolerance is most important as it translates into grain yield but one cannot underestimate the seedling stage as tolerance at the seedling stage could open avenues for direct seeding in salt-affected areas. IRRI is in process to develop the multiple abiotic stress tolerance for the wider adaptation.

CPT 3 (INVITED)

Boosting Agricultural Production under Stressed Coastal Environment

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India is endowed with panorama of agro-climates and soil types to support diversified agriculture vis-à-vis multidisciplinary farming systems. The country has an 8,129 km long coastal line. The Coastal Saline Zone of West Bengal consists of 1456879 ha area spreading over 78 blocks of six southern districts. The agricultural development in the coastal saline belt is constrained by various physical, chemical and social factors. Apart from the homestead upland, the crop fields of this region are often classified as medium-up, medium-low and low lands, amongst them latter two are usually inundated by floods and rain water associated with poor drainage. Inundation of saline water from Bay of Bengal makes almost the entire part of this zone saline. Rainfall varies from 1500-1800 mm per year mostly precipitated during monsoon months. Soils are silty-clay type, rich in Mg, Na, Ca, Cl^-, SO_4^{2-} salts. Fertility varies from medium to high, pH varies from 7.5-8.5. Average amount of soluble salt in soil varies from 3-18 dS m^{-1}. Due to presence of high Mg, the soils become hard and dry and get deflocculated when wet leading to impeded drainage condition. Because of these factors the agriculture of the region is predominantly rain-fed and cropping pattern is almost mono-cropped. Only 4% of the cultivated area of the coastal zone can be irrigated with available sweet water. The region is, therefore, a mono-cropped area with 4.2 lakh ha cultivated area in the wet season; during the rest six to seven months the lands generally remain fallow in winter and summer. Excepting the extremely saline island situation, in the coastal zone of West Bengal, climatic condition favours intensive cropping and it is possible to take two crops in a year under rainfed condition and three crops per year under irrigated condition. In most cases the farmers of the coastal zone are habituated to follow the traditional cropping systems satisfying their own needs, without thinking of their cost effectiveness, agro-ecological suitability and sustainability. Increasing total productivity through judicious repeated use of same piece of coastal land not only increases the farmers' income but also maintains the soil health. So, there is an urgent need for refinement of prevailing agro-techniques through adoption of sustainable cropping system using right nutrient source, at the right rate, at the right time and in the right place also. Not only that, to adjust with the seasonal salt dynamics and climatic obstacles, flexibility in cropping window should be brought into practice encompassing the issues of efficient nutrient utilization, choice of appropriate rice cultivars as well as succeeding winter crops.

CPT 4

Mechanization in Coastal Horticulture Crops: Status and Scope

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The demand for sustainable mechanization and services will continue to rise naturally with a growing population's demand for food, feed and biological/industrial raw materials from agriculture and horticulture. As the younger generation responds to economic opportunities in the agricultural service sectors as well as non- agriculture sectors, and with the growing urban employment and improved quality of life, mechanization is necessary. The machinery improves the farmer's ability to perform operations in a timely manner. It also reduces the risks associated with the

need for large amounts of seasonal labour for short periods of time and lessens the social problems. It is important to encourage sustainable private sector development that can offer farmers the right choice of technology at the right price to increase productivity to support rural economic development, contribute to local and national food security, reduce post-harvest losses and promote local manufacturing of equipment and machinery. Modern day horticultural mechanization includes various growing techniques and production processes, working operations, technical procedures, appropriate techniques for soil management systems, orchard tractors, machines for working the soil, machines for mulching and mowing grass, post hole diggers, spreaders, sprayers, front-fitted knife trimmers, harvesting machines, transporting equipment ,shakers ,harvesters etc.The harvesting, pruning and spraying are still a manual task and need to be mechanized. The average farm power density in India is 1 $kWha^{-1}$. Power availability during crucial period of operations causes limitation in timeliness. Required power density to achieve timeliness of operations is estimated as 3.75 kW ha^{-1}. The demand for sustainable mechanization and services will continue to rise with a growing demand for food, feed and biological industrial raw materials from the rural infrastructure, domestic supply chains and service providers. Local manufacturers and world markets in equipment and machinery are all of vital importance. It is crucial that multidisciplinary research, involving plant scientists, engineers, food scientists, economists and marketing expertise needs to be focused on creating new production systems. Innovation will come through intimate understanding of the system. Growing systems need to be designed for specific crops and then dedicated machines will fit. Mechanization and robotics for fruit harvesting, grading and packing remains more of a problem than for vegetables. The study of various control systems such as pneumatic, hydraulic, hydro-pneumatic and electrical control reveals that the use of hydraulic control system will be more beneficial and reliable for horticultural crop harvesting equipment.

CPT 5

Isolation of Secondary Metabolites from Sarpgandha (*Rauwolfia serpentina*)

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Ten gram of callus of *R. serpentina* were soaked in 10 ml methanol and left for 30 min. After 30 min, the soaked plant material was filtered. The residue obtained after filtration is further dissolved in 5.0 ml methanol and filtered after 10 min, the same step is repeated once again and final filtrate is collected in 50 ml conical flask. The extract was evaporated to dryness in the soxhlet evaporator. The crude extract was dissolved in 100 ml of 0.01 M HCl. The pH of filtered solutions was adjusted to 6.0 with 0.01 M NaOH. The crude extracts obtained were used for TLC and spectrophotometric analysis. Qualitative analysis of major groups of indole alkaloid derivatives of *R. serpentina* was initially run by Thin Layer Chromatography (TLC) technique on preparative silica gel. Mobile phase or solvent system used for alkaloid estimation was chloroform: methanol at 97:3 ratio. Spots were visualized by the spray of Dragendorff´s reagent. The sprayed plates develop orange spots. Spot intensify if the plates further sprayed with HCl or 50% water-phosphoric acid and finally the R_f value was calculated. Callus culture contains more or less homogenous clumps of dedifferentiated cells are used for secondary metabolite production. The spot of callus of sarpagandha had R_f value of 0.96. The standard R_f value of reserpine was 0.96 and spot of root extract had a R_f value 0.957 for the same mobile phase. This reveals the presence of reserpine in callus and root extracts and intensity of the spot showed extract obtained from callus had higher concentration of reserpine. One mg of reserpine was taken and dissolved in 10 ml of methanol, and various dilutions are made from it having concentration (2 µg ml^{-1} - 10 µg ml^{-1}). All the various dilutions of reserpine were observed under UV spectrophotometer using λmax 268 nm. Absorbance of all the samples and standard was calculated. The experiment was done in triplicate. Calibration curves series of standard curves were prepared over a concentration range 2-10 µg (n=3, five standards). The data of concentration versus absorbance was treated by liner test square regression analysis. The concentration of reserpine observed in callus extract was 6.8 µg ml^{-1} whereas the concentration of reserpine observed in root extract was 6.4 µg ml^{-1}**.**

CPT 6

Effect of Different Levels of NPK in Combination with Biofertilizers on Groundnut under Konkan Conditions

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The study on the effect of inoculation of biofertilizers *i.e. Rhizobium* and PSB in combinations along with different levels of nitrogen (*viz*., 20, 25 and 30 kg ha^{-1}), phosphorus (*viz*., 25 and 50 kg ha^{-1}) and potassium (*viz*., 15, 30 and 45 kg ha^{-1}) in comparison with RDF on groundnut was conducted during *rabi* 2011-12 at Central Experiment Station, Wakawali using RBD comprising ten treatment combinations and 3 replications. The results revealed that considering growth parameters, yield contributing characters, pod and haulm yield, quality parameters *viz*., oil, protein and methionine content and nutrient uptake by plants, the application of N:P_2O_5:K_2O @ 25:25:30 kg ha^{-1} along with seed inoculation of *Rhizobium* and PSB had recorded the highest favourable parameters even with reduction in 50 per cent P_2O_5 dose over the sole application of recommended dose of fertilizers @ 25:50:00 N:P_2O_5:K_2O kg ha^{-1}, which was at par with the treatment of N:P_2O_5:K_2O @ 25:25:00 kg ha^{-1} along with seed inoculation of *Rhizobium* and PSB, indicating reduction in 50 per cent P_2O_5 dose and seed inoculation of *Rhizobium* and PSB. Collation of data on soil fertility indicated that the application of N:P_2O_5:K_2O @ 25:25:00 kg ha^{-1} along with seed inoculation of *Rhizobium* and PSB resulted in a significant increase in soil pH, EC, organic carbon, available macronutrients (N, P, K and S), micronutrients (Fe, Mn, Zn and Cu) contents and microbial count (bacteria, fungi and actinomycetes) of the soils, indicating build up of soil fertility. Further, with the application of N:P_2O_5:K_2O @ 25:25:30 kg ha^{-1} along with seed inoculation of *Rhizobium* and PSB had recorded the highest favourable parameters over the sole application of recommended dose of fertilizers @ 25:50:00 N:P_2O_5:K_2O kg ha^{-1}, indicating reduction in 50 per cent P_2O_5 dose and seed inoculation of *Rhizobium* and PSB. In general, application of N:P_2O_5:K_2O @ 25:25:00 kg ha^{-1} along with seed inoculation of *Rhizobium* and PSB is recommended for maximum crop yield of groundnut and soil sustainability in lateritic soils of Konkan.

CPT 7

In vitro Efficacy of Various Fungicides against *Alternaria chlamydospora* causing Leaf Spot of Okra

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Okra (*Abelmoschus esculentus* L. Moench) crop is being affected by several fungal, bacterial, viral and nematode induced diseases. However, leaf spot, caused by *Alternaria chlamydospora* has been of common occurrence, causing quantitative as well as qualitative losses in okra. Therefore, in the present study, seven systemic (each @ 1000 and 1500 ppm) and nine non-systemic /contact plus four combi-fungicides (each @ 2000 and 2500 ppm) were evaluated *in vitro* by applying poisoned food technique, against *A. chlamydospora.* Two separate experiments were planned in CRD and all the treatments replicated thrice. The results revealed all of the systemic and contact/ combi-fungicides as effective against the test pathogen, with significant reduction in mycelium growth, over untreated control. Further, the per cent inhibition was found directly proportional to the concentrations of the test fungicides. Among systemic fungicides, Difenconazole 25% EC, Propiconazole 25% EC, Hexaconazole 5% EC and Tebuconazole 25.9% EC (each @1000 and 1500 ppm) resulted with cent percent mycelia growth inhibition. These were followed by Pyraclostrobin 20% WG (72.66 and 82.22%), Thiophanate methyl 70% WP (61.77 and 71.55%) and Carbendazim 50% WP (28.22 and 34.00 %), respectively @ 1000 and 1500 ppm.

CPT 8

Efficacy of Insecticides against Pumpkin Caterpillar (*Diphania indica* Saunders) on Watermelon under Laboratory Conditions

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The present investigation to evaluate the efficacy of some insecticides against Pumpkin caterpillar, *Diphana indi*ca Saunders was carried out on watermelon under laboratory conditions in completely randomized design. Post spray observations were recorded at an interval of 24, 48 and 72 hours after spraying. Treatments T_1 (Emamectin benzoate), T_6 (Triazophos) and T_7 (Cartap hydrochloride) showed 100 per cent mortality at 24 hrs after spraying and all these treatments were at par with each others. At 48 hrs of spraying, the treatments T_3 (Dimethoate) and T_4 (Profenophos) recorded 100 per cent mortality and both these treatments were at par with each other. At 72 hrs post spraying the treatment T_5 (Azadirachtin) recorded 79.99 per cent mortality and was found to be at par with treatment T_2 (Acetamiprid) with 76.67 per cent mortality. The treatment T_8 (control) showed no mortality.

CPT 9

Evaluation of Pyraclostrobin 13.3% + Epoxyconozole 5% SE against Late Leaf Spot (*Phaeoisariopsis personata*) of Groundnut

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Late leaf spot (Tikka leaf spot) is an endemic diseases of groundnut under coastal Maharashtra conditions in both Kharif and post monsoon season. The disease many times attains an epiphytotic state. It becomes practically difficult to reduce disease severity by using conventional practices including commonly used fungicides. It was therefore, felt necessary to evaluate new generation pre formulated fungicide combinations for better management of this disease. Performance of pre formulated fungicide consisting of Pyraclostrobin 13.3 % + Epoxyconozole 5% SE was evaluated against late leaf spot (*Phaeoisariopsis personata*) of groundnut in comparison with the recommended fungicide for this purpose. A field trial was conducted in RBD with eight treatments and three replications at Agricultural Research Station, Shirgaon, Ratnagiri during *rabi* cum hot weather season of 2014-15. Efficacy of Pyraclostrobin 13.3% + Epoxiconazole 5% SE was tested at 3 concentrations (0.1, 0.125 and 0.15%) along with respective individual fungicides against the disease. These fungicides were applied in the form of spray starting from the initiation of primary symptoms of the disease (52 DAS) followed by two more sprays at 15 days interval. All fungicidal treatments were found to be statistically significant in reducing the disease severity of late leaf spot of groundnut over control. Maximum mean disease severity (66.21%) was recorded in control where no fungicide was applied. Minimum disease severity (19.92%) was recorded in the treatment of Pyraclostrobin 13.3% + Epoxiconazole 5% when applied @ 0.15%. This treatment was on par with Pyraclostrobin 13.3% + Epoxiconazole 5% @ 0.125% with disease severity of 20.71 %. The treatment of Propiconazole 25% EC (0.05%) ranked third in its efficacy with disease severity of 25. 86% and was on par with the treatments of Pyraclostrobin 13.3% + Epoxiconazole 5% @ 0.1%, Epoxiconazole 7.5% EC @ 0.1%, Pyraclostrobin 20% WG @ 0.05% and Hexaconazole 5% EC @ 0.1%. Maximum dry pod yield of groundnut (18.86 q ha^{-1}) was recorded in the treatment of Pyraclostrobin 13.3% + Epoxiconazole 5% @ 0.15% and this treatment was on par with Pyraclostrobin 13.3% + Epoxiconazole 5% @ 0.125% and Hexaconazole 5 EC (0.05%). This indicated that pre formulated fungicide combination consisting of Pyraclostrobin 13.3% + Epoxiconazole 5% when applied @ 0.125%, gives better control of late leaf spot of groundnut with significant increase in dry pod yield of groundnut.

CPT 10

Effect of Drip Fertigation on Growth and Yield of Papaya (*Carica papaya* L.) under Semi-Arid Tropics Region in Maharashtra

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The experiment was conducted for two consecutive years of 2015-16 and 2016-17 at Irrigation Water Management Farm of the Mahatma Phule Krishi Vidyapeeth, Rahuri to assess the effect of drip fertigation on growth, yield of papaya (*Carica papaya* L.) cv. Red lady. The soil of the experimental site was clayey and well drained with medium organic carbon. The experiment was laid out in split plot design with three replications. The treatments comprised of four levels of drip irrigation *viz*., 60, 80, 100 and 120 per cent of ETc as main plot treatments and fertigation levels *viz*. 75, 100 and 125 per cent of RDF as subplot treatments. Besides, surface irrigation with soil surface application of 100 per cent RDF and surface irrigation without fertilizer application were used as control and absolute control treatments, respectively. The plant height, stem girth, number of functional leaves, E-W plant spread and N-W plant spread of papaya were influenced significantly due to the different drip irrigation levels. Significantly more plant height (322.05 cm), stem girth (48.17 cm), number of functional leaves (38.27), E-W plant spread (294.99 cm) and N-S spread (290.56 cm) was recorded when crop was irrigated at 120 per cent ETc. Fertigation of 125 % RDF registered significantly higher plant height (287.99 cm), stem girth (45.49 cm), number of functional leaves (35.52), E-W plant spread (284.41 cm) and N-S plant spread (280.00 cm). Drip irrigation at 100 % ETc and fertigation level of 125% RDF registered the maximum papaya yield of 207.96 and 211.35 t ha^{-1}, respectively, which was 87.75 and 90.80% higher over control.

CPT 11

Effect of Pulse Irrigation (Drip) under Different Irrigation Levels on Yield, Quality Attribute Parameters and Water Use Efficiency of White Onion

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The field experiment was conducted during two *rabi* seasons of 2014-15 and 2015-16 on sandy clay loam soil at Instructional Farm of Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, Dr. B. S. Konkan Krishi Vidypeeth, Dapoli, Maharashtra. The experiment was arranged in twelve treatment combinations with strip plot design as horizontal factor (main treatment) one continuous irrigation (P_1), two pulses (P_2), three pulses (P_3) and four pulses (P_4), while vertical factor (sub treatment) as irrigation levels viz. I_1 (0.80 ET_C), I_2 (1.0 ET_C) and I_3 (1.20 ET_C) treatments. It was revealed that the average seasonal water applied to white onion under pulse irrigation (drip) through different irrigation levels varied from 282.58 mm for I_1 (0.8 ET_C) to 419.21 mm for I_3 (1.2 ET_C). The main treatments increased significantly the yield parameters like bulb diameter, average bulb weight and yield of white onion. The highest polar diameter (61.30 mm), geometric mean diameter (58.41 mm), equatorial diameter (60.86 mm), average bulb weight (107.38 g) and yield (36.50 t ha^{-1}) of a white onion was recorded in P_4 (four pulse treatment). It was observed that irrigation levels I_2 (1.0 ETc) and I_3 (1.2 ETc) significantly increased the yield parameters like bulb diameter, average bulb weight and yield of white onion. The highest geometric mean diameter (54.24 mm), equatorial diameter (55.53 mm), average bulb weight (95.97 g) and yield (33.15 t ha^{-1}) of white onion was found in I_3 (1.2 ETc) except polar diameter (57.07 mm) in I_2 (1.0 ETc)

irrigation levels. The interaction effect revealed that highest polar diameter (63.88 mm), geometric mean diameter (59.51 mm), equatorial diameter (63.16 mm), average bulb weight (112.05 g) and yield (38.52 t ha^{-1}) of white onion was found in treatment combination I_2P_4 followed by I_3P_4. Among the different treatment combinations, I_2P_4 was found to be significantly superior over I_1P_1 with continuous irrigation and at par with I_3P_4.

CPT 12

Evaluation of Different Crop Sequences on Partially Reclaimed Salt Affected Soils

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A field experiment was conducted to evaluate different crop sequences on partially reclaimed salt affected soils at Agricultural Research Station, K. Digraj during 2015-16. The experiment was laid out in randomized block design with three replications and eight treatment combinations. The treatment comprised of Soybean-Wheat (T_1), Soybean-Maize (T_2), Soybean-Onion (T_3), Soybean-Chickpea (T_4), Rice-Wheat (T_5), Rice-Maize (T_6), Rice-Onion (T_7) and Rice-Chickpea (T_8) cropping sequences. Green manuring of *Dhaincha* was taken during summer in all the treatments. The FYM, chemical fertilizers, biofertilizers and *Trichoderma* was applied as per recommendation to the experimental crops. Results revealed that there was no difference in the yield of *Kharif* crops *viz.,* soybean and rice. However, in rice-chickpea cropping sequence, soybean equivalent yield was higher (2.21 t ha^{-1}), GMR (Rs. 77292 ha^{-1}), NMR (Rs. 44561 ha^{-1}) and B: C ratio (2.36) as compared to other cropping systems. Among the different *rabi* crops, chickpea recorded higher soybean equivalent yield (2.07 t ha^{-1}), GMR (Rs. 72500 ha^{-1}), NMR (Rs. 42199 ha^{-1}) and B:C ratio (2.39). Evaluation of different crop sequences on partially reclaimed salt affected soils revealed that significantly higher soybean equivalent yield (4.19 t ha^{-1}), GMR (Rs. 146741 ha^{-1}) was observed in soybean-onion crop sequence. However, maximum NMR (Rs. 82594 ha^{-1}) and B:C ratio (2.31) was observed in soybean-chickpea crop sequence.

CPT 13

Effect of Potassium Fertilization on Hybrid Rice in Saline Soil of West Bengal

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Field experiments were conducted during the wet (rainy) season of 2016 and 2017 at Research Farm under BCKV, Akshaynagar, Kakdwip, West Bengal, to optimize the potassium application rate for better growth, yield, and nutrient-use efficiency of hybrid rice (cv. Arize 6444) on saline soil under coastal eco-system of West Bengal. The soil was clay in texture, acidic in reaction (pH 5.91) and saline in nature (EC 1.53 dS m^{-1}). The experimental plots were laid out in a randomized block design with six (6) K doses (0, 30, 60, 90, 120 and 150 kg K ha^{-1}) and replicated four times. Results revealed that K application at 60 and 90 kg ha^{-1} resulted in taller plants at harvest, accounting 5.95% more over the plant in K-omitted plot. Stem, leaf and grain dry matter (DM) production, recorded at 60 days after transplanting (DAT) and harvest, was more when the crop fertilized with 90 kg K ha^{-1}. The DM production at plot fertilized with 90 kg K ha^{-1} was statistically at par with DM production at plot 60 kg K ha^{-1}. The number of tillers $hill^{-1}$ was significantly ($p \leq 0.05$) higher in plants fertilized with 90 kg K ha^{-1}, accounting 64.3% more than that obtained with K omission; however, it had no significant difference with the K application at 60 kg ha^{-1}. Further, application of K @ 60 kg ha^{-1} produced higher number of filled grains $panicle^{-1}$, accounting 26.4% more than that obtained with K omission; being statistically at par with its lower dose (30 kg K ha^{-1}). Both grain and straw yield of hybrid rice increased with the increase in K level from 0 to 60 kg K ha^{-1} to the tune of 85.3 and 80.9% more than that

obtained with K omission, respectively. Further increase in K level significantly ($p \leq 0.05$) reduced both grain and straw yield. At harvest, grain K concentration improved significantly with K fertilization at 90 kg ha^{-1}, accounting 116.3% more than the value recorded with zero-K; however, it was statistically at par with the grain K concentration under 60 kg K ha^{-1}. The present study also showed the better profitability of hybrid rice (cv. Arize 6444) cultivation with 60 kg K ha^{-1} as it gave highest net return (Rs. 30,732 ha^{-1}) and benefit:cost ratio (1.81) over other treatments. Hence, it can be concluded that 60 kg K ha^{-1} through muriate of potash (MOP) could result in higher productivity of hybrid rice during wet season in coastal region of West Bengal.

CPT 14

Comparison of Different Multivariate Regression Models for Rice Yield Prediction using Long-term Weather Information

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Weather has a profound influence on rice crop production which can be assessed using statistical and simulation models. In this study, statistical crop weather models were developed for rice for 6 coastal districts of West Bengal and Orissa. For the development of district-level rice yield forecast models, weather indices are generated using weekly cumulative value for rainfall and weekly average value for other parameters like maximum and minimum temperature, relative humidity, solar radiation, etc. Long period rice yield data (33 years) for those stations were collected from the website of Directorate of Economics and Statistics and Department of Agriculture and Cooperation. Different multivariate models like artificial neural network (ANN), elastic net (ELNET), least absolute shrinkage and selection operator (LASSO), principal component analysis (PCA), stepwise multiple linear regression (SMLR), PCA-SMLR and PCA-ANN were employed to model the rice yield using the weekly weather indices as inputs. The models performance was evaluated using R^2, root mean square error (RMSE) and normalised root mean square error (nRMSE). The R^2 and RMSE ranged between 0.64-0.97 and 54.19-229.17 kg ha^{-1}, respectively during calibration of the crop yield model. The developed models were validated using the data of 2012-2015. The RMSE and nRMSE during validation of the developed model for rice varied between 102.88-699.83 kg ha^{-1} and 4.92-44.63, respectively. The overall average ranking of the models on the basis of these performance statistics showed LASSO (2.85) as the best model followed by PCA-ANN (3.04) and ANN (3.06). So, LASSO was suggested as a better method for rice yield prediction.

CPT 15

Assessment of genetic diversity in rice genotypes for seedling stage salinity tolerance using *Saltol* linked SSR markers

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The present study was carried out to assess the response of rice genotypes to salinity stress at seedling stage. A set of 79 diverse rice genotypes comprising of landraces, released varieties, advanced breeding lines and wild relatives were phenotyped for salinity stress tolerance at seedling stage under controlled microplot condition at electrical conductivity (EC) of 12 dS m^{-1}. The genotypes were grouped into highly tolerant, tolerant, moderately tolerant, sensitive and highly sensitive based on their response to salinity stress. Four genotypes were found to be highly tolerant, six of them were tolerant, 13 genotypes fell in the category of moderately tolerant, and remaining genotypes showed sensitive to highly sensitive response. The genotypes were further screened for *Saltol* locus on chromosome 1 using closely linked Simple Sequence Repeat (SSR) markers. A total of 24 alleles were scored with six polymorphic markers *viz*., RM 3412, RM 493, RM 10843, RM 10852, RM 10748 and RM 10713. The highest number of alleles was found in RM 3412 (6) followed by RM 493 (5), RM 10748 and RM 10852 (4 each), RM 10843 (3) and RM 10713 (2). The Polymorphic Information Content (PIC) value ranged from 0.05 to 0.720. The highest PIC value (0.720) was found for the marker RM 493 followed by RM 3412 (0.674), RM 10748 (0.549), RM 10843

(0.467), RM 10852 (0.423) and the least PIC value was observed in RM 10713 (0.051). Among the tolerant genotypes, Korgut (landrace from Goa) and its pure line derivatives KS-17 (Goa dhan-2) and KS-4 were found to be highly tolerant (SES score 1-2). The landraces Kagga and Shidde and two wild rice collections of Goa *viz*., WR-18 and WR-2-1-1 showed tolerant (SES score 3-4) reaction to salinity stress at seedling stage. These germplasm showing highly tolerant (HT) to tolerant (T) response to salinity stress can be used as a genetic stock for future breeding programmes aiming at development of high yielding salt tolerant rice varieties for coastal saline soils.

CPT 16

Fertilizer Recommendation through STCR Approach for Rice var. ADT 43 in Inceptisol of Puducherry

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Soil test based fertilizer recommendation plays a vital role in ensuring balanced nutrition to crops and fertilizer schedules should therefore be based on the magnitude of crop response to applied nutrients at different soil fertility levels. Nevertheless, soil test based fertilizer application has helped and has been helping to avoid wasteful expenditure on nutrient quantities that need to be applied to maximize the returns from investment on fertilization. Hence, soil test based fertilizer application needs to be popularized among the farmers. The gradient crop (Rice var.ADT 39) and the test crop (Rice var. ADT 43) experiments were conducted at farmer's field in Arachikuppam village, Puducherry. The soil of the experimental field belongs to Sanyasikuppam series, taxonomically *Typic Ustropept*; sandy clay loam in texture, pH- 6.47, EC-0. 095 dS m^{-1}, CEC-32.5 cmol (p^+) kg^{-1}, $KMnO_4$-N-142.8 kg ha^{-1}, Olsen-P-36.5 kg ha^{-1} and NH_4OAc-K-131 kg ha^{-1}. The treatments consisted of four levels of N (0, 60, 120,180 kg ha^{-1}), four levels of P_2O_5 (0, 25, 50, 75 kg ha^{-1}), and four levels of K_2O (0, 25, 50, 75 kg ha^{-1}) and three levels of farm yard manure (0, 6.25 and 12.5 t ha^{-1}). Each strip was divided into 24 sub plots and pre sowing soil samples were collected from each sub plots. At maturity, the grain and straw yields were recorded plot wise. Plant and grain samples were collected and analyzed for their P content and uptake values were computed. Making use of the data on pre sowing soil test values, yields and uptake of nutrients by rice and the levels of fertilizers nutrients and FYM, fertilizers prescription equation for $rice_5$ was developed. In the present investigation, the beneficial effect of combined use of NPK fertilizers with FYM was studied at two different levels of FYM *viz*., 6.25 and 12.5 t ha^{-1}. Nomograms was developed for desired yield target of rice for a range of soil test values under NPK alone, NPK plus 6.25 t FYM and NPK plus 12.5 t ha^{-1} of FYM. Using the fertilizer prescription equations, nomograms were formulated for a range of soil test values under NPK alone and under IPNS for desired yield target of rice. For a yield target 70 q ha^{-1} of rice with available soil N, P and K values of 200, 22 and 200 kg ha^{-1} respectively, the doses of fertilizer N, P_2O_5 and K_2O required were 186, 72 and 47 kg ha^{-1}, respectively for NPK alone, 148, 44 and 20 kg ha^{-1} respectively for NPK + FYM @ 12.5 t ha^{-1}. Using the fertilizer prescription equations under IPNS, the extent of saving of inorganic fertilizers for rice computed. The results showed that with the application of FYM @ 12.5 t ha^{-1} with 28 percent moisture and 0.43, 0.31 and 0.41 per cent of N, P and K respectively, there was a saving of 39, 28 and 37 kg of fertilizer N, P_2O_5 and K_2O respectively.

CPT 17

Diversity and Management of Cassava Whitefly, *Bemisia tabaci* in Different Cassava Ecosystems

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Cassava is one of the most important tuber crop cultivated both in plains as well as coastal areas. While considering the main limiting factor in cassava production, cassava mosaic disease stands out. Cassava whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) is the most notorious invasive insect pests reported, infesting more than 900

species of plants and spreading more than 200 plant viral diseases including cassava mosaic disease, which is caused by Cassava mosaic virus. *Bemisia tabaci* was collected from all the 13 agro-ecological zones of Kerala, India, where cassava is cultivated. Genetic variability study was conducted with 10 selected ISSR primers which had shown polymorphism in their banding pattern with amplicon size ranged between 200 bp to 2900 bp. Phylogenetic analysis using NTsys software revealed the presence of two major clusters with Sulthan Bathery population as out group. Similarity matrix had shown up to 49 per cent variation between the samples. Polymerase chain reaction using mitochondrial *cytochrome oxidase1* primers, C1-J2195 and L2-N-3014 had given bands at 850 bp. Nucleotide sequences had shown variation up to 16.5 per cent and dendrogram generated out of the sequences using MEGA-6 (Neighbor Joining Method) gave two clusters and one out group. Sequence similarity check using reference sequences from NCBI data base indicated the presence of two biotypes, Asia I and Asia II5 in cassava plants of Kerala. Fourteen insecticides were used at different concentration, for the management study of the whitefly, in cassava. Thiamethoxam 25 WG showed maximum reduction in whitefly populations (92.3 %) followed by Imidachloprid 17.8 SL (83.3 %) and Dimethoate 30 EC (70 %) (3rd day after application). In drenching study, nine insecticides were used and four among them found to be effective and the order of reduction in insect population on 7th day after drenching was Thiamethoxam 25 WG (89.82 %) followed by Imidachloprid 17.8 SL (83.5 %), Dimethoate 30 EC (65.91 %) and Diafenthiuron 50 WP (65.14 %). The periodicity of application of effective insecticides is standardized as 14 days, as their effectiveness was reduced drastically after two weeks.

CPT 18

Conservation and Evaluation of Different Cut Foliage Species Comprising Pteridophytes (Ferns and Fern Allies) of West Coast Regions of India

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There is a great need to find cut foliage species suitable for use in floral displays for florists and floral designers. The cut foliages which stay green for long time, retain their appearance and which do not shed leaves or berries are desired characteristics for cut greens used in floral displays. Ferns and Asparagus are important cut foliages which play a key role in flower arrangements and floral designs. They are the most popular cut foliages for use in arrangements because of its year-round availability and good vase life. Ferns, apart from its use as a durable cut foliage crop for use in floral designs and arrangements, also serve as a good ground cover for shady locations. It can also be planted in pots since potted ferns are commercially used in various landscape projects. Ferns are considered to be the first true land plants and are among the world's oldest living plants. Ferns, with their marvellous shape of foliage and ample ecological adaptability, are of high significance with respect to urban landscaping. Fern fronds are also used in bouquets and for decorating stages, halls, etc. during various functions. Extensive investigations were conducted to trace and explore different cut foliage species comprising Pteridophytes (Ferns and fern allies) in the West Coast regions of India by the team of Researchers at ICAR- Central Coastal Agricultural Research Institute, Goa. Flora of Western Ghats consists of about 12,000 species ranging from unicellular cyanobacteria to angiosperms. Amongst these, flowering plants constitutes about 27% of Indian flora with 4000 species of which about 1500 species are endemic. Apart from harboring a rich diversity of angiospermic flora, Western Ghats are also a rich repository of cryptogams such as pteridophytes, bryophytes, lichens, fungi and algae. Ferns grow luxuriantly in moist tropical and temperate forests and their occurrence in different eco-geographically threatened regions from sea level to the highest mountains are of much interest. Large scale collection of ferns from forests by the visitors and local people for ornamental purpose, medicinal purpose and during excursions also increases the pressure on these plants. Hence conservation of biodiversity of these plants is the need of the hour. As an outcome of the botanical survey, cut foliages *viz*., Boston fern (*Nephrolepis exaltata*), Bridal fern(*Asparagus setaceus* syn. *Plumosus*), Button fern (*Nephrolepis cordifolia* 'Duffii'), Compact sprengeri fern (*Asparagus densiflorus* 'Sprengeri' compacta), Creeping fern/Wart fern (*Polypodium scolopendria*), Emerald fern (*Asparagus densiflorus* 'Sprengeri'), Fish tail fern (*Nephrolepis biserrata furcans*), Fox tail fern (*Asparagus densiflorus* 'Myers'), Hard fern (*Blechnum orientale*), Ladder brake fern (*Pteris vittata*), Leather leaf fern (*Rumohra adiantiformis*), Maiden hair fern (*Adiantum raddianum*), Oak-leaf fern (*Drynaria quercifolia*), Peacock fern (*Selaginella willdenowii*), Silverback fern (*Pityrogramma calomelanos*), Soft fern (*Christella dentata*), Staghorn club moss (*Lycopodiella cernua*) and

Vine like fern *(Lygodium palmatum*) were collected, conserved and evaluated for their suitability for use as cut foliages or fillers. Significant variation was noticed among different ferns and *Aspargus* used in the study for various morphological and leaf quality traits. The results of the study reflect the aptness of different cut foliages to function for various purposes in floristry.

CPT 19

Effect of Integrated Nutrient Management on the Yield and Nutrition of Glory Lily (*Gloriosa superba* L.) in Coastal Sandy Soils

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The productivity of crops in coastal sandy soils is low owing to salinity, poor organic matter, nutrient availability, leaching etc. Alternate land use involving cultivation of medicinal plants has a greater scope of improving farm income due to increasing demand and export potential. One field experiment was carried out in a farmer's field near Chidambaram in a coastal sandy soil which analyzed for pH 6.74 and EC 1.52 dS m^{-1}. The soil had organic carbon content of 0.32 per cent and available nutrient status was low in N, medium in P and K. The treatments evaluated were T_1 – Absolute Control, T_2 – Recommended NPK, T_3 – FYM alone @ 12.5 t ha^{-1}, T_4 – Humic acid alone @ 20.0 t ha^{-1}, T_5 – 75 % NPK + FYM @ 12.5 t ha^{-1}, T_6 - 75 % NPK + Humic acid @ 20.0 kg ha^{-1}, T_7 - 50 % NPK + FYM @ 12.5 t ha^{-1}, T_8 – 50 % NPK + Humic acid @ 20.0 kg ha^{-1}, T_9 – T_5 + $ZnSO_4$ @ 25 kg ha^{-1} + Panchakavya foliar spray, T_{10} – T_6 + $ZnSO_4$ @ 25 kg ha^{-1} + Panchakavya foliar spray , T_{11} – T_7 + $ZnSO_4$ @ 25 kg ha^{-1} + panchakavya foliar spray and T_{12} – T_8 + $ZnSO_4$ @ 25 kg ha^{-1} + Panchakavya foliar spray. The experimental was carried out in Randomised Block Design with three replications. Medicinal plant *Gloriosa superba* was grown as test crop. The results of the field experiment clearly indicated the beneficial effect of INM treatments in increasing the growth and yield of Glory lily. Among various treatments evaluated, T_{10}- 75 per cent NPK + $ZnSO_4$ @ 25 kg ha^{-1} + Humic acid 20 kg ha^{-1} + Panchakavya foliar spray accounted for higher plant height (148.5), number of branches (5.32), number of pods per plant (179) and seed yield (21.24 g $plant^{-1}$). This treatment also significantly increased the major nutrient N, P and K content in haulm and seed of Glory lily.

CPT 20

A Mechanical Unit for Mulch Laying with Punching Unit

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Mulching is an advance technology for better crop production. A mechanical unit which can be operated manually has been developed and its performance has been found to be effective and low cost. Mulching is the process of covering soil around the plant root area with a view to insulate the plant and its roots from the effect of extreme temperature fluctuation, increases moisture retention capacity, reduces weed growth and improves the seed germination rate. The mechanical unit consists of the major parts as the mulch laying unit and punching unit. The machine performs the operations like formation of soil beds, laying mulching paper, punching holes and covering of soil from both sides on laid polyethylene mulch in a single pass. The developed unit can be operated manually with less than 0.1 hp operating power. The effective field capacity of the manually operated mulch laying machine was observed as 0.145 ha h^{-1} at the mean forward speed of 1.5 km h^{-1}, with an overall field efficiency of 85 per cent. The width of bed size, spacing of punching holes can be adjusted as per the requirement of crop. This developed mechanical unit is advantageous for small scale land holding farmers, with low initial investment along with long time benefit.

CPT 21

Genetic Improvement of Popular Rice Land Races of Andaman & Nicobar Islands in the Context of Conservation and Sustainable Utilization

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Rice being important cereal crop of A&N Islands represents agro-biodiversity in terms of unique and well adapted land races introduced by settler population originating from various places. Despite efforts to introduce high yielding varieties, about 40% rice area is still occupied by traditional types like C14-8 (*Aath Number Dhan*). Though their yield potential is generally less compared to high yielding varieties due to admixtures and traditional plant types, their adaptive agronomic advantages under climatic aberrations and preferred grain quality parameters enable their popularity in the islands. Our aim was to document their traditional knowledge, characterize and investigate the extent of prevailing intra-varietal variation and isolate the better and stable high yielding types. The social interactions across islands revealed their specific variety preferences by farmers due to various reasons. Significant intra-varietal variation was also noticed among panicle to row progenies of the popular C14-8 (*Aath Number Dhan*) for grain colour and grain yield traits which was followed by selection of promising types. This was followed by systematic evaluation of promising types across 5 years coupled with farmers' participatory variety selection and front-line demonstrations in the islands. This resulted in the development of purified improved versions of C14-8 in the name of varieties CIARI Dhan 8 (yellow grains) and CIARI Dhan 9 (brown grains) both of which out-yield the original C14-8 population by about 20%.Through a Department of Biotechnology (DBT)-funded program, 4 genes (*Xa4, xa5, xa13, Xa21*) conferring resistance to blight blight- a major rice disease (*Xanthomonas oryzae pv. oryzae*) are also being transferred through marker assisted selection in CIARI Dhan 8 (BC_3F_2 stage). Similarly, traditional knowledge of Karen community rice cultures *viz.,* Black Burma, White Burma, Red Burma, Khushbuyya, Mushley, Nyan-win from Middle Andaman was documented and detailed DUS (distinctness, uniformity, stability) characterization performed. The purification, selection and evaluation program across 5 years also resulted in the identification of high yielding types in Black Burma (BB13-50 and BB 13-62) and Khushbuyya (KU13-51, KU13-65 and KU 13-76). The concerted efforts resulted in the award of PPVFRA instituted Plant Genome Saviour Community Award of Rs. 10 lakh to Karen community for their contribution to the on-farm conservation of these unique types since 1925 in the islands. In addition, these varieties were also facilitated for registration by PPVFRA, New Delhi which accords a legal ownership to the Karen community of these traditional varieties. These concerted efforts are likely to boost and sustain rice production in the islands especially in the perspectives of agro-biodiversity conservation and sustainable utilization, IPR and resilience to climatic aberrations.

CPT 22

Ergonomic Evaluation of Modified Dryland Weeder

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Weeds are unwanted and undesirable plant that interfere with utilization of land and water resources and thus adversely affect crop production and human welfare. Weeds compete with the crops for water, soil nutrients, light and space thus reducing crop yields. Dry land weeder is used to remove weed between two rows in push pull mode, work being performed in the standing posture. The handle height, length, grip diameter etc. of existing dryland weeder were modified based on the relevant anthropometric dimensions. Ergonomic evaluation of developed dryland weeder was carried out with six male subjects. The Energy Expenditure Rate (EER) was decreased by 14.5% in modified dryland weeder. The work pulse was decreased by more than 10 beats per min in modified dryland weeder. As comparison of existing dryland weeder, the field capacity and weeding efficiency in modified

dry land weeder were increased by 30% and 6%, respectively. The overall discomfort rate was also decreased by 33.8% in modified dry land weeder.

CPT 23

Performance of Drip Irrigated Okra under Stressed Environment of Coastal West Bengal

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The coastal West Bengal consists of low lands which are flat with little or no slope and often suffer from inadequate drainage and waterlogging during the rainy season (June-Sept.). Agriculture in the lean period of eight months suffers from acute water scarcity and salinity. Ground water in this region varies spatially and temporally and often carries threats for water table depletion and sea water intrusion. In this scenario, cultivating more with little available water propels the idea of using highly efficient drip irrigation system. A number of experiments were carried out at ICAR-CSSRI, RRS, Canning Town farm with the drip irrigation systems in the years 2013-18 taking different crops during post monsoon period (*rabi* season). The soil salinity in the rootzone was less than 3 dS m^{-1} at the beginning of the *rabi* season. Irrigations were scheduled based on cumulative pan evaporation data. Measurements were made to evaluate the salinity in the root zone and crop performance in terms of yield and return. In the gravity drip irrigation system, four crops such as okra, red beet, basella and cowpea were taken for the experimentation in the year 2013. Cowpea suffered most and okra crop performed best among the vegetables if there was flash flood in the field. The yield of all the crops was converted into okra equivalent yield (OEY) by taking the prevalent market price. Highest OEY was obtained in okra (0.42 kg $plant^{-1}$) followed by Basella (0.19 kg $plant^{-1}$), and lowest in case of beet (0.07 kg $plant^{-1}$). In other experiments during 2014-18, water of different salinities was prepared by mixing the saline groundwater with fresh water for the four treatments such as T_1: 2 dS m^{-1}, T_2:6 dS m^{-1}, T_3: 10 dS m^{-1} and T_4:14 dS m^{-1}. Only one quality of water was applied through the drip irrigation system at a time. The treatments were imposed after 20-25 days of fresh water irrigation when the crop is established. The highest okra yield (14 t ha^{-1}) was obtained for the treatment T_1. There was about 50% less yield in case of T_4 in comparison to T_1. The NDVI value was higher for the irrigation water of lower salinity (T_1>T_2>T_3>T_4) throughout the experimental period. The salinity build up was highest for T_4 during the experimental period, but the salts were leached out by the runoff during rainy season.

CPT 24

Responses of *SUB1* Gene- Introgressed Rice Genotypes to Stagnant and Flash Flooding in Coastal Rainfed Low Land Ecosystem

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Submergence of low land rice fields during the wet season in coastal regions adversely affects productivity of transplanted rice. Tolerant rice lines have been developed that carry the *SUB1* gene from the tolerant rice landrace FR 13A. Field experiment was conducted for two consecutive wet seasons of 2016 and 2017 at ICAR-CSSRI, RRS, Canning Town to evaluate six *SUB1* introgressed rice genotypes (Ciherang - *SUB1*, CR 1009 - *SUB1*, IR 64 - *SUB1*, BR 11 - *SUB1*, Samba - *SUB1* and Swarna - *SUB1*) along with two checks (DRR 39 and Sabita). Seedlings were transplanted under two different situations *viz*., (1) stagnant flooding with prevalence of standing water of more than 40 cm during most part of the growing season and (2) flash flooding situation, where the crop was submerged only during high rainfall, when field water level was more than 40 cm, and completely covering the plants for two weeks, with water level recedes with decrease in rainfall intensity. During *kharif* 2016, the highest grain yield was produced by CR 1009 - *SUB1* (3.67 t ha^{-1}) under stagnant flooding, which was at par with Sabita (3.50 t ha^{-1}). However, under

flash flooding situation, CR 1009 - *SUB1* produced 4.75 t ha^{-1}, which is significantly higher over all other varieties. During *kharif* 2017 there was significant variation in grain yield under stagnant flooding. None of the *SUB1* introgressed varieties performed better than local check variety Sabita (grain yield 3.4 t ha^{-1}) under stagnant flooding. Among the *SUB1* varieties highest grain yield of 2.87 t ha^{-1} was produced by CR 1009 - *SUB1* followed by Samba - *SUB1* (2.61 t ha^{-1}). Under flash flooding, the highest grain yield of 3.43 t ha^{-1} was produced by CR 1009 - *SUB1*, while the local variety Sabita produced grain yield of 1.94 t ha^{-1}. The lowest grain yield of 0.74 t ha^{-1} was produced by IR 64 - *SUB1*. Participatory varietal selection (PVS) was conducted during both the years to find out the preference of farming community for these varieties. Under stagnant flooding, the highest positive preference score was recorded for Sabita (+25 and +27 during 2016 and 2017, respectively) followed by CR 1009 - *SUB1* (+22) and BR 11 - *SUB1* (+18). The lowest preference score was observed for IR 64 - *SUB1* (-30 and -17 during 2016 and 2017 respectively), Ciherang - *SUB1* (-19) and Samba - *SUB1* (-10). Under flash flooding, highest preference score (+35 and +20 during 2016 and 2017 respectively) was recorded for CR 1009 - *SUB1* followed by BR 11 - *SUB1* (+19) and Sabita (+18). The lowest preference score was observed for IR 64 - *SUB1* (-38), Samba - *SUB1* (-26), DRR 39 (-19) and Ciherang - *SUB1* (-16). On the basis of the results of field experiment and farmer's preference, CR 1009 - *SUB1* can be recommended for cultivation under flash flood situation in the coastal areas of India.

CPT 25

Effect of Boron Fortified Konkan Annapurna Briquettes (KAB) on Yield and Nut Splitting of Arecanut in Coastal Konkan of Maharashtra

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The present investigation was conducted at Dr. B. S. Konkan Krishi Vidyapeeth, Arecanut Research Station, Shriwardhan, Dist. Raigad, Maharastra for the three years from 2013-14 to 2015-16. The experiment was planned to maximize the yield of arecanut and to reduce the splitting of the arecanut and transfer the technology to the farmers. The 10-15 year old palms of arecanut were selected for the study. Total seven treatments were replicated four times and laid in randomized block design for statistical analysis. The treatment comprises viz. T_1 - Recommended Dose of Fertilizers; T_2 - RDF + 4 kg B ha^{-1} through soil application; T_3 - RDN + 4 kg B ha^{-1} containing KAB; T_4 - RDN + 2 kg B ha^{-1} containing KAB; T_5 - 150 % RDF + 4 kg B ha^{-1} through soil application; T_6 - 150 % RDN + 4 kg B ha^{-1} through KAB and T_7 - 150 % RDN + 2 kg B ha^{-1} through KAB. All the briquettes were prepared as per the treatments based on the recommended dose of nitrogen. All the treatments were applied by ring method in June and October month of every year of the investigation. The application of the Boronated KAB as well as application of straight fertilizers showed the significant reduction in splitting of nuts as well as increasing yield of arecanut. The results showed that the application of 150% RDF along with 4 kg B ha^{-1} through KAB recorded highest B:C ratio with higher yield and lowest percentage of splitting of the nuts in arecanut of Konkan region in Maharashtra.

CPT 26

Effect of Supplementary Irrigation with Reference to Growth and Yield of Cashew under South Konkan Region of Maharashtra

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A field trial was conducted at Regional Fruit Research Station, Vengurle, Dist. Sindhudurg, Maharashtra with an objective to study the effect of post monsoon irrigation on flowering, fruiting and yield of cashewnut (*Anacardium occidentale* L.) under South Konkan region of Maharashtra under AICRP-Cashew programme during the year 2016-17. The experiment was laid out with 5 treatments *viz*., Irrigation at 20%, 40%, 60% and 80% CPE (cumulative pan evaporation) and control (no irrigation) under Randomized Block Design with four replications through drip irrigation method from January to April. The quantity of water required in litres per tree day^{-1} and month-wise as per treatment was calculated on the basis of daily evaporation averages of 5 years. The recommended

package of practices was simultaneously followed including the plant protection schedule. The various flowering, fruiting and yield parameters were recorded at appropriate stages during both the years and data was statistically analyzed. Among the different irrigation levels investigated, application of drip irrigation at 80% CPE recorded the highest nut weight (10.68 g), apple weight (83.50 g) and nut yield of 11.06 kg tree^{-1} and 2.21 t ha^{-1}, and it also increased the nut yield by 31.91% over control. While, the lowest yield 7.53 kg tree^{-1} was recorded in control (no irrigation).

CPT 27

Biological Management of Slow-Decline Disease of Black Pepper

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Black pepper (*Piper nigrum* L.) is cultivated as an intercrop in coconut or arecanut garden or sole crop using *Erythrina indica* or other suitable forest trees as living standards under adequate irrigation facilities. Co-infection of the fungus *Phytophthora capsici* and phyto nematode *Radopholus similis* induced most dreaded disease 'slow decline' causing considerable yield losses as well as are also responsible to completely wipe out the black pepper vines, in Konkan region of Maharashtra. Both pathogens leading soil borne are difficult and uneconomical to manage with chemical fungicides and nematicides and also are hazardous to human health and ecosystem. Exploration of biologicals seems to be economical and environment friendly to manage both of these diseases and also to produce chemicals free black peppers intended to export. Therefore, present study was planned and conducted by using biocontrol agents and nematicide (alone and combination) to manage slow decline disease of black pepper. The field experiment comprising seven treatments replicated thrice in RBD was laid out on living standard (Ran Bhend – *Thespesia populnea*) at Asond Block, Central Experiment Station, Dr. BSKKV, Wakawali during 2015-16, 2016-17 and 2017-18. Three years pooled mean data revealed significantly, least mean disease *i*ntensity (6.78%) with the treatment, soil application of *Pochonia chlamydosporia* @ 2 kg vine^{-1} (1.05 kg P. chlamydosporia/ 50 kg partially decomposed FYM), followed by soil drenching with *Pseudomonas fluorescens IISR-6* @ 2% (10^6 cfu) (drench 3 L vine^{-1}). The treatment, soil application of *Trichoderma harzianum* (10^8 cfu @ 50 g vine^{-1}) followed by soil drenching with *Pseudomonas fluorescens* and another treatment, soil application of *Pochonia chlamydosporia* @ 50 g vine^{-1} followed by soil drenching with *P. fluorescens* @ 2% were at par to each other. Maximum reduction in the disease over control was observed in vines treated during onset of monsoon (June – July) and again during August – September with soil application of *Pochonia chlamydosporia @ 2 kg vine^{-1},* followed by soil drenching with *Pseudomonas fluorescens* @ 2%. The maximum dry pepper yield (1.16 kg plot^{-1}) was recorded with the treatment, soil application of *Pochonia chlamydosporia @ 2 kg vine^{-1},* followed by soil drenching with *Pseudomonas fluorescens* @ 2%, which was on par with the treatments, soil application of *Trichoderma harzianum* followed by soil drenching with *Pseudomonas fluorescens* (0.98 kg plot^{-1}) and soil application of *Pochonia chlamydosporia* @ 50 g vine^{-1} followed by soil drenching with *P. fluorescens IISR-6* @ 2% (0.86 kg plot^{-1}).

CPT 28

Seasonal Variation of Green Seaweeds (Chlorophyta) from the Undi Coastal Area of Ratnagiri, Maharashtra

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In the present study, monthly and seasonal variation in abundance of green seaweeds from the coastal region of Undi, Ratnagiri district along the west coast of Maharashtra were investigated. Stratified random sampling was carried out during monthly lowest tides along exposed rocky shore area. For the estimation of percentage coverage

of seaweeds, photo-quadrate method was employed. For the quantitative estimation of green seaweed, collected samples from the quadrate were sorted out separately into species wise and wet/ fresh weight was taken for density and biomass estimation. Rocky shore of Undi comprised of ten green seaweeds *viz*., *Bryopsis plumosa, Chaetomorpha antennina, Chaetomorpha crassa, Caulerpa racemosa, Caulerpa peltata, Caulerpa taxifolia, Caulerpa sertularioides, Ulva lactuca, Ulva fasciata* and *Valonia utricularis*. In the study area, maximum green seaweed abundance species was recorded during pre-monsoon and post-monsoon, while in monsoon, the abundance of green seaweed was remarkably declined. But in case of *Bryopsis plumosa* and *Ulva lactuca*, unlike other seaweeds maximum biomass was observed during monsoon season. Among the green seaweed, species like *Caulerpa peltata, Ulva fasciata* and *Caulerpa taxifolia* were recorded throughout the year. The maximum biomass of *Caulerpa peltata* was recorded in the month of February 2018 in pre-monsoon period. The water pH showed highly significant positive correlation with abundance of green seaweeds *viz*., *Caulerpa peltata* and *Ulva fasciata*. Macro marine green algae species were found abundantly along the coast line of Ratnagiri.

CPT 29

Effect of Different Levels of Dilutions and Pectinase Enzyme on the Quality of Jackfruit (*Artocarpus heterophyllus* L.) Wine

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An investigation was undertaken to study the effect of different levels pectinase enzyme treatments and dilution levels on quality of jackfruit wine. The clear and thick juice of jackfruit was mixed according to various treatments in fixed dilution levels. This juice was taken in different vessels and the T.S.S content of juice adjusted to 25 brix by addition of powdered sugar**.** The pH was adjusted to 3.5 by addition of citric acid and calcium carbonate. Pectinase enzyme was added in various concentrations (0.0%, 0.1%, 0.15%, and 0.20%). The must was taken in fermentation flask (1 kg per flask) and used further for fermentation. Must was inoculated with yeast culture (*Saccharomyces cerevisiae)* @ 0.30 g kg^{-1} and kept for fermentation at room temperature. The start of the fermentation was indicated by evolution of gas bubbles in the distilled water through rubber tubing. During active fermentation, foam formation was observed in the fermentation flasks. The end of fermentation was indicated by the cessation of foaming and bubbling and even constant T.S.S. recorded by the must during fermentation. The wine that was prepared from jackfruit juice with 0.10 per cent pectinase enzyme treatment and 1:1 dilution level recorded the lowest tannin and pectin content, highest protein content, alcohol content and desirable level of T.S.S. On the basis of chemical composition and the organoleptic evaluation of wines prepared from different levels of pectinase enzyme concentration and dilution levels, it was observed that 0.10 per cent pectinase enzyme concentration and 1:1 dilution level were the optimum conditions for preparation of good quality wines from jackfruit juice.

CPT 30

Utilization of Gamma Irradiation for The Management of Sweet Potato Weevil *Cylas formicarius*

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Sweet potato *Ipomoea batatas (*L.) Lam, an important tropical root and tuber crop, considered for promoting food and nutritional security, particularly in agriculturally backward areas, is ranked seventh in global food crop production, with a global production of 105 Mt from 8.6 Mha. In India, it is grown in an area of about 0.134 Mha, with a production of 1.4 Mt. Asian sweet potato weevil (SPW) *Cylas formicarius* (Fab.) (Coleoptera: Brentidae) is the single most important pest limited to the perspective increase in sweet potato production and storage. Post-harvest disinfestation by methyl bromide was in vogue, but in accordance with the Montreal Protocol, it was phased out from its use due to its ozone depleting property. There is a global drive to search for alternative to synthetic

insecticide for saving crops from biotic factors. In this context, exploitation of gamma irradiation for the management of sweet potato weevil was contemplated, as it is non-chemical and eco- friendly. In order to standardise the appropriate dose of gamma irradiation required for the management of SPW, tubers of sweet potato and SPW collected from the field were exposed to different doses (10, 30, 50, 100, 250, 500, 750 and 1000 Gy) of gamma irradiation separately from a Cobalt-60 source with a dose rate of 9.878 kGy h^{-1}, using gamma chamber 5000. Mortality of weevils treated with 750 and 1000 Gy was 60 and 100% respectively within a week, whereas no mortality was observed in weevils exposed to other doses and control. The experiment on feeding behaviour revealed that there was a negative correlation between dose and feeding by the treated weevils, however, normal feeding was observed when the non-irradiated weevils were exposed to the irradiated tubers, irrespective of doses. This proves that irradiation does not retain any toxic residue in the tuber. It was also noticed that the irradiated weevils exhibited lighter body weight and lower growth rate compared to control. Endosymbiont studies were also conducted to ascertain the effect of irradiation on weevils and the result exemplify a pronounced reduction in bacterial colonies after treatment compared to control.

CPT 31

Nutrient Management in Yard Long Bean (*Vigna sesquipedalis* L.) in Konkan Agroclimatic Conditions

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A field experiment on nutrient management in yard long bean (*Vigna sesquipedalis* L.) in lateritic soil of Konkan region was conducted during *rabi* seasons of three succeeding years from 2012-13 to 2014-15 at Vegetable Improvement Scheme, Central Experiment Station, Wakawali. The experiment was laid out with four treatments consisting of various levels of nitrogen and potassium *viz*., T_1 (20 t FYM + 60:60:30 kg NPK ha^{-1}), T_2 (20 t FYM + 90:60:30 kg NPK ha^{-1}), T_3 (20 t FYM + 120:60:30 kg NPK ha^{-1}) and T_4 (20 t FYM + 150:60:30 kg NPK ha^{-1}). The experimental results revealed that the treatment T_4 (20 t FYM + 150:60:30 kg NPK ha^{-1}) recorded the maximum number of pods (55.91) per vine, pod length (36.76 cm), pod weight (11.02 g) and pod yield (13.75 t ha ha^{-1}) as compared to the rest of the treatments under study. It was also observed that maximum cost benefit ratio (1.978) was obtained in treatment T_4 followed by T_3 (1.882), T_2 (1.768) and T_1 (1.584), respectively. Hence the treatment T_4 (20 t FYM + 150:60:30 kg NPK ha^{-1}) was found to be economically beneficial for getting maximum returns in yard long bean under coastal environment.

CPT 32

Response of Cashew cv. Vengurla-4 under Organic Management

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An experiment was conducted to study the performance of cashew cv. Vengurla-4 under organic management during 2016-17 at RFRS, Vengurle, Maharashtra in Randomized Block Design with three replications and eight treatments. Treatments comprised of different source of manures and were applied in June. Among the different organic manure studied, application of 100% N as Vermicompost + BCF (T_4) produced the highest number of nuts per panicle (8.29), yield (8.44 kg $tree^{-1}$ and 1.72 t ha^{-1}) with comparatively good shelling percentage (29.50%) and apple weight (85.83 g). Whereas, the highest nut weight (10.10 g) was observed under treatment T_6 (*in situ* green manuring/green leaf manuring to meet 100% N retain litter + planting cowpea) followed by T_4 (9.83 g) and T_1 (9.50 g) (100% N as FYM). The available soil N content after harvest was noted highest (320.91 kg ha^{-1}) with application 100 % N as FYM + biofertilizers consortium (BCF) (T_2) while highest available soil P_2O_5 (6.77 kg ha^{-1}) and available soil K_2O (217.79 kg ha^{-1}) was observed in treatment T_4. In present investigation, treatment T_4 (100% N as Vermicompost + BCF) appeared as best organic manure to enhance the yield and quality of nut of cashew cv. Vengurla-4 with retention of optimum soil nutrients in the soil. However, the experiment is to be continued again for 2-3 years to arrive at specific recommendation.

CPT 33

Effect of Different Value Added Briquettes on Soil Nutrient Status and Yield of Cashew in Konkan Region of Maharashtra

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A field trial was conducted at two locations one at Regional Fruit Research Station, Vengurle with cashew cv. Vengurla-7 and another at Cattle Breeding Farm, Nileli with cashew cv. Vengurla-4 during the year 2016-2017 with a view to study the effect of different value added briquettes on yield and soil nutrient status. The experiment was conducted in a randomized block design with four replications and seven treatments *viz.*, T_1: absolute control (no manure, no fertilizers), T_2: RDF (1000:250:250g NPK tree^{-1} year^{-1}), T_3: RDF + copper through copper sulphate @ 15 kg ha^{-1} + boron through borax @ 10 kg ha^{-1} + molybdenum through sodium molybdate @ 0.250 kg ha^{-1}, T_4: 100% RDN through Konkan Annapurna Briquettes (KAB), T_5: 100% RDN + copper through copper sulphate @ 15 kg ha^{-1} + boron through borax @ 10 kg ha^{-1} + molybdenum through sodium molybdate @ 0.250 kg ha^{-1} through KAB, T_6: 80% RDN + copper through copper sulphate @ 15 kg ha^{-1} + boron through borax @ 10 kg ha^{-1} + molybdenum through sodium molybdate @ 0.250 kg ha^{-1} through KAB, T_7: 60% RDN + copper through copper sulphate @ 15 kg ha^{-1} + boron through borax @ 10 kg ha^{-1} + molybdenum through sodium molybdate @ 0.250 kg ha^{-1} through KAB. The different value added briquettes were prepared at Regional Fruit Research Station, Vengurle and applied by ring method in June, 2016. The recommended package of practices including plant protection was uniformly followed for all the treatments including control. The data on yield attributes recorded at appropriate stages similarly the soil samples after harvest were collected from both locations and analyzed. Application of 60% RDN + copper sulphate @ 15 kg ha^{-1} + borax @ 10 kg ha^{-1} + sodium molybdate @ 0.250 kg ha^{-1} through KAB (T_7) recorded the maximum numbers of nuts per panicles (6.0 and 7.12), nut weight (11.65 g & 8.8g) and yield (9.22 kg tree^{-1} and 1.84 t ha^{-1}, 9.35 kg tree^{-1} and 1.87 t ha^{-1}) at Vengurle and Nileli location, respectively and it was superior over rest of the treatments except treatment T_6 in respect of yield (8.84 kg/tree and 1.77 t ha^{-1}) at Vengurle location and treatment T_5 in respect to number of nuts per panicles (6.22) at Nileli location. The highest apple weight of cashew cv. Vengurla-7 was recorded in treatment T_1 (106.25 g) followed by treatment T_7 (102.50 g) at Vengurle location while the highest apple weight (86.7 g) of cashew cv. Vengurla-4 recorded under T_7 at Nileli location. In the present study, treatment T_7 recorded yield increment of 32% at Vengurle location and 22% at Nileli location over control. At both locations treatment T_7 appeared as a best treatment. At Vengurla location, treatment T_6 recorded significantly the maximum Fe content (40.41 ppm) and followed by T_5 treatment (40.24 ppm) while significantly the highest Zn content was recorded in treatments T_1 (36.97 ppm) and followed by T_5 treatment (35.68 ppm). At Nileli location, application of 100% RDN + copper sulphate @ 15kg ha^{-1} + borax @ 10 kg ha^{-1} + sodium molybdate @ 0.250 kg ha^{-1} through KAB (T_5) recorded significantly the maximum Fe content (32.74 ppm) and followed by T_6 (32.41 ppm) and T_7 (31.64 ppm). Significantly the highest Mn content (332.20 ppm) was recorded in treatment T_6 (80% RDN + copper sulphate @ 15 kg ha^{-1} + borax @ 10 kg ha^{-1} + sodium molybdate @ 0.250 kg ha^{-1} through KAB and was at par with all the treatments except treatment T_7. Application of nutrients through briquettes instead of straight fertilizers was found as the best option for enhancement of cashew yield while maintaining sufficient amount of nutrients in soil. However, further detailed investigation in this direction in cashew is necessary.

CPT 34

Assessment of Suitable Rate and Method of Application of Silica on Alphonso Mango (*Mangifera indica* L.) in Lateritic Soil of Konkan Region of Maharashtra

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Silicon is one of the elements found abundantly in the earth's crust. Recent research and advances in physiology, biochemistry and genetics suggest that silicon interacts with other native or applied nutrients and has the potential to

induce resistance tolerance in the plants to biotic (insects, pests and diseases) and abiotic stresses (Al, Fe and Mn toxicity, salt injury, lodging, etc.). Although silicon is not generally listed in the list of essential elements, it is considered as one of the important beneficial nutrients for plant growth. Mango, known as "king of fruits" is the third largest fruit cultivated throughout the tropics and subtropics. The productivity and quality of mango is highly constrained by major factors like nutrient deficiency, disease and pest incidence. Proper nutrition is pre-requisite for a tree to sustain the normal crop load to maturity. Higher rates of nutrient utilization by developing fruits, lead to a competition for survival of fruits on a tree. Soluble silicon ranges from 2 to 375 ppm in various soils. Silicon though not considered as beneficial nutrient, has well documented beneficiary role in nutrient uptake and mitigation of abiotic and biotic stresses by plants. However, the information on the role of silica as beneficial or harmful effects on mango crop is not in the literature. Keeping this in view, an investigation was carried out to assess the suitable rate and method of application of silica in Alphonso mango (*Mangifera indica* L.) in lateritic soil of Konkan region of Maharashtra. In the experiment four sources of silica were used for study with three different concentrations. There were total thirteen treatments and two trees for each treatment were selected. The study was conducted on the 25-year old mango orchard at Dapoli, located at 17° 45' N latitude and 73° 12' E longitude at an elevation of 280 m above mean sea level. The climate of Dapoli is warm and humid with the mean annual rainfall of 3000 mm during June-September. According to the agro-climatic zone of Maharashtra, the soil comes under high rainfall with lateritic soil type. The soil was moderately acidic in reaction having pH 4.96 with 0.043 dS m^{-1} electrical conductivity. The status of organic carbon 8.9 g kg^{-1}, available nitrogen 326 kg ha^{-1}, available phosphorous 6.8 kg ha^{-1}, available potassium 384 kg ha^{-1}. To assess the impact of various silicon sources both soil applications (calcium silicate and rice husk ash) and foliar applications (potassium silicate and stabilized silicic acid (Silixol, a commercial product) were used. Soil applications were done twice in year (July and September), while foliar applications were done at pre flowering stage, peanut stage, marble stage fruit and three weeks before harvest. During the course of investigation chemical properties of soil, nutrient content in plants, the fruit retention and chemical composition of Alphonso mango fruits were analyzed by appropriate methods at mature and ripe stage and yield was studied. A significant increase in number of fruits per tree was recorded in all treatments of silicon sources when used at the lowest concentration. Among the two soil application sources, calcium silicate was better than rice husk ash resulting in yield increment more than 90%, while among the two foliar sources, Silixol had attributed to more than three-fold increment in yield. This observation is supported by the better nutrient status of leaves and fruits done at various stages. For horticultural crops including mangoes, sugar content is a key quality attribute. Sugar content measured as TSS, increased substantially following the application of silicon sources as silicon has a well-documented role in sugar accumulation pathways. Shelf life of fruits was also increased by 5 days following the application of Silixol, compared to other silicon sources. To conclude, the present study reveals that silicon sources plays a distinctive role in improving the yield and quality of Alphonso mangoes of Konkan region and the foliar application of Silixol has the potential of increasing the profitability of mango growers substantially.

CPT 35

Antagonistic Potentials of *Trichoderma* spp. from Saline Soils of Konkan Region against *Sclerotium Rolfsii*

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Biological control, the use of specific microorganisms which act against plant pathogens and pests, is a nature-friendly, ecological approach to overcome the problems caused by usage of chemical methods of plant protection. *Trichoderma* is widely used bio-agent against phytopathogenic fungi. Thirty four isolates of *Trichoderma spp.* were obtained from rhizosphere of different crops from saline soils and were evaluated for their antifungal activity against *Sclerotium rolfsii*. Among 34 isolates of *Trichoderma* tested, isolates SP2, WP5, GW5, GP3, CPK4 and RP4 were highly effective against *Sclerotium rolfsii* as they recorded 78.79 to 82.96 per cent inhibition of the pathogen. Based on qualitative and quantitative parameters *viz.,* fast radial growth and simultaneous lysis and over growth on *S. rolfsii,* six *Trichoderma* isolates *viz*., SP2 (*Trichoderma atroviride* Bissett.), WP5 (*Trichoderma harzianum* Rifai), GW5 (*Trichoderma atroviride* Bissett.), GP3 (*Trichoderma koningii* Oudem), CPK4 (*Trichoderma viride* Pers.) and RP4 (*Trichoderma harzianum* Rifai.) were selected for further studies on their antagonistic potential *in vivo.* Seed treatment with all the six isolates of *Trichoderma spp.* and one known *Trichoderma harzianum* isolate from

Pantnagar were found effective against *Sclerotium rolfsii* in increasing germination and decreasing the mortality of seedlings over control. *Trichoderma harzianum* (Poynad), *Trichoderma atroviride* (Wave), *Trichoderma harzianum* (Panvel), *Trichoderma harzianum* (Pantnagar), *T. atroviride* (Panvel) and *T. koningii* (Poynad) gave good germination percentage (93.01, 89.06, 84.07, 83.95, 80.80 and 73.02% respectively) and minimum average mortality (16.01%). The per cent disease incidence was recorded in the range of 6.99 to 32.00 when seeds were treated with *Trichoderma* as compared to pathogen inoculated check which showed 51.99 PDI. Least PDI was recorded in T2 - *T. harzianum* (Poynad) (6.99%) and was at par with T3 - *T. atroviride* (Wave) (10.94%). There were followed by T6 - *T. harzianum* (Panvel), T7 - *T. harzianum* (Pantnagar) and T1 - *T. atroviride* (Panvel) which showed 15.93, 16.05 and 19.20 PDI, respectively. Maximum reduction in disease over inoculated check was recorded in T2 - *T. harzianum* (Poynad) (86.55%) followed by T3 - *T. atroviride* (Wave), T6 - *T. harzianum* (Panvel), T7 - *T. harzianum* (Pantnagar) and T1 - *T. atroviride* (Panvel) with 78.96, 69.36, 69.13 and 63.07 per cent reduction over control, respectively. T4 - *T. koningii* (Poynad) (48.10%) and T5 -*Trichoderma viride* (Cowpea Khargaon) (38.33%) were least effective.

CPT 36

Yield, Quality and Nutrient Uptake of Sweet Corn as Influenced by Irrigation and Fertigation Levels in Red Ferruginous Soils of Coastal Region

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A field experiment was conducted for three consecutive years (2009-10 to 2011-12) during *rabi* season under the project AICRP on Irrigation Water Management at Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli. The soil of the experimental plot was sandy loam in texture, moderately acidic in reaction, very high in organic carbon, medium in available nitrogen, low in available phosphorus and high in available potassium content. The experiment was laid out in split plot design with three replications consisting twelve treatment combinations. The main plot treatments consist of two irrigation methods (M_1 - Online drip and M_2 -Inline drip) and three irrigation levels (I_1-100% ET_{crop}, I_2-80% ET_{crop} and I_3- 60% ET_{crop}). While, sub-plot treatments consisted of two fertigation levels: F_1-100% recommended dose of fertilizers (RDF) and F_2- 80% RDF through water soluble fertilizers (WSF). Besides, for comparison two control treatments (C_1- absolute control and C_2- 100% RDF) were kept out of experimental design. The pooled data revealed that the treatment inline drip method recorded significantly highest cob yield, sugar content, total soluble salts and total uptake of N, P_2O_5 and K_2O than the online drip method of irrigation. The treatment 100% ET_{crop} was found significantly superior over rest of the irrigation levels in respect of cob yield (17.13 t ha^{-1}), sugar content (4.29%), T.S.S. (12.50 ^{0}Brix) and total uptake of N, P_2O_5 and K_2O. In case of fertigation levels, the treatment 100% RDF through water soluble fertilizer recorded significantly highest cob yield (18.15 t ha^{-1}), sugar content (4.63%), T.S.S. (13.17 ^{0}Brix) and total uptake of N (154.46 kg ha^{-1}), P_2O_5 (24.27 kg ha^{-1}) and K_2O (85.10 kg ha^{-1}) than the treatment 80% RDF through WSF. Under different irrigation levels, the total water applied was 46.3, 37.0 and 27.8 ha-cm, respectively. While in surface irrigation total water applied was 60 ha-cm. The treatment combination $M_2I_3F_1$ recorded highest (578.8 kg ha^{-1} cm^{-1}) water use efficiency, while lowest (182.5 kg ha^{-1} cm^{-1}) was with surface irrigation. The maximum benefit cost ratio of 2.89 was observed under inline drip irrigation method with 100% ET_{crop} and 80% recommended dose of fertilizer through WSF which was followed by online drip irrigation with 100% ET_{crop} and 80% recommended dose of fertilizer through WSF. Therefore, for obtaining higher yield, better quality, efficient nutrient uptake and saving of fertilizers in sweet corn, irrigation should be given at alternate day through inline drip at 100% ET_{crop} with 80% of RDF through WSF.

CPT 37

Study of Fuel Characteristic of Cashew Nut Shell

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Cashew (*Anacardium occidentale* L.) is one of the most important tropical crops. Cashew is a traditional crop of

Konkan region mainly grown on hill slope as rainfed perennial horticultural crop. The area under the cashew cultivation in India is about 8,54,000 ha and production of about 6,20,000 tons. The area under the cashew in Maharashtra is about 1,64,000 ha with annual production of about 1,97,000 tons. Engineering properties of cashew nut shell of Vengurla- 4 were determined as it was commonly used variety for processing in the Konkan region of Maharashtra The average size and sphericity of cashew nuts were found to be 29.85 mm and 2.38, respectively. The bulk density, true density and porosity of cashew nut shell were found to be 350 kg m^{-3}, 1031.09 kg m^{-3} and 66.04% respectively. The thermal conductivity of the cashew nut shell was found to be 0.1042 W m^{-1} K^{-1}. Engineering properties of cashew nut shell was affected by the moisture content. The bulk density and true density of cashew nut shell was increased from 350 to 427 kg m^{-3} and 1031.09 to 1135.66 kg m^{-3} respectively with increased moisture content from 10.17 to 38.46%. The length, width and thickness of cashew nut shell was increased from 29.85 to 30.33 mm, 20.62 mm to 21.06 mm and 6.45 to 6.94 mm respectively with increased moisture content from 10.17 to 24.07%. The coefficient of static friction of cashew nut shell increased from 0.44 to 0.72 with different material and coefficient of friction was found to be maximum on plywood surface. The terminal velocity of cashew nut shell was found to be increase from 6.5 to 8.1 m s^{-1} with increase in moisture content from 10.8 to 23.0%. To know the quality and suitability of cashew nut shell as fuel, the proximate and ultimate analysis of cashewnut shell was carried out. The moisture content, volatile matter, ash content, carbon content and calorific value of cashew nut shell was found to be 10.17%, 68.45%, 1.22%, 19.6% and 5014 kcal kg^{-1} respectively. The amount of carbon, hydrogen, nitrogen and oxygen content of the cashewnut shell was found to be 62.18%, 6.31%, 0.73% and 29.55%, respectively.

CPT 38

Study of Ethanol Production from Cashew Apple Juice Using Solar Energy

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Ethanol production from cashew apple juice was carried out on solar concentrating collector at the energy park of the Department of Electrical and Other Energy Sources, College of Agricultural Engineering and Technology, Dapoli. Production of ethanol involves two processes *i.e*., fermentation and distillation. *Saccharomyces cerevisiae* was used at rate of 0.30 g L^{-1} as inoculation for better fermentation. For distillation the capacity of the system was kept at 3 kg of fermented cashew apple juice for a day. A solar concentrating collector having aperture diameter of 1.4 m, depth 0.35 m and focal length of 0.30 m was designed and fabricated. The solar concentrating collector was tested for its performance with (*i.e*., fermented cashew apple juice) and without load. The without load test was carried out to know the inside temperature of receiver with respect to various climatic parameters and with respect to time. During the without load testing, the maximum temperature at the focal point of the receiver was found to be 225 ^{o}C at 13.00 h when solar radiation was 611 W m^{-2}. In the full load testing the temperature profile was found 109 ^{o}C at 13.00 h when solar radiation was 594 W m^{-2}. The quantity of ethanol solution distilled during the entire experiment of one day (7 h) was 3.00 kg. After distillation, ethanol was collected by using proper condensation. The total distillation rate per day of the system was measured and it was obtained 2230 ml. The average distillation efficiency of the system was computed as 33.41%. Analysis was made from sensible heating and cooling curves. The average value of the overall heat loss factor (F'_{UL}) was found as 12.83W m^{-2} K^{-1} after analyzing the sensible cooling curve. The average optical efficiency factor (F'no) was found as 0.1202. The values of the optical efficiency factor (F'no) were used to determine the optical efficiency of the solar concentrating collector. The average optical efficiency of the system was found to be 12.02%. To test the thermal performance of the solar concentrating collector, average thermal efficiency for water boiling was determined and found to be 33.41%. Percentage of ethanol available in raw fermented cashew apple juice was 12%. After using raw fermented cashew apple juice for ethanol production on concentrating solar cooker for distillation process, the ethanol percentage was increased up to 18.6%. After second distillation of product of first distillation, value of ethanol concentration was obtained 35.5%. Specific gravity and acid value of the ethanol were determined and found to be 0.947 and 1.044 mg KOH g^{-1} respectively.

CPT 39

Growth, Yield and Quality of Ridge Gourd as Affected by Integrated Nutrient Management in Coastal Region of Maharashtra

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A field experiment was conducted during *kharif* 2016 to study the effect of integrated nutrient management on growth, yield and quality of ridge gourd at Central Experiment Station, Wakawali in Coastal region of Maharashtra. There were eight treatment combinations replicated thrice in a randomized block design. The treatment consists of recommended dose of nitrogen (RDN), phosphorus and potassium (100:50:50 kg ha^{-1}) 75 and 50% RDN, 25% and 50% N through organic manure (FYM, Vermicompost and Poultry manure), P and K as per recommendation and *Azotobacter* @ 250 g 10 kg^{-1} seed. The result of the experiment showed that the growth, yield and quality of ridge gourd were significantly increased with integrated use of manure, fertilizers and bio-fertilizer. Among the various treatments tried, the treatment receiving an integration of manure, fertilizers and bio-fertilizer *viz.*, 50% RDN + 50% N through poultry manure + P and K + *Azotobacter* @ 250 g 10 kg^{-1} seed was significantly superior and recorded maximum growth parameters, yield and quality of ridge gourd. However, the treatment consisting 50% RDN + 50% N through vermicompost + P and K + *Azotobacter* @ 250 g 10 kg^{-1} seed was at par with the earlier treatment in respect of these characters. On the basis of the results obtained during present investigation, it was concluded that integrated use of 50% RDN + 50% N through poultry manure + P and K + *Azotobacter* @ 250g 10 kg^{-1} seed is essential for improving growth parameters, yield and quality of ridge gourd grown in coastal region of Maharashtra.

CPT 40

Effect of Integrated Nutrient Management on Yield, Dry Matter and Nutrient Uptake by Ridge Gourd in Coastal Region of Maharashtra

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In order to study the effect of integrated nutrient management on yield, dry matter and nutrient uptake by ridge gourd cv. Konkan Harita, an experiment was undertaken during *kharif* 2016 at Central Experiment Station, Wakawali in coastal region of Maharashtra. The treatments comprised of recommended dose of nitrogen (RDN), phosphorus and potassium (100:50:50 N : P_2O_5 : K_2O kg ha^{1}), 75 and 50 per cent RDN, 25 per cent and 50 per cent N through organic manures (FYM, Vermicompost and Poultry manure), P and K as per recommendation and *Azotobacter* @ 250 g 10 kg^{-1} seed. There were eight treatment combinations replicated thrice in a Randomized Block Design. The result of the experiment showed that the integrated use of manure, fertilizers and bio-fertilizer was significantly superior in producing fruit yield and dry matter production of ridge gourd. As far as the uptake of major nutrients *i.e.*, N, P, K and secondary nutrients *i.e.*, Ca, Mg, S was concerned, it showed significantly highest uptake with integration through 50% RDN + 50% N through poultry manure + P and K + *Azotobacter* @ 250 g 10 kg^{-1} seed. However it was at par with the treatment consisting 50% RDN + 50% N through vermicompst + P and K + *Azotobacter* @ 250 g 10 kg^{-1} seed. From the present investigation, it was concluded that either 50% RDN + 50% N through poultry manure + P and K + *Azotobacter* @ 250 g 10 kg^{-1} seed or 50% RDN + 50% N through vermicompost + P and K + *Azotobacter* can be used for maximizing yield of ridge gourd.

CPT 41

Effect of Micronutrients and Chemical Fertilizers on Biological Efficiency of Oyster Mushrooms

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Biological efficiency of four oyster mushrooms *viz*., *Pleurotus sajor caju*, *P. citrinopileatus*, *P. florida and Hypsizygus ulmarius* was evaluated on paddy straw substrate as well as paddy straw supplemented with micronutrients and chemical fertilizers. Among the four oyster mushrooms under study, *H. ulmarius* was the best performer with highest biological efficiency (90.10%) and was followed by *P. citrinopileatus* (85.66%), *P. sajor caju* (77.68%) and *P. florida* (57.63%). Cultivation of *Hypsizygus ulmarius* or *P. citrinopileatus* or *P. sajor-caju* should be preferred than that of *P. florida*. The effect of micronutrients and chemical fertilizers was evaluated on mycelial growth at three concentrations (500, 1000 and 1500 ppm) as well as on the biological efficiency of these mushrooms. In case of micronutrients, maximum yield was recorded from the beds of *H. ulmarius* sprayed with $ZnSO_4$ (500 ppm). Maximum biological efficiency was observed in case of all four mushrooms sprayed with 500 ppm solution of DAP. Among the fertilizer, urea and Sampoorna supported the maximum mycelial growth of all mushrooms tested at 1000 ppm and diammonium phosphate (DAP) and muriate of potash (MOP) were effective at 500 ppm. The performance of *P. florida* was unsatisfactory in all the treatments. The treatments with micronutrients *viz.,* manganese sulphate **(**$MnSO_4$), zinc sulphate ($ZnSO_4$), ferrous sulphate ($FeSO_4$) and sodium molybdate dehydrate ($Na_2MoO_4.2H_2O$**)** and fertilizers **(**Urea, Sampoorna, DAP and MOP**)** were at par with each other. Though the micronutrients and fertilizers had shown some promising trends in colony growth of the mushrooms under study, their role in enhancing biological efficiency was inadequate.

CPT 42

Efficacy of Insecticide for the Management of Cashew Apple and Nut Borer

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Cashew apple and nut borer is one of the most important pests that casuses severe economic losses. Considering the importance of this pest, a field experiment was conducted at Regional Fruit Research Station, Dr. BSKKV, Vengurle, during the year 2012-13 to 2015-16 to find out the efficacy of insecticide for the management of apple and nut borer in cashew. The results revealed that the treatment Dichlorvos caused larval mortality (79.99%) of cashew apple and nut borer followed by the treatment Lambda Cyhalothrin (75.99%) and Qunialphos (60.44%).

CPT 43

Feeding Potential of Common Species of Spiders in Cashew

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An experiment was conducted to study the feeding potential of common species of spider in cashew garden during the year 2013-14, based on 12 different species of spiders collected and identified from cashew plantation at Regional Fruit Research Station, Vengurle and nearby area during the flowering and fruiting season. Out of these *Oxyopes shweta* and *Telamonia dimidiate* were noted the predominant species with higher occurrence of 37.20 and 18.90 percent, respectively. The feeding potential of these commonly observed spiders species were studied in laboratory by feeding them on cashew tea mosquito bug (TMB) in the month of February, 2014. The feeding potential of *Oxyopes shweta* was found 2.2 to 3.1 TMB per day while in case of *Telamonia dimidiate* spider, it was found to be 1.8 to 3.8 TMB per day.

CPT 44

Effect of Sowing Dates on Aphids Infesting Okra

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Okra (*Abelmoschus esculentus* L. Moench) is an annual vegetable crop and occupies a place of prominence amongst summer vegetables in our country. Many options such as chemical, cultural, mechanical, biological, *etc*., are available for the management of insect pests. Cultural control is the deliberate manipulation of the environment to make it less favourable for the pests by disrupting the reproductive cycle, eliminating their food or by making it more favourable for their natural enemies. Many cultural practices can be usually applied in an IPM scheme such as sanitation or destruction of debris, destruction of alternate hosts and volunteer plants, changing dates of planting and harvesting to avoid pest attack, crop rotation to avoid built of pests, tillage practices, habitat diversification, cropping systems or intercropping, plant density, trap crops, water management etc. The present investigation on 'Effect of different sowing dates on aphids infesting okra' was undertaken at Agronomy Farm, College of Agriculture, Dapoli, during *rabi* 2016-17. A statistically designed field experiment using split plot design having replications and treatments was laid out to evaluate effect of sowing dates against aphids of okra. Observations were recorded at weekly interval. The five plants per plot were selected randomly from each treatment plot. The numbers of aphids were recorded from three leaves *i.e.,*top, middle and bottom per plant. The data recorded was averaged as per three leaves per plant, converted to square root transformation and analyzed statistically. During 4th and 5th weeks after sowing (WAS), the minimum (6.61 and 5.63 respectively) aphid population was recorded in treatment S_1 (46th SMW, 12th-18th Nov.) which was found to be at par with the treatments S_2 (49th SMW, 3rd-9th Dec.). During 6th and 7th WAS the lowest aphids (8.06 and 11.69, respectively) were noticed in S_1 (46th SMW, 12th-18th Nov.) and the treatment was at par with S_2 (49th SMW, 3rd-9th Dec.) During 8th and 9th WAS, the treatment S_1 (46th SMW, 12th-18th Nov.) recorded lowest aphid population (7.45 and 4.80 respectively) and was at par with S_2 (49th SMW, 3rd-9th Dec.). From the results it can be concluded that the sowing of okra crop between 46th to 49th SMW i.e. November 12-18 to December 3-9 can be recommended for reducing aphid damage in *rabi* okra.

CPT 45

Effect of Mulches on Aphids Infesting Okra

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Okra (*Abelmoschus esculentus* L. Moench) is an annual vegetable crop belongs to family *Malvaceae* and occupies a place of prominence amongst summer vegetables. Mulching is the process or practice of covering the soil to make more favourable conditions for plant growth, development and efficient crop production and to control pests. Natural mulches such as leaf, straw, dead leaves and compost have been used for centuries; however in recent past, by the advent of synthetic materials, various types of polythene mulches are being used. These materials are completely impermeable to water, which prevents direct evaporation of moisture from the soil and thus limits the water losses. Similarly, mulching modify the micro climate in crop canopy which in turn affect the pest occurrence. Since many insects use visual cues to find host plants, interference with these cues can cause increased attraction or repulsion to the insects in plastic mulched fields. The present investigation on 'Effect of different mulches on aphids infesting okra' was undertaken at Agronomy Farm, College of Agriculture, Dapoli, during *rabi* 2016-17. Five plants per plot were selected randomly from each treatment plot. The numbers of aphids from top, middle and bottom leaves per plant were recorded, data was averaged, converted to square root transformation and analyzed statistically. The data on effect of different mulches on mean aphid population per three leaves revealed that during 4th and 5th weeks after sowing (WAS), the minimum (5.42 and 5.45, respectively) aphid population was recorded in treatment M_2 (Silver polythene mulch) which was found to be at par with the treatment M_3 (White polythene mulch). During 6th and 7th WAS the lowest (8.37 and 12.27 respectively) aphids were in M_2 (Silver polythene mulch) which was at par with the treatment M_3 (White polythene mulch). During 8th and 9th WAS the treatment M_2 (Silver polythene mulch**)** recorded lowest (8.20 and 5.43 respectively) aphids and was at par with M_3 (White polythene mulch). From the present investigations it can be concluded that the silver and white polythene mulch harboured less aphid population therefore, can be recommended for the management of aphids in *rabi* okra.

CPT 46

Biology of Pod Borer, *Maruca vitrata* (Fabricus) Infesting Dolichos Bean under Laboratory Condition

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Dolichos bean or field bean, *Lablab purpureus L.* (Sweet) is an ancient legume crop widely grown throughout the world for its vegetable or pulse for human consumption or as animal forage or feed. The pod borer, *Maruca vitrata* is known to cause considerable damage to Dolichos bean attacking various parts *viz*., buds, flowers, pods and seeds. The larva causes damage by weaving unopened buds and flowers, further damages the reproductive parts of flower leading to poor pod setting and pod formation. The laboratory investigations on biology of pod borer, *M. vitrata* was carried out during the year 2016-17 at the Department of Agricultural Entomology, College of Agriculture, Dapoli, Dist. Ratnagiri. The laboratory studies revealed that the pre-oviposition, oviposition and post-oviposition period lasted for 3.4, 3.3 and 1.4 days, respectively. A female laid on an average 64.4 eggs singly or in batches on flower buds and tender pods. Incubation period lasted for 3.3 days with 79 per cent egg hatching. The first instar larva was greenish white with head width of 0.14 mm and body length of 1.41 mm, but prior to pupation larvae changed its colour from deep white to green and pupated at the corner of petriplate. The larval development completed within 12.2 days passing through five instars and the duration of each instar observed to be 2.3, 2.2, 2.2, 2.3 and 3.2 days, respectively. The full grown larva measured 1.6 mm in head width and 15.94 mm in body length. The pre-pupal and pupal period lasted for 2.2 and 8.8 days, respectively. Longevity of male and female moths was 4.5 and 8.9 days, respectively. Male moth measured 11.08 mm in length, 2.15 mm in width and 24.46 mm in wing expanse. Female measured 11.90 mm in length, 2.22 mm in width and 25.32 mm in wing expanse. The sex ratio for male and female was 1:1.17. The life cycle of male and female was completed within 32.2 and 36.7 days, respectively.

CPT 47

Efficacy of Insecticides against Pod Borer, *Maruca vitrata* (Fabricus) Infesting Dolichos Bean

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A field experiment was conducted at Botany farm, College of Agriculture, Dapoli, Dist. Ratnagiri during *rabi* season of 2016-2017 to study the effectiveness of insecticides against pod borer infesting Dolichos bean variety 'Konkan Bhushan'. The experiment was laid out in Randomized Block Design having eight treatments and replicated thrice. Seven insecticides were used with one control. Two sprays of each insecticide were applied at 50 per cent flowering and 50 per cent pod filling stage. The observations were taken from five randomly selected plants from each plot at 3,7,10 and 14 days after application of insecticides. The pre-count observation was recorded before application of insecticides. The percent pod damage was calculated on the basis of total number of pods and infested pods. Data thus obtained were converted into arcsine transformation and statistically analyzed. The overall mean per cent pod damage of two sprays revealed that the treatment Emamectin benzoate 5 SG @ 0.002 per cent was effective (2.57 per cent) in reducing the pod damage and was at par with Indoxacarb 14.5 SC @ 0.014 per cent (3.51 per cent). The next best treatments were Profenofos 50 EC @ 0.075% (4.38 per cent), Lambda cyhalothrin 5 EC @ 0.003% (6.33 per cent), Dichlorvos 76 EC @ 0.11% (6.37 percent) and Deltamethrin 2.8 EC 0.0025% (8.06 percent). The highest (17.80 percent) pod damage was recorded in the untreated control. It can be concluded that, the insecticides Emamectin benzoate 5 SG @ 0.002 %, Indoxacarb 14.5 SC @ 0.014 % and Profenofos 50 EC @ 0.075% were found to be the best insecticides in protecting pods and can be included in the spray schedule for the effective management of dolichos bean pod borer.

CPT 48

Population Dynamics and Natural Enemies of Mango Hopper- A Review

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Mango hopper is an important pest of mango causing severe losses in yield. Both nymphs and adults suck cell sop from all tender parts of the plant. There are many different species of mango hopper found all over India, among which *Idioscopus niveosparsus* Leth, *Idioscopus clypealis* and *Amritodus atkinsoni* Leth are predominant. The peak activity period of mango hopper is different at different locations. In the present review paper efforts have been made to review the research work done on population dynamics of mango hopper and its natural enemies. In the review it has been observed that the peak intensity period of mango hopper is different at different places. Also, the correlation studies indicate different trends at different locations. The natural enemies are also different at different locations, however, the predominant natural enemies are spider, chrysopids and coccinellids.

CPT 49

Effect of N-Mythelene Phosponic Chitosan on Growth and Yield of Okra

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A field experiment was conducted at Agriculture Research Station, Repoli to study the effect of N-Mythelene Phosponic Chitosan 1.75 % solution on growth and yield of okra during summer 2018. The field experiment was laid out in randomised block design with 7 treatments and three replications. The treatment consists of T_1-N-MythelenePhosponic Chitosan 1.75 (250 ml ha^{-1}), T_2-N-MythelenePhosponic Chitosan 1.75 (500 ml ha^{-1}), T_3-N-MythelenePhosponic Chitosan 1.75 (750 ml ha^{-1}), T_4-N-MythelenePhosponic Chitosan 1.75 (1000 ml ha^{-1}), T_5-N-MythelenePhosponic Chitosan 1.75 (1250 ml ha^{-1}), T_6-University standard, T_7-Untreated control. The application of N-Mythelene Phosponic Chitosan 1.75 at 1250 ml ha^{-1} (T_5) recorded significantly more number of fruits per plant, weight of fruits per plant (g) and fruit yield (kg ha^{-1}) as compared to rest of the treatments under study except application of N-Mythelene Phosponic Chitosan 1.75 at 1000 ml $ha^{-1}$and N-Mythelene Phosponic Chitosan 1.75 at 750 ml ha^{-1}. The application of N-Mythelene Phosponic Chitosan 1.75 at 1000 ml $ha^{-1}$and N-Mythelene Phosponic Chitosan 1.75 at 750 ml $ha^{-1}$was at par with application of N-Mythelene Phosponic Chitosan 1.75 at 1250 ml ha^{-1}.

CPT 50

Bioefficacy of Bio-Fungicide Marvel against Powdery Mildew (*Erisiphe cichoracearum*) of Bottle Gourd [*Lagenaria ciceraria* (Molina) Standl.]

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Powdery mildew of bottle gourd (*Lagenaria ciceraria*) caused by *Erisiphe cichoracearum* is one of the major constraints in profitable production of cucurbits in general and bottle gourd in particular. The disease is of common occurrence during *kharif* season, thereby inducing premature drying of the foliage, which consequently hampers crop productivity. For eco-friendly management of this disease, a bio-fungicide Marvel (a plant based product of M/S Nirmala Seeds Pvt.Ltd., Pachora, Jalgaon) was evaluated at various concentrations along with Hexaconazole 5 EC @ 0.1 % as standard check. The field experiment was conducted at the Research Farm of this Department, during Kharif 2016-17, in RBD with eight treatments replicated thrice. A total of four sprayings of the treatments were undertaken, starting first spray at initiation of the disease and subsequent three sprays at an interval of 10 days. The observations on disease intensity were recorded, one day before each spraying, by applying 0-9 grade disease rating scale and finally mean disease intensity was computed. Simultaneously, fruit yield was recorded intermittently, before each spray and cumulative fruit yield data was presented. The results revealed that all the treatments resulted

with significantly minimum mean powdery mildew intensity and significantly highest in fruit yield (q ha^{-1}), over untreated control. However, significantly least mean disease intensity (23.59%) and highest fruit yield (100.33 q ha^{-1}) were recorded with three sprays of Hexaconazole 5% EC @ 0.1%. The second and third best treatments found were four and three sprays of Marvel @ 1 ml L^{-1} and 2 ml L^{-1} water respectively, with the disease intensity of 33.63 and 33.31%, respectively and fruit yield respectively of 92.97 and 87.77 q ha^{-1}, both treatments were on par. Rest of the treatments also resulted with significantly minimum mean powdery mildew intensity in the range of 34.28 to 47.98% and fruit yield in the range of 71.53 to 82.50 q ha^{-1}. Thus, for eco-friendly management of bottle gourd powdery mildew, especially under organic farming, four sprayings of Marvel either @ 1 ml or 2 ml L^{-1} water can be used.

CPT 51

Effect of Chemical and Plant Extract on Sclerotial Viability of *Sclerotium rolfsii* Sacc. Inciting Collar Rot of Gerbera

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The collar rot of gerbera caused by *Sclerotium rolfsii* Sacc. is a major challenge for gerbera growers in its successful cultivation under greenhouse condition. Five chemical and one plant extract were tested with different concentrations for their effect on viability of sclerotia of *S. rolfsii* Sacc. Firstly 30 days old sclerotia collected from cultured Petri plates were soaked in chemicals and phytoextracts for 30, 60 and 120 minutes. The result revealed that soaking of sclerotia of *S. rolfsii* Sacc with formaldehyde (5%) and ethyl alcohol (40%) showed complete inhibition of sclerotial germination and were at par with each other. Both formaldehyde (5%) and ethyl alcohol (40%) completely killed the sclerotia irrespective of soaking period and were statistically significant over rest of the treatment. This was followed by metalaxyl (0.3%), carbendazim (0.1%), captan (0.2%) and soapnut extract (10%) with 8.89, 6.67, 4.44 and 2.22% inhibition of sclerotial germination, respectively.

CPT 52

Management of Post Harvest Anthracnose of Mango by Pre- and Post-Harvest Treatments

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Anthracnose caused by *Colletotrichum gloeosporides* is the major disease of mango, which occurs all growth stages of mango *viz.,* vegetative, flowering, fruiting and during ripening. The post harvest anthracnose reduces the fruit quality and ultimately fetching low market value. Accordingly the experiment was carried out at Regional Fruit Research Station, Vengurle during 2015-16 and 2016-17 for management of post harvest anthracnose of mango by pre- and post-harvest treatments. The experiment was laid out in RBD with four replications and six treatments consisting three pre-harvest sprays of *Azadirachtin* (2%) and hexaconazole (0.1%) followed by post-harvest treatment with hot water (52 C for 10 min.). The disease incidence was recorded 5, 10 and 15 days after treatment. The treatment (T_4) three sprays of hexaconazole (0.1%) followed by hot water treatment (52 C for 10 min) was found to be effective for management of post-harvest anthracnose in mango. This treatment recorded minimum disease incidence (11.25%) and PDI (4.75) 15 days after treatment compared to other treatments under study.

CPT 53

Study on Field Screening of Ginger Varieties against *Phyllosticta* Leaf Spot and *Pythium* Rhizome Rot Diseases

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Ginger (*Zingiber officinale* Rosc.) is an important commercial crop grown for its aromatic rhizomes which are used both as a spice and a medicine. Ginger of commerce is the dried rhizome and marketed as raw ginger, dry ginger, bleached dry ginger, ginger powder, ginger oil, ginger oleoresin, gingerale, ginger candy, ginger beer, brined ginger, ginger wine, ginger squash, ginger flakes, etc. Ginger crop is affected by many diseases, such as, rhizome rot, bacterial wilt, yellows, *Phyllosticta* leaf spot and storage rot causing economic losses. In the present study, ten ginger varieties were screened against *Phyllosticta* leaf spot and *Pythium* rhizome rot diseases. The field experiment was conducted for three years (2015-16, 2016-17 and 2017-18) to identify resistant sources against these two major diseases, at Asond Farm, AICRP on Spices, Dr. BSKKV, Dapoli. Three years pooled mean data revealed that out of ten varieties of ginger screened, nine varieties were resistant (R) (6.27 – 9.69 PDI) against *Phyllosticta zingiberi* and rest one variety, Athira (12.17 PDI) was found moderately resistant (MR). Whereas, against *Pythium* rhizome rot, variety Rejatha (4.70 PDI) and Mahima (4.77%) were moderately resistant (MR) and rest of the varieties were tolerant (T). On the yield basis all varieties performed well, but on basis of per cent leaf spot intensity, rhizome rot incidence, two varieties Rejatha and Mahima were found superior, with maximum yield of 14.83 kg plot^{-1} and 15.53 kg plot^{-1}, respectively.

CPT 54

Reactions of Turmeric Varieties against Diseases of *Colletotrichum* Leaf Spot and *Pythium* Rhizome Rot

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Turmeric (*Curcuma longa* L.) is well known for its medicinal value, its cultivation is hindered by several diseases *viz.*, leaf spot, anthracnose and rhizome rot. These diseases are managed by using the fungicides, which leads to development of resistant strains besides the environmental pollution and also the residue problem in final produce. Host resistance seems to be most promising means of disease management. Therefore, field screening trial was planned and conductd at Asond Block, AICRP on Spices, DBSKKV, Dapoli for three years (2015-16, 2016-17 & 2017-18) to identify the disease resistant sources against *Colletotrichum* leaf spot and *Pythium* rhizome rot with high yield potential. Three years pooled mean data revealed that out of 30 turmeric varieties screened, 29 were found moderately resistant (MR) and only one variety Kanti was susceptible (S) to *Colletotrichum* leaf spot. But, on the yield basis amongst all varieties, four varieties *viz*., Pratibha, Sudharsana, Krishna and Narendra Haldi performed well. Minimum *Colletotrichum* leaf spot intensity was recorded in Pratibha (11.69%), Sudharsana (12.99%), Krishna (13.23%) and Narendra Haldi (13.82%) with high yield of 17.66 kg plot^{-1}, 18.86 kg plot^{-1}, 19.46 kg plot^{-1} and 18.10 kg plot^{-1}, respectively. Whereas, for *Pythium* rhizome rot, the varieties Pratibha, Sudharsana and Narendra Haldi were tolerant (T) and only one variety Krishna was found moderately resistant (MR). None of the turmeric variety was found susceptible to rhizome rot of turmeric.

CPT 55

Effect of Protein Hydrolysate Powder (50%) on Fruit Set and Yield in Mango (*Mangifera indica*) cv. Alphonso

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The low productivity is a major problem in Alphonso mango. To improve the fruit set and yield of Alphonso mango the present investigation was carried out at Regional Fruit Research Station, Vengurle, Dist. Sindhudurg, Maharashtra during the year 2016-17 on mango (*Mangifera indica* cv. Alphonso). The foliar spray of protein hydrolysate (50%) powder was carried out at three times *viz.,* first at flower bud differentiation stage, second at the time of reproductive flush, third at the time of peanut stage. The experiment was laid out in Randomized Block Design with four treatments (protein hydrolysate powder (50%) @ 2, 2.5 and 3 g L^{-1} of water and control) and six replications. The mango tree sprayed with protein hydrolysate powder (50%) @ 2.5 g L^{-1} of water recorded significantly the highest fruit set 12.75, 7.06, 1.88 and 1.54 fruits per panicle at peanut stage, marble stage, egg stage and at harvest, respectively. Significantly the highest fruit weight (271.00 g), fruit volume (259.99 ml), number of fruits per tree (304.40) and shelf life (15.85 days) were recorded in treatment T_2 (Protein hydrolysate powder (50%) @ 2.5 g L^{-1} of water). With regard, to chemical composition, TSS and acidity at ripe stage, fruit were better in protein hydrolysate powder (50%) treated fruits as compared to control. Sensory evaluation of Alphonso mango fruits indicated that T_2 treatment (protein hydrolysate powder (50%) @ 2.5 g L^{1} of water concentration) was superior over control.

CPT 56

Studies on Processing of Sapota [*Manilkara achras* (Mill.) Fosberg] Syrup

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An investigation was carried out to develop sapota syrup by using sapota juice and dry sugar in the proportion of 1:1.5 and 75°Brix sugar syrup in the ratio of 1:4, 1:5 and 1:6 with 1 per cent citric acid in each treatment. The physico-chemical composition and organoleptic qualities of sapota syrup were studied during 3 months of storage period to standardize optimum recipe for the preparation of sapota syrup. An increasing trend in T.S.S., reducing and total sugars was noticed with decline in the titratable acidity and ascorbic acid content of the sapota syrup during storage period of 90 days. The sapota syrup prepared with dry sugar or 75°Brix sugar syrup in the proportion of 1: 1.5 or 1:4 proportions, respectively recorded the highest organoleptic score for colour, flavour and overall acceptability throughout the storage period of 90 days.

CPT 57

Efficacy of Various Oils against *Alternaria chlamydospora* Causing Leaf Spot of Okra

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Okra (*Abelmoschus esculentus* L. Moench) crop is being prone to many biotic and abiotic agents. Among biotic agents, leaf spot caused by *Alternaria chlamydospora* is one of the economically important disease causing

considerable yield loss. Though, the disease is being managed with chemical fungicides, but their intensive use leads to bad effects on human health and environment. Under organic cultivation of okra crop, the use of chemical fungicides has been discouraged and consequently, essential oils with antifungal potential are being used to manage several plant diseases. Therefore, in present study seven essential oils were evaluated *in vitro* (each @ 1000 and 2000 ppm) by applying poisoned food technique against *A. chlamydospora.* The experiment was planned in CRD and all the treatments replicated thrice. The results indicated that all of the seven oils tested as fungistatic/fungicidal with significant inhibition of mycelial growth of the test pathogen, over untreated control. Further, the mycelial growth inhibition was found to be directly proportional to concentration of the essential oils tested. However, significantly highest and cent per cent (100%) mycelia growth inhibition was resulted with the oils of Garlic, Peppermint, Citronella (each @ 1000 and 2000 ppm) and Clove (@ 2000 ppm). These were followed by the oils of Clove @1000 ppm (83.27%), Cassia @ 1000 and 2000 ppm (44.26% and 93.16%, respectively) and Neem @ 1000 and 2000 ppm (35.93% and 40.44%, respectively); whereas, Eucalyptus oil @ 1000 and 2000 ppm was found significantly least mycelia growth inhibition (13.33% and 19.40 %, respectively). Thus, except Eucalyptus oil, rest of the oils tested exhibited strong fungistatic activity against *A. chlamydospora*.

CPT 58

Effect of Farmscaping with Flowering Plants on Infestation of Rice Armyworm, *Mythimna separata* (Walker)

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Rice (*Oryza sativa* L.) is the most important staple food grain crop of the world which constitutes the principle food for about 60 per cent of the world's population and about 65 per cent population in India. The warm and humid climatic condition being conducive for many pests, form a major constraint for increasing rice production in this ecosystem. The average yield losses in rice have been estimated to vary between 21-51 per cent. In view of reducing the unnecessary insecticide use, promotion of natural cultural control ecosystem services through enriching bunds and other surrounding areas with flowering plants can significantly prevent outbreaks of rice pests. A field experiment was conducted at Agronomy Farm, College of Agriculture, Dapoli, Ratnagiri district of Maharashtra during two seasons *viz*., *kharif* 2015 and 2016 to study the effect of different flowering plants on infestation of rice armyworm *Mythimna separata* (Walker). Flowering plants *viz*., mustard, sesamum, cosmos, marigold, niger, sunflower, gomphrina, ekdandi, cock's comb, calendula, harana, balsam, zinnia and blackgram were planted on bunds of rice field as treatments in randomized block design. Data on different natural enemies observed in rice ecosystem were also recorded (on rice hills and flowering plants on bunds). Data on per cent armyworm infestation during *kharif* 2015 and *kharif* 2016 revealed that during both years the incidence of armyworm was observed after grain filling stage in SMW 39 (4th week of September) and SMW 40 (1st week of October). During *kharif* 2015 overall seasonal mean per cent infestation due to armyworm was in the range of 5.39 to 42.81. The treatment with cosmos as the farmscape plant on rice bunds recorded lowest rice armyworm infestation (5.39%) and was significantly superior over rest of the treatments. The next best treatments were mustard followed by gomphrena, sesame, niger and marigold recorded with 11.69, 11.86, 12.06, 12.92 and 16.92 per cent infestation, respectively; all these treatments were at par with each other. During *kharif* 2016 overall per cent infestation of armyworm in two weeks was in the range of 3.03 to 22.28. The treatment with cosmos as the farmscape flowering plant on rice bunds was the best treatment for reducing the armyworm infestation by recording minimum infestation of 3.03 per cent. The other treatments *viz.,* gomphrena and sesame recorded 4.30 and 5.31 per cent infestation of rice army worm, respectively. These treatments were at par with each other but were significantly superior over rest of the treatments with regard to armyworm infestation in paddy. From both seasons of study, it can be concluded that farmscaping with cosmos, mustard, gomphrena, sesame and niger as flowering plants on rice bunds was found most effective to minimize armyworm infestation in rice ecosystem.

CPT 59

Effect of Post-Harvest Treatments on Quality of Sapota Fruits

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Sapota [*Manilkara achras* (Mill) Forsberg], popularly known as *Chiku* is native to tropical America belongs to family Sapotaceae. India is considered to be the largest producer of sapota in the world. Various chemicals have been used to improve and maintain quality by slowing down the metabolic activities of fruits. Among various chemicals, calcium has received considerable attention in recent years due to its desirable effect in delaying ripening and senescence, increase firmness, vitamin C and phenolic contents, reduced respiration, extending storage life and reducing the incidence of physiological disorders and storage rots. The mature fruits of sapota cv. Kalipatti were subjected to various post harvest chemical and growth regulator treatments *viz*., calcium chloride (5000 and 10000 ppm), calcium nitrate (2 and 4 %), gibberellic acid (200 and 400 ppm), benzyl adenine (75 and 150 ppm) and control (distilled water) and stored at ambient temperature. The level of acidity and ascorbic acid decreased with advancement of storage period and titratable acidity was found maximum (0.18 %) in control *i.e*., fruits treated with distilled water. The TSS, reducing sugars and total sugars were found to increase up to 9th day of storage and then decreased at 12th day of storage. $CaCl_2$ (10000 ppm) was found to be best treatment since it resulted in highest amount of TSS (23.81 ^{0}Brix), reducing sugars (10.69 %), total sugars (19.18 %) and ascorbic acid (10.08 %) in sapota fruits.

CPT 60

Responses of Rice under Salinity Stress: A Review

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Rice (*Oryza sativa* L.) is an important staple crop that feeds more than one half of the world's population. Salinity has been a key abiotic constraint devastating crop production worldwide. Rice is very sensitive to salinity and is the most salt sensitive cereal crop with a threshold of 3 dS m^{-1} for most cultivated varieties. Even at EC as low as 3.5 dS m^{-1}, rice loses about 10% of its yield and 50% yield loss was recorded for rice at EC 7.2 dS m^{-1}. Attempts in understanding salt tolerance mechanisms has revealed several key enzymes and altered biochemical pathways inferring resistance to crop plants against salt stress. Being a glycophyte by nature, its growth is severely imparted in presence of excess salt. Rice is susceptible to salinity specifically at the early vegetative and later reproductive stages and the response of the crop to excessive salt toxicity at biochemical and molecular level as well as physiological level is well studied and documented. An understanding of the specific response of rice to ion accumulation at the toxic level can aid in identifying the key factors responsible for retarded growth and limited production of rice with the future scope of mitigating the same. The present review summarizes the differential responses of rice, in particular, to salt toxicity enumerating the detailed morphological, physiological, biochemical and molecular changes occurring in the plant. An attempt to explain salinity tolerance and its future scope and implications in screening for salt tolerance has also been elucidated in the present study.

CPT 61

Studies on the Effect of Different Concentrations of Growth Regulators on Root and Shoot Production of Kokum Grafts (*Garcinia indica* Choicy)

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The present investigation entitled "Studies on the effect of different concentrations of growth regulators on product of root and shoot on production of Kokum grafts (*Garcinia indica* Choisy)" was carried out at Department of Horticulture, College of Agriculture, Dapoli, Dist. Ratnagiri during the year 2015-2016. The experiment was conducted in Randomized Block Design (RBD) with ten treatments replicated thrice. The treatments were T_1: GA_3 150 ppm, T_2: GA_3 200 ppm, T_3: GA_3 250 ppm, T_4: NAA 50 ppm, T_5: NAA 100 ppm, T_6: NAA 150 ppm, T_7: BA 5 ppm, T_8: BA 10 ppm, T9: BA 15 ppm and T_{10}: control. From this study, it was observed that the treatment showed the best results with respect to root length (cm) was T2 (18.69 cm), in case of number of secondary roots (8.67) the treatment T9 (BA 15 ppm) was the best. While the highest root dry weight (8.33 g) and absolute growth rate (0.0706 cm day^{-1}) were observed in T10 (control) and relative growth rate (cm day^{-1}) was maximum in T_2 (0.0035 cm day^{-1}). Shoot dry weight (13.50 g) was the best recorded in treatment T9 (BA 15 ppm).

CPT 62

Biology of Pumpkin Caterpillar, *Diaphania indica* Saunders Infesting Watermelon under Laboratory Conditions

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Biology of pumpkin caterpillar, *D. indica* revealed that the female usually laid eggs singly or in clusters of two or more during night time mostly on tender leaves or on leaf stalks. Freshly laid eggs were white to yellowish in color and elongated in shape. The eggs measured 0.87 mm in length and 0.57 mm in breath. Pre-oviposition, oviposition and post-oviposition period was 2.2, 4.4, and 1.6 days, respectively. The total number of eggs laid by female in her life span varied from 116 to 308 with an average of 193.4 with incubation period of 4.3 days and 100 per cent hatching. Larval development was completed within 13 days on watermelon and 11 days on pointed gourd. During which larva passed through five instars, the duration of these five instars lasted for 2, 3, 2, 3 and 3 days on watermelon and 2, 3, 2, 2 and 3 days on pointed gourd, respectively. Freshly emerged larva measured 1.2 mm in length and 0.14 mm in breadth and 1.83 mm in length and 0.24 mm in breadth on watermelon and pointed gourd, respectively. Full grown larva measured 15.92 mm in length and 1.63 mm in head breadth and 15.47 mm in length and 1.36 mm in head breadth on watermelon and pointed gourd, respectively. Pre-pupal period lasted for 2.17 days and 2.12 days on water melon and pointed gourd, respectively. The full-grown larva pupated in silken cocoon on lower surface of leaf. Pupa was object and brown. Pupal period lasted for 6.71 and 6.19 days on watermelon and pointed gourd, respectively. Adult was medium sized, stoutly built with white wings which had an iridescent purplish reflection and brownish border. Longevity of male and female moths lasted for 6.8 and 8.6 days, respectively on watermelon and 6.2 and 7.8 days, respectively on pointed gourd. Sex ratio of male to female was 1:4 on watermelon and 1:5.6 on pointed gourd. Total life cycle was completed in 33.53 and 30.66 on watermelon and pointed gourd, respectively.

CPT 63

Kokum (*Garcinia indica*): A Potent Spice in Coastal Region

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Kokum (*Garcinia indica*), a tropical spice tree native of western ghat of India. It is gaining importance in coastal region of Maharashtra. India produces around 10,200 metric tons of kokum with a productivity of 8.5 tons/ha. It is grown on more than about 1000 ha area in the konkan region with production of about 4500 MT fruits. The crop has sufficient domestic as well as international market potential. It is a good source of bioactive constituents like anthocyanin, Hydroxyl citric acid and Garcinol which are very important for pharmaceuticals industries. It is called as an Indian spice with a pleasant acceptable flavor and has a sweet acidic (sour) taste which makes it a popular food-additive. Beside this it can be used as culinary agent in food, pharmaceutical, neutraceuticals product development. It is used for preparation of different traditional and value added products such as amsul, dried rind powder, sarbat, solkadhi, wine, honey, RTS, squash, etc. The fruit has many medicinal applications such as it is useful against piles, dysentery, heart diseases and anti-obesity agent. The kokum butter prepared from its seed which contains 33 to 44 % oil which is a good replacer for cocoa butter fat used in confectionary industry. It can be useful in pharmaceutical and cosmetic industries as surfactant. This crop is gaining increasing importance, as it has multifarious utilities ranging from food processing, pharmaceuticals and medicinal uses which attract the health conscious people. It is a commercial crop for economic and social development of coastal region with vast potential.

CPT 64

Response of Kholrabi to Different Irrigation and Fertilizer Levels under Protected Cultivation in Lateritic Soil of Konkan

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The experiment was conducted at Hi-Tech Project, Dr. B.S.K.K.V., Dapoli under shed net condition to study the response of kohlrabi under different irrigation and fertilizer levels in terms of growth and yield. The study concluded that the kohlrabi showed positive response to the different irrigation and fertilizer levels under shed net house over open field condition. The alternate day irrigation and split application of WSF (water soluble fertilizers) with different levels through drip irrigation system responded well by kohlrabi in terms of growth and yield. The higher levels of irrigation and fertilizer were also boost the yield of kohlrabi under shed net house. The study suggested that treatment I_3F_2 (1.0 PE, 100 per cent RD) gave maximum gross monetary returns (Rs. 56.40 m^{-2}) and B:C ratio. (1.59).

CPT 65

Effect of Different Irrigation and Fertigation Levels on Performance of Broccoli Grown under Protected Cultivation (*Brassica oleracea* var. italica L.)

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An experiment was carried under lateritic soil for broccoli crop at Hi-Tech project, under protective cover *i.e.*, shed net house. The study concluded that broccoli crop showed positive response to higher levels of irrigation and nutrients levels when these inputs were individually applied. But when irrigation and nutrients were associated and applied with higher levels, the crop responded and yield increase. The economic analysis concluded that the returns and net income were influenced by productivity and the B: C ratio for all treatments was more than one, under protective cultivation, which showed that the broccoli crop was found more economical under protective cultivation.

CPT 66

Study on Preparation of Wine by Blending of Cashew Apple and Pineapple Juices

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An experiment was undertaken at Fruit Beverages Research Centre, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli to study the effect of blending of cashew apple and pineapple juices on wine recovery, sensory quality and benefit cost ratio of wine. The experiment was planned with various blend ratios of cashew apple and pineapple juices by using completely randomized design (CRD).Considering perishable nature and therapeutic value of cashew apple the present investigation was carried out with the objective to explore the production of acceptable wine by blending of cashew apple and pineapple juices in different proportions (100:00 (T_1), 90:10 (T_2), 80:20 (T_3), 70:30 (T_4), 60:40 (T_5), 50:50 (T_6), 40:60 (T_7), 30:70 (T_8), 20:80 (T_9), 10:90 (T_{10}) and 00:100 (T_{11}) (Cashew apple: pineapple)). Wine thus prepared was evaluated chemically as well as organoleptically**.** The score for all sensory parameters and overall quality increases with increase in pineapple juice percentage in blends except astringency. The score for astringency decreases with increasing pineapple juice percentage in blends. The maximum wine recovery (83.2%) and benefit cost ratio (4.38) was obtained in the treatment T_1 *i.e.*, wine prepared by sole cashew apple juice. Wine recovery and benefit cost ratio increases with increasing cashew apple juice in the blends. Blending of cashew apple and pineapple juices before fermentation helps in reduction of astringency with improvement in overall acceptability and overall quality of wine when compared to sole cashew apple wine. From the present investigation, considering to sensory evaluation, wine recovery and benefit cost ratio of wine, it was concluded that, 40:60 blend of cashew apple: pineapple juice was best for preparation of wine.

CPT 67

Effect of Land Configuration and Nutrient Management in Wheat (*Triticum aestivum* L.) under Partially Reclaimed Coastal Salt Affected Soils of South Gujarat

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A field study was conducted during two consecutive years 2016-17 and 2017-18 in *rabi* season at coastal soil salinity research station, Danti farm, NAU, Navsari to find out the individual and combined effect of land configuration and nutrient management on yield of wheat crop. The experiment was laid out in split plot design with four replications. The main plot treatment consists of three methods of planting method viz., flat bed, broad bed furrow and ridge and furrow, each main plot divided into six subplots consist of control (without organic manure), FYM, bio-compost, 80 % RDF, 100% RDF and 120 % RDF as organic and inorganic fertilizers. The results revealed that, land configuration with nutrient management significantly influenced in yield attributing characters and yields of wheat crop. The broad bed furrow followed by ridge and furrow sowing methods along with application of 120 % RDF (N:P::216:108 kg ha^{-1}) and 10 t ha^{-1} FYM recorded significantly higher productivity and profitability compared to flatbed sowing under partially reclaimed coastal salt affected soils.

CPT 68

Performance of *Rabi* Sweet Corn under Different Irrigation Regimes and Fertigation Levels

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The investigation was carried out on *rabi* sweet corn to evaluate the response of irrigation regime and fertigation levels under *manad* soils of Raigad district during *rabi* 2015 to 2017 at Agriculture Research Station, Repoli, Tal. Mangaon, Raigad, Maharashtra. The experiment consists of fifteen one combinations with three irrigation regimes and five fertilizer levels. Irrigation regimes consist of 40, 60 and 80 % of ETc, while fertilizer levels consist of five treatments *viz.*, 100% recommended fertilizer through soil application, 100% N through fertigation + 100% P and K through soil application, 80 % N through fertigation + 80% P and K through soil application, 100 % N P and K through fertigation, 80% N, P and K through fertigation. The treatments were replicated thrice in split plot design. Control treatment was done with recommended package of practice. Fertigation of N, P_2O_5 and K_2O was applied in six equal splits at 15 days interval in all fertigation treatments by using water soluble fertilizers. The number of cobs (71825) and cob yield (18.86 t ha^{-1}) of sweet corn was significantly higher in irrigation regime of 80% ETc, however it was at par with 60 % of ETc. While, fertigation level of 80% of recommended N, P and K recorded significantly higher number of cobs (74871) and cob yield (20.87 t ha^{-1}) of sweet corn, however it was at par with fertigation level of 100% of recommended N, P nd K. Treatment combination of 80 % ETc with 80% of recommended N, P and K recorded additional net returns of Rs.15844 with incremental cost benefit ratio of 0.44.

CPT 69

Effect of Spacing and Nitrogen Levels on Growth and Yield of Yard Long Bean [*Vigna unguiculata* sub sp. sesquipedalis (L.) Verdcourt]

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Yard long bean [*Vigna unguiculata* sub sp. sesquipedalis (L) Verdcourt] belonging to family leguminaceae is cultivated mainly for its crisp and tender green pods. It's cultivation in Konkan is increasing especially during *rabi* season. However, systematic work on various agro practices for yield maximization is present need. Hence, an investigation was conducted at College of Agriculture, Dapoli, Dist. Ratnagiri during *rabi* season, 2016-2017 in split plot design with three replications. Two factors were studied during the investigation *viz.,* different spacing levels - S_1 (90 cm X 30 cm), S_2 (90 cm X 45 cm), S_3 (90 cm X 60 cm), S_4 (90 cm X 90 cm) as main plot treatment and fertilizer levels *viz.,* N_1 (60:60:30 NPK kg ha^{-1}), N_2 (75:60:30 NPK kg ha^{-1}), N_3 (90:60:30 NPK kg ha^{-1}), N_4 (120:60:30 NPK kg ha^{-1}) as subplot treatments. The result revealed that, maximum number of primary branches (14.18), number of nodes (23.98), number of leaves (59.13) and total leaf area was recorded in S_1 (12071.22 cm^2). The highest pod yield per plant (0.69 kg), number of pods per plant (58.83) and pod yield (19.09 t ha^{-1}) was also recorded in S_1 and was significantly superior over other spacings. The effect of nitrogen levels on pod yield per plant and number of pods per plant were found to be significant. The highest pod yield per plant (0.66 kg) and number pods per plant was recorded in N_1 (56.25). With regards to interaction of spacing and nitrogen levels, at 120 DAS, length of vine (375.00 cm), number of primary branches (15.33), number of leaves S_1N_1 (69.47) and total leaf area (14083.64 cm^2) was highest in S_1N_1 and found to be significant. Highest yield per plant (0.73 kg) and pod yield (20.29 t ha^{-1}) was recorded in S_1N_1. However, the highest number of pods per plant was recorded in S_1N_2 (62.73). For better vegetative growth, yield and yield contributing characters of yard long bean should be planted at the spacing of 90 cm X 30 cm with application of compost 15 t ha^{-1} and NPK of 60:60:30 kg ha^{-1}.

CPT 70

Effect of Tillage Practices and Nutrient Sources on Yield and Nutrient Uptake by Sweet Corn (*Zea mays* L. sp. saccharata)

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An experiment was carried out during *rabi* seasons of 2015-16 and 2016-17 at Agronomy Farm, College of Agriculture, Dr. BSKKV, Dapoli to study the effect of tillage practices and nutrient sources on yield and nutrient uptake by sweet corn. The field experiment was laid out in split plot design comprising of 20 treatment combinations replicated thrice. Main plot treatments comprised of four tillage practices *viz*., one pass of rotavator (T_1), one pass of cultivator + one pass of rotavator (T_2), one mouldboard ploughing + one pass of rotavator (T_3) and one mouldboard ploughing + one pass of cultivator + one pass of rotavator (T_4), while in the sub plot there were five nutrient sources *viz*., 100% RDF through chemical fertilizers (S_1), 75% RDN through chemical fertilizer + 25% RDN through FYM (S_2), 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3), 75% RDN through chemical fertilizer + 25% RDN through poultry manure (S_4) and 75% RDN through chemical fertilizer + 25% RDN through goat manure (S_5). Tillage practice of one mouldboard ploughing + one pass of cultivator + one pass of rotavator (T_4) recorded significantly higher green cob yield with sheath, green fodder yield, biological yield, nitrogen, phosphorus and potassium content as well as uptake of these nutrients over rest of the tillage practices except tillage practice T_3 for green cob yield with sheath, for phosphorus and potassium content in grain and potassium content in fodder which remained statistically at par with T_4. Tillage practice T_4 recorded 7.73, 5.22 and 2.78 % higher green cob yield with sheath, 10.21, 6.53 and 3.40% higher green fodder yield, 24.55, 15.06 and 7.52 % higher total nitrogen uptake, 21.38, 14.06 and 7.41% higher total phosphorus uptake and 12.53, 7.92 and 3.88 % higher total potassium uptake over tillage practices T_1, T_2 and T_3, respectively. The combined application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3) proved significantly superior over rest of the nutrient sources in respect of green cob yield with sheath, green fodder yield, biological yield, nitrogen, phosphorus and potassium content as well as uptake of these nutrients. However, it was statistically similar with S_2 for green cob yield with sheath and green fodder yield. Nutrient source S_3 registered 8.56, 6.93, 6.18 and 0.71% higher green cob yield with sheath, 6.85, 3.85, 2.03 and 0.89% higher green fodder yield, 24.28, 13.95, 9.30 and 3.82 % increase in total nitrogen uptake, 20.29, 13.68, 10.36 and 4.42% increase in total phosphorus uptake and 11.12, 7.51, 5.27 and 1.57% increase in total potassium uptake over nutrient sources S_1, S_5, S_4 and S_2, respectively. Interaction T_4S_3 recorded significantly highest green cob yield with sheath and biological yield than rest of the interactions except interactions T_4S_2, T_3S_3 and T_3S_2 for green cob yield with sheath and interactions T_4S_2 and T_3S_3 for total biological yield. On the basis of results, it can be concluded that sweet corn should be grown in soil prepared by one mould board ploughing + one pass of cultivator + one pass of rotavator with combined application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost to obtain higher yield.

CPT 71

Genetic Diversity Analysis in Black Gram [*Vigna mungo* (L.) Hepper]

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A field experiment was conducted to examine the genetic divergence among 64 black gram genotypes at Research and Education Farm, Department of Agril. Botany, College of Agriculture, Dapoli during *rabi* 2017-18. Sixty four genotypes were grouped into 9 different clusters on the basis of magnitude of D^2 values evaluated by Mahalanobis

D^2 analysis. Among sixty four genotypes, 16 genotypes were clustered into fourth and fifth cluster followed by cluster I having 13 genotypes. The cluster II included 10 genotypes, while cluster III had 5 genotypes. Cluster VI, VII, VIII and IX were mono-genotypic. The maximum intra–cluster distance was observed in cluster V (D= 9.108), while the lowest intra–cluster distance was found in cluster I (D = 5.865) .The inter–cluster distance was high between cluster VI and VIII (D = 46.48) and clusters VI and VII (D=37.06), thereby indicating wide range of variation among the clusters formed. In contrast, the lowest inter–cluster distance (between cluster I and II) suggested that the genetic constitution of the genotypes in both the clusters were in close proximity. Among the thirteen characters studied, 100 seed weight contributed maximum (62.80%) followed by pod length (18.60%) towards genetic diversity. Hence, these characters may be considered during selection of genotypes for further improvement and hence to increase the productivity.

CPT 72

Effect of Organic Manures and Bio-fertilizer on Growth and Productivity of Garlic (*Allium sativum* L.) under Coastal Saline Soils

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The present study was aimed to improve the growth, yield and economics of garlic (*Allium sativum* L.) with organic manures and bio-fertilizers in saline soils of coastal areas of South Gujarat. A field experiment was conducted during *rabi* season of 2012-13 to 2014-15 at Coastal Soil Salinity Research Station, Navsari Agricultural University, Danti-Umbharat. The application of recommended dose of N @ 100 kg ha^{-1} of which 50 % N through bio-compost as basal and remaining 50 % N through castor cake at 40 DAS recorded significantly higher values of bulb weight, lower value of weight loss and higher bulb yield. In case of bio-fertilizer, seed inoculation with bio-fertilizers (PSB and *Azotobacter*) resulted in significantly higher plant height and bulb weight. In case of bulb yield, the application of recommended dose of N @ 100 kg ha^{-1} of which 50 % N through bio-compost as basal and remaining 50 % N through castor cake at 40 DAS along with seed inoculation with bio-fertilizers (PSB and *Azotobacter*) and application of recommended dose of N @ 100 kg ha^{-1} of which 50 % N through vermi-compost as basal and remaining 50 % N through castor cake at 40 DAS along with seed inoculation with bio-fertilizers (PSB and *Azotobacter*) remained at par with each other and both were significantly superior over rest of the treatment combinations. Also, both the treatment combinations were at par and gave the maximum net returns.

CPT 73

Effect of Arbuscular Mycorrhizal Fungi on Growth of Indian Bean (*Lablab purpureus* L.) under Water Stress

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Water availability is crucial for plant growth. Water is a major constituent of plant protoplasm. It provides turgidity to cells and tissues. Moreover, it plays an important role in the translocation of salts and nutrients. Low rainfall and unavailability of sufficient irrigation water are major causes of limited water availability to crops in the month of September and October in *Kokan* region. Drought is undoubtedly the most important environmental stress limiting the productivity of crop. The Arbuscular mycorrhizal (AM) symbiosis helps in increasing the drought tolerance of plants in the commonly observed higher rates of photosynthesis. A study was conducted to determine the effect of Arbuscular Mycorrhizal (AM) fungi inoculation on growth of Indian or Dolichos bean growth under water stressed plot culture conditions. Water stress was given to the Indian bean plants after 30 days at the interval of 5, 10 and 15 days. Three replicates of each set were maintained. The mixture of AM fungi used for current experiment included the species of *Acaulospora undulata, A. spinosa, Glomus macrocarpum, G. maculosum, G. fasciculatum* and *Scutellospora minuta*. Water stress caused decrease in dry weight of shoot and root both in control and mycorrhizal plants at all levels of stresses and decrease was more with the increase in water stress interval. In control plants, the

dry weight of shoot was 0.201±0.25g, 0.172±0.64g and 0.124±0.36g at 5, 10 and 15 days intervals, respectively. However, in mycorrhizal plants, it was 0.290±0.08 g, 0.243±0.40 g and 0.200±0.09 g at 5, 10 and 15 days intervals, respectively. The dry weight of root in control plants at the interval of 5 days was 0.009±0.52 g and it decreased to 0.005±0.45 g at the interval of 10 days and it declined significantly at the interval of 15 days where it was 0.002±0.74 g. In mycorrhizal plants, the dry weight of root was 0.017±0.62 g, 0.010±0.62 g and 0.008±0.83 g at 5, 10 and 15 days intervals, respectively. The results were significant at $P \leq 0.05$ level.

CPT 74

Effect of Different Levels and Sources of Nitrogen on Yield of Wheat under Saline Condition

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A field experiment was conducted to study the effect of different levels and sources of nitrogen on yield of wheat under saline condition at Agril. Research Station, K. Digraj during 2014 - 2016. The wheat (cv. Tryambak) was used as a test crop. The experiment was laid out in randomized block design with three replications and ten treatment combinations. The treatment comprised of 100% N- urea (T_1), 100% N- ammonium sulphate (T_2), 100% N- calcium nitrate (T_3), 125% N-urea (T_4), 125% N- ammonium sulphate (T_5), 125% N- calcium nitrate (T_6), 150% N-urea (T_7), 150% N- ammonium sulphate (T_8),150% N- calcium nitrate (T_9), absolute control (T_{10}). The RD of P_2O_5 through SSP and K_2O through MOP was applied at the time of sowing and RDF - 120:60:40 N:P_2O_5:K_2O kg ha^{-1}. FYM 10 t ha^{-1} was applied one month before sowing. Half dose of N was applied at the time of sowing and remaining half dose of N at 21 days after sowing in treatments T_1 to T_9. The pooled results of three years revealed that significantly highest grain yield (3.27 t ha^{-1}) of wheat is recorded in the treatment with application of 150% N- calcium nitrate and it was at par with grain yield recorded in the treatment 150% N- ammonium sulphate (3.16 t ha^{-1}), 125% N- ammonium sulphate (3.11 t ha^{-1}), 125% N- calcium Nitrate (3.09 t ha^{-1}) and 100% N- calcium nitrate (2.96 t ha^{-1}). It was observed that significantly highest straw yield (4.03 t ha^{-1}) of wheat is recorded in the treatment with application of 150% N- calcium nitrate and it was at par with 150 % N- ammonium sulphate (3.90 t ha^{-1}) and 125% N- calcium nitrate (3.74 t ha^{-1}). The significantly highest nitrogen uptake was recorded in the treatment with application of 150% N- calcium nitrate (98.12 kg ha^{-1}) over rest of the treatment except the treatment 150 % N- ammonium sulphate (89.15 kg ha^{-1}). The significantly highest phosphorus uptake (23.88 kg ha^{-1}) and potassium uptake (67.89 kg ha^{-1}) was recorded in the treatment with application of 150 % N- calcium nitrate over rest of the treatment. The significantly highest residual available nitrogen (217 kg ha^{-1}) and phosphorus (11.79 kg ha^{-1}) was recorded in the treatment with application of 150% N- ammonium sulphate. The improvement in soil fertility level in respect of available potassium was observed in all the fertilizer treatments except absolute control. The highest value of SAR (11.07) and ESP (13.05) was observed in the absolute control. It was observed that the application of 150% N through urea recorded the higher net monetary returns (Rs. 27,830 ha^{-1}) and B: C ratio (1.74) over the rest of other treatments.

CPT 75

Nutrient Requirement of Turmeric Based on Soil Test Crop Response Correlation Approach

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A field experiment on nutrient requirement of turmeric based on Soil Test Crop Response Correlation (STCR) approach was conducted at Agricultural Research Station, K. Digraj during 2016-17. Three fertility gradient strips were prepared by addition of graded levels of N, P_2O_5 and K_2O fertilizers. For L_0 strip no fertilizer applied, L_1 strips 100:50:50 and L_2 strip 200:100:100 kg ha^{-1} N, P_2O_5 and K_2O were applied. Fodder maize was grown up to tasseling stage as an exhaust crop and to develop the relationship between soil nutrients and plant. After harvest of the exhaust

crop the field was prepared for planting of turmeric without disturbing the fertility strips, three FYM blocks were created across the fertility gradient by applying levels of FYM (0, 25 and 50 t ha^{-1} respectively). Before applying the FYM, soil samples from each plot of individual strips were collected and analyzed for NPK. The FYM blocks were created across the fertility gradients which were further subdivided into 24 equal plots to accommodate the 24 treatments and thus, making 72 plots in all the three strips. Out of these 24 treatments, 21 were NPK treatments and 3 control treatments. The treatments were as per standard techniques of STCR. Turmeric was taken as a test crop in these FYM blocks and at harvested rhizome and haulm yield was recorded. Representative rhizome and haulm samples were obtained from each plot for analysis of NPK and their uptake. The initial soil samples from each 24 treatments plots were carried before fertilizer application to turmeric. The fertilizer for turmeric crop was as per recommended time of application. The turmeric rhizome yield in F_0, F_1 and F_2 blocks were ranged between 7.56 - 22.22 t ha^{-1}, 11.04 - 31.56 t ha^{-1} and 13.56 – 36.19 t ha^{-1}, respectively with average values of 14.52, 21.77 and 25.88 t ha^{-1}, respectively. The soil available N was ranged between 161 - 217, 170 - 212 and 155 - 227 kg ha^{-1} with average value of 192, 198 and 197 kg ha^{-1}, respectively. Soil available phosphorus 9 - 22, 8 - 22 and 11 - 21 kg ha^{-1} with average value of 16, 16 and 17 kg ha^{-1}, respectively and soil available potassium 305 - 450, 305 - 540 and 340 - 451 kg ha^{-1} with average value of 396, 409 and 399 kg ha^{-1}, respectively. Similar trend was observed in total uptake of nitrogen, phosphorus and potassium. The average value of nutrient uptake in F_0, F_1 and F_2 blocks for nitrogen 66.80, 103.19 and 124.47 kg ha^{-1}, phosphorus 16.01, 24.06 and 30.13 kg ha^{-1} and for potassium 93.32, 136.06 and 164.31 kg ha^{-1}, respectively. The basic data was computed from these values for derivation of fertilizer prescription equation as nutrient requirement (kg q^{-1}), contribution of soil (%), contribution of fertilizer in absence of FYM (CF %), and in presence of FYM (CF FYM %) and contribution from FYM (CFYM) for nitrogen, phosphorus and potassium. The basic data was used to formulate the fertilizer prescription equations.

CPT 76

Yield Response of Okra to Graded Levels of Boron Application in Different Soils of Coastal Konkan Region

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The present investigation was conducted in pot culture at Plant Biotechnology Centre, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, during *kharif* season 2017-2018 .The study conducted with a view to delineate boron responsive and non-responsive soil judged by yield response of okra cv. Varsha uphar. The treatment comprised of three soil types from different regions of coastal Konkan and four levels of boron consisting 0, 2, 4 and 6 kg B ha^{-1}, which were obtained by application of graded dose of boron fertilizer to each set of 30 kg soil in the pot. Each treatment replicated thrice in a factorial completely randomized design. The soil of pot culture study was lateritic and medium black soil, sandy clay loam and clay loam in texture and slightly acidic to alkaline in reaction. It was low to high in organic carbon content, low to high in available N, very low to medium in P_2O_5 and high to low in K_2O content respectively. The result of the experiment showed that the high boron status with 6 kg B ha^{-1} significantly improved the plant height, number of fruits, length of fruit and yield of the okra crop. The organic carbon, available nitrogen, phosphorus, potassium and boron content was significantly increased with high boron status with the application of 6 kg B ha^{-1} in all types of the soils of Konkan region. As far as the yield of the okra was concerned, the high boron status with 6 kg B ha^{-1} application significantly increased the stover and fruit yield of crop, as compare to all other treatments. The available nitrogen at harvest stage varied in between 300.12 to 407.05 kg ha^{-1} in all treatments applied. The treatment in which 6 kg B ha-1 was applied recorded highest available nitrogen (407.05 kg ha-1) in medium black soil than the lateritic soil of Karjat. In general, it was observed that the residual available phosphorus in soil was highest in high level of boron applied in all types of soils of Konkan region. The treatment in which 6 kg B ha^{-1} applied in lateritic soils of Dapoli recorded highest available potassium (305.04 kg ha^{-1}) followed by rest of soils of coastal region of Konkan. At harvest, the highest hot water extractable boron i.e. 0.38 mg kg^{-1} was recorded in medium black soil of Karjat in which 6 kg B ha^{-1} applied. The linear relationship for boron levels with boron application for stover and fruit yield was found positively and significantly correlated and showed linear relationship by the okra crop.

CPT 77

Effects of Diffused and Non- diffused Polyfilms on Greenhouse Vegetable Production: A Review

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The process of providing a supportive environment for the better growth of a plant is known as greenhouse technology. The plants in the greenhouse are protected from adverse climatic conditions to get maximum yield and best quality output. The requirement of light, temperature, relative humidity, and CO_2 plays an important role in crop yield and quality. The light intensity and temperature in greenhouses with diffused polyfilms are observed higher than that of the clear polyfilm. The relative humidity is found more in clear polyfilm as compared to diffused polyfilm. Many researchers worked on greenhouses with clear and diffused poly films from which they conclude that the diffused poly films for greenhouses are beneficial for vegetable cultivation. About 8 to 11% higher yield of tomato, 18.9% more growth rate of cucumber plants have been reported to be achievable in greenhouse with diffused polyfilm as compared to greenhouse with clear polyfilm. As in greenhouse with diffused films, light penetrates deeper into the plant canopy leading to increased photosynthesis. Based on the works of various researchers, it can be concluded that diffused polyfilm are more suitable for cultivating vegetables instead of clear polyfilm.

CPT 78

Effect of Ambient Environment and Ageing on Greenhouse Polyfilms: A Review

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A large quantum of plastic is used annually world-wide in the agricultural sector. Out of that, a significant amount is used for protected cultivation- greenhouses, low tunnels, etc. For this purpose low density polyethylene films (LPDE) are widely used. Due to the harsh ambient conditions, ultraviolet radiation, heat, agrochemicals, limited thickness of films, such films degrade in a short period. The degradation of films results into improper environmental conditions for the plants as well as direct economic loss due to film replacement. Many researchers studied film ageing phenomenon by observing their physical, chemical, and mechanical properties over the years under field and laboratory conditions. Solar radiation affects the physicochemical properties of polyethylene (PE) plastic film and degradation occurs due to their photosensitivity which causes change in mechanical properties as well as reduces the service life of the film. Ageing has an effect on the properties of tri-layer polyethylene film used as greenhouse covering materials it has been observed that the modulus of elasticity significantly increases with the age of the film. Besides, the material also loses its fracture stress in comparison to virgin material. The combined effect of the temperature and UV radiation (100-280 nm) reduces the life span of the films. Thus, the intensity of light and ageing affects physical, chemical and mechanical properties of covering material to the great extent.

CPT 79

Rice Bean (*Vigna umbellata*) - A Potential Dual Purpose Crop for Coastal Belt

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Rice bean (*Vigna umbellata*) is a neglected legume regarded as a minor food and fodder crop in hilly and costal area. It is grown in a range of cropping systems with maize during summer, as a sole crop in the uplands, on rice bunds. It is mainly grown for human consumptions as pulse, though it is also used for fodder and green manure. Rice bean can be sown in between rows of a tall cereal such as maize or sorghum. Rice bean is a hardy plant that is resistant to many pests and diseases, and it may grow well without fertilizer or special care during growth. Rice bean is useful for livestock feeding. The vegetative parts can be fed fresh or made into hay and the seeds are used as fodder. It is grown by subsistence farmers in a very limited scale and most of the produce is consumed at home. The crop contributes to household food security as several food items are prepared from rice bean and also it is culturally important and is thought to have important nutritional values. Rice bean foliage and dry straw are valuable livestock feed and when used as a green manure it improves soil fertility. Thus, rice bean is a vibrant potential fodder legume crop which has capacity to provide balance diet to the livestock and to sustain under wide range of climatic condition. But, there is need to focus on the crop for more popularity as a potential legume crop.

CPT 80

Fertilizer Prescription Equation for Rice Based on STCR in Sanyasikuppam Soil Series of Puducherry

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Fertilizer application is one of the most efficient means of increasing agricultural profitability. Soil test based fertilizer recommendations result in efficient fertilizer use and maintenance of soil fertility. Several approaches have been used for fertilizer recommendation based on chemical soil tests so as to attain maximum yield per unit of fertilizer use. Among these, the targeted yield approach gained popularity in India. Targeted yield concept is based on quantitative idea of the fertilizer needs, yield and nutrient requirements of the crop, per cent contribution from soil and applied fertilizers. It also provides scientific basis for balanced fertilization of crop by creating balance among the nutrients from organic and inorganic sources and from the soil. In order to reduce the fertilizer dose and also to monitor the fertility, the field experiment was conducted at farmers' holding of Arachikuppam village in Puducherry district, U.T. of Puducherry by using STCR approach. The soil of the experimental field belongs to Sanyasikuppam series, taxonomically *Typic Ustropept* having sandy clay loam texture, pH- 6.47, EC - 0. 095 dS m^{-1}, CEC - 32.5 cmol (p^+) kg^{-1}, $KMnO_4$-N - 142.8 kg ha^{-1}, Olsen-P - 36.5 kg ha^{-1} and NH_4OAc-K - 131 kg ha^{-1}. The treatments consisted of four levels of N (0, 50, 100, 150 kg ha^{-1}), four levels of P_2O_5 (0, 25, 50, 75 kg ha^{-1}), and four levels of K_2O (0, 25, 50, 75 kg ha^{-1}) and three levels of farm yard manure (0, 6.25 and 12.5 t ha^{-1}) and the rice variety was White Ponni. Soil test data, rice grain yield and NPK uptake by rice crop were used for obtaining four important basic parameters *viz*., nutrient requirement to produce one quintal of rice grain (NR), contribution of nutrients from fertilizers (Cf), contribution of nutrients from soil (Cs) and contribution of nutrients from organic matter (Cfym). Making use of these basic parameters the fertilizer prescription equation was developed. Nomograms was developed for desired target yield of rice for a range of soil test values under NPK alone, NPK + 6.25 t ha^{-1} FYM and NPK + 12.5 t ha^{-1} of FYM. For a yield target 7 t ha^{-1} of rice with available soil N, P and K values of 200, 22 and 160 kg ha^{-1} respectively, the doses of fertilizer N, P_2O_5 and K_2O required were 159, 80 and 57 kg ha^{-1} respectively for NPK alone, 113, 54 and 25 kg ha^{-1} respectively for respectively with NPK + FYM @ 12.5 t ha^{-1}. Using the fertilizer prescription equations under IPNS, the extent of saving of inorganic fertilizers for rice computed. The results

showed that with the application of FYM @12.5 t ha^{-1} with 28 per cent moisture and 0.58, 0.30 and 0.45 per cent of N, P and K respectively, there was a saving of 46, 26 and 32 kg of fertilizer N, P_2O_5 and K_2O, respectively.

CPT 81

Effect of Drip and Surface Irrigation on Quality and Water Use Efficiency of Tomato (*Solanum lycopersicum* L.) in Coastal Saline Soil of Sundarbans, India

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To assess the effect of different water saving options on tomato, a field experiment was conducted in *rabi* (winter) season of 2016-17 and 2017-18 at farmers' field in Rangabelia, Gosaba, South 24 Paraganas, West Bengal, India. The experiment was laid out in randomized block design with five treatments *viz*., T_1- Surface irrigation (at critical growth stages), T_2- Surface irrigation (at critical growth stages) + Straw mulching, T_3- Drip irrigation at 100 % ETo, T_4- Drip irrigation at 80 % ETo, T_5- Drip irrigation at 80 % ETo + Straw mulching. Experimental results revealed that growth, yield and quality parameters of the crop were significantly influenced by adoption of different water saving options in coastal saline zone of West Bengal. The same treatment also recorded the maximum amount of fruit yield as well as marketable yield of tomato. The physical and bio-chemical quality parameters of tomato were influenced significantly by different water saving options. Significantly higher total soluble solids, lycopene and vitamin C content were found in T_5 treatment. From the study it was quite clear that surface irrigation methods significantly increased the salinity level at surface and sub-surface soil layers while the least salinity development was observed in plots which received irrigation water through drip irrigation along with surface mulch. The situation of the post harvest soil characters suggested that the maximum soil fertility and higher total microbial population status were found with T_5 treatment. The highest water use efficiency and profitability was obtained from the same treatment. Thus it can be concluded that judicious application of irrigation water not only increases growth, yield and quality of tomato but also minimizes the negative impact of soil salinity.

CPT 82

Standardization of *Utera* Management Practices of *Lathyrus* in Coastal Saline Zone of West Bengal

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Due to increase in salt accumulation on soil from winter to summer days the cultivation of the second crop in *rabi* season is limited to only a few areas with a resultant low cropping intensity. Inclusion of pulses may be a potential option in rice-fallow areas with a dual advantage of crop diversification for sustainable production and area expansion of pulses. To address this issue, a field experiment was conducted in *rabi* seasons of 2016-17 and 2017-18 in the farmers' fields of Rangabelia, Gosaba, South 24 Pgs, West Bengal to standardize the *utera* management practices of *rabi Lathyrus* in coastal saline zone of West Bengal. The *utera* experiment was set up in a randomized block design with four replications. *Lathyrus* cv. BioL-212 was selected for this present experiment. The experiment comprised of five utera management treatments *i.e*., dry seed 2 weeks before harvest of rice + no fertilizer, water soaked seed 1 week before harvest of rice + no fertilizer, water soaked seed 1 week before harvest of rice + foliar application of 2% DAP, water soaked seed 1 week before harvest of rice + Rhizobium inoculation and sowing of seed by reduced tillage. Different *utera* management practices significantly influenced the yield components and yield of *lathyrus.* In both the years of experiment (2016-17 and 2017-18), the maximum seed yield was obtained when plants received 2% DAP as foliar spray and rest other *utera* management treatments were statistically at par except dry seed sowing just two weeks before harvesting of *kharif* rice.Thus foliar applications of 2% DAP may be advocated for better yield and growth of *utera Lathyrus* in coastal saline zone of West Bengal.

CPT 83

Effect of Land Situation and Date of Sowing on Dry Matter Accumulation, Nutrient Partitioning and Yield of Rice in Coastal West Bengal

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The cropping systems of the coastal Gangetic Plains of India are basically rice based. Early sowing, naturally early transplanting enables the rainy season rice to exploit more sunlit days under un-inundated field condition resulting in less loss of precious plant nutrients associated with higher photosynthetic activities and ultimately better photosynthate accumulation.To assess the effect of date of sowing and land situation on dry matter accumulation, nutrient partitioning and yield of *kharif* (rainy) rice in coastal saline zone of West Bengal, a field experiment was conducted in consecutive two years (2016-17 and 2017-18) in the farmers' fields of Rangabelia, Gosaba, South 24 Pgs. The experiment was conducted in strip plot design having horizontal factor: Date of sowing of rice (2nd week of June to 3rd week of July) (Factor A) and Land situation (Medium-upland and Medium-lowland) (Factor B) and Vertical factor: Cropping system (Factor C) (Rice - *Lathyrus* and Rice – Lentil). Date of sowing significantly influenced dry matter accumulation m^{-2} of rice in the both years of experiment (2016-17 and 2017-18). Unlike the growth parameters of rice, irrespective of land situation, crop sown on 1st and 2nd dates recorded significantly higher grain and straw yield of rice. Date of sowing has influenced macro-nutrient uptake (NPK) in rice grains. In both the land situations higher NPK content in rice grains was observed at early date of sowing (1st and 2nd dates of sowing).

CPT 84

Rooting and Surviving Ability of Dragon Fruit Cutting as affected by Salicylic Acid Grown in Salt Affected Soil of *Sundarbans* Delta

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Dragon fruit (*Hylocereus spp*.) belonging from the botanical family cactaceae, is a recent addition in the list of popular exotic fruit of India considered to be a promising, remunerative and profitable item for fruit grower mainly due to its easy cultivation ways, high medicinal values and good market price. Though it is propagated through stem cutting easily and cheaply, rooting and surviving ability of dragon fruit cutting in salt affected soil of *Sudarbans* delta is not studied so far. So, to study the affect of salicylic acid treatment on rooting ability of dragon fruit grown in soil media collected from *Sundarbans* delta, an experiment conducted at shade net house under faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya during February – May, 2018. The experiment was laid out with two factorial complete randomized design (CRD) where 1st factor was two types of dragon fruit (*H. costaricensis* type Red and White) and 2nd factor was cutting treatment with four doses of salicylic acid (10, 20, 30 and 40 mM) along with a control *i.e*., direct planting of the cutting. Experimental results revealed that dragon fruit could be successfully grown in salt affected soil of *Sudarbans* delta as rooting and survibility % was not affected both for cutting type and salicylic acid treatment. Other growth parameters like number of root laterals, stem suckers, length increment of the sprouted suckers, main stem girth, eyes in sprouted sucker were varied among the cutting type and with different doses of salicylic acid. Most of the growth parameters of red type recorded maximum values with 10 mM salicylic acid while white type responded better under 40 mM might be due to differential response of cutting type to salicylic acid.

CPT 85

Influence of Agro-Climatic Factors on the Performance of Different Rice Cultivars in Coastal Saline Zone of West Bengal

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Rice based cropping system is the common practice in coastal saline zone of West Bengal where long duration, fertilizer non responsive, lodging prone indigenous rice cultivars were mainly grown. In order to investigate the performance of different rice varieties in the coastal environment, thirteen rice cultivars including ten salt tolerant, high yielding varieties (Amal-Mana, Canning 7, CR 1017, Gitanjali, Koushlya, Lal Minikit, Pratiksha, Sabita, Sujala and Swarna Sub1) and three indigenous varieties (Dudheswar, Dadsal and SR 26B) were grown in Rangabellia village of Gosaba block, South 24 Pgs, West Bengal during mid-July to mid-December in the year 2017. Occurrence of three phenological events *viz*., flag leaf initiation, panicle initiation and 100% flowering were recorded and accumulated heat units (day ℃), average bright sunshine hours and mean nycto (night) temperature (℃) were computed during each phenophase. Among the varieties, Lal Minikit took the shortest period to mature while Sabita, Gitanjali, CR 1017, Dadsal and SR 26B took longer duration. Rice var. Sujala produced the highest grain yield (5.72 t ha^{-1}) which was statistically at per with the grain yield of Sabita, Pratiksha, Amal-Mana, Canning 7, CR 1017 and Gitanjali. The lowest grain yield was obtained from Lal Minikit (2.33 t ha^{-1}) variety. Grain yield exhibited significant positive correlation with accumulated heat units during transplanting to panicle initiation stage and average bright sunshine hours during the entire period from transplanting to harvesting. On the contrary both the grain yield and total biomass were found to be adversely affected by mean nycto temperature as indicated by the correlation and regression analysis. The present study explained the influences of different agro-climatic factors on the yield of rice cultivars. Accordingly, rice cultivars, suitable for growing under the uncertain coastal environment were identified.

CPT 86

Integrated Farming Systems – A Key to Sustainable Agriculture, Food and Livelihood Security for Small and Marginal Farmers

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Food security, employment, income generation, resource conservation and environment protection have emerged as major world concerns. Indian agriculture has achieved significant advances during the last six decades. Total food grain production has increased from 50 MT to 272 MT accounting for over 14% of gross domestic product. Sustained growth in agriculture sector is essentially required from crop diversification, agri-processing and secondary agriculture to provide ancillary income to the farmers. Crop husbandry alone has now become non-remunerative particularly for small and marginal farmers due to high cost of external inputs and labours. Besides, farm families need a variety of products for their healthy living. India is dominated by small holders who constitute 86% of farm households and own 44% of operated area but their output exceeds 50% production. Predominance of small and marginal land holdings poses a serious challenge to enhancing productivity and profitability in the face of increasing input costs and changing climate. Integrated farming system (IFS) is one approach towards transforming the idea of sustainable development from concept to reality. IFS approach is a judicious mix of two or more components while minimizing competition and maximizing complementarities with advance agronomic management tools aimed at sustainable and environment friendly improvement of farm income and family nutrition. The combination of crop production, livestock, horticulture, agro-forestry, fisheries, sericulture, apiary, etc. provide round the year income to the farmers and utilize the waste of one component for other components with or without treatments. IFS has potential to decrease the cost of cultivation, increase the efficiency of natural resources and ultimately protect the farmers, especially small and marginal ones, from huge losses in case of weather vagaries. The farm wastes are better used for productive purposes in IFS. Vertical expansion in small farms is possible by integrating appropriate farming system components requiring less space and time and ensuring

periodic income to the farmers. ICAR - Indian Institute of Farming System Research (ICAR - IIFSR), Modipuram, Meerut (U.P.) has given serious research attention to design and develop agro-ecology-based IFS models in different states. All India Coordinated Research Project on Integrated Farming System, Regional Agricultural Research Station, Karjat have studied, developed and recommended Integrated Farming System models for small and marginal farmers of North Konkan Coastal Zone in Maharashtra. The IFS model is sustainable and provides livelihood security to small and marginal farmers.

CPT 87

Influence of Micro Nutrients and Growth Regulator on Sesame (*Sesamum indicum L.*) in Coastal Saline Soil

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The prevailing high salinity and sodicity of coastal saline soil restrict the availability of micro nutrients and reduces the yield of crops. A pot experiment was conducted in the Department of Soil Science and Agricultural Chemistry, Annamalai University using coastal saline collected from a farmer's field from Parangipettai during February 2016. The initial soil analyzed for pH 8.02, EC 4.16 dS m^{-1} and low organic C content (0.3 %). The available N, P and K status were low, low and medium respectively. The DTPA extractable Zn and Mn were below the critical limit. The design of experiment was Completely Randomised Design and the treatments were: T_1: NPK (35: 23: 23 kg N: P_2O_5: K_2O ha^{-1}), T_2: NPK + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1} + sea weed extract @ 0.5 %, T_3: T_2 + FYM @ 12.5 t ha^{-1}, T_4 : T_2 + Vermicompost @ 4 t ha^{-1}, T_5: T_2 + Humic acid @ 20 kg ha^{-1}. The number of replications was four and sesame var. TMV-3 was tested. The results of the experiment showed that all the treatments applied with organic manure applied and micronutrients increased the growth and yield of sesame. Among all the treatments, T_5 *i.e.,* recommended NPK + $ZnSO_4$ + $MnSO_4$ + humic acid with foliar application of sea weed extract recorded significantly higher seed (35.7 g pot^{-1}) and haulm yield (67.3 g pot^{-1}) and increased nutrient uptake by sesame. A significant reduction in the pH and EC and increase in the organic carbon and availability of macro and micro nutrients in soil was recorded with this treatment.

CPT 88

Effect of Foliar Application of Macronutrients (N, P and K) on Growth and Yield of Green Gram

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A field experiment was carried out to study the effect of foliar application of macronutrients (N, P and K) on growth and yield of green gram during *kharif* season of the year 2017-18 at the research farm of College of Agriculture, Latur. The experiment was laid in randomized block design with three replications and variety BM 2003-2 as a test crop along with eight treatments *viz*., T_1: Control, T_2: RDF + Water Spray, T_3: RDF + 19:19:19 @ 0.5 % at vegetative stage, T_4: RDF + 00:52:34 @ 1.0 % at flowering stage, T_5: RDF + 13:00:45 @ 1.0 % at grain filling stage, T_6: T_3 + T_4, T_7: T_4 + T_5 and T_8: T_3 + T_4 + T_5. The results of field study indicated that, the growth, yield uptake and quality of green gram were significantly influenced by foliar application of macronutrients (N, P and K). The growth parameters *viz.*, plant height, number of branches, number of leaves $plant^{-1}$, leaf area $plant^{-1}$, number of pod $plant^{-1}$ and dry matter of green gram were significantly improved due to treatment T_8 (RDF + 19:19:19 @ 0.5 % at vegetative stage, RDF + 00:52:34 @ 1.0 % at flowering stage and RDF + 13:00:45 @ 1.0 % at grain filling stage). Whereas, yield contributing characters *viz*., seed yield, straw yield and biological yield as well as quality parameters such as protein content, protein yield and test weight of seed in green gram were also increased.

CPT 89

Nutrient Management in Watermelon in Konkan Agroclimatic Conditions

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A field experiment on nutrient management in watermelon in lateritic soil of Konkan region was conducted during *Rabi* season of three succeeding years from 2012-13 to 2014-15 at Vegetable Improvement Scheme, Central Experiment Station, Dr. B.S Konkan Krishi Vidyapeeth, Wakawali. The experiment was laid out with three treatments of various levels of nitrogen and potassium *viz*., T_1 (20 t FYM + 150:50:50 kg NPK ha^{-1}), T_2 (20 t FYM + 200:50:75 kg NPK ha^{-1}) and T_3 (20 t FYM + 250:50:100 kg NPK ha^{-1}) with seven replications. The experimental results revealed that the maximum number of fruits per vine (1.99), fruit girth (61.20 cm), fruit weight (3.19 kg) and fruit yield (30.45 t ha^{-1}) was recorded in the treatment T_3 (20 t FYM + 250:50:100 kg NPK ha^{-1}) as compared to the rest of the treatments under study. Further from the data on cost of cultivation, it was noticed that in T_3 treatment (20 t FYM + 250:50:100 kg NPK ha^{-1}) the cost benefit ratio (C: B ratio) was found to be the maximum (1.88) followed by T_2 (1.72) and T_1 (1.57). Hence the treatment T_3 (20 t FYM + 250:50:100 kg NPK ha^{-1}) was found to be economically beneficial for getting maximum returns in watermelon hybrids under coastal environment.

CPT 90

Effect of Spray of Combination of Thioproline, Folic Acid and Brassinolides in Cashew (*Anacardium occidentale*) for Increasing Retention, Yield and Raising Farmer's Income

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Cashew is considered as wild and drought tolerant crop and is cultivated on sloppy and rainfed areas in Konkan. To meet the requirement of raw cashew nuts required for 1500 cashew processing units working in Konkan, processors importing raw cashew from other parts of India and also from African and other countries. Various efforts were made to become self-sufficient. Falling of immature cashew apple with nuts and reduction in yield were the serious issues. Hence investigation on effect of spray of combination of thioproline, folic acid and brassinolides on increase in retention and yield of cashew was conducted at Department of Horticulture in RBD with three treatments and seven replications for four years. The uniform trees of 12 to 15 years age were selected and spraying was done at nut set and on 15th and 30th day after first spray. Spraying with combination of thioproline, folic acid, brassinolides on cashew nuts exhibited significant difference in terms of retention and yield. The maximum percent retention (72.32%), yield (4.44 kg), number of nuts (553), nut weight (8.27 g) and nuts in one kg (121.51) were recorded with three sprays of the combination of thioproline, folic acid and brassinolides which were at par with two sprays of combination of thioproline, folic acid and brassinolides but significantly superior over control. Among the treatments, three sprays of combination of thioproline, folic acid and brassinolides showed highest (1.47) cost benefit ratio resulting in additional profit of Rs. 60240 over control (0.66).

CPT 91

Use of Soilless Media for Raising Mango Grafts - An Innovative Solution on Soil Scarcity for Nursery Industry

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Soil is generally used as a basic medium because it is cheapest and easy to procure the soil. Annually for preparing 100000 grafts, a nursery man requires 200 tonnes of soil. The growing medium other than soil like cocopeat, leaf manure and compost also plays an important role in seed germination not only it does act as a support, but also a source of key nutrients for plant growth. These growing media having characteristics of light in weight and good porous structure can be used along with soil as potting mixture. Hence an investigation was conducted in RBD with ten treatments of different media mixtures and three replications. In the present study, maximum survival was noticed in media containing mixture of soil + cocopeat (1:1) and cocopeat + leaf manure + compost (1:1:2) in stone grafting despite of fungal attack and heavy rain causing waterlogging in root zone immediately after shifting of grafts in open field condition. Mango stone grafts raised in cocopeat + leaf manure + compost (1:1:2) followed by cocopeat + leaf manure + compost (1:1:1) gave maximum growth results with respect to all morphological parameters. Media containing cocopeat + leaf manure + compost (1:1:2) recorded highest benefit cost ratio 1.31 in stone grafting thus reflecting that raising of mango grafts in nursery by using soil less media has bright future as it performed better, is easy for handling and light in weight for transport.

Session III:

Technological Advancement in Aquaculture and Livestock Production Systems for Higher Productivity

TAAL 1 (INVITED)

Island Agriculture: Boosting Production and Income for Decent Livelihood in Andaman and Lakshadweep Islands with Special Emphasis on Animal Husbandry and Fisheries

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In Andaman and Nicobar Islands, more than 85% of the 8249 km^2 total geographical area is covered under forests and only limited area (6%) is available for cultivation. The climate is humid tropical and the terrain is in general undulating. The average annual rainfall is about 3000 mm. The mean maximum temperature is 30.16°C and the mean minimum temperature is about 23.34°C. Presently, the emphasis is on increasing the area and production through crop diversification from traditional plantation and food crops and optimum exploitation of cultivable wastelands. Nevertheless, agriculture is the main occupation in the islands as 50% of the total population is directly dependant on agriculture and allied activities. Small and marginal farmers constitute nearly 57% of the 14000 farm families but own only 25% of the cultivated area. The average size of the agriculture landholding in the islands is only 1.89 ha. The contribution of agriculture towards the Islands GDP is 17.40%, whereas the industries and service sector contribute 6.4 % and 76.2 %, respectively. However, new work opportunities are growing at a moderate pace thereby increasing the spectre of unemployment in the islands. Land holdings in Lakshadweep are predominantly small and marginal, 87 percent of the operational holdings were of the size of 0.5 hectare or less. The other striking feature is that almost the entire cultivable lands are planted with coconut, with intercropping in some. These factors, coupled with lack of irrigation facilities, have generally limited the availability of employment from the agriculture sector. Livestock farming in Andaman is considered to be a profitable enterprise in agriculture and constitutes an important activity for accelerating the rural economy. There is enough scope of improving the productivity status through more scientific management and appropriate development programmes. As per livestock census of 2012, the cattle, buffalo, goat, pig and poultry population in the Island is 45625, 7863, 65324, 35921 and 11,65,363 (nos.) respectively. The major bottlenecks for low productivity are indiscriminate inbreeding and free mixing of the animals, dilution of genetic superiority, long inter-calving period, inadequate availability of feed and fodder and high parasitic load. Promotion of sustainable and profitable coconut-based farming systems and Entrepreneurship Development Programme are the major challenges for agricultural sector in Lakshadweep. There are also scope for development of poultry and fishery sector in these islands too. Coconut is the major crop of these islands. The area under the crop is 2570 ha with an annual production of 70.91 million nuts and the average productivity is 27,591 nuts ha^{-1}. High planting density is the serious structural constraint for improving the income from coconut plantations. Lakshadweep is situated in an advantageous position in Arabian Sea of west coast of India. It has an area of large territorial waters. The island is having vast potential for the development of fisheries. The islands have a coastal length of 1912 km and the continental shelf area of about 35000 km^2. The Exclusive Economic Zone (EEZ) around these islands is about 6,00,000 km^2, forming 28% of the total EEZ of the country. Hence there are ample scope for fishery development in Andaman and Nicobar Islands. Apart from the vast tuna resources, the Andaman Sea is also potentially rich in grouper, snapper, lobster and shrimp resources that are having export potential Exclusive Economic Zone (EEZ) around Lakshadweep is approximately 46 percent of total EEZ of west coast of India. Inhabitants of Lakshadweep are seafarers and many of them traditionally depend on fish for their livelihood. The waters around Lakshadweep are rich with fishery resources. At present a small fishing industry has been developed in Lakshadweep. There has been a steady growth of fish production, which once stood at 500 tonnes during 1950s crossed 15,000 tonnes in recent years. However, compared to fishery potential of this area, which comprises of manly tuna, but this is almost negligible compared to the available potential, which is estimated to be between 50,000 to 1, 00,000 tonnes per annum. A well thought out strategy to periodically monitor the movement of the various varieties of fishes, prawns, shrimps, etc. needs to be developed. Simultaneously sophisticated vessels to enable the catch, store it in cold conditions on the high seas, and to handle at the shore such as packaging, etc. needs to be worked out. About 80 percent of fish caught in Lakshadweep is tuna. Attention is also required to increase the facilities for storage, processing, marketing and export of the various types of fishes including the ornamental varieties as well as tuna/fish products. In Lakshadweep commercial livestock farming is neither feasible nor advisable. Keeping small units of cows and goats under stall-feeding should be an ideal model to meet the requirement of livestock products and for supplemental income. It is desirable to make the islands self-sufficient in respect of fodder and feed. The local people can also be trained to provide basic veterinary care. In the paper strategies for development of agriculture *vis-a-vis* animal husbandry including fisheries in both the islands have been discussed.

TAAL 2 (INVITED)

Role of Livestock in Coastal Agriculture

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India has a coastline of 6100 km of mainland, touching 11 States and Union Territories (UTs). East Coast of India lies between the Eastern Ghats and the Bay of Bengal. Indian coastal region comprised of Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha, West Bengal, Puducherry, Lakshadweep, Daman & Diu, Andaman & Nicobar Islands. Such vast geographical area and copious natural resources paved the path for the flourishing of animal husbandry in the coastal regions from the time immemorial to the present. Different livestock breeds particularly local and indigenous breeds are distributed along the coastal region and contributing for sustainable agriculture practices. Cattle breeds such as Gir, Sahiwal, Red Sindhi, and Veture; buffalo breeds like Murrah, Pandarpuri; goat breeds such as Konkan Kanyal, Telicheri and Black Bengal; pig breeds like Agonda Goan and various backyard poultry breeds are very well adapted and contributing to coastal agriculture. In coastal region, agricultural production makes an extremely important contribution to the local economy or to national agricultural production. There are a number of reasons for giving coastal agriculture particularly livestock sector. Livestock can be a major component and contributor in integrated farming system practices that are mostly prevalent in coastal region. Livestock forms an integral part of agriculture in India and involves the participation of around 70% of its population, most of which are small/medium scale holders. In coastal region of the India livestock resources are diverse and plenty in number. Coastal region of the India, which constitutes for the 14.2% of total Indian landmass, possesses the 19.5% of the livestock population of total Indian livestock population. The East Coast of the country is more affluent in both population and the genetic diversity in livestock resources than the west coast.

TAAL 3 (INVITED)

Coastal Aquaculture: Enhancing Production Potential under Stressed Environment

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The long coast line of India about 7517 km covering all the coastal States of mainland India as well as the coastline of Andaman and Nicobar Islands and Lakshadweep Islands; offers a varied landscape and diverse ecosystem based on the local topography and prevailing climate. Generally, the landscape has high hills & mountains in the upland, in the middle, region dominated by valley and then the land meanders to the coast. Invariably there is huge interaction between the sea and land. These coastal zones are very dynamic in nature there is constant change in the coast line. Most of the coastline are having unique ecosystem like mangrove, coral, ecosystem or marshes. They may be interspersed with wetlands estuarine areas, back waters, lakes, bays & creek, saltpans, derelict water bodies, water logged areas, agricultural lands and non-productive lands etc. The coastal lands are also very prone to natural stressors like storm, cyclones, sea surges, *tsunami,* etc. to name a few. Climate related vagaries may also cause drought like situation for few months. Hence these coastal zones are subject to various stresses. Therefore, any aquaculture activities in these places needs to factor in such elements. These diverse land and water bodies provides opportunities of for aquaculture per se. All the aqua cultural practices *viz* brackish water aquaculture, Mariculture as well as fresh water aquaculture can be practised based on the prevailing aquatic environment. It is well known that coastal aquaculture has provided ample opportunities to the farmers, fishers to earn a decent livelihood. In some States, the coastal aquaculture has taken the status of Fishery Industry. A state like Andhra Pradesh, is supplying freshwater fish to almost all the States of India. West Bengal is a hub for freshwater fish and freshwater seed production. States like Odisha has made major strides on freshwater aquaculture. Karnataka, Tamil Nadu, Maharashtra have not also lagged behind. In the Eastern States of India, numerous shrimp hatcheries have been established. Biosecurity & Quarantine is the buzz word in aquaculture farms. Farmers are conscious about quality seed and feeds. States like Andhra Pradesh, West Bengal, Odisha, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra and Gujarat has made significant progress in brackish water aquaculture. Shrimp culture has shown enormous promise and contributing substantially to the revenue earning through sea food export. There is scope of diversifying the species for culture practices involving species like sea bass, milk fish, mullet and host of prawn

species. There is vast scope of cage culture in the protected bays and creeks of the coastal areas. Other mariculture activities like raft culture of mussels, oysters etc., sea weed culture in the rafts. Marine ornamental fish breeding & culture. Pearl oyster culture & pearl production have got enormous scope. These hold good for the Island Territories like A & N Islands and Lakshadweep Island also. Along with the intensive aquaculture, there will be advent of disease due to overcrowding and deterioration of water quality, causing stress to the cultured finfishes and shell fishes. Hence adequate measures are to be taken to prevent occurrence of dreadful diseases. The paper proposes to deal with all the aspects mentioned above.

TAAL 4 (INVITED)

Engineering Interventions along the Fish Value Chain

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Fisheries engineering is aimed at overall development of fisheries sector and improvement of the livelihood of fishermen community by application of principles and techniques of basic engineering. Appropriate technological solutions have been developed to cater the needs of different stake holders including fishers, fish vendors, seafood industry, small scale entrepreneurs and the public. Engineering interventions in fisheries sector includes indigenous electronic instruments for application in harvest and post-harvest technology of fish; fuel efficient fishing vessels and fiber glass canoes; quality improvement of Indian fishing fleet; design and development of energy efficient and eco-friendly solar fish dryers; machineries for pre-processing of fish; ergonomic, gender friendly, hygienic and mobile fish vending systems and energy and water optimization techniques for fish processing industries. The advent of electronics in fisheries sector reflected in development of a series of instruments for systematic monitoring, analysis and assessment of marine environment. Suitable machineries have been developed across the fish value chain including harvesting the resources and post-harvest processing. The notable achievements designed at ICAR-CIFT comprises of environmental data acquisition system, freezer temperature monitor, salinity temperature depth meter, hydro meteorological data acquisition system, warp load meter, solar radiation monitor and integrator, ship borne data acquisition system, water level recorder, ocean current meter, remote operated soil moisture meter, water activity meter, rheometer and micro algae concentration monitor. Since the instruments are designed to be compatible with computer and solid-state memory module, the information can be stored for long duration and retrieved at our convenience. A fuel-efficient steel fishing vessel of 15.5 m named “Sagarkripa” was designed and fabricated with customized propeller designs. Unique fibreglass fishing vessels were designed, developed and fabricated for operation all around India especially in NEH regions. Sun drying (open air drying), which is accepted widely as the easiest and cheapest method of fish drying was proved to be inferior with respect to quality, hygiene, reliability and shelf stability of the dried products. As an alternative to this, ICAR-CIFT has developed Solar-hybrid dryers which offer numerous advantages over the traditional method with respect to environment friendliness and economic viability in the developing countries. In solar drying, solar radiations are tapped by means of solar panels and use it to improve drying rates and lower final moisture content of the dried products. In a hybrid solar drying system, drying can be continued during off-sunshine hours by utilizing back up heat source (Electrical, LPG, Biomass) and stored heat energy of the daytime sunshine. In this way, drying becomes continuous process and the product is saved from possible deterioration by microbial infestation. ICAR-CIFT has successfully established solar hybrid dryers of varying capacities from 10-250 kg. Descaling of fish serves as one of the tedious jobs encountered in pre-processing of fish. In processing industries, it was estimated that manual descaling of larger fishes requires almost 50% of the total time necessary to produce beheaded and gutted fish without fins. As a solution to the drudgery involved in fish de-scaling, ICAR-CIFT has developed hand operated and motor operated versions of fish descaling machines with capacities from 3-10 kg. The descaling machine could successfully remove the scales with an efficiency of 85-90%. Taking into consideration, women's predominant role in street fish marketing and greater female participation in business management activities, hygienic and ergonomic design for fish handling and marketing should be encouraged. In this context, ICAR-CIFT has developed a hygienic and mobile refrigeration enabled mobile fish vending kiosk with provisions for basic facilities on handling, chilled storage, preparation and waste disposal in street areas. Hygienic fish vending free from flies, insects and bad odour, delivery of quality fish without incorporation of chemical preservatives in ice to preserve fish are the advantages of the modern and hygienic refrigeration enabled mobile fish vending kiosk. Also, the shelf life of fresh fish can be extended up to 4-5 days in the kiosk without any quality deterioration. Thus, the intervention of engineering covers almost all areas pertaining to harvest and post-harvest fisheries.

TAAL 5 (INVITED)

Sustainable Dairy Development in Coastal Region of India under Changing Climate

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Agro-climatic condition in coastal regions of India is always considered to be the triggering factor for diversification in agriculture, livestock development and its productivity. India continues to be the largest producer of milk in the world. Several measures have been initiated by the Central and State Governments to increase the productivity of livestock, which has resulted in increasing the milk production significantly from the level of 102.6 million tonnes in 2006-07 to 163.7 million tonnes in 2016-17. Coastal zones are the most fragile ecosystem having an interface of sea and land, vulnerable to population pressure, industries, effluents, floods, periodic storms as well as erosion. Nine Indian States and two union territories have coastlines. They are Kerala, Tamil Nadu, Karnataka, Gujarat, Andhra Pradesh, Goa, Orissa, West Bengal, Maharashtra, Daman & Diu and Puducherry. Some of the island territories are Andaman and Nicobar Island (Bay of Bengal) and Lakshadweep Island (Arabian Sea). Population in the coastal areas is sparsely distributed and nearly 35% Indians live within 100 km of the country's coastline measuring 7517 km, out of which the mainland coastline is 5422.6 km, whereas, the island territory is 2094 km. Out of 1.28 billion people in our country, 171 million live in coastal areas. Agricultural yield is also poor due to the rising salinity of water and some land remains fallow for most part of the year. Among the livestock, coastal regions are well dominated by cattle population followed by small ruminants especially goat and sheep. Dairying has become an important secondary source of income for millions of rural families and has assumed a most important role in providing employment and income generating opportunity. Therefore, rearing of dairy animals as a component of integrated farming may help in escaping poverty, livelihood security and bringing stability in the earnings of the people living in coastal areas. Most of the household in the coastal areas maintain 2-3 dairy animals along with sheep/goats or backyard poultry in a traditional way. Similarly, the concentrates and green fodder, required for the livestock, are also in acute shortage as a result, even the high yielding animals have poor yield. Therefore, farmers of this coastal areas may be trained with latest scientific dairy production technologies for adoption in their farms for increasing income generation. Genetic potential of local indigenous dairy animals may be enhanced by upgrading with high yielding Indian pure-bred cattle. Even high yielding indigenous pure-bred cattle may be introduced based on their suitability in the particular coastal region. Feed resources may be identified from the particular area for ration balancing of the dairy animals. Area under cultivated fodder production must be enhanced to economize the milk production in the region. Application of AI technologies, scientific housing system, clean milk production, scientific approaches for management of reproductive problems in dairy animals, vaccination and disease control may be given more importance for increasing the milk production and health of the animals. Balancing among the components of genetic potential of animals, agro-climatic condition of the particular zone and availability of feed resources is a real challenge to Animal Scientists in coastal region of India Therefore, scientists of ICAR Institutes/SAUs, central/state development agencies/line departments, NGOs and KVKs may work jointly for scientific dairy development in the coastal regions of India with integrated approaches so that farmers can get maximum benefits per hectare of land without compromising the soil fertility and productivity. It is also believed that these strategies will be helpful for greater nutritional security of the farming community and common people of this region where natural resources are abundant to solve such problems.

TAAL 6 (INVITED)

Aquaculture for Augmenting India's Food and Nutrition Security

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India was transformed from a begging bowl to a net food exporter and second largest food producer in the world. However, India stands 67th position in the recent Global Hunger Index released by the International Food Policy Research Institute. About 190 million Indians end their day chronically undernourished and 22% of children below five years are undernourished. In spite of various targeted programmes and initiatives by the government, the socio-cultural inequalities in the society push us back in the race. Amidst all these setbacks, we must put our concentrated

efforts to boost the food production to feed more than 1.2 billion people. This paper attempts to showcase the scope of aquaculture to improve food security. The fish food security of the country in future lies in the augmentation of fresh water aquaculture and a growth rate of 8% per year is expected. Aquaculture's meteoric rise during the last two decades provokes both optimism and apprehension among scientists and policy analysts concerned with global food security. The aquafarming of fish and shellfish in inland freshwater and marine systems grew at an annual rate of 7.8% worldwide between 1990 and 2010; a rate that substantially exceeded that of poultry (4.6%), pork (2.2%), dairy (1.4%), beef (1.0%), and grains (1.4%) over the same period. Aquaculture currently provides roughly half of the fish consumed worldwide, and its share is expected to increase in the future as capture fisheries reached to maximum sustainable yield or exceed their sustainable yield and as innovative aquaculture technology and management continue to improve. Fish is a super food due to its superior nutritive value and affordability. India has made remarkable strides in thefisheriessector and increased the production to 12 folds during the past few decades. Meanwhile, India's per capita fish consumption is presently 6.5 kg, which is expected to be 9 kg by 2030. Fish consumption is improving due to the increasing trend in urbanization, purchasing power of the middle-income group. Aquaculture in India has evolved from a state of homestead activity in few pockets of Eastern Indian states during the1950s to the present state of a vibrant commercial enterprise. India is endowed with enormous inland water resources (29,000 km of rivers, 0.3 million ha of estuaries, 0.19 million ha of backwaters and lagoons, 3.15 million ha of reservoirs, 0.2 million ha of floodplain wetlands and 0.72 million ha of upland lakes) and we are presently producing about 6 million tonnes of fish out of it. However, we have exploited only ten percent of our resources, offers a tremendous scope for planned aquaculture development in the country. The union government has envisaged the ambitious Blue Revolution Scheme for the development of fisheries and aquaculture. ICAR-CIFA has a variety of technological offerings in its basket to augment the fish production such as the technology packages for more than thirteen fish species, Jayanti Rohu- which gives 19 percent additional growth in a year; CIFABROOD™- a broodstock diet helps in quality egg; FRP hatchery - a portable small size hatchery facilitates to undertake breeding programs even in hilly terrains; CIFAX- a therapeutic formulation to combat disease problems in fish. In addition to the technological , ICAR-CIFA advocates different approaches to the state governments and other stakeholders to maximise the fish production such as system diversification and species diversification. Although we have attained commendable technological advancements in aquaculture research, the major bottleneck for aquaculture development is the lack of convergence and synergy among all stakeholders. However, a renewed momentum has been initiated to get the synergy and timely flow of technological information from the lab to land and pitch for improved convergence of stakeholders. These forward steps would steer us further to excel in various frontiers of aquaculture production to ensure the supply of fish for the future.

TAAL 7

Seasonal Patterns of Plankton Biomass in Some Brackish Water Shrimp Ponds of Raigad District of Maharashtra

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Shrimp farming is expanding rapidly owing to its good potential to provide the employment opportunities in rural India and also contribute to the country's foreign exchange through exports. In addition, it helps in exploiting the unutilised resources such as coastal saline lands, swamps and brackish water bodies. Natural productivity in shrimp ponds is receiving special attention by aquaculturists and researchers as an important contributor to the farmed shrimp. The live food organisms contribute for more than 50% of the nutrition of *P. vannamei* in semi-intensive system and indicated that juvenile shrimp consume zooplankton of different sizes especially copepods. It is

therefore imperative to have a thorough knowledge of interrelationships of plankton with environment to determine its abundance, in shrimp cultured ponds. The study regarding seasonal plankton distribution in different seasons was undertaken. The average percentage composition of phytoplankton showed the predominance of *Cyanophyceae*, followed by *Bacillariophyceae, Dinophyceae* and *Chlorophyceae* during Crop I. During Crop II under two different seasons *Bacillariophyceae* was dominant followed by *Cyanophyceae, Dinophyceae* and *Chlorophyceae.*

TAAL 8

Study of Physicochemical Parameters of Soy-Fortified Cow Milk

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Cow milk, is a product of the mammary gland and soymilk is a creamy, milk-like product made by soaking and grinding soybeans in water. The present investigation was made to develop soy-fortified cow milk by partial addition of different levels of soymilk to cow milk and to determine physico-chemical properties of these blends. The physico-chemical properties *i.e*., fat, protein, acidity, ash, TSS, specific gravity, and pH of soy: cow milk in the ratio 100:00% (T_1), 75:25% (T_2), 50:50% (T_3), 25:75% (T_4) and 00:100% (T_5) was determined. The treatments T_1, T_2, T_3, T_4 and T_5 had 1.9 to 3.3% fat; 3.1 to 3.3% protein; 0.14 to 0.22% acidity; 0.33 to 1.88% ash; 6 to 10.7 °B TSS, 1.014 to 1.025 specific gravity and pH of 6.8 to7.3. The treatment T_4 gave best results for physico-chemical properties of soy: cow milk blend with 2.75% fat, 3.10% protein, 0.15% acidity, 0.50% ash, 10.7°B TSS, 1.023 specific gravity and 7.26 pH, respectively.

TAAL 9

Value Addition in Fish: An Overview

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India has a coastline of 7517 km covering 9 states and 3 union territories. India's marine fish catch has increased by 5.6% (3.83 MT) and 8.3% (Rs. 52431 crores) in 2017 for catch (landing) and value respectively. World seafood demand has been growing steadily over the past years for a variety of reasons including, a rise in living standards, the greater variety of seafood available compared to other meats, more affordable pricing and growing appreciation for alternative forms of healthy foodstuff, due to omega-3 fatty acid and high-quality amino acid. A wide range of value added products are available for domestic as well as export market due to recent development in fish processing technology *i.e*., whole frozen fish, fillets, mince and value-added products.

TAAL 10

Batter and Breaded Products: A Need for Low Cost Fish Utilization

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In recent scenario there is a rapid increase in production as well as consumption of fast foods. Urbanization has

changed the food habits and lifestyle of people. Nowadays more and more people are engaged in outdoor jobs and they hardly find time to cook food. Batter and breaded products are value added products containing high quality protein and other necessary nutrients. These kinds of products are in the forms of "easy-to-cook", "easy-to-fry" and "easy-to-digest" due to their characteristics. There is a great scope to develop batter and breaded products from low cost fish in national and international market. Fish and fishery products contain high quality protein and other necessary nutrients. They are low in saturated fatty acids and contain high content of unsaturated fatty acids. Recently, batter and breaded fish products are convenient food items preferably eaten as starter foods in between regular meals for the purpose of satisfying hunger, providing nutrition and energy. There is a great scope to increase the fish consumption in India and abroad by developing and marketing in variety of innovativevalue added fish products in the form of whole, filleted, steaks, fingers, patties, cutlets, burger, etc. In the present paper different types of batter and breaded fish products prepared from low cost fish are discussed in detail.

TAAL 11

Application of Optimal Amount of Sewage Water for Fish Rearing in Coastal Areas

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A huge amount of domestic sewage is generated every day from Kolkata city. Eventually, this sewage reaches estuary through runoff and thus pollute water bodies of coastal areas. However, such domestic sewage with its potential nutrients load can enhance water productivity for fish rearing, if utilized properly. To evaluate the effect of different sewage concentrations on fish survival and application of sewage with split doses on fish growth in relation to water productivity, two different experiments were conducted consecutively, each with four treatments. In both experiments, three fish species namely rohu, *Labeo rohita*; mrigal, *Cirrhinus mrigala;* and bata *Labeo bata* were tested in triplicate in FRP (Fibreglass reinforced plastic) tanks. Different sewage concentrations (0, 25%, 50% and 75%) used in the first experiment was prepared by mixing freshwater, which had biochemical oxygen demand (BOD) 2.0±0.4, 10.8±1.4, 19.6±1.5 and 41.6±2.58 mg L^{-1}, respectively. After 30 days of rearing, results showed $\geq$ 75% fish survival in sewage concentrations up to 50% with a BOD level of 19.6±1.5 mgL^{-1}. Less than 50% fish survived in 75% sewage concentration, with a BOD level of 41.6±2.58 mgL^{-1}. The second experiment was conducted for 90 days considering 50% sewage concentration as basal dose with a BOD level of 19.6 mg L^{-1} as an acceptable limit for fish survival. Split doses of sewage were applied in T_1, T_2 and T_3 treatments fortnightly, weekly and semi-weekly intervals, while single dose was used in C (control) treatment. Application of split doses resulted better hydro-biological changes, including nutrients recovery in T_1, T_2 and T_3 than that of single dose in C. Fish growth plotted with net primary productivity (NPP), phytoplankton and zooplankton densities exhibited positive correlation in T_2 (12 times) and T_3 (24 times), considered as optimal doses to ensure better water productivity for desirable fish production than sewage with single dose or limited doses (6 times). Once such sewage is utilized with optimal dose (twice a week) for fish production, it may serve three important purposes: production of protein rich crop, water conservation and mitigation of aquatic pollution.

TAAL 12

Washing Processes and its Impact on Quality Parameters of Surimi Prepared from Lesser Sardine (*Sardinella fimbriata*)

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Lesser sardine (*Sardinella fimbriata*) is a pelagic shoaling fish, and Ratnagiri is one of major landing in India. The fish having high percent of fat and myoglobin, which affects the quality of surimi. The gel strength characteristic plays important role in preparation of crab/lobsters analogues and other value added products. The gel strength characteristic of surimi can be improved by applying different washing processes. In the present study effect of washing processes *viz*., conventional washing process (CWP) and alkaline-saline washing process (ASWP) on surimi was compared with unwashed mince (UWM) prepared from lesser sardine. Surimi prepared by these methods were analysed for parameters like gel strength, whiteness, expressible moisture, pH, solubility and organoleptic characteristics. Gels strength of unwashed mince (UWM) and different washing processes like CWP and ASWP were depicted as 28.67, 42.00 and 68.00 g cm^{-1}, respectively. High values of whiteness and pH, decreasing with expressible moisture content was observed in ASWP as compared to others. The results showed that alkaline-saline washing process (ASWP) could improve the gel forming ability of surimi particularly prepared from low quality fatty fish (*Sardinella fimbriata*).

TAAL 13

Ornamental Fishery Resource of Sundarbans – An Option for Livelihood Security in the Coastal Area

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The Sundarbans delta covering about one million ha in which the Bangladesh shared about 60% and India 40 %. The Indian Sundarbans in the north east coast of India occupy 9630 square kilometre and are bounded by River Hooghly in the West, River Raimangal in the East, Bay of Bengal in the South and Dampier Hodges line in the North. It consists of 102 islands of which 54 are put under two districts - North 24 Parganas and South 24 Parganas. It covers 6 Blocks of North 24-Parganas and 13 Blocks of South 24-Parganas with 44% of its total area under forest. The whole area of the Sundarbans encompasses about 0.6 million hectares of which 0.4 million hectares are forest areas and the remaining part includes water bodies comprising of hundreds of muddy ground, swamps, estuaries, large and small rivers, canals, and creeks interlaced almost in every direction. Salinity gradients change over a wide range of spatial and temporal scales. Species composition and community structure vary east to west, and along the hydrological and salinity gradients. These water resources harbour diversified potential ornamental fin fish and shell fish resources which have high demand both in domestic and overseas market. Among the freshwater ornamental fish Bele, *Glossogobius guiris*; Chanda, *Chanda ranga*; Kholse, *Colisa fasciata*; Red Colisa, *Colisa lalia*; Koi, *Anabas testudineus*; Bot Koi, *Badis badis*; Tepa, *Tetraodon cutcutia*; Kankley, *Xenentodon cancila,* etc. are popular, and some common brackish and marine water ornamental fishes are Paira Chanda, *Scatophagus argus*; Pearl spot, *Etroplus surstensis*; Lal Bhola, *Johnius coitor*; Kat–Koi, *Terapon jarbua*; Bak, *Hemiramphus far*; Archar fish, *Toxotes chatareus* and Moon fish, Chanda koi, *Lutjanus johni*; *Mene maculata*; Helicopter, *Triacanthus biacculeatus*; Chanda, *Monodactylus argenteus,* etc., respectively. Beside the ornamental fishes there are several ornamental crustaceans and molluscs are available; Galda Chingri, *Macrobrachium rosenbergii;* Ghuso Chingri,

Acetes indicus; Blue Manna Crab, *Portunus pelagicus;* Flower moon crab, *Matuta planipes;* Crufix crab, *Charybdis feriata; Calappa pustulosa; Sartoriana sartoriana; Charybdis rostrata;* Venus clam, *Meretrix meretrix;* Pearl oyster, *Pinctada fucata; Littorina melanostoma; Acrilla acuminate;* Apple Snail, *Pila globosa;* Cuttle fish, *Sepia aculeate.* Traditionally the fisher folk community of the Sundarbans depends on fish catching, prawn seed collection, crab fishing, etc. In the recent time the coastal people suffering from professional hazards for livelihood security due to several reasons. Various organisations with their institutional support address for livelihood issue. In this direction the diversified ornamental fishery resources can play a potential role for the livelihood improvement as the beautiful ornamental fin fish and shell fish are gradually becoming popular both in domestic and international market. Encouraging income is possible for the ornapreneurs through collection, breeding and rearing of these indigenous ornamental fish.

TAAL 14

Karad Grass Feed Block: An Economical Feed Resource for Dairy Cows

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Dicanthiumm annulatum commonly known as karad grass is a perennial densely growing grass in Goa. Huge biomass of karad grass grows every year as wild grass but it is not harvested and goes unutilized. However, the karad grass if utilized properly has a great potential as a feed resource for dairy animals. Therefore, in the present experiment the dry karad grass was used to produce feed blocks by applying compression pressure using hydraulically operated machine. Two kinds of feed block *viz*., plain karad grass block and compound feed block (grass mixed with concentrate in 1:1 proportion) were produced. Each feed block weighed 1.5 kg. The blocks were fed to dairy cows in the institute dairy farm to test its acceptability and effect on milk production. The cows initially took one to two weeks to acclimatize to feed block however later the feed blocks were very well accepted. It was observed that cow yielding up to 10 liter milk per day can be maintained by feeding compound feed blocks and concentrate ration can be reduced proportionately from the total ration. Another advantage of feed block is the compact nature which needs less storage space, easy to transport and convenient to handle.

TAAL 15

Prevalence of Subclinical Mastitis and Antibiotic Sensitivity Screening of Major Associated Pathogens in Dairy Farms of West Coast

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Dairy farming is the most important livestock enterprise in the west coast of India. Mastitis is one of the most expensive diseases of dairy animals in the world and subclinical mastitis occupies the major proportion of mastitis burden. Subclinical mastitis is characterised by increase in the somatic cell count of milk, while udder and milk quality appear to be normal. The condition can be diagnosed only by laboratory testing of milk samples. When the clinical mastitis is easy to detect and amenable for immediate treatment, subclinical mastitis (SCM), on the other hand, is an invisible malady and it is mostly neglected. The economic loss due to subclinical mastitis is associated with reduction in milk yield and the average milk yield loss reported was 2.58 L day^{-1} $animal^{-1}$. A study was conducted to screen the prevalence of subclinical mastitis (SCM) in dairy animals including cattle and buffalo in coastal states Goa, Kerala and Maharashtra. A total of 195 animals were examined for clinical mastitis and apparently healthy animals were screened for subclinical mastitis by California Mastitis Test. Milk samples from SCM cases were collected and were screened for the presence of major mastitis associated pathogens by bacterial isolation and identification by biochemical and molecular techniques. The prevalence of clinical mastitis in cattle and buffalo were 9.2% and 6.6%, whereas subclinical mastitis prevalence was 62.71% and 63.3% respectively. *Staphylococcus aureus*, coagulase negative *Staphylococci spp.*, *Streptococcus spp*., *E. coli* and *Bacillus spp*. were isolated from subclinical mastitis. Antibioic sensitivity screening of the *E coli* and Coagulase negative *Staphylococci* isolates showed they were susceptible to commonly used antibiotics except for Oxytetracyclin. The

findings of the study revealed that subclinical mastitis is highly prevalent in dairy farms of coastal states. Even though the present study shows pathogens are susceptible to antibiotics, antibiotic therapy is not advisable in these cases as the prevalence rate of subclinical mastitis is very high. This may lead to development of antibiotic resistance. To a large extend incidence of subclinical mastitis can be reduced by adoption of managemental practices like maintenance of clean premises, complete milking, use of disinfectant teat dips and nutritional interventions including feeding probiotics and vitamin-mineral supplements. Hence importance of subclinical mastitis must be targeted and sustained active surveillance programmes and application of preventive measure should be adopted to reduce its incidence.

TAAL 16

Length-Weight Relationship of Anchovies under Family Engraulidae Collected from Indian Coast

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The present study consists the length-weight relationships (LWRs) of 22 species of family Engraulidae reported under five genera *i.e*., *Thryssa*, *Stolephorus*, *Encrasicholina*, *Coilia* and *Setipinna*, collected along the Indian coast during November 2015 to March 2019. The value of parameter b in the equation of LWRs was estimated as in the species of genus *Thryssa viz., Thryssa hamiltoni*, *T. dayi*, *T. vitirostris*, *T. mystax*, *T. dussumieri*, *T. kammalensis*, *T. setirostris*, *T. polybranchialis* are 3.303, 3.291, 3.132, 3.360, 1.306, 1.139, 2.710 and 2.495, respectively; in the species of genus *Stolephorus viz*., *S. commersonii*, *S. indicus*, *S. insularis*, *S. dubiosus*, *S. baganesis* and *S. waitei* are 3.309, 3.519, 2.906, 3.558, 3.748 and 3.025, respectively; in the species of genus *Encrasicholina viz*., *E. heteroloba* and *E. punctifer* are 2.782 and 3.017, respectively; in the species of genus *Coilia viz*., *C. dussumieri* and *C. ramcarati* are 3.226 and 3.156, respectively and in the species of *Setipinna viz*., *S. phasa*, *S. wheeleri*, *S. taty* and *S. tenuifilis* are 2.768, 2.588, 3.470 and 3.474, respectively. The outcome of the present study of length-weight relationship is useful in the future study of biology of anchovies.

TAAL 17

Dietary Intervention of Dry Banana Powder as a Prebiotic on Growth and Survival of Fry of Catla, *Gibelion catla*

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Nursery management of Indian major carps is one of the crucial practices carried out by fish farmers of India. Although many farmers are facing the issue of mortality of fish fry during nursery management of these important fishes. The fish Catla, *Gibelion catla* is one of the important carp species and has good preference by human for consumption. The improvement of survival in the nursery rearing of catla is a great challenge for fish farmer. Various nutraceuticals and probiotics have been used to promote the growth of the carp species. Probiotics have been found beneficial in boosting the immunity but prebiotic is equally important to keep the probiotics available for effective action. A prebiotic is a non-digestible food ingredient which stimulates the activity of useful bacteria in the colon and thus improves host health leading to improved survival. The dried banana powder is one of the important natural prebiotics that can be used in fish feed as a supplement. Hence, the effect of the banana powder as prebiotic

on growth and survival was tested for the fry of catla fish. The results suggested that the prebiotic along with probiotic gave better growth and survival in catla, *Gibelion catla*. It is recommended to supplement dry banana powder at the rate of 2 g kg^{-1} as a prebiotic along with probiotic at the rate of 0.5 g kg^{-1} in the diet of Catla fish fry (*Gibelion catla)* for better growth and survival.

TAAL 18

Emergence and Prevalence of β-Lactamase Producer Non-Shigatoxigenic Escherichia coli in Healthy Livestock from West Coastal Region of India

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Escherichia coli (E. coli) that harbours Extended Spectrum β-lactamases (ESBL) are real game-changers in livestock health and production. These strains of *E. coli* from different livestock farms evince diversity in resistogram pattern. Such *E. coli* strains in livestock are given less importance in comparison to human studies in India. To detect phenotypic and genotypic diversity of antimicrobial resistance pattern associated with ESBL producing *E. coli* in healthy livestock in coastal region of Maharashtra, Goa and Karnataka, a total of sixty-one multi-resistant ESBL *E. coli* strains were retrieved from rectal swab of young and goat, pig, cattle per standard guidelines. Multiplex PCR (mPCR) assays were carried out to detect ESBL genes (^{bla}CTX, ^{bla}TEM, ^{bla}SHV) and virulence genes (*stx_1, stx_2, eaeA)* in isolated strains of *E. coli.* PCR amplicons were subjected to sequencing. The phenotypic resistogram represented 16 different phenotypes of the ESBL producing *E. coli* isolates. Almost all isolated strains exhibited extreme resistance to penicillin derivatives and third generation cephalosporins but only one isolate was found resistant to carbapanem. 9 out of the 61 sampled showed extreme resistance to clavulanic acid. In mPCR assay, ^{bla}CTX (16/61) genes were most dominant than ^{bla}TEM (7/61) and ^{bla}SHV (8/61). mPCR of virulence genes showed presence of *stx_1 (4/6)* and *eaeA* (6/61) but no *stx_2* gene was detected. This study confirmed presence of ESBL *E. coli* in intestinal microbiome of healthy livestock. Thus, frequent monitoring of antibiotic resistance status in livestock is needed to minimize the dissemination of antimicrobial resistance among livestock and humans.

TAAL 19

Evaluation of Adaptability and Performance of Konkan Kanyal Goat Breed under Coastal Climatic Conditions of Goa

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Goa state is rich in biodiversity as it is flanked by the Western Ghats. Goat husbandry is an integral part of livelihood for poor and landless population particularly "*Dhangar*" community mainly in the ghat regions *viz*. Bicholim, Pernem, Satari, Quepem and Canacona Talukas of Goa. The population of goats in Goa state is about 13,000 and most of local goats in Goa are nondescript in nature. The breeds, their habitat, adaptation and performance in west coastal line is poorly studied. Konkan Kanyal goat is a meat purpose breed adapted to high rainfall, hot and humid climatic conditions of Goa (Min-Max temperature18.5-35.3°C and total rainfall of 2648.4 mm during the study period). The study was conducted to evaluate the performance of Konkan Kanyal goat breed under coastal climatic conditions of Goa. A group of 12 (6 males and 6 females) animals of pure Konkan Kanyal breed were kept under semi-intensive feeding on raised platform housing system for 8 months. Green fodder leaves such as Mulberry (*Morus alba*), Subabul (*Leucaena leucocephala*) and drumstick (*Moringa oleifera*) were fed daily @ 50 kg. Concentrate diet of 200 g $animal^{-1}$ for initial 4 months and 300 g $animal^{-1}$ during later 4 months was fed daily. The production traits such as body weight, twinning, birth weight of kids and feeding behavior were recorded. Physiological parameters such as rectal temperature and hematological parameters were also studied. Twinning percentage up to 63% and triplet percentage of 22% was recorded in this study. Birth weight of male kids ranged from 2.8-3.2 kg and female kids from 2.4 to 2.8 kg. At 8-months age, the female goats weighed 32.36 kg and males weighed 36.43 kg. The hemoglobin levels in adult male ranged from 9.4 to 12.4 g dl^{-1} and female goats ranges from 8.2 to 10.8 g dl^{-1}. The mean rectal temperature in male was 102.8 ± 0.43 and in female 103.5 ± 0.22 degrees

Fahrenheit. Red blood cells count (RBC) ranged from 10 to 15 × 10^6 μL^{-1} and WBC count was 6.6 to 12.4 × 10^3 μL^{-1} during winter and rainy seasons. The semi intensive feeding on raised platform housing system was found to be most efficient rearing practice for better adaptability of this breed under coastal climatic conditions of Goa.

TAAL 20

Shelf-life and Volatile Flavourants of Thermal Processed Clam Extract Traditionally Prepared in Ratnagiri

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Kaat is a popular clam juice extract prepared from marine clam (*Paphia malabarica*) in several households in Ratnagiri district. It is a self-stable thermal processed extract of clam juice requiring no preservation. It is often utilized either in the raw form or as a flavouring agent in several recipes. Studies were carried out on keeping quality including flavour compounds in traditionally prepared *kaat* product. During storage, the changes in biochemical (pH, TMA-N, TVB-N, AAN and whiteness), microbiological (TPC) and organoleptic characteristics (odour, taste, overall acceptability) were monitored for a period of 120 days. TMA-N, TVB-N, alpha-amino nitrogen, whiteness, TPC were found gradually increasing. The pH of the sample remained steady at 5.35. Organoleptic analysis revealed that the product had better overall acceptability up to 120 days. When analysed for content of volatile flavour compounds using GC-MS, it contained 213 hydrocarbons, 68 alcohol, 228 esters, 14 phenols, 8 aldehydes, 22 ketones, 2 furans, 35 acids, 3 pyridines and pyrimidines, 1 ether and other diverse functional groups. The product was acceptable even after 120 days of storage at ambient temperature. It has good potential as a food flavourant in the preparation of several value-added products such as clam soup.

TAAL 21

Effect of Ethanolic Groundnut Husk Extract on Functional Characteristics of Pink Perch (*Nemipterus japonicus*) Surimi

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Groundnut skin and husk are by-products of groundnut processing industry. These are considered as agro-waste and often used in animal feedstuffs and fertilizers. Husk is good source of phenolic compounds that have antioxidant and antibacterial properties. The interactions between phenolic compounds and proteins also play a role in the processing and quality enhancement of certain food products. The present study aims to investigate the effects of ethanolic groundnut husk extract on gel enhancement of pink perch (*Nemipterus japonicus*) surimi. The extraction of phenolic compounds was done in 50% ethanol and the extracted material was added to surimi at concentrations of 0.5, 1, 1.5 and 2 % on w/w basis. The dried husk had total phenolic content of 20.55 mg TAE g^{-1} powder. The surimi had highest gel strength with 0.5% and 1% concentration of extract. The whiteness and expressible moisture content of surimi decreased as the concentration of extract was increased. The SDS-PAGE showed myosin heavy chain (MHC) and actin in all the concentrations but the lighter bands were seen with higher concentrations. Phenolic compounds are rich in hydroxyl groups, surimi gel can be strengthened via hydrogen bond and other interactions. Ground nut husk extracts at appropriate level could improve gel strength of pink perch Surimi.

TAAL 22

Nutritional Evaluation of Creep Feed Replaced with Azolla Meal in Konkan Kanyal Kids

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The Present investigation was carried out at Livestock Instructional Unit, College of Agriculture, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra to nutritionally evaluate the creep feed replaced with Azolla (*Azolla pinnata*) meal in Konkan Kanyal kids. Study on nutritional evaluation of 16 Konkan Kanyal kids were randomly divided into four treatments *viz.* T_0- 100% creep feed, T_1- 10% creep feed replaced with Azolla. T_2- 20% creep feed replaced with Azolla, T_3- 30% creep feed replaced with Azolla and Mulberry (*Morus alba*) leaves fed *ad lib.* The samples of feed were analysed as per dry matter basis (AOAC). The aproximate composition showed that dry matter content of Azolla meal, Mulberry and creep feed 0, 10, 20 and 30 per cent replacements with Azolla were as 89.98, 31.68, 93, 92.69, 92.39 and 92.09 per cent, respectively. The crude protein was 14.6, 22.68, 16.2, 16.85, 17.49 and 18.14 per cent;the ether extract was 6.98, 3.27, 6, 5.73, 5.45 and 5.18 per cent;the crude fibre was 9.67, 8.98, 8.4, 8.46, 8.52 and 8.57 per cent;the nitrogen free extract was 56.96, 52.07, 65.8, 64.37, 63.06 and 61.69 per cent;the total ash was 11.79, 13, 3.6, 4.59, 5.48 and 6.42 per cent;the calcium was 2.36, 1.48, 0.86, 0.92, 0.98 and 1.04 per centand the phosphorus was 0.31, 0.66, 0.34, 0.37, 0.4 and 0.44 per cent for T_0, T_1, T_2 and T_3, respectively. The nutritive value of creep feed replaced with Azolla meal was 10.05 ± 0.06, 10.23 ± 0.1, 11.71 ± 0.05 and 10.31 ± 0.09 DCP and 61.44 ± 0.22, 63.70 ± 0.39, 68.98 ± 0.21 and 64.75 ± 0.20 TDN in T_0, T_1, T_2 and T_3 respectively in Konkan Kanyal kids. It can be concluded that feeding of 20 per cent creep feed replaced with Azolla meal and *ad lib.* Mulberry leaves were nutritionally useful in Konkan Kanyal kids.

TAAL 23

Nutritional Evaluation of Sampoorna Fodder as a Feed for Buffalo Calves

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An experiment was conducted on six Mehasana male buffalo calves at the age of 14th months for evaluation of Sampoorna grass. They were fed Sampoorna fodder for 28 days. The chemical analysis of Sampoorna fodder revealed that, it contains 23.5, 32.39, 9.93, 5.9, 23.93, 51.35, 8.89, 0.13, 0.23 per cent dry matter, organic matter, crude protein, ether extract, crude fibre, nitrogen free extract, ash, calcium and phosphorus, respectively on DM basis. The nutritive values of Sampoorna fodder in terms of DCP and TDN in calves were observed as 8.90±0.09 and 86.18 per cent, respectively. Mineral balances observed for calcium and phosphorous was 3.42 ± 0.14 and 6.22 ± 0.25 g day^{-1}, respectively. The calves showed gain in body weight of 449.53 ± 37.22 g day^{-1}. From the overall results it can be concluded that Sampoorna fodder can be used as good fodder for maintenance of buffalo calves in adverse climatic conditions.

TAAL 24

Utility Perception of Marathwadi Buffalo by the Rearers in Latur District of Maharashtra State

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Marathwadi buffaloes are found to inhabit the Marathwada region particularly the district of Parbhani, Beed, Jalna, Latur and part of adjoining districts of Maharashtra State. A Marathwadi buffalo on account of its sizable population contributes significantly to the economy of the farmers. Marathwadi breed represents the very ancient indigenous type characterized with larger built and long flat horns. The present study was conducted in Latur district, in Marathwada region, of Maharashtra State in the year of 2015-16 with specific objective to study the utility perception of Marathwadi buffalo by the rearers. From Latur district, Ausanilanga and Udgir talukas were selected for study. From each taluka four villages having the considerable population of Marathwadi buffalo were selected. From each village ten respondents were selected. The sample constituted 120 Marathwadi buffalo rearers drawn from twelve villages. The percentage of respondents who perceived that Marathwadi buffaloes have high disease resistance power so had less percentage of diseases, calving age of Marathwadi buffalo is earlier than other indigenous buffalo, dry period for Marathwadi buffalo is minimum as compared with other indigenous buffalo, daily milk production of Marathwadi buffaloes is higher than other indigenous buffaloes of Marathwada were 62.50, 3.33, 6.66 and 65.84 %, respectively.

TAAL 25

Soil and Water Quality Parameters of Freshwater Fish Farms in South Raigad District of Maharashtra

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Investigation of soil and water quality parameters of operational freshwater fish farms of South Raigad district were conducted as per the standard procedures of American Public Health Association. The soil parameters such as pH, conductivity, moisture, water holding capacity, bulk density and seepage rate ranged from 6.8 to 7.5, 1.12 to 2.92 dS m^{-1}, 10.0 to 13.0%, 52.49 to 62.30%, 1.22 to 1.27 g cm^{-3} and 3 to 6 cm day^{-1}, respectively. Whereas the range of water parameters namely salinity, temperature, pH, dissolved oxygen, ammonia, alkalinity, hardness and transparency were found between 0.00 PSU, 28.0 to 29.0 C, 7.4 to 7.8, 4.0 to 5.0 mg L^{-1}, 0.0 to 0.01 ppm, 110 to 130 mg L^{-1}, 90 to 130 mg L^{-1} and 30 to 40 cm, respectively. Minor seepage rate of 3 to 6 cm day^{-1} was recorded in sampled freshwater fish farms. The observed values of soil and water parameters as well as seepage rate of South Raigad Region are within the ideal recommended ranges, thus, indicating that a very great potential exists for developing freshwater fish farming in the South Raigad Region.

TAAL 26

Soil and Water Quality Parameters of Brackish Water Shrimp Farms in North Raigad District of Maharashtra

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Soil and water quality parameters of operational brackish water shrimp farms of North Raigad district were studied on the basis of standard procedures of American Public Health Association. The soil parameters comprising of moisture, pH, electrical conductivity, water holding capacity and bulk density ranged from 8.25 to 16.11, 7.5 to 8.5, 1.03 to 4.15 dS m^{-1}, 31.47 to 46.69%, and 0.98 to 1.47 g cm^{-3}, respectively. Whereas the range of water parameters namely salinity, temperature, pH, dissolved oxygen, ammonia, total alkalinity, total hardness and transparency were found to vary between 15-32 PSU, 27-30 C, 7.5 to 8.0, 4.0 to 5.6 mg L^{-1}, 0.001 to 0.008 ppm, 120-140 mg L^{-1}, 90-120 mg L^{-1} and 30-35 cm, respectively. In all shrimp farms moderate seepage rate of 5-7 cm day^{-1} was recorded. Thus, with the ideal range of soil and water parameters a great potential for brackish water shrimp farming exists in the North Raigad district of Maharashtra.

TAAL 27

Evaluation of In-vitro Probiotic Properties of *Bacillus* Strains Isolated from Gift Tilapia Culture Ponds using Biofloc Technology

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Biofloc based fish farming is a sustainable technique where manipulation of carbon nitrogen ratio in the culture system through external application of carbohydrate sources or lowering the protein content in the feed stimulates the formation of microbial floc. In the water column, conglomerates of microbes, algae and protozoa, together with detritus and dead organic particles is developed. This microbial flora presents in the system can be used to maintain optimum pond water quality parameters and the microbial protein will serve as a feed. In the nursery culture of GIFT Tilapia, 4 different *Bacillus* species has been isolated from culture water and the intestine of Tilapia. Isolated bacteria were biochemically characterized and the DNA isolation followed by PCR amplification was done for the 16srRNA region. The *Bacillus* species identified are *Bacillus infantis, Exiguobacterium profundum* (isolated from Biofloc)*, Bacillus subtilis and Bacillus megaterium* (isolated from intestine of Tilapia). The accession numbers for the bacterial sequences were obtained and phylogenetic tree was constructed to find the relationship between the 4 different bacillus sp. Then invitro probiotic properties such as resistance to gastric acidity, Bacterial adhesion to hydrocarbons and auto aggregation test for the four *Bacillus* species were evaluated. Out of four species, *Bacillus infantis*- MH424755 showed best results for all the 3 tests when compared to the other 3 strains. This study indicates the bioremediation potential of microbial floc in the biofloc culture system with the possible effect of probiotic in GIFT Tilapia culture.

TAAL 28

Supplementation of Mulberry Foliage (*Morus alba*) Meal on Growth Performance of Broilers

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A five week feeding experiment was conducted to study the effects of mulberry foliage (*Morus alba*) meal supplementation on growth performance and economic analysis of broilers. A total of 200, day old broiler chicks

(Vencob) were divided into five treatments *viz*., T_0 (control), T_1: 25 per cent mulberry foliage meal (MFM), T_2: 30 per cent MFM, T_3: 35 per cent MFM and T4: 40 per cent MFM with four replications and each replication have 10 birds. Feeding mulberry foliage meal (MLM) significantly ($P<0.05$) improved body weight gain, feed conversion ratio (FCR). However, feed intake was not affected ($P>0.05$). Net profit was increased fed 30 per cent MFM. Also, feeding of 30 per cent MFM improved the benefit cost ratio as compared to control. The results indicated the possibility of including up to 30 per cent of mulberry foliage meal in diets of broilers without adversely affecting the growth performance and economic analysis. Therefore, it can be concluded that inclusion of mulberry foliage meal up to 30 per cent used for profitable broiler farming.

TAAL 29

Effect of Flaxseed Powder Supplementation on the Productive Performance of Giriraja Birds

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The aim of this experiment was to evaluate the beneficial effects of flaxseed powder as a phytogenic supplement on performance of Giriraja chickens. The assumption was the flaxseed powder could improve production performance of Giriraja chickens *viz.,* body weight, feed intake, feed conversion ratio and feeding cost. A total of 140 one-day-old Giriraja chicks were individually weighed and randomly assigned to five treatment groups, each with 4 replicate pens of 28 chicks. The dietary treatments included were T_0: Control (basal ration), T_1: basal ration + 2 per cent flaxseed powder, T_2: basal ration + 3 per cent flaxseed powder, T_3: basal ration + 4 per cent flaxseed powder and T_4: basal ration + 5 per cent flaxseed powder. The results of the experiment revealed that incorporation of flaxseed powder in Giriraja bird was diets as feed additive significantly enhanced growth, economics and productive performance of these chickens. The body weight gain, feed intake and feed conversion ratio showed better performance with flaxseed fed birds compared with control group. The study concluded that flaxseed can be effectively used in Giriraja feeding to replace antibiotic as growth promoter.

TAAL 30

Sero-Prevalence of Blue Tongue Virus (BTV) and Peste des Petits Ruminants (PPR) among Goats in Goa State

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Blue Tongue Virus (Reoviridae) and Peste des Petits Ruminants (Paramyxoviridae) are the major emerging viral diseases in small ruminant livestock, as these diseases are causing huge economic loss to the goat production. Sero-prevalence detection for such viral diseases would be very useful for disease control and to understand disease forewarning. During the period April 2017-March 2018, this study was carried out in 5 villages from two districts of Goa state; Sera samples (n=121) were collected from goats with no vaccination history as per sampling protocol designed by the ICAR-NIVEDI through project AICRP-ADMAS. Collected sera samples were screened for BTV and PPR specific antibodies by ELISA. Out of 121 sera samples, the prevalence of BTV and PPR in Goa is 75.20 (91/121) and 19.83% (24/121) respectively. The sero-prevalence of BTV was higher (91.48%) in North Goa distract and PPR was higher in South Goa (24.32%). The sero-prevalence report suggested that the BTV and PPR are present throughout Goa state. The present study would be helpful to generate epidemiological information of BTV and PPR in Goa state. Thus, there is urgent need to design vaccination framework and improvement in control strategies for management of viral diseases in small ruminants to prevent economic losses in coastal region including Goa.

TAAL 31

Comparative Study of Population Dynamics and Seasonal Variation of Mysid, *Mesopodopsis orientalis* (Crustacea: Mysida) in Coastal, Estuarine and Salt Pan Waters of Mumbai Area

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Mysids or opossum shrimps are component of zooplankton composition which is used for human consumption. Mysids are harvested using hand trawl made of mosquito netting during low tide period at surface of water. The study was carried out monthly basis from one site from Coastal area, three sites from Mangrove estuarine area and three sites from Saltpan during May 2016 to December 2017. In Coastal waters mysids were present year-round and exhibited marked monthly variations in abundance, with modal peaks during summer period. In estuarine waters as also in saltpans waters maximum quantity was found during summer period. Females predominated over males in the entire population, and brooding females were present at every monthly sample, indicating that reproduction is continuous year round. Sex ratio within the population was found to be variable. Brooding females occurred together with immature mysids (Male & Female juveniles) in all monthly samples, indicating that reproduction was year round. *Mesopodopsis orientalis* breed throughout the year but there is a seasonal variation in the intensity of breeding. The species produced more than one generation per year and the number of embryos carried by a single female ranged from 5 - 25. All developmental stages were observed. This evidence indicates that the Coastal waters population would differ to some degree from those of the Estuarine and also Saltpan waters counterparts. In terms of mysid population density, a greater abundance of mysids occurred in the Coastal waters and Estuarine waters (35.59% and 35.67%) compared to the Saltpan waters (28.72%). As a result of its abundance, this mysid is regarded as one of the most important species of the shallow-water crustacean community.

TAAL 32

Prospects and Challenges of Freshwater Prawn Farming in Coastal Areas of Sundarbans, West Bengal, India

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The Sundarbans contain the world's largest coastal mangrove forest, with an area of about 4,000 km^2 in India comprising 40% of the total area. These areas have long served as breeding and nursery ground of many freshwater prawns including Giant freshwater Prawn (*Macrabrachium rosenbergii*). The state of West Bengal in India endowed with the Sundarbans is working towards developing coastal areas for production of tiger shrimp, mud crab and other brackishwater fishes. The state has a coastline of 158 km with 2.1 lakh ha brackishwater area. In addition, there are ponds totalling 2.88 lakh ha comprising 44% of the total fisheries resources in Bengal. There is great potential for widespread practice of prawn farming in coastal districts of West Bengal due to the availability of wild post-larvae. The present culture system consists of stocking during March - April for nursery rearing. Within 30-45 days, juveniles reach 3-5 g individual weight and these are stocked at the rate of 3-5 nos, in grow out ponds with the onset of monsoon. Generally, production is about 1500 kg ha^{-1} with survival of around 60% within 4 months. Prawn farming in coastal Bengal presents diversified livelihood and income generating options for the coastal population. However, climate change remains as a major threat to vast coastal agriculture including freshwater prawn farming. Sundarbans is a hotspot for climate change. Considering extreme vulnerability of prawn farming to the effects of climate change, adaptation strategies must be put into place to cope with the challenges. Some of the climate change effects are increase in salinity, flood, cyclone, sea level raise and intrusion of saline water in inland areas. Adapting prawn farming to climate change, however, requires a combination of strategies and policies. Community-based adaptation strategies have to be formulated to meet the challenges to avoid early harvesting of undersized prawn, poor feeding, disease outbreaks, etc. Some of the strategies include polyculture of prawns with carps, translocation into interior coastal areas, etc. Suitability of polyculture of carps and prawns has been demonstrated by ICAR-CIFE,

Kolkata Centre through its Tribal Sub Plan (TSP) initiatives in which 8000 carp fingerlings were stocked with 4000 prawn juveniles per ha producing 6400 kg of carps and 300 kg of prawns at the end of 8 months. Community based skill development programs coupled with proper extension services and credit support are required to counter high cost of production, poor growth and variation.

TAAL 33

Impact of Salinity Level of Pond Water on Growth and Survival of Freshwater Fish

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Freshwater fishes are generally grown in salinity level of water upto 0.5 ppt. Many times, it is observed that fishes from freshwater ponds tries to come out of pond particularly during summer months when fish farmers try to replenish the depleted level of water in ponds by pumping out underground water. This situation is common in arid regions and in coastal areas. The reason for this is addition of high saline groundwater. Therefore, it is necessary to find out the level of salinity upto which freshwater fish can be cultured. We have observed that growth of common carp (*Cyprius carpio*) is more in water having 2.5 ppt salinity than in freshwater (0.2 ppt); but the growth was reduced to some extent when the salinity level was increased to 5 ppt. This was mainly due to change in standard metabolic rate, food intake, food conversion, hormonal stimulation etc. Recently it was reported that Rohu (*Labeo rohita*) can grow well upto 4 ppt salinity level. Various factors affect the growth and feed conversion ratio of the fish but the best response is strongly related to the optimise environment to which the fish is accustomed. Therefore, for carp fishes, salinity level of water should be within 5 ppt above which osmoregulatory stress increases to a great extent. To reduce the salinity level, the pond water has to be diluted by mixing with freshwater having salinity below 1 ppt, *e.g.* rain water, water from rivers, canals or nearby ponds. When this is not possible, feed manipulation can be tried. Incorporate of high-quality feeds with lots of protein and highly unsaturated fatty acids (HUFAs). Some anti-stress nutrients like vitamin C, betaine, and astaxanthin will also help. High quality proteins with balanced amino acids supply high digestibility and palatability and help reduce the amount of nitrogen released into the environment, resulting lower food conversion ratio (FCR) and better protein utilization. This is important because NH_3 is more toxic at high salinities and temperatures. Protein remains a good source of energy as long as ammonia levels are kept in check. Few years back, there was an incident of mass mortality of large sized fishes in a very deep big sized freshwater pond (45 ha) in Kolkata city, India during summer months. The fishes are dying out of hypoxia though the pond water has sufficient level of dissolved oxygen. On analysis it was found that the water has high organic load and higher level of nitrite (>0.3 ppm) due to regular recharging of pond water with Kolkata city sewage. Nitrite ions prevent the entry of oxygen in blood. In that case, the toxicity of nitrite was averted by incorporating a competitive anion *i.e.,* chloride (Cl^-) for nitrite. The salinity level of the pond was increased (just 10 ppm) by application of common salt @ 1 t day^{-1}. Three applications at an interval of 3 days were found to be sufficient to check the mass mortality of fishes. It was also observed that freshwater fishes of that pond and other ponds of the city which have very high organic load, exhibited reduced level of pathogen load and lower level of disease incidence by increasing the salinity level (10 to 20 ppm) of pond water. Thus, it can be concluded that salinity level of water has great impact on growth and survival of freshwater fish and can be managed judiciously to optimize the benefit in inland aquaculture.

Session IV:

Climate Change, Ecological Threat, Biodiversity and Coastal Forestry Management and Preparedness to Forewarn Disaster and Suggestion to Mitigate Miseries along with Adaptation Measures

CEB 1 (INVITED)

Lightning Intensity and Atmospheric Nitrogen Fixation under Climate Change Perspective - An Initiative of ISRO

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Lightning is a transient, high current (typically tens of kiloamperes) electrical discharge in air by different modes viz. intra-cloud discharges (ICD), cloud to ground discharges (CGD), cloud to cloud discharges (CCD) and cloud to air discharges (CAD). Lightning is considered to be most significant and possibly the major pathway by which nitrogen is fixed to NO_x. The atmospheric NO_x plays a critical role in regulating the concentration of hydroxyl radical (OH), a major oxidant for many atmospheric trace gases. The chemical reaction between NO_2 and OH leads to the formation of relatively stable nitric acid (HNO_3), which can be removed from the atmosphere by precipitation or wet deposition and hence provides an important naturally fixed nitrogen for the biosphere. Large variation in estimated annual production of NO_x is reported by the researchers because the estimates of the global production of NO_x by lightning requires understanding of the lightning physical characteristics, the chemical mechanism of NO_x formation by lightning, and the global and seasonal lightning distributions, all of which are not well characterized presently. It is certain that direct observations on number and energy density of lightning strokes in a storm, the radius of the core lightning channel and the amount of NO_x produced is difficult and mostly to be relied on simulated laboratory-based experiments, the range of which varies from 0.23×10^{26} to 21×10^{26} number of NO molecules / Joule in case of CG flash. Large uncertainties in NO production from lightning probably emerges from the averaging over the range of lightning-stroke energy densities and altitudes as well as the production rate by individual lightning flashes. In contrast to CG flash the IC flashes are more frequent but contain only 10% energy of CG stroke resulting is less production of NO_x. The other uncertainties include source, magnitude and mechanism of NO_x production by the hot gases produced by a lightning discharge, the NO_x production by the corona sheath surrounding the lightning channel, tortuous path of the lightning channel and the rate of cooing of lightning channel. The rate of cooling together with the volume of air processed determines the final NO production per flash. It is even more difficult to integrate over the air entering and leaving a thunderstorm in order to quantify the addition of NO molecules on their subsequent chemical products such as NO_2. The ambient factors that may also influence the amount of NO_x produced per flash, include updraft intensity in thunderstorm, deep convection, convective cloud height, pressure, relative humidity, and the duration of the discharge. Besides the thunderclouds and flash types, the moisture, pressure and temperature gradients also play important role in lightning activity. The NO_x production is strongly dependent on relative humidity. As the lightning channel cools from outside inward, the amount of NO produced each point is governed by the rate of cooling. As the lightning occurs only in well-developed convective clouds, and thus the convective transport is an important process to re-distribute NO_x released from lightning. The estimated global NO production ranges from 2.5 Tg N yr^{-1} for 30 flashes per second to 8.3 Tg N yr^{-1} for 100 flashes per second. Using the NO_x production rate of 6.7×10^{26} and 6.7×10^{25} NO molecules for each CG and IC flash, a global lightning NO_x emission of 8.8 Tg N yr^{-1} has been estimated based on analysis of the OTD lightning data. Hence it is clear that large variability exists in the global NO_x production due to lightning which varies between 2.5 and 8.8 Tg N yr^{-1}. There are recent reports that there will be 15% decrease in the lightning activity by 2100 with global temperature rise by 5C and an increase in 1C temperature will increase lightning strike by 12%. But there is no systematic observation available over India about the lightning intensity, NO_x production rate and its seasonal variability and long-term trend in climate change perspective. To understand the lightning strikes, its types, location and associated atmospheric chemistry, Department of Space has taken initiative to install 32 number of ground-based Lightning Detection System (LDS) sensors in selected locations where higher number of lightning incidences occur. With the implementation of Lightning Detection System Network (LDSN) across specified locations in the country, it would be possible to measure precisely the number of cloud to ground (CG) and Intra / Inter cloud (IC) strokes and their geo-locations. The LDS systems are capable to detect the lightning signals within the radius of ~200 km from the instrument. These instruments are equipped with wideband magnetic direction finders, augmented by time-of-arrival (TOA) sensors. The two orthogonal magnetic loop antennas, a flat plate antenna, is able to provide the location and polarities of the incoming lightning waves. The ground-based observation in tandem with the space borne Optical Transient Detector (OTD) can be extremely useful to generate lightning intensity map, atmospheric NO_x production and its seasonal variability as well as trend under climate change scenario. The OTD is capable of observing momentary changes in the neutral oxygen emission line at 777.4 nm that indicates the

occurrence of lightning. The use of LDSN data is expected to reduce significantly the uncertainty in terms of type of discharge, seasonal and geographical distributions as well as IC to CG ratio in order to calculate the production rate towards estimation of annual NO_x production.

CEB 2 (INVITED)

Impacts of Climate Change on Water Footprints and Adaptation Options for Enhancing Farm Income in Coastal Agro-Ecosystems

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Increase of global mean surface temperatures for 2081–2100 relative to 1986–2005 is projected to likely be in the ranges from 0.3°C to 1.7°C (RCP 2.6), 1.1°C to 2.6°C (RCP 4.5), 1.4°C to 3.1°C (RCP 6.0), 2.6°C to 4.8°C (RCP 8.5). The rate of warming has been much higher in recent decades. This has, in turn, resulted in increased average temperature of the globe, sea level rise, decline in glaciers and snow cover. There is also a global trend for increased frequency of droughts, as well as heavy precipitation events over most land areas. Study revealed that climate change due to increase in temperature rise will increase crop water demand and water footprints by 10-12% under RCP 4.5 scenario. Global mean sea level is also projected to rise by 0.40-0.63 m under different scenarios at the end of this century. Thus, vast coastline of the country (about 7,516 km, of which mainland accounts for 5,422 km and islands 2094 km) spread across 9 coastal states and 3 union territories are going to face severe threat in the form of sea level rise, extreme weather events, storm/cyclonic disasters and coastal erosion in near future. In spite of the abundant groundwater resources in coastal regions, the complex hydro-chemical situation restricts the usage of this resource mainly due to poor water quality (mainly salinity and presence of iron, nitrate, *etc*.) Even a slight overexploitation however, can result in reversing the gradients towards the aquifers because of the proximity to the sea and causes sea water intrusion. Rainwater management is also most crucial to overcome the impending water crisis particularly for small holdings in the coastal ecosystem. The poor and inefficient water management practices result in about 70% of the rainwater to flow to the sea as surface runoff. Therefore, it calls for development of integrated strategies based on natural resource management to reduce the impacts of climate change on water footprints and for enhancing agricultural productivity and farm income in different coastal sub-systems. Studies showed that water savings up to 40% can be realized if improved on-farm crop and water management packages are implemented in deltaic coastal areas. Introduction of sub-surface drainage systems in areas with shallow water-table can help to combat deltaic environmental degradation and salinization besides increasing water productivity up to 50%. To manage groundwater intrusion, one key is to maintain proper balance between water being pumped and the amount of water recharged in the aquifer. Promoting water conservation to restrict withdrawals is another option. Micro-irrigation especially drip-irrigation can be beneficially adopted to irrigate the high value plantation crops and spices. Besides, water conservation, drip-system provides opportunities to use poor quality water for irrigation either alone or in conjunction with fresh water. Above all, detailed and accurate long-term monitoring of groundwater situation is critical in coastal zones, particularly in the wake of climate change. To minimize the wastage of rainwater, the excess rainwater during the monsoon needs to be conserved and stored in ponds for reuse during the lean periods. Study revealed that 14-20% of the farm area needs to be converted to on-farm reservoir which provides scope for cultivation of high-yielding varieties of rice in rainfed humid rice lowlands in *kharif.* Excess rainwater in reservoir may be effectively utilized for growing rabi crops such as pulses, oilseeds, tuber crops, vegetables, spices etc. Another intervention for *in-situ* rainwater management is through the land shaping or land modification which includes pond-based integrated farming, broad bed and furrow, rice-cum-fish, three tier land management and ridge and furrow systems. As a case study, development and management strategies of wetlands in coastal areas of Puri district of Odisha were developed through deep water rice, water harvesting, on-dyke agro-forestry and multiple use of water after analyzing rainfall-flooding depth analysis and pond-based farming potential. The suitable structure to create micro-water resources in seasonal waterlogging area was designed and implemented in farmers' field. Waterlogging tolerant rice varieties (cv. 'Hangseswari', 'Sabita') were grown surrounding the dyke of the structure during *kharif* season. The dyke was utilized to grow forestry species like *Acacia auriculiformis*, *Casuarina,* etc. which has great demand in the market. The harvested water inside the structure was utilized for fish rearing, also to grow second crops (rice, vegetables) surrounding the structure by providing supplemental irrigation from harvested water. Gain of Rs. 60,000-80,000 ha^{-1} $annum^{-1}$ with B:C ratio - 3.0 was obtained after the inventions. Presently, about 250 farmers of Satyabadia and Kanas blocks of Puri district have adopted the technology covering about 100 hectares area. Besides, technological interventions, to sustain the current efforts on water management in coastal areas, it may be necessary to provide policy or legal support to these efforts for reducing the impact of climate

change on water footprints of this fragile ecosystems. It may begin with the linking of coastal water management and land shaping interventions with several government programme like RKVY, PMKSY, MGNREGS, etc. for their long-term sustainability.

CEB 3 (INVITED)

Climate Change and India's Coastal ecosystem: Socio-Economic Impact, Vulnerability and Adaptation Measures of Coastal Fishing Communities

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Coastal ecosystems around the world are under stress due to climate change and related ecological threat. Studies show that SLR during the twenty-first century could be much higher and will result in faster coastline recession along with increase in incidences of storms and tropical cyclones that will also lead to significant effects at the coast. Physical impacts of SLR are loss of property and habitats, damage to coastal infrastructure, loss of tourism, loss of agriculture productivity including fisheries and also inundation and displacement of coastal wetlands. However, studies also derive that the low-income settlements, and poor income groups within all settlements, tend to be the most vulnerable to these changes. Rise in temperatures, change in rainfall patterns and monsoon timings along with rapid economic growth, fueled by the pressures of liberalization and globalization has already altered India's entire environment and in the coming years there will be adverse impact on nation's water resources, sea-levels, and biodiversity. The unprecedented and over exploitation of coastal and marine resources and extensive use of the coastal and marine environment for a number of developmental activities has seriously affected the coastal ecosystem of the country. The 7500 kms of coastline in India has low-lying and densely populated regions with frequent occurrence of cyclones and storms, and high rate of coastal environmental degradation contributing to the high degree of vulnerability in Indian coast. The vulnerability atlas of India shows 8.5% of total land in India is vulnerable to cyclones, 12% of land vulnerable to floods, 1 million houses damage annually. A study by JNU shows 1-meter sea level rise will directly affect 5763 km^2 (or 0.41%) of the combined area of coastal states in India. The responses to climate change impacts on the other hand vary across scales (e.g., local, regional, national, global), and by activity (e.g., aquaculture, fisheries, agriculture) or by actors (e.g., individuals, communities, private sector, governments). The second part of this lecture will covered analysis of response measures undertaken by coastal fishing communities to climate change in India. The fisheries sector in India plays a major role in the socio-economic life of the poor and vulnerable people in terms of generating income and employment especially for women and economically backward population (for nearly 14 million people) of the country. However, fishery communities lack proper housing and other basic amenities. Still 40% of the marine fishing populations in India live in huts and '*Kutcha'* houses. The incidence of poverty in marine fisheries sector is much higher. There are many cases of displacement of fishing communities (in states like Odisha, and Andhra Pradesh), loss of access to beaches where they engaged in drying fish, berthing boats, etc. (Mumbai and Goa). Studies show fishermen are not well aware of climate change issues. Climate change response measures in fishing are mostly the actions taken by local communities. And these measures are intended to meet the immediate livelihoods need. The overexploitation of fisheries resources through mechanized fishing is also an issue across the fishing communities, this also impact sustainability of fishing yield. From my interaction with fishermen in Mumbai (Koli Communities), I found that proper training on climate change and fish availability, better marketing facilities, subsidies and insurance, regulations by the government will help the fishing communities in terms of maintaining sustainable livelihood. This will further help in adaptation of fish stocks and will reduce climate impacts on marine ecosystems.

CEB 4

GHGs Emissions, Carbon Footprints and Energy Budget on Conservation Tillage Practices Under Rice Based Cropping System in Coastal Saline Soils

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Inappropriate farm practices can increase green house gases (GHGs), emissions and reduce soil organic carbon sequestration, thereby increasing carbon footprints (CFs), jeopardizing ecosystem services and affecting climate change. In this study, a systematic assessment of energy budget, GHGs emissions, carbon footprints and ecosystem service values of climate regulation was estimated on conservation tillage practices under rice-based cropping system in coastal region to provide insights on the environmental impacts associated with the crop production technologies and management practices. The design of experiment was split-split plot with cropping system (rice-rice and rice-cotton) (*kharif-rabi*) as main plot treatments and tillage type such as zero tillage (ZT), reduced tillage (RT), and conventional tillage (CT) as sub plot treatments and residue (R) and no residue (NR) under sub-sub plot treatments. Energy input of different tillage and residue treatments in rice-rice and rice-cotton systems were estimated by using both direct (amount of fossil fuel used in tillage, sowing, harvesting, human labour, and electricity or diesel for irrigation) and indirect (energy used in production like mineral fertilizers, pesticides and seeds) energy inputs. The energy output of rice grain and seed cotton and biomass for each treatment was calculated based on the total yield (kg ha^{-1}) and its corresponding calorific values. Operation wise energy used was calculated and treatment under reduced tillage condition was most efficient in utilizing energy. In most of the cases chemical fertilizer and pesticides consumed more than 70% of energy utilization. The static gas chamber consisted of a permanent round base (43 cm diameter), made of galvanized steel, inserted 8–10 cm below the soil surface, and a portable chamber top, 100-L plastic bucket were used for collecting GHGs flux from fields and was analysed using gas chromatography. The GHGs emissions from agricultural inputs were estimated to 1096-1520 and 1067-1447 kg CO_2-eq. ha^{-1} yr^{-1} under rice-rice and rice-cotton systems, respectively. Whereas, the direct GHGs emissions flux were 6002-9253 and 5710-8006 CO_2-eq. ha^{-1} yr^{-1} under rice-rice and rice-cotton systems, respectively. The CFs at yield scale during the entire growing season were 0.84, 0.92, 0.98, 1.04, 1.11, 1.13, respectively, in rice-rice and 1.20, 1.26, 1.04, 1.09, 1.25, 1.27, respectively, in rice-cotton systems under treatments ZTR, ZTNR, RTR, RTNR, CTR and CTNR. Regardless of tillage the CFs of rice-rice system was less than rice-cotton systems. We also calculated CFs considering the soil organic C (SOC) sequestration and reduced tillage with residue was estimated minimum CF among all tillage treatments. The ecosystem service value of climate regulation estimated considering from the point of biomass C fixation, SOC sequestration, indirect GHGs emissions from agricultural inputs and direct GHGs emissions from the soil as well as cost of forestation and treatments wise values were 13534, 11089, 13849, 12045, 13235, 12037 Rs ha^{-1}, respectively, in rice-rice and 7529, 5981, 8786, 8020, 8327 and 7710 Rs. ha^{-1}, respectively in rice-cotton systems under the treatment ZTR, ZTNR, RTR, RTNR, CTR and CTNR. Therefore, reduced tillage with residue could be a preferred climate resilient technology for lowering CFs and enhanced ecosystem services of climate regulation for rice-based cropping systems in coastal regions.

CEB 5

Frequency Analysis of One Day to Six Consecutive Days of Annual Maximum Rainfall in Mulde, District Sindhudurg, Maharashtra

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Mulde comes under heavy rainfall zone having average annual rainfall 3128 mm still there is a scarcity of water from the month of March onwards. This is due to undulating topography of the area steep slope more than 15 %. The hilly track is characterized by lateritic and hard rock. The soil texture in most of the part of the study area is loam to

sandy loam with reddish brown colour. Rill erosion is very severe and have resulted in formation of gullies. Construction of rainwater harvesting structures, nala bund, embankment and masonry check dam is an important activity carried out in this area. This activity is presently done without ascertaining the amount of rainfall and corresponding expected runoff for the desired return period. Due to this fact, many of the soil conservation structures, constructed with huge investment and labour are failing occasionally due to flash floods. However, analysis of rainfall data for computation expected rainfall for the desire frequency and consequent excess rainfall is required for safe design of any structure. The knowledge of consecutive days maximum rainfall can lead to successful crop planning. For prediction of design rainfall fairly accurately, various probability distribution functions are used. The primary need of water resource development in any area depends on estimation of rainfall at different probabilities for efficient planning and design of irrigation and drainage systems, command area development, soil and water conservation programmes and the optimum utilization of water resources in various agricultural production systems. The annual maximum daily rainfall data of 18 years (1991 to 2008) was obtained from ARS, Mulde. It was analyzed for maximum one day and extended days (up to 6 day) rainfall for Mulde. Normal, Log Normal, Gumbel, Pearson Type-III and Log Pearson Type-III were used for extreme rainfall events. The relationships between annual maximum values of 1 day and D-days rainfall were found polynomial for Mulde (R^2 = 0.9292 to 0.9615). Based on statistical test for goodness of fit, the Pearson Type-III distribution was found as the best fit for observed 2-day, 5-day and 6-day annual maximum rainfall. Log Normal distribution gives the best for the annual maximum one day and 3-day annual maximum rainfall data where as, Normal distribution gives the best for the annual maximum 4-day annual maximum rainfall data for Mulde. Maximum value of 1-day rainfall for Mulde ranges from 102.8 to 295.0 mm. Maximum value of 2-day rainfall ranges from 185.0 to 371.3 mm. Maximum value of 3-day rainfall ranges from 260.2 to 463.8 mm. Maximum value of 4-day rainfall ranges from 270.7 to 523.5 mm. Maximum value of 5-day rainfall ranges from 295.2 to 643.3 mm. Maximum value of 6-day rainfall ranges from 358.4 to 676.3 mm. An annual maximum rainfall of 167.03 mm in one day, 261.79 mm in two days, 335.24 mm in three days, 390.42 mm in four days, 450.22 mm in five days and 505.17 in six days was expected to occur at every two years. For recurrence interval of 100 years, the annual maximum rainfall expected in one day, two days, three days, four days, five days and six days was 368.31 mm, 487.73 mm, 588.90 mm, 700.17mm, 835.89 mm and 1068.35 mm, respectively. Consecutive day's rainfall analysis provides valuable information for planning and management of runoff in watershed.

CEB 6

Spatio-Temporal Trends of Rainfall and Rainy Days in Konkan Region of Maharashtra

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In the present study, spatial and temporal trend analysis of annual, seasonal and monthly rainfall and rainy days was carried out for the Konkan region of Maharashtra State. Trend analysis was undertaken for rainfall and rainy days of twelve different locations spread over the region. Mann Kendall and Sen's slope test were used to know nature of trend and its magnitude, respectively. Results showed significant increase in rainfall ranging from 26.23 to 38.27 mm yr^{-1}, however, rainy days were significantly increasing with a meagre value of 0.25 day per year at Wakawali. Results also illustrated that monthly rainfall evidenced significant trends during August, September, November and December. Monthly rainy days also exhibited significant change during May, July, August, September, October and November. Overall, the changes in annual rainfall amount and rainy days were observed in the region. These changes may further have influence on water resource availability for agriculture in the region. Mango and cashew crop were also affected by climate change in the region and climatic suitability of this crop was also severely changing in the south part of the Konkan region.

CEB 7

An Assessment of Water Requirement of *Rabi* Rice Under Projected Climate Change Scenario in the Sundarbans, West Bengal

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The *Sundarban* region of West Bengal is one of the most fragile and vulnerable zones to the impacts of climate change. Farmers prefer to grow rice during the dry (*Rabi*) season as the yields are higher than in *kharif*. However, rice cultivation during this season is limited due to the shortage of good quality irrigation water. The surface water resources are limited and with the progress of the dry season, the ground water becomes increasingly saline and unfit for irrigation. Climate change impacts could further complicate the existing problems with serious impact on the agricultural production thereby threatening food and livelihood security of the resource poor farmers. With rising temperatures and changes in rainfall pattern, climate change would affect the water balance, as well as, water requirement of agricultural crops. We therefore assessed the effect of climate change on future water requirement of *rabi* rice by estimating the crop water requirement with CROPWAT model using the downscaled MarcSim weather data (2016-95) obtained from an ensemble of all 17 General Circulation Models (GCMs) for Representative Concentration Pathways (RCP) 4.5 and 8.5 emission scenarios and compared with the base period (1966-2015). An increasing trend of reference crop evapotranspiration (ET_0) was observed for both RCP 4.5 and 8.5 scenario, however the rate was steeper for RCP 8.5 particularly during the period 2076-2095. Compared to the base period (1966-2015), the ET_0 increased by 2.30% and 2.21% during 2020s for RCP 4.5 and 8.5, respectively and by 7.15% and 10.76% during 2090s. Similarly, the irrigation requirement of rice during *rabi* would increase by 6.79% and 6.26% during 2020s for RCP 4.5 and 8.5, respectively and by 9.31% and 13.38% during 2090s. On the other hand, the effective rainfall during the crop growth period would reduce by 22.48% and 30.32% in 2090s for RCPs 4.5 and 8.5, respectively over the base period. The study quantified the impact of future climate change on the ET_0 and water requirement of *rabi* rice which showed an increasing trend under climate change.

CEB 8

Assessment of Ecosystem Services Provided by Arecanut Agroforestry System in West Coast Region of India

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The survey was undertaken in seventy arecanut agroforestry farmers of Goa state to know the agronomic management practices, crop diversity, and ecosystem services. We analyzed the individual effect of management practices and species richness on provisional and regulatory ecosystem services of arecanut agroforestry system. The management of arecanut agroforestry system was found very low, many of the farms are poorly managed due to shortage of labours, low productivity, wild animal menace, and increase in the cost of inputs. The intercropsin the agroforestry system are introduced without considering the basic principle of the intercropping system and species adoptability. Most indicators of ecosystem services have not shown synergy between ecosystem services, biodiversity, and level of management. The availability of major soil nutrients was found lower due to exhaustive nature and competition among intercrops. Deficiency of phosphorus and boron was found in all the farms, the soil pH was acidic in nature. The results also showed that the intercrops are abruptly planted without considering their environmental suitability. The practices such as nutrient management, pest management, management of crop geometry, and intercrops management are neglected and thereby ecosystem services from arecanut agroforestry were decreased considerably. The study concludes that the timely management practices to meet the soil and crop requirement, and medium to high level of diversification with adoption of improved cultivars of intercrops is necessary to achieve the sustainability from arecanut agroforestry system. The arecanut agroforestry system can be developed as a climate resilient system in the west coast region of India.

CEB 9

Impact of Agroforestry Residues on Microbial Diversity, Respiration and Soil Fertility in Red Ferruginous Soil of Konkan Region

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An experimental study was conducted during 2016-17 at the research farm of All India Coordinated Research Project on Agroforestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra to assess the "impact of agroforestry residues on microbial diversity, respiration and soil fertility in red ferruginous soil of Alfisol". The experiment was laid out in a randomized complete block design with ten treatment and three replications. All the treatments are treated with fully mature collected agroforestry residues (litters) except absolute control. The treatment comprised *viz.,* T_1- Ain (*Terminalia tomentosa* L.*),* T_2- Acacia (*Acacia auriculiformis* L.), T_3- Mangium (*Acacia mangium* L.), T_4- Gliricidia (*Gliricidia sepium* L.), T_5- Mango (*Mangifera indica* L.), T_6- Cashew (*Anacardium occidentale* L.), T_7- Jambhul (*Synzygium cumini* L.), T_8- Rice straw, T_9- Finger millet straw and T_{10}- Absolute control. The higher microbial community (*viz*., bacteria, actinomycetes & fungi), soil respiration rate, soil fertility and yield of mustard were recorded in *Glyricidia sepium* litter management practices (T_4) followed by Ain (*Terminalia tomentosa*) litter (T_1) and Mango (*Mangifera indica* L.) litter incorporated plot over its absolute control (without applying any litters). Among the different long-term agroforestry residues nutrient management practices, treatment (T_5) and (T_1) receiving Mango (*Mangifera indica*) and Ain (*Terminalia tomentosa*) @ 5 t ha^{-1} litter were in most of the parameter noticed closely at par with Gliricidia (*Gliricidia sepium*) litter management practices (T_2) than other treatments. Application @ 5 t ha^{-1} *of Gliricidia sepium*, *Terminalia tomentosa* and *Mangifera indica* litter enhanced soil fertility, microbial diversity and productivity of any test crop e.g. Mustard under the experimental site than other litter species. By using different leaf litters in soil for development of soil fertility, microbial activities and productivity of mustard mainly by *Gliricidia sepium*, *Terminalia tomentosa* and *Mangifera indica* which helps nutrient releasing capacity of soil and also could be used to more suitable for bund plantation, alley cropping, multipurpose trees, NFTs (nitrogen fixing trees), block plantation and as a source of nutrients in a Konkan humid ecosystem of Maharashtra.

CEB 10

Seasonal Incidence of Chilli Thrips in Relation to Weather Parameters in Konkan Region of Maharashtra

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Chilli (*Capsicum annum* L.) is one of the important vegetables and condiments crop having immense commercial dietary and therapeutic values and grown throughout the year. Due to variation in the agro climatic conditions of different regions, the nature and extent of damage caused by thrips varies. Environmental factors play an important role in determining the seasonal abundance and damage caused by the insect pests. Hence it is necessary to study the influence of various abiotic factors effecting the population fluctuation of thrips species in chilli crop. A field experiment was conducted at Central Experimental Station, Wakawali., Dapoli, during *rabi* season of 2017-2018 to study the seasonal incidence of chilli thrips in relation to weather parameters. For this purpose, 'Konkan Kirti' variety was selected and fourty days old seedling were transplanted on 26th December 2016 on raised beds with 60 cm x 60 cm spacing in field by following recommended cultivation practices. Observations were recorded as soon as the infestation is noticed. The population of thrips were recorded at weekly interval during morning hours on five randomly selected and tagged plants in plot. Population was counted on three leaves (top, middle and bottom) and expressed as number on three leaves. The data were subjected to statistical analysis and correlation coefficient was worked out. The study revealed that there were marked differences in thrips population with standard meteorological weeks (SMW). The mean population of thrips per three leaves per plant was first observed from 2nd week of January. Minimum (0.02) population was recorded in 2nd SMW (08-14 January) and the mean population ranges from 0.02 to 5.25. It reached to peak in 11th SMW (12-18 March) with mean thrips population of 5.25. Later it

declined gradually (4.45) from 12th SMW (19-25 March). The minimum temperature had significant correlation with mean population of thrips (r= 0.770) and other parameters were non-significant. The maximum temperature (r= 0.225), morning relative humidity (r= 0.091), evening relative humidity (r= 0.505) and bright sunshine hours (r= 0.238) were found to have positive non-significant correlation with mean thrips population.

CEB 11

Effect of Climate Change on the Incidence of Tea Mosquito Bug on Late Cashew Variety in Konkan Region

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Cashew is one of the foreign exchange earning cash crops of India. Nowadays cashew is commercially cultivated along the west coast of India particularly in Maharashtra, Kerala and Karnataka states. Day by day due to its keeping quality and storage value, cashew crop is treated as one of the important horticultural crops. More than 65 pests are reported to infest cashew crop, out of which cashew tea mosquito bug is one of the important serious pests of cashew all over the Konkan region of Maharashtra. It is observed that from this study, that the minimum temperature, afternoon humidity and wind speed had a significant negative correlation with tea mosquito bug (TMB) population whereas the population had a positive correlation with maximum temperature and sunshine hours. The TMB incidence was negligible below 18 ± 1°C. The maximum incidence was observed in between 18 ± 1°C to 21 ± 1°C and it gets declined. Whereas regarding afternoon humidity, TMB incidence was found negligible below 53% ± 1% and maximum incidence was observed in between 53% ± 1% to 64% ± 1% and it declined afterwards. The prediction equations were derived through multiple regression analysis for late varieties based on pooled data for all five years with respect to the pest population and the variety. Thus, these equations can be useful for the cashew growers, extension workers, scientists to take immediate effective control measure against tea mosquito bug.

CEB 12

Effect of Weather Parameters on Termite (*Odontotermes Obesus* Fam. Termitidae, Isoptera) Activity

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A novel method for quantification of termite activity was used. The time taken to repair and seal a 10 mm hole in the termite mound was noted to gauge the effect of various ecological factors on the termite activity. Observations were noted from the second fortnight of October, 2015 to the second fortnight of September, 2017. The maximum time of 52.6 minutes required to repair the breach of 10 mm was recorded in the second fortnight of February 2017 indicating the slowest or least activity. The fastest reconstruction time of 9.2 minutes was noted in the first fortnight of September 2016. The minimum temperature showed a strong negative coefficient of correlation (-0.89939) indicating that the lower temperature resulted in longer time taken to repair the holes thus indicating lower termite activity. Similarly, minimum humidity was also found to bear a strong negative correlation (-0.714) with the time taken to repair a 10.00 mm diameter breach in the termite nest walls.

CEB 13

Impact of Climate Change on Marine Fishes

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Now a days, fish farming plays a key and leading role to increase the income of farmers but climate change will affect population and communities of marine fishes in various ways, ranging from indirect effects associated with habitat degradation and altered resource availability to direct effects on rapidly changing environment. There are

many critical knowledge gaps in our understanding of the effect of climate change on marine fishes, including the impact of global warming on adult reproduction, development, survival and behaviour of larvae. An unexpected discovery is that larval fishes are usually more sensitive than adults to environmental fluctuations. In short term (upto 2050), it might be especially vulnerable to elevated temperature, CO_2 concentration, ocean circulation and ocean acidification has a dramatic effect on a wide range of behaviour and sensory responses with consequences for the timing of settlement, habitat selection, predator avoidance and individual fitness. In longer term (after 2050), sea level rise and changed patterns of precipitation will also significantly alter coastal wetlands that are important nursery areas for estuarine and nearshore species. Differences in the sensitivity of species and populations to climate change have been identified that will lead to change in fish community structure as the ocean warm and becomes more acidic. However, the prospect for acclimatisation and adaptation of populations to these threats also needs to be considered. Ultimately, it will be the capacity for species to adjust to environmental fluctuations over coming decades that will determine the impact of climate change on marine ecosystems.

CEB 14

Tuber Crops: An Option for Climate Change and Livelihood Vulnerability

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Tropical root and tuber crops are considered as climate resilient crops. These crops grow and produce economic yield where other crops may fail; hence these crops are expected to play a key role in food security. Konkan region having warm and humid climate receives heavy rainfall. This region is a known as hub of tuber crops. Due to suitable soil and climatic conditions, the farming community of Konkan grows almost all type of crops in their homestead / backyard as sole crop or as intercrops in their own consumption. Under changing climatic scenario, tuber crops play vital role in crop diversification. They are available and sustain their production even in adverse weather conditions. That is why, tuber crops are known as the crops of adversity. Tuber crops can tolerate drought and shade, are adaptable marginal environment, low input situation, adverse soil and climatic conditions and also have great flexibility to thrive in mixed cropping systems. Cassava is drought resistant and able to withstand dry spells for more than three months. Sweet potato and yams have also wide climatic adaptability. Taro can withstand water logging. *Xanthosoma* is grown in warm and humid climate and is giving sustainable production as intercrops grown in irrigated fruit crops like coconut, arecanut, sapota. Elephant foot yam is shade loving plant and is suitable for any cropping and intercropping systems. The pooled result of experiments conducted on different tuber crops at All India Coordinated Research Project on Tuber Crops at Central Experiment Station, Wakawali, Dist. Ratnagiri showed higher production and economically remunerative. Sweet potato (Cv. *Kamala Sundari*), greater yam (Cv. Sree Kartika), elephant foot yam (Cv. Gajendra), aerial yam (Cv. Konkan Kalika) realized the highest net returns of ₹. 77,238/- ha^{-1}, ₹. 2,42,078/- ha^{-1}, ₹. 1,53,444/- ha^{-1}, ₹. 71,087/- ha^{-1} with B: C ratio of 1.47, 1.70, 1.85 and 1.88, respectively. In the event of global warming tuber crops can be a good alternative to mitigate the effect of climate change and also to sustain marginal farmers in Konkan region of Maharashtra.

CEB 15

Role of Plastic Waste Management in Sustainable Coastal Ecosystem

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Plastic products have become an integral part of our daily life. Plastic accumulate and remain persistent in environment. Management of plastics found in MSW is critical due to its non-biodegradability and direct harmful effect to society. World Plastics production has increased twenty-fold since 1964 (15 MT) reaching 311 million tonnes in 2014. In 2013-14, plastic polymers consumption was 11.34 MT. Packaging represents largest single sector of plastics use (42%) in India. It is estimated that approximately 70% of plastic packaging products are converted into plastic waste in a short span. About 62 million tonnes of waste is generated annually in India out of which 5.6 million tonnes is plastic waste, which amounts to 15342 tons per day (TPD). Of the total plastic waste generated in

India, approximately 60% to 65% of plastic waste is processed whereas the rest remains unprocessed and may find its way to landfills, open burning, etc. The usage of plastic packaging and products has increased multi-fold in the last one decade due to its low price and convenience, however, general public is not aware about its impact on the human and environment on littering or dumping. Indiscriminate littering, unskilled recycling/reprocessing and non-biodegradability of plastic waste raise environmental issues and affect coastal ecosystem. In this paper, various methods of plastic waste management were discussed. The method includes utilization in road construction, fuel recovery by pyrolysis, gasification and co-processing of plastic waste in cement kiln and power plants. There is huge scope for setting-up of systematic mechanism for plastic waste collection, segregation and disposal; recycling of plastic waste in an environmentally friendly manner. As plastic is petrochemical product, it can be useful for resource/fuel recovery after the end of its useful life. The incorporation of plastic waste with different material i.e. wood/concrete in different forms, compositions etc. can be experimented for use in building materials. The innovative ideas for reuse of plastic products not only improve its aesthetic value but its useful life too. In order to manage the huge waste, the preference should be given for waste reduction, reuse, recycling, resource recovery, incineration and landfilling.

CEB 16

Agroforestry Practices for Soil and Water Conservation

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Agroforestry plays a significant role in soil and water conservation, especially in hilly area, where sever soil erosion is major area of concern due to faulty cultivation practices. It helps in optimizing the use of resources through the principles of recycling, internalizing the input production, reducing risk and conserving natural resources. It can reduce erosivity of rainfall and erodibility of soil through dissipation of energy of raindrops by canopy at low heights, surface litter, obstructing runoff, root binding and improves soil organic matter, physicochemical and biological properties. Trees in agroforestry systems provide good vegetative cover to the soil, reduce runoff and soil loss, and enrich soil physical, chemical and biological properties and also provide fodder, fuelwood, fruit and other products. Also slow down water movement, reduce surface flow, and facilitate water infiltration into the ground. Roots help to hold the soil in place, create macro pores to increase infiltration and enhance soil moisture holding capacity. Canopy of the trees in agroforestry provide shade which prevents the soil to become too dry and help in maintaining micro-climate. Canopy also helps in lessening the impact of rain drops on the soil, thereby reducing soil erosion and increasing water absorption into the ground. Litter from agroforestry prevents runoff and allows the water to percolate into the soil thereby helping ground water recharge. Dead plants decompose to form humus, organic matter that holds the water and provides nutrients to the soil. The hydrological cycle and microclimate is also affected by agroforestry. Trees in agroforestry help filtering the water thereby, keeping it as sediment free as possible and maintaining high water quality. The surface cover, debris and tree roots in agroforestry trap sediments and stop their down slop movement and helps in stabilizing slopes and preventing shallow landslides. The effect of perennial vegetation in controlling erosion however, depends on a number of factors such as canopy cover, ground vegetation, litter effects, root effects and changes in the physio-chemical properties of the soil. Thus, trees on the field are the important component of the sustainable land use systems (agroforestry), which improves soil nutrient status by various processes, such as litter addition, decomposition, nutrient release, atmospheric N_2 fixation, nutrient pumping, etc. The nutrient loss through soil erosion is also controlled by tree species. The improved soil through agroforestry systems helps to meet increased food requirement and serve as an evergreen revolution. Some of agroforestry practices for soil and water conservation are plantation crops, multistoreyhomegardens, hedgerow intercropping and barrier hedge, boundary planting and live fences, plantation of soil binding grasses, windbreaks and shelterbelts, silvopastoral practices, agri-horticulture systems, reclamation forestry, torrent control, contour farming, etc.

Session V:

Technology Impact, Markets & Institutions, ICTs And Eco-Tourism for Better Livelihoods

TMIT 1 (INVITED)

Progress of Market Reforms and Policies

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The recently introduced Model Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act (APLM), 2017, provide some hope in increasing efficiency in agricultural markets in India. There was a good improvement in the functioning of the agricultural markets in India with the adoption of Model APLM, 2017 by many states. There were visible signs of increasing farmers share in consumer's rupee across many states and many crops. The innovating marketing models like direct marketing by farmers (Rythu bazaars), contract farmers, Foreign Direct Investment in food business, private markets and produce companies are right moves to increase farmers well being. The Electric Markets (National Agricultural Markets) across all Agricultural Produce Market Committee (APMC) markets at block level is major game changer in increasing farmers share in consumer rupee. The Model APLM Act advocates increased competition in the marketplace by allowing private markets, farmers' markets, and electronic-National Agricultural Markets (eNAM). Under eNAM, the Central Government introduced electronic trading in about 400 APMC markets in 2016 and connected them through uniform market platform in line with the e-markets of Karnataka introduced in 2012. This article examines experience of e-markets in Karnataka since 2012, with the intention to suggest improvements to eNAM. Results show that e-markets help increase competition, eliminate collusion among traders resulting in increased farmers' price and market arrivals. They facilitate competitive bidding and same day payments to farmers. However, there was some resistance from traders and commission agents as they felt that there were no benefits in e-auction compared to physical transactions. In addition, there was fear of taxation of on-line transactions. Aligning interests of all stakeholders, including farmers, traders and commission agents is the biggest hurdle in the implementation of eNAM.

TMIT 2 (INVITED)

Impact Assessment of Climate Change: Resilience, Livelihood Sensitivity and Adaptation of Farm Households in Coastal and Non-Coastal Region of West Bengal

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Climate change impact is a growing concern in all over the world, particularly so in India, where most of the population relies directly or indirectly on agriculture for livelihood. The net impacts of climate change on agricultural output in India are uncertain, yet specific regions and certain groups of farmers, particularly those farming on marginal, rainfed lands, are likely to suffer significant damages as the result of climate change. In India, eastern coast is more vulnerable than the western coast with respect to the frequency of occurrence of extreme events like cyclones and depressions. Climatic hazards like cyclone, drought, flood, heat wave, etc cause damage every year in terms of human lives and livelihood, which are distributed heterogeneously across space. On this back-drop, an impact assessment study was conducted to analyse resilience, livelihood sensitivity, and adaptation of farm households in purposively selected three districts of West Bengal *viz*., flood prone Cooch Behar district, flood and cyclone prone coastal district South 24 Parganas and drought prone Purulia district, respectively. The study considered both time series panel data for a period of 12 years obtained from secondary/ published sources of information and cross-sectional data on selected variables gathered through household level interview schedule survey covering a random sample of 150 farmers each representing selected districts. Thus, a total of 600 farmers sampled for the present study. The value of Agriculture Scenario Index (ASI) of a district suffered from a climatic event in a given year as comparison to range of ASI values during the study period in case of that district indicated the extent of resilience of agriculture. Higher the ASI value, better the resiliency showed by a district in a calamity

year as compared to other districts suffered the same event. Accordingly, agricultural scenario of coastal district South 24 Paraganas suffered most in 2007-08 due to flood as evident from lowest ASI value for this year. Agricultural scenario of North Bengal district Cooch Behar was suffered most in 2006-07 due to flood with lowest ASI value. Purulia district suffered mostly from the drought during 2010-11 as indicated by lowest ASI value. Climatic vulnerability during four seasons is assessed, according to which most vulnerable districts are found to be South 24 Parganas district during post monsoon (October-December) and winter season (January-February), Purulia district during pre-monsoon season (March- May), Cooch Behar district during monsoon season (June-September). Thus, these three districts are found most vulnerable to climate change in West Bengal. Vulnerability of different livelihood groups was assessed through livelihood sensitivity matrix that included both exposure index and impact index. Crop farmers are most exposed livelihood group followed by labourers, livestock keepers and fish farmers. It is evident that cyclone has made highest impact on livelihoods followed by flood, drought and heat wave, respectively. It is worth mentioning here that the coastal districts are more vulnerable to the climate change as evident from the comparative vulnerability scenario of three district sampled for present study. The adaptation mechanism through technological and institutional innovations were recorded For natural resource management, the important technological innovations are found as *in-situ* moisture conservation through mulching (straw mulch, polythene mulch), water saving irrigation methods, zero tillage, land configuration/modification and renovation of water bodies/ponds to provide opportunities for growing multiple crops and having an integrated farming system through multiple use management. Plantation of trees at fallow land was also undertaken. The technological innovations in case of crop farming during *kharif* season are mainly for the paddy crops, which are cultivation of short duration varieties, tolerant varieties, water saving cultivation methods like SRI, etc. The innovative technology like floating nursery of paddy has helped the farmers to combat inundation during monsoon. The crop diversification is adopted by the farmers by growing pulses, oilseeds and vegetables. The technological innovations for livestock included vaccination, fodder cultivation, feed supplementation, etc. In South 24 Parganas district, dual purpose poultry birds and two-tier hosing poultry birds were very much successful. The popularization of tolerant fish species like Tilapia in South 24 Parganas district and renovation of fish ponds have made positive impact on farmers' livelihoods in study areas. Extension interventions are made mainly by the KVKs in study area in term of various capacity building approaches. Prevalence of seed bank, fodder bank, custom hiring centre, community nursery, weather based agro advisory, etc. in the study area have inculcated a culture of community-based activities for climate resilience in study areas.

TMIT 3 (INVITED)

Agro-Ecotourism: A Concept, its Role and Prospects for its Promotion and Livelihood Security

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Agro-ecotourism (AET) is a concept evolved based on the mutual needs of farming sector and tourism industry for sustainability of the rural and peri-urban economy. Of late, this concept has been a major pep and fillip imparting multiple dimensions to diversify Farming sector. Agro-ecotourism, indeed, adds a new dimension to subsistence farming especially, in the country side and hinterland horticulture arena. On the other hand, growing tendency of people to take a break from the urban fatigue and visit the serene country sides for enjoying natural beauty and aesthetic pleasure has led to Agro-ecotourism concept to become a reality. Vast tourist destinations extend great opportunities for Agro-ecotourism endeavours which in turn absorb energetic youth for the task. Agro-ecotourism is the symbiotic association of farming sector, tourism industry and farm business. Here, horticulture components play a vital supporting role to secure a multifunctional, sustainable and competitive enterprise, maintain the landscape and the countryside, contribute to the vitality of rural communities, environmental protection, aesthetic pleasures, etc. Eco-friendly plantations of horticultural crops like, fruits and flowers of regional specialty, coconut, areca nut, cashew nut, spices and beverage crops (coffee, tea) have emerged as most sought-after tourist destinations with natural scenic beauty. From historical times India is regarded as the 'House of spices'. Coffee based cropping systems comprising of spices like cardamom and pepper in Kodagu district of Karnataka, coconut and areca nut-based cropping systems of Goa, Karnataka and Maharashtra, and tea-based cropping systems (tea + pepper) are envisaged as potential horti-eco tourism destinations. Organic cultivation and organic recycling of farm waste for raising organic spices, Vermi-composting, etc., are the vital activities and provide the most sought-after

commodities to the visitors besides generating employment. Potential of AET venture lies in its strength for multiple employment opportunities to the youth. But, comprehensive planning by the stake holders for this venture opens up vast and multiple linkages within the niche domain to make this a reality through the empowerment of villages and the villagers. AET centres can be the effective learning centres for school children where, children can see crops practically, understand their role in human health, enjoy the local skills and products displayed there and develop, right from that age, the awareness and interest in the area of sound and safe food production. Thus, this article is an effort made to envisage importance of AET in the current perspectives and its need and constraints in the relevant areas for encashing the potential opportunities for livelihood security for youth.

TMIT 4 (INVITED)

Ecotourism with Horticultural Crops: Options, Global Perspectives and Potential

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Ecotourism is taken up as a diversification option by few enterprising farmers to harness tourism to augment income and enhance marketing. Current report is an attempt to review the potential of fruits, vegetables, flower crops, spices, plantation, medicinal and aromatic crop components in ecotourism. In this report, a description of how the different crops are used to awaken the senses especially feel, sight, smell and taste. A list of case studies of successful implementation in specific crops and models in India and Abroad is presented. Ecotourism projects operated in Turkey, Thailand, Indonesia, Vietnam, China, Nepal, Ghana are reviewed in the paper. The studies highlighted include the spice and aroma tourism in Goa and Kerala of India, Sri Lanka, Grenade Island and Changbai of China. Wellness or medicinal plant tourism projects including horticultural therapy and nakshtra/zodiac gardening at Australia, Belize, China and India are reviewed. Cocoa tour at Ghana and chocolate making demonstration to tourists at Goa, India are indicated in the review. Food tourism and ecotourism as a market channel and as an educational and advertisement medium followed at different farms are highlighted. Other options attempted in our unit to engage the ecotourists to feel the experience of specific farming operations include the climbing coconut, areca palms, make their eco-friendly plates and cups from areca leaf sheath waste, make container/substrate from banana pseudostem wastes, use banana leaf as a plate for food, etc. An overview of horticultural ecotourism is furnished to indicate the researchable issues, extension issues and policy matters in preparing for the paradigm shift. The work so far done using interview questionnaire on tourist attitude and needs, logistic requirements are highlighted. Latest ICT tools like geographic information systems, robotic bionic devices, internet and social media are employed in making ecotourism. Policy matters including support, training needs are also discussed to harness the potential of ecotourism in a sustainable and profitable manner.

TMIT 5

Appropriate Technology Dissemination Model for Wide-Scale Adoption of Improved Agricultural Technologies in the Polders of the Coastal Zone of Bangladesh

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The cropping intensity and productivity have significantly increased all over Bangladesh due to the adoption of green revolution (GR) technologies, except in the polders of the coastal zone. The main reason is the polder hydrology, which is quite different from other parts of the country. It is practically impossible for an individual to manage huge tidal river water resources for cropping in the polders, while an individual in non-coastal zone managed groundwater and rain for farming without much difficulty. Using the FFS model, the Department of Agricultural Extension (DAE) has successfully disseminated the GR technologies that helped achieving self-sufficiency in rice. But despite tremendous efforts from the government, non-government and international organizations, about 1.2 m ha polder lands are deprived of this technological advancement. There has been little change in production practices since the polders were constructed about 50 years ago, mainly because the FFS model did not consider hydrology as the determinant in agricultural technology dissemination. Still, this has not been recognized by the policymakers, water management and agricultural extension professionals, and the millions

of farming families living inside the polders of the coastal zone of Bangladesh. Our study showed that improved production systems, having 2-3 times higher productivity than the farmers' practice, can be adopted when the farming communities are organized on the basis of hydrological within the catchment area of a sluice gate installed in the polder embankment. Such approach of organizing the community was not considered in the FFS model. That's why the productivity of the polders is the lowest in comparison with other parts of the country despite huge efforts and investment from GO, NGO and international organizations. The Bangladesh Water Development Board (BWDB) is responsible for water resources management and are doing this forming Water Management Organizations (WMO) based on geographical area. Although DAE is responsible for agricultural technology dissemination, they don't have linkages and control over the activities of WMOs including the operation of the sluice gates. To harness the production potential of the polders, crop and water management need to be synchronized based on the hydrological area (not by geographical area) and management of the sluice gates with particular emphasis on empowering WMOs and communities to enable them to take advantage of the available water resources and agricultural opportunities, which is at present lacking. Therefore, the DAE should mentor WMOs and adopt hydrology-bounded technology dissemination model not only to enhance food security and improved livelihoods of the coastal communities, but also to achieve the Sustainable Development Goals 1 and 2 (SDG1 and SDG 2) of Bangladesh.

TMIT 6

Extension Approaches for Paddy Pest Management in Konkan Region of Maharashtra

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In Konkan region, rice is mainly cultivated during *kharif* season. One of the major constraints of rice crop is attack of pests and diseases resulting in low yield. To change from the situation of repetitive sprays to Economic Threshold Level (ETL) based application of pesticides, constant watch is required on pest activity. It was made possible with the help of information technology that helped to develop an e-pest surveillance programme through Crop Pest Surveillance and Advisory Project by recording pest activity data with the help of scouts and pest monitor employed by Department of Agriculture, Govt. of Maharashtra. The project was implemented in five districts of the Konkan region of Maharashtra *viz.,* Palghar, Thane, Raigad, Ratnagiri and Sindhudurg districts comprising 45 tahsils, during July to November, 2017. The important pests on rice crop are yellow stem borer, brown plant hoppers, blue beetle, swarming caterpillar, leaf folder and caseworm. As per the data obtained, the incidence of yellow stem borer was crossing ETL in all the districts selected under the project. The incidence was mainly occurred in Raigad and Ratnagiri districts. The incidence of gall midge was not crossing ETL in any district throughout the survey period. The incidence of leaf folder and armyworm crosses ETL in some pockets of Ratnagiri and Raigad districts. Armyworm outbreak was noticed especially at the time of crop harvesting stage but these areas were visited by the Scientists and remedial measures were suggested to avoid the crop losses. The brown plant hopper crossed ETL in some pockets of Raigad, and Palghar tahasil only. The field visits by scientists along with staff of the Department of Agriculture and small group meetings of the farmers from different villages were taken to make aware about the problem and to take remedial measures against this pest. The outbreak of blue beetle was noticed in Raigad, Ratnagiri, Sindhudurg and Palghar districts, however, timely and proper pest management strategies were suggested and prevented further crop loss.

TMIT 7

Study on Yield Gap in Nagli in Hilly Coastal Area of Konkan of Maharashtra

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The study was conducted in College Development Block of College of Agriculture, Dapoli with 100 Nagli growers, randomly selected from hilly coastal area. All the respondents had cultivated the local variety with an average of 0.07 ha area under Nagli. Majority (88 percent) of the respondents were from 'medium' group of land holding. 'First

fortnight of June' was the sowing time of 89 percent respondents and 63 percent respondents reported 'first fortnight of July' as transplanting time. Nearly three fourth (73 percent) of the respondents had harvested the crop during 'first fortnight of October' with average yield of 12.09 q ha^{-1}. More than three fourth (79 percent) of the respondents were having 'medium' yield level. All the respondents utilized the Nagli for 'family consumption' and 'seed' for next season. Maximum growers had knowledge about recommended practices but their adoption was at medium level. It was also seen that regarding preparatory tillage, nursery management and transplanting, the respondents had fair knowledge and adoption. Regarding the practices under fertilizer application and plant protection they had poor knowledge and adoption. Nearly, two-fifth respondents had 'low' and 'medium' level of yield gap. The reasons for yield gap were 'uneven distribution of rainfall', 'costly fertilizers', 'non-availability of FYM' and 'Nagli fields are far away from the residence'. The major suggestions to minimize the yield gap were 'fertilizers should be supplied through co-operative society with subsidized rates', 'knowledge about HYVs and package of practices be given' and 'Nagli cultivation be encouraged through different government schemes'. The study recommended that there was considerable yield gap in Nagli production, when compared with the district average yield. There is a need to educate the Nagli growers in respect of nursery management and fertilizer management, besides making special efforts to promote Nagli cultivation. The State Department of Agriculture may initiate appropriate measures towards reducing the yield gap.

TMIT 8

Farm-Level Agricultural Risks Under Coastal Region of West Bengal – A Socio-Economic Analysis

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Agricultural risks in coastal areas is mostly inherent to soil and water resources characteristics. Often farm-level agricultural risks and their impact, in terms of loss of production are not realised at the macro level, but has serious concern at the regional level. Yield losses are particularly detrimental at a local scale because salt-affected soils are not uniformly distributed and threaten the continued existence of agriculture across coastal region of the country. Quantification of farm level agricultural risks and their ways of mitigation is important for making the production system profitable. Studies identified various sources of farm level agricultural risks were, pest & diseases, salinity, lack of quality seeds availability, waterlogging (either due to excess rainfall or heavy rainfall in a very short time like flash rain particularly during harvest time), uncertain market paddy, long dry spell and also sporadic presence of acid sulfate soils. Study pertains to assessing risk associated with major crops grown in the coastal area, estimated through primary survey on sample farmers during 2016-18 that includes farmers growing Kharif paddy (45 no.), Rabi paddy (45 no.), tomato (45 no.), moong (41 no.) and potato (45 no.). The quantification loss due to various identified sources of risks were estimated based on production system of best and worst either/or with and without approach. The average quantity of production of major crops grown by the farmers were estimated to be 0.82 t, 1.24 t, 3.45 t, 0.19 t and 4.73 t per household with marketable surplus of 15.5%, 64%, 84.5%, 33.5% and 75% for the crops Kharif paddy, Rabi paddy, tomato, moong and potato, respectively. Source-wise damage and production loss estimation indicated that together with all sources of risks the loss of production for Kharif paddy and Rabi paddy was 0.33 t ha^{-1} and 0.89 t ha^{-1}, respectively. The value of production loss was estimated as Rs. 3960 and Rs. 7280 per hectare for Kharif and Rabi paddy respectively. Salinity and pest (insect) were major contributor for crop loss in Rabi paddy whereas excess rain (waterlogged) and lack of quality seeds were the major sources of crop loss for kharif paddy. Similarly, the crop loss was estimated for other cash crops (tomato and potato) in the study area and the crop loss was estimated to be 5.1 t ha^{-1} and 5.41 t ha^{-1} for tomato and potato, respectively. The value of loss was quantified as Rs. 35700 ha^{-1} and Rs. 29760 ha^{-1}, for tomato and potato, respectively. Pest and disease attack, high salinity and lack of timely irrigation (non-availability of good quality water) were the major sources of crop loss for both the crops. Damage in terms of crop loss and monetary loss was also estimated for moong as 0.19 t ha^{-1} and Rs. 4158 ha^{-1}, respectively. Despite production risk due to different sources, agriculture continues to be major occupation and livelihoods in the region. Mitigating of farm-level risk need micro management like regular weather advisory services, disease or pest attack forecasting (weather aberrations are more critical factor). Farm-level risks very often does not qualify (>33% area damage) for obtaining the compensation from insurance, hence farmers are reluctant. Cropping system intensification and crop diversification are the suitable options for risk mitigation at farm level and can increase farm income significantly, despite the prevailing risk.

TMIT 9

Economics of Red Wal (*Kadva*) Cultivation in Raigad District of Konkan Region, Maharashtra

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The study was conducted to estimate cost, returns, profitability of red wal cultivation in Raigad district of Maharashtra. For this study 103 red wal cultivators were selected randomly from two tahsils, Mahad and Roha and the cultivators were classified into three categories as small, medium and large group according to area under red wal cultivation. The analysis revealed that, the per hectare physical input utilization in red wal cultivation such as proportion of family labour was higher 82.94 days than hired labour (0.51 days) with per hectare average of 83.45 labour days employed. The average fertilizers and manures used were 108.9 kg of nitrogen, 4.03 kg P_2O_5 and 8.06 q of FYM.The per hectare cost of cultivation of red was worked out to Rs. 39270 in which, cost 'A' and cost 'B' shared was 25.35 and 50.26 per cent, respectively. Per hectare average gross returns was estimated to Rs. 48563 and the net returns was Rs. 9293. The average per quintal cost of cultivation of red wal was Rs. 5667 with benefit-cost ratio of 1.24. Benefit-cost ratio was more than one indicating red wal cultivation was profitable in the study area.

TMIT 10

Trends in Area, Production and Productivity of Rice Crop in Konkan Region

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India ranks second in terms of total rice production in the world, after China. India provides around 21 per cent of global rice production from its 28 per cent of the world's rice area. The total area under rice crop was 15.03 lakh hectares during 2015-16 which contributed 19.60 percent of the total area under cereal crops (76.67 lakh hectares) in Maharashtra. The Konkan region occupies about 4.01 lakh hectares area under rice with production of about 11.28 lakh tonnes with productivity around 2.81 t ha^{-1}. It was revealed that in 1979-80 the area under rice was 4.44 lakh hectares, which declined by 5.83 per cent during the study period. Area under rice in Konkan region decreased at the rate of 0.29 per cent per annum. The disaggregated analysis of area indicated that except Sindhudurg district, area under rice declined to the extent of 0.18 to 0.55 per cent per annum in different districts of Konkan region. Production of rice in Konkan region increased from 788 MT in 1979-80 to 1120.2 MT in 2014-15. This indicated that during the period under study production of rice in Konkan region increased to the tune of 42.16 per cent over base year. The trends in production of rice indicated a positive growth. In Konkan region, production of rice registered a growth of 0.81 per cent per annum during the period under study. It was observed that in 1979-80 productivity of rice in Konkan was 1796 kg ha^{-1} which increased to 2679 kg ha^{-1} in 2014-15. The per cent change in productivity during this period was to the tune of 49.16 per cent. The compound growth rate revealed that productivity of rice grew at the rate of 1.09 per cent per annum during the same period. The temporal changes and compound growth rates of area, production and productivity of rice revealed that there has been continuous decline in area under rice in Konkan region. However, there has been increase in production and productivity of rice during the period under study. This significant increase in production and productivity could be attributed to development of different rice production technologies by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.

TMIT 11

Socio-economic Impact of Technological Interventions for Cropping System Intensification in the Salt-affected Coastal Zone of West Bengal

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To adjudge the impact of technological interventions among the respondents through participatory innovation tree, the present study was conducted at Rangabelia and Jyotirampur villages under Rangabelia gram panchayat, Gosaba Community Development Block (located in between 22° 12' 44″ N & 88° 46' 42″ E) of South 24 Parganas district, West Bengal, India. Some improved technologies have been implemented jointly by Bidhan Chandra Krishi Viswavidyalaya and Australian Centre for International Agricultural Research for last two years for the agricultural, social and economical development of the study region. The technologies are: introducing post-monsoon relay crop lathyrus (var. Bio L-212) in medium-up and medium-lowland by adjusting date of sowing of rice varieties – technology I, changing the date of sowing of rice and introducing post-monsoon crop lentil (var. Maitree) – technology II and green-gram (var. Samrat)– technology III in medium-upland, performing water saving options (drip irrigation + straw mulch) in high value post-monsoon crop tomato – technology IV, and performing zero tillage and mulching techniques for different potato cultivars – technology V. However, only for technology I, IV and V, impact pathway was assessed as the adoption of other technologies was not much significant among the respondents. Total eighteen (18) impact indicators (II) were selected based on the questionnaire results. The study revealed that among the eighteen IIs, better yield (II-8) had the highest sensitivity towards adoption of technology I. Less water requirement (II-2) was highest sensitive for adoption of technology IV. Both the above-mentioned indicators were equally sensitive for adoption of technology V. All three technologies had mostly reduced the fertilizer application, increased the system productivity, net return and B:C ratio over farmers' practices during previous years (before technology adoption). All three technologies had almost equal values of sustainable yield index (SYI); however, on the basis of lowest standard deviation (σ) of respective yield values, technology I can be considered as most sustainable in terms of yield for the study location.

TMIT 12

Economics of Fish Production in Farm Pond at Household Level in Raigad District

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Fish culture is an important activity to improve nutritional standards of people. With decline in farm size, problem of drainage in kharif season in low lying areas, farm pond fish culture is becoming more and more popular as a supplementary enterprise with agriculture in rural areas in Konkan region. The study was undertaken to know the economics of fish production in farm pond at household level with specific objective; to study fish production practices in fish pond and to work out cost, returns and profitability of fish production at household level. A list of farm pond owners was obtained from Taluka Agricultural Officer, Alibag, Dist. Raigad. Out of total 104 farm pond owners, 20 farm pond owners were selected randomly. They were interviewed personally and information collected by designed schedule for the reference year 2014-15. Average size of farm pond was 0.10 ha of which 70 percent of ponds were earthen and 30 per cent were semi-pakka. The capital investment per farm was Rs. 99320, of which 83 per cent investment was on construction of pond with single ownership. Per farm input cost was estimated to be Rs. 16120 of which cost to labour alone was accounted for 50 percent. Total cost of production was Rs. 27913 and returns were Rs. 67010 with the benefit cost ratio of 2.40 per farm. Thus, fish pond activity supplemented farming business in this area substantially.

TMIT 13

Impact of EGS Linked Horticultural Development Programme on Income and Employment in Konkan Region

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The Government of Maharashtra realized the importance of fruit crops in employment generation and upliftment of poor marginal farmers and launched an ambitious Employment Guarantee Scheme (EGS) linked with plantation of horticultural crops in Maharashtra state from 1990-91. Fruit crops like mango, cashew, coconut, ber, guava, orange, sweet lime, tamarind, etc. are covered under the scheme. The main objectives of the scheme are to generate sustainable employment on the farm itself, increase the production of high value crops, to increase the income and standard of living of farmers, to control soil erosion, to maintain ecological balance and to bring waste land under cultivation. The present study was undertaken with the specific objectives to assess the socio-economic impact of horticulture development programme. The study is based on cross sectional data from 120 randomly selected farmers from Dapoli tehsil. The per hectare capital investment for establishing mango, cashew and coconut orchard was Rs. 78119, Rs. 64574 and Rs. 82788, respectively. Overall, per hectare annual cost of maintenance of mango orchard without and with subsidy was Rs.58178 and Rs. 54645, respectively. Average per hectare annual cost of maintenance of cashew orchard without and with subsidy was Rs. 36684 and Rs. 33517, respectively. An average annual cost of maintenance of coconut orchards was Rs. 70143 without subsidy and Rs. 66977 with subsidy, per hectare. At overall level per hectare net returns from mango, cashew and coconut were Rs. 35157, Rs. 27597 and Rs. 68325, respectively. The study revealed that per hectare total employment generated up to 15 year was 1078 man-days which has been resulted in generation of additional employment to the tune 503 man-days through mango plantation. The additional employment generated through cashew and coconut plantation was 53 man-days and 334 man-days respectively. The per hectare additional income generated through mango (Rs. 582917), cashew (Rs. 380655) and coconut (Rs. 459803) was profitable. The EGS linked horticultural development programme had positive impact on income and employment generation in Konkan region.

TMIT 14

Socio-Economic Characteristics of the Farm Women from Konkan and Western Maharashtra

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Agriculture in India is the main occupation of rural people and important source of livelihood for majority of the people. Agriculture is not merely the means of subsistence, but also plays an important role in economic development of the country. Women constitute nearly 50 percent of our country's population. Despite the legal and constitutional provisions for equal status, they have been traditionally put in weaker position in Indian society and have a subordinate role to play. In spite of this fact, women share most of the family responsibilities and perform wide range of duties on-farm and in-home. The objective of this study was to study the personal and socio-economic characteristics of the farm women from Konkan and Western Maharashtra. The present study was conducted in Mandangad and Akole tahsils of Ratnagiri district of Konkan region and Ahmednagar district of Western Maharastra, respectively. The sample constituted 60 farmer women from each region. The respondent was personally interviewed with the help of a specially designed survey schedule. Collected data were classified, tabulated and analyzed by using statistical method as correlation coefficient and non-paired 't' test to study the significance of difference in mean score of farm women from Konkan and Western Maharashtra. It was found that the farm women from both the regions were middle aged, less educated, belonged to nuclear families of medium size, medium annual income, medium farming experience and medium knowledge level about cultivation practices. The farm women from both the regions were medium to high participation in agricultural activities. Further, the participation of the farm women from both the regions in agricultural activities was more or less same. None of the selected personal and socio-economic characteristics of the farm women from Konkan had any impact on their participation in agricultural activities, while in case of western Maharashtra, education, extension contact, knowledge level and family type a positive impact on their participation in agriculture.

TMIT 15

Perceived Effect of Industrialization on Agriculture and Allied Sectors in Raigad District of Kokan Region

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The present study was conducted in Mahad and Khalapur tahsils of Raigad district of Konkan region. The sample was constituted 120 respondents drawn from twelve villages of two tahsils. The respondents were interviewed with the help of a specially designed survey schedule. The ex-post-facto research design was used for the present study. Main objective of this study was to determine the perceived effect of industrialization on agriculture and allied sectors. The analysis of data revealed that majority of the (73.33 percent) respondents had medium level of perceived effect of industrialization. Regarding statement wise perceived effect of industrialization on agriculture and allied sectors it was observed that all of respondents 'strongly agree', regarding increase in air pollution and increase environment heat. However, 95.84 percent respondents 'agreed' with minimization in milk production and 92.50 percent of respondents agreed with area under agriculture decreased. Majority (68.34 percent) of respondents agreed with adverse effect on germination, followed by more than half (64.17 percent) agreed with water contamination lead to death of fish and aquatic insects, that lead to animals poisoning and reduction in reproduction capacity of animals. All of respondents were strongly agreed in regards to increase in literacy percentage, implementation water supply scheme in village and majority, 86.66 percent agreed with increase in livelihood sources in village. Majority (75.83 percent) of respondents agreed that industrialization helped in minimizing of migration, followed by more than half 63.34 percent agreed with increase in standard of living of village peoples and 61.66 strongly agreed with availability of better communication facilities in village.

TMIT 16

Marketing Efficiency of Mango in South Konkan Region

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An attempt has been made to study the price spread, marketing efficiency and constraints in marketing of mango in South Konkan region of Maharashtra. Primary data were collected from various stakeholders constituting 100 farmers and 50 intermediaries in various channels. Five marketing channels of Alphonso were identified in south konkan area. Intermediaries like retailer, wholesaler, wholesaler-cum commission agent and village merchant took more profit margins in various marketing channel. The marketing efficiency was higher in channel V (11) where farmers sells direct to the consumer and poor marketing efficiency was found in the channel I and II where more market intermediaries involved. From the result it showed that the movement of mango from farmers to consumer at lowest market cost observed in channel V which benefits both farmers and consumer. The major constraints faced by farmers in marketing of mango were high fluctuation in market price (91%), poor roads and unavailability of transport facility in time (83%), low price to mango fruits (80%), high transport cost (65%), high cost of packaging material (63%), late fruiting result in less price (61%) and dependent on intermediaries (60%).

TMIT 17

Economics of Production and Value Addition in Groundnut in South Konkan Region of Maharashtra

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India sows the highest area under groundnut and is the second largest producer next to China. In Konkan region,

groundnut occupies an area of about 4,000 hectares in *rabi* / summer and 1600 hectares in *kharif* season. The average productivity of *rabi* / summer season is 1984 q ha^{-1} and *kharif* groundnut is 823 kg ha^{-1}. A cross sectional sample of 120 groundnut growers was selected from south Konkan region *viz.,* Ratnagiri and Sindhudurg districts. From each district 60 groundnut growers were selected randomly. From each selected village five rainfed groundnut growers and five summer groundnut growers were selected randomly pertaining to the agricultural year 2013-14. Per hectare cost of cultivation (Cost C) was worked out to Rs. 79292 for rainfed group and Rs. 84520 for summer group. Out of total cost of Rs.79292 in rainfed group share of cost A and cost B was 37% and 57%, respectively. In case of summer groundnut out of total cost of Rs. 84520, cost A accounted for 35% and cost B 57%. The net returns per hectare at cost A were Rs. 60364 and Rs. 74809 in case of rainfed and summer groups respectively. The returns per hectare at cost B were Rs. 44521 in rainfed group and Rs. 56513 in summer group respectively. While the net returns at cost C were Rs. 10594 in rainfed group and Rs. 19982 in summer group. Per quintal cost was worked out to be Rs. 4699 and Rs. 4294 in rainfed and summer group, respectively. The benefit cost ratio was 1.13 for rainfed and 1.24 for summer group. The analysis of profitability indicated that groundnut cultivation of sample farms in summer season was more profitable than rainfed season. In terms of value addition, oil recovery from 1 quintal groundnut was 42.85 lit value of which came to Rs. 4927. Gross returns obtained (oil + cake) were Rs. 7133. Cost of processing was Rs. 598 per quintal. Thus, total cost incurred on processing of 1 quintal groundnut was Rs. 5095. It was observed that by processing 1 quintal groundnut the gross returns obtained were Rs. 2637 and net returns were Rs. 2038. It indicated that in terms of percentage there was 58.65% increase in gross returns and 45.33% increase in net returns over the processing of 1 quintal of groundnut.

TMIT 18

Adoption of Recommended Rice Cultivation Practices by the Farmers from Palghar District of Maharashtra State

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In Maharashtra, rice is the main crop grown in the costal districts of the Konkan region mainly in the five districts namely Thane, Raigad, Ratnagiri, Sindhudurg and Palghar districts. The package of practices of rice cultivation is being recommended by Dr. BSKKV, Dapoli since 1972. In Konkan region the area is about 0.44 million hectares with a production of about 15.10 lakh tons in the year 2013-2014.The area, production and productivity of rice crop in Palghar district was 14980 ha., 36641 q, 2446 kg ha^{-1} respectively, in the year 2014. The major food of the people in Konkan region is rice. It occupies an area of about 0.44 million hectares with annual production of nearly 15.10 lakh tonnes. The area under rice in Konkan is about 30.00 per cent of total area. However, productivity of Konkan region is 2.40 t ha^{-1}. Hence the present study was conducted in Wada and Palghartahsils of Palghar district of Konkan region. The objective of this study was to ascertain the package of practices adopted by the rice growers from Palghar district of Maharashtra state. The sample constituted 120 rice growers drawn from twelve villages. The respondents were interviewed with the help of a specially designed schedule. The ex-post facto research design was used for the present study. Majority of the respondents were medium adoption of the selected agricultural technologies of rice crop. The data regarding practice-wise adoption revealed that the respondents fully adopted high yielding variety 65.00 per cent, use of wooden plough for puddling 69.17 per cent, place the seedling upright and shallow 80.84 per cent, harvest the crop at 90% grain maturity and when plants are slightly green 100 per cent. Overall adoption is more than half 68.34 per cent of the respondent's medium adoption of the selected agricultural technologies of rice crop. The average adoption score was 66.49 indicating medium adoption.

TMIT 19

Adoption of the Farm Tools and Implements Used by the Farmers for Different Crops in North Konkan Coastal Zone of Maharashtra

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The present study was conducted in the tahsils namely Dahanu and Palghar from Palghar district and Alibaug and Mangaon from Raigad district, as gross cropped area in these four tahsils was comparatively higher than other tahsils. The sample constituted 10 farmers from each of the 20 selected villages by using n^{th} number method of random sampling. Thus, 200 respondents comprised the sample for the study. The respondents were personally interviewed with the help of a specially designed schedule. The information regarding farm tools and implements used by the respondents revealed that, they used only thirty-six farm tools and implements in their fields for performing different crop operations. It was noticed that cent percent respondents were using the traditional implements namely *kudali*, spades, pick axe, crow bar, etc. for their day to day work in agriculture. Twenty two farm tools and implements like power tiller, puddler, power tiller drawn cultivator, tractor, tractor drawn plough, Amar loranthus cutter, coconut climber, etc. were used by less than 30 per cent of the respondents in their farming Further, it was observed that farm tools and implements namely harrow, tractor drawn rotor, leveller, rice transplanting frame, power tiller drawn seed drill, tractor drawn seed drill, Annapurna rice transplanter, tractor drawn grass cutter, two way plough and electric thresher, were not used by the respondents.

TMIT 20

Promotion of Small Enterprises through Training Intervention on Value Addition of Tuber Crops

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Self sufficiency in food production in India is achieved due to scientific breakthrough in agriculture, equally supported by capacity building over a period of time. Tuber crops are the important group of horticultural crops. Due to suitable soil and climatic condition, almost all types of tropical tuber crops *viz.,* sweet potato, aerial yam, lesser yam, greater yam, *Xanthosoma,* colocasia, elephant foot yam, arrowroot, etc. are grown by tribal's and marginal farmers of Konkan in their homestead/ backyards for their own consumption. Most of the tuber crops are utilized as a vegetable and subsidiary food by tribal community and poor people. Farmers from this region are consumed these crops only just boiling/ cooking and making vegetable or fried. But these tuber crops are amenable to processing and diversified value-added products could be made from them. For popularization of these tuber crops and increase in the consumption of people in the daily diet, AICRP on Tuber Crops, Dapoli Centre have developed delicious recipes. These value-added products of tuber crops were popularized through organizing training programmes of women's Self Help Groups with the help of Department of Agricultural Extension, College of Agriculture, Dapoli and in collaboration of some NGO's. Realizing the roles played by rural women in various processing enterprises, promotion of small enterprises is the surest way to enlarge employment opportunities for them. In all 9 training programmes were conducted in different tahsils of Ratnagiri and Raigad district in Konkan region, through which 403 women were trained. The feedback received from the trainees was encouraging and the women's liked these products very much. Some of the women come forward and prepared these products through their Self Help Groups. The women reacted that such type of programmes should be conducted on large scale so that Self Help Groups will get a new avenue for their business in Konkan region.

TMIT 21

An Economic Analysis of Production and Disposal of Lesser Yam at Farmer's Level

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Socio-economical factors individually and interactively affect the adoption behavior towards new technology. Economical analysis for any crop at farmer level is more important for planning of future strategies for upliftment of farmer. In this context, this study was undertaken with the specific objectives such as, to estimate physical input use, cost, returns, profitability, resource use efficiency and constraints and cultivation practices followed in lesser yam production. For this purpose, 90 lesser yam cultivators were selected randomly from Dapoli, Khed and Sangameshwar Tahsil. Data related to the agriculture year 2013-2014 were collected by personal interviews with the lesser yam cultivators and analyzed with statistical tools and Cobb-Douglas production function. The average size of the land holding of lesser yam growers was 0.69 ha. The area under lesser yam was 4.55%. The per hectare inputs required for lesser yam production were 298.77 labour days including bullock and machinery labour, 84.39 q manures, 179.88 kg fertilizer (urea), 58.54 kg rabbing material, 194.2 kg plant protection and about 18,888 sticks. The per hectare yield of lesser yam was 239.15 q and total cost of cultivation of lesser yam (Cost-C) was worked out to Rs. 4,00,272/-. Out of which share of Cost-A was 47.99% and Cost-B was 86.66%. Therefore benefit-cost ratio was found to be 2.39. Per farm production of lesser yam was 1.09 q, out of which 0.59 q (54.13%) was sold out, about 0.33 q (30.28%) retained for home consumption and 0.14 q (12.84%) was retained for seed purpose, losses accounted about 0.02 q (1.83%). The major constraints faced by lesser yam grower were lack of storage facilities and no knowledge about value addition reported by 100 % lesser yam grower. Small land holding (76%) followed by no knowledge about recommended cultivation practices (71%), lack of extension services (50%), poor road facilities (44%), high labour cost (39%) and inadequate marketing facilities (33%) reported by the respondents. The common cultivation practices followed in lesser yam were collection of stubbles/rab material (100%), preparatory tillage (R & F) (100%), manuring (100%), dibbling (100%), stacking for vine support (100%), earthing up (100%), digging (100%), weeding practices (60%), fertilizer application (48%), mulching (24%) rabbing (22%) and plant protection chemicals (3%) were followed by many respondents.

Session VI:

Coastal Agriculture, Horticulture, Aquaculture, Livestock and Forestry in Konkan Region – Performance, Challenges and Options

CAK 1 (INVITED)

Mangroves of Konkan – Performance, Challenges and Opportunity

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The mangrove forests help to stabilize shorelines and reduce the devastating impact of natural disasters such as tsunamis and hurricanes. Mangrove forests are productive and species-rich hubs for marine life. However, mangrove ecosystem is facing constant pressure due to various natural and anthropogenic activities, like, climate change, quantum of fresh water reaching sea, pollution, real estate demand to accommodate increased human population and their rising demand for fodder, fuel wood. The ecosystem is so fragile that smallest change can alter the composition of the entire ecosystem. Although, CRZ notification 1991, in India, offers protection to mangroves, the effectiveness and importance was felt only after the devastating experience during the tsunami in 2004. Many initiatives were taken at international as well as national level for protection of mangrove ecosystem. Presently, total mangrove cover of Maharashtra is 304 sq. km. However, there has been increase and decrease of mangrove cover over the time, across coastal belt of Maharashtra, due to various reasons. The decrease is due to the, cutting for developmental activities, change in water exchange, demand for land requirement. On the other hand, the increase is due to increase siltation – result of developmental activities, improper industrialization and ignorance towards biodiversity, human settlement near water bodies, etc. Through the various independent projects, carried out for various clients in coastal region of Maharashtra, Terracon Ecotech Pvt. Ltd. (TEPL) has come across situations wherein traditional livelihood has conflict with presence of mangroves. On the other hand, local urban bodies are taking interest in mangrove conservation, by restoring degraded habitat. This paper discusses two these experience through two case studies and concludes that the plantation or the presence of mangrove should not be considered as the threat to livelihood but should be promoted for alternative livelihood such as crab farming or other fish culture. However, on the basis of negative implications, prawn culture should be avoided. At as same time, siltation near the creek mouth should be reduced by controlling soil erosion (presence of green belt, avenue plantation) and effective solid waste / waste water treatment to keep the fresh water sources clean.

CAK 2 (INVITED)

Medicinal Plants: Potential and Prospects for Costal Konkan Region

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Medicinal plants (MPs), worldwide are recognized of their sustained and strategic utility to a large section of people as potential sources of medicine (traditional, largely herbal) to meet the primary healthcare needs. Estimates for the numbers of species used medicinally vary from 35,000 to 70,000 worldwide. China and India are two great producers of MPs having more than 40% of global diversity. Medicinal plants are used at the household level by women to improve the health of the family members, at the village level by medicine men or tribals, by the practitioners of classical traditional systems of medicine such as Ayurveda, Chinese medicine, or the Japanese Kampo system. Medicinal plants are gaining importance in the fields of research, especially in the field of genetics and pharma biotechnology. India occupies a unique position in MP- related health culture, health security, economic and resource context in the world. It is the second largest exporter of medicinal aromatic plants after China with an average export of 36,750 t yr^{-1}. The herbal sector in India has an industrial turnover of Rs. 4200 crores per annum. Of its estimated 45,000 plant species, 8000 are medicinal plants. Around 70% of India's medicinal plants are found in tropical forests spread across the Western and Eastern Ghats, the Vindhyas, Chhota Nagpur plateau, Aravallis, the terai region in the foothills of Himalayas and the North-East. Less than 30% are found in temperate forests and higher altitudes. Also, MPs are distributed across various habits like- trees, shrubs, herbs, grasses, climbers, lichens, ferns, algae, etc. More importantly, the availability of MPs is under serious threat. More than 85% of MPs used by Indian Industry are collected from wild/ forests and much of this is illegal as the Forest Department does not conduct sales except Minor Forest Produce and Non-Timber Forest Produce (MFP/NTFP), and more than 70% of the collection involves destructive harvesting practices and over exploitation, fragmentation of natural habitat and

introduction of exotic species. A threat assessment exercise carried out for southern and northern India has brought to notice around 200 Red listed MPs (IUCN guidelines). From the trade data available, it is clear that the global market for medicinal plants has always been very large. Therefore, it is important to conserve the extensively traded medicinal plants in its natural environment or cultivating it in favorable environments. Out of the large variety of species available in the Western Ghats, about 50 species hold a very high value in the folk and herbal health forms for the treatment of different forms of ailments. The most common plants like the *Mimosa pudica, Hibiscus angulosus, Leucas aspera, Phyllanthus neruri, Calotropis gigantea, Tridax procumbens, Parthenium hysterophorus* (which is considered to be a noxoious weed) are all found to have cure for many major ailments like jaundice, asthma, piles, bronchial and blood disorders. Plants like *Anona squamosa, Buchanania lanzan, Semecarpus anacardium, Dioscorea bulbifera* and *Aphanamixis polystachya* are recommended for various forms of tumor. Plant parts of Pepper (fruit) and Cinnamom (bark) when mixed together make up a very strong formula for curing Migraine. Frequent doses of medicinal plant extracts of *Rhincanthus nasuta, Momordica dioica, Cinnamomum zeylanicum* and *Ophiorhizza mungos* relieves cancer patients. The spread of knowledge on the natural wealth is more important for a country like India, at a time when the synthetic drugs are stealing the economy rates. Most of the medicinal plants are found to occupy forest types like deciduous forests, evergreen forests and they are found in fallow lands and wayside. It can be noted that the plants that were very common in the area when they were first studied have got into the IUCN Red List over the years. *Rauvolfia serpentina, Saraca asoca, Gymnema sylvestre, Gloriosa superba* and *Strycnos nux-vomica* are included in the list which are very rich in their medicinal strength but are in the verge of extinction. The Western Ghats also hosts many medicinal plants that are endemic to the area. Appropriate conservation strategies have to be implemented immediately to protect the fragile habitats of many such medicinal plants.

CAK 3 (INVITED)

Research Outcome for Doubling the Farm Income in Konkan

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Konkan region is distinguished from rest of Maharashtra by virtue of its distinct agro-climatic conditions, soil types and topography. Its location between Sahyadri ranges and the Arabian sea, crops and cropping pattern, land holdings and socio-economic conditions of the farmers are unique. Besides agriculture, fisheries sector is very big and equally important, spread over 720 km on western sea coast. Rice is the main food grain crop of both the south and north zones during *kharif* season. Ragi (nagli) is also grown under upland conditions during *kharif* season. Pulse crops such as dolichos bean, pigeon pea, horse gram and chickpea are grown on the residual moisture during Rabi season. The university has recommended improved varieties of rice as well as developed hybrid rice varieties with high yield potential, recommended package of practices, nutrient management and plant protection for improvement of farm income. The university has developed varieties of nagali, wal, dolichos bean, ground nut, etc. and different vegetable crops. The climatic conditions and soil of this region is highly suitable for horticultural crops. Mango in Konkan region is established on 1.82 lakh ha with a productivity of 3.16 t ha^{-1} Cashew is also a major economical plantation crop in the region which is established on 1.82 lakh ha with production of 1.75 lakh tones and productivity of 1.3 t ha^{-1} Among the other fruit crops, kokum, jackfruit, jamun and sapota are important which are cultivated in the Konkan region mostly in rainfed condition. The university has developed improved varieties of mango, cashew, kokum, jamun, coconut, karonda, spices, etc. Various package of practices for mango, cashew, coconut have been standardized. Technology based on research work with respect to nutrient management, application of paclobutrazol, rejuvenation technique high density planting, mango blossom protection, value addition through post harvest management are widely adopted by the farmers. The forest in Konkan region is on 5.86 lakh ha and most of the forest is owned by private farmers. The cultivation of Bamboo species *Dendrocalmus stocksii* (manga bamboo) in Sindhudurg district of Maharashtra is found to be highly economical. Apart from Bamboo, number of medicinal and aromatic crops such as Sonchafa (*Michelia champaka*), sandal wood (*Santalum album*) and Undi (*Calophyllum inophyllum*) have potential to improve farm income. Konkan possesses 720 km long seashore. There is a substantial scope for marine, brackish water and inland fisheries. The marine area on Konkan is 1.12 km^2 with production of 4.34 lakh MT. The brackish water area in Konkan region is 2,216 ha. The shrimp farming in brackish water area is highly economical. The farmers in Konkan region construct polythene lined farm pond for storing the water and utilizing the same for irrigation and horticultural crops. Such ponds provide

incredible scope for fish culture. Apart from fisheries, green mussels and mud crab culture, fish production in rainfed farm ponds and hatcheries are beneficial to improve farm income. The ornamental fish sector is expanding rapidly in Konkan. The continuous warm and humid climatic conditions in Konkan region restrict commercialization in dairy sector with the existing hybrids. However, ample green biomass is available in Konkan throughout year. The situation provides good scope for goat farming. The improved local breed Konkan Kanyal produces two kids per parturition. The breed is also good for meat purpose. Agriculture, horticulture, fisheries and animal husbandry along with the natural resources are the growth engines for Konkan agriculture. The integrated approach in the form of farming systems is inevitable. For instance, intercropping of spices in coconut provides opportunity to earn more than 2.5 lakhs per hectare.

CAK 4 (INVITED)

Transfer of Technologies in Konkan Region

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Agricultural extension in India is in transition. After several years of relentless effects, extension has been witnessing renewed interest and policy attention during the last few years. It is also under pressure to reform its purpose and the way it is managed as well as to address the new challenges faced by Indian agriculture effectively. The Science and Technology development in agriculture has opened tremendous opportunities for income and employment generation. The empowerment and development of rural people and sensitization of research and extension systems about their roles and contributions are important for sustainable growth in agriculture. Different Transfer of Technology and methodologies are available now a days. Number of extension functionaries and organizations are making efforts to fulfil the changing needs of people. Now a days, social media is the tools for the extension functionaries for TOT. WhatsApp, Hike, Facebook are few of them. Various mobile apps have been developed by the DBSKKV, Dapoli. ITK's plays an important role in refinement of the technologies. So, the research system must focus on the ITK's while designing research. Various extension strategies need to assess for changing scenario of Konkan agriculture in general, and rice, mango, cashew, fisheries and forestry in particular. The success stories of the farmers from all the areas of agriculture in collaboration with line department are need to be document and replicate in large. Natural resources management and climate change studies need to be undertaken for making farmers aware about it. Women empowerment is the major issue. The involvement of the women in agriculture is more in Konkan region. Small agricultural tools and machinery are need to be developed for drudgery reduction. Strengthening of women SHG's can be possible through their involvement right form cultivation of crop up to its value addition and marketing. The Agriculture Extension in Konkan region is nothing but the 'reaching the unreached' and from 'Masses to Classes'. The finger millet crop has now become gold millet and cultivation of finger millet from 1.5 acre now is reached to 150 acres at Khed tehsil of Ratnagiri district. The success story of SHG's of Khed CMRC is one of the idols for the MAVIM Ratnagiri and IFAD (Rome). Farmers – Scientist – Extension functionaries forum (FSEF) is the platform for the diffusion of the technology and quick feedback to the research extension system. Seven FSEF have been formed and have good interactions. Impact of First Line Transfer of technologies need to be documented which obtained from OFTs, FLD's of KVK's and SAU's. Farmers Producers Companies (FPC), Group farming, Linking of CSR activities of the companies and strong linkages with all the stakeholders are the keys of effective transfer of technologies.

CAK 5 (INVITED)

Research and Development in Coastal Saline Soil of Konkan Region of Maharashtra

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About 65,000 ha of. coastal salt affected soils occurs in Konkan causing reduction in crop yield by 30 to 50 per cent,

if not manage properly. The coastal region of Konkan is spread over 720 km. in length represents great diversity with respect to soil and land use. The region comprises of five districts *viz.,* Greater Bombay, Thane, Palghar, Raigad, Ratnagiri and Sindhudurg. Coastal saline soils, developed due to tidal ingress and capillary rise of salts during summer season. The region is mono-cropped, cultivated during rainy season, mainly rice. Coastal saline soils were reported for physico-chemical properties and nutrient status. Particle size distribution was observed as silty clay to silty loam. Maximum water holding capacity varied from 50 to 68 percent, pH varied from 6.50 to 8.5, however average ECe was 11.12 dS m^{-1}. The soils in general were moderate to high in organic carbon, available phosphorus and rich in was available potassium as well as DTPA extractable micronutrients. The soil infiltration rate found to be 7.84 cm day^{-1} and hydraulic conductivity observed to be 0.62 cm day^{-1}, which was rated as very low. Salinity of the ground water some time was more than sea or creek water. The salts existing in the ground water come to surface of soil through capillary movement of salts through groundwater and resulted in development of coastal saline soils. The intensity of salts presents in the ground water depends on the distance from sea or creek and strata existing in the area. It was seen that up to 500 m distance ground water salinity was high from the creek or sea and then it reduces as further distance increases. The salinization through capillary rise and tidal ingress in Konkan region is up to 2.5 to 3.0 km from creek or sea side. Salinity of coastal salt affected soils can be reduced by taking suitable reclamation measures such as construction of dyke, excavation of drains along with use of green manures, amendments like FYM. Better rice yields can be harvested with adopting salt tolerant rice varieties (Panvel-1, 2, 3) and use of nitrogenous fertilizer. Nitrogen use efficiency could be increased by the placement of nitrogen fertilizers. It was evident that stored rainwater in fish pond had shown influence on reduction in soil salinity. Salinity seems to be gradually increases as distance from fish pond increases. It was lowest at 0 m and maximum at 50 m. The rainwater stored in the pond during rainy season was used for fish culture getting benefit cost of 1.53. The water is used as irrigation for production of salt tolerant vegetable crops such as palak, radish, spinach, beet root, etc. The research done at Panvel and Pargaon has shown that *Cyprinus carpio* and *Lates calcarifer* with tilapia can be successfully grown in paddy fields without hampering rice yields as well as in farm ponds. With proper management and adopting integrated farming system in coastal saline soils can become profitable venture.

CAK 6 (INVITED)

Agronomic Practices for Field Crops for Doubling Income in Konkan Region: Performance, Challenge and Options

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Konkan region is geographically hilly area of Maharashtra state situated on west coast having narrow strip of 720 km length. This region comprises of two agro climatic zone *i.e*., South and North Konkan Coastal Zone. It receives annual rainfall from 2500 to 4500 mm during monsoon *i.e.* (June to September) but irrigated area is only about 5 per cent. Agriculture in Konkan region is characterised by small and fragmented land holding and highly dependence on monsoon rains. Operating small holdings in respect of field crops is often unviable and farming is not a profitable enterprise. Rice is the major staple food crop in *kharif* season in south zone and in *kharif* and *rabi* season in north zone. Ragi (Nagli) is grown next to rice mainly under upland conditions during *kharif* season. Ground nut and niger are two important oil seed crops grown in this region. Crop improvement in major field crops by Dr. Babasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli helped in enhancing the production and productivity of the major field crops in Konkan region of Maharashtra state. This resulted in improving economic status of the farmers in existing cropping situation in Konkan. Further, development of infrastructure facilities like feasible minor irrigation project, adoption of improved cultivation practices and development of mechanised implements suitable for small and fragmented land holdings and inclusion of diversified crops in cropping system will help farmers to bring more area under cultivation and will ultimately increase the production of field crops. Creating awareness about self-help group (SHG) will help in reduce cost of production and helps in enhancing economic status of farmers in Konkan.

CAK 7

Constraints in Rice Production in Konkan Coastal Zone of Maharashtra

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The Konkan region of Maharashtra is the predominant rice growing belt with an average productivity of 3.35 t ha^{-1}. The region comprises five districts *viz.,* Thane, Palghar, Raigad, Ratnagiri and Sindhudurg. The total area under rice cultivation was more than 3.5 lakh ha. The farmers of the region cannot grow any other crop than rice in *kharif* because of high rainfall and geographically low land. The production-oriented survey of rice was conducted in the region from 2013 - 2017 to know the constraints in rice cultivation. It was observed that the rainfall pattern was changed and onset of monsoon was irregular. The maximum rainy days in the region varied from 75-128 days. The total rainfall and its distribution in all the districts of the region was not satisfactory and the late rainfall at harvesting caused severe losses in most of the season. Because of fast urbanization in most of the districts, area under rice cultivation is tremendously decreasing and farmers are facing acute shortage of farm labourers. Among the biotic constraints the insect pest and disease intensity in the region was very low to high. The balanced use of fertilizers was not practiced in the region because of its unavailability. Farmers in the region were unaware about integrated pest, disease and weed management. *Rabing* is a common practice and more than 95 per cent farmers follows this exhaustive and man power consuming technique. The mechanization is poor due to unavailability of low cost machines, small land holding and geographical situations.

CAK 8

Berseem - A New Forage Legume Crop for Coastal Region of Maharashtra State

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Berseem is popularly known as the "King of fodder legume", because it is available for 6 - 7 months from November to May. The crop gives 4 to 6 cuts during winter and early summer season and provides nutritious, succulent and palatable forage. Berseem contains 17 - 22% crude protein, 42 - 49 % NDF, 35 - 38% ADF, 24 - 25% cellulose and 7 - 10% hemicellulose. The green forage can also be converted in to excellent hay and utilized for enrichment of poor quality roughages. A trial was conducted at Regional Agriculture Research Station, Karjat, Maharashtra for screening varieties of berseem. In coastal region paddy straw is the main feed of cattles, but now farmers of this region are made well acquainted with this crop. Berseem has got a soil building characteristic and improves the physical, chemical and biological properties of the soil, resulting in better growth and yield of crops in rotation. Berseem is adapted to cool and moderately cold climate. Such conditions prevail during winter seasons in coastal region of Maharashtra State which is considered to be favorable and productive this crop. The optimum temperature at the time of sowing is for 25ºC. For luxuriant vegetative growth temperature range of 25ºC to 27ºC has been found ideal. Due to shorter winter period 2 -3 cuttings can be made and near about 150 q ha^{-1} green fodder can be harvested.

CAK 9

Assessment of Soil Quality Parameters in Coastal Konkan Region of Maharashtra during Pre-monsoon Period

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The present investigation was undertaken to study the quality parameters of coastal saline soils of Konkan region of Maharashtra. The surface soil samples (0-20 cm) were collected during pre-monsoon season from coastal Konkan area including five districts *viz*., Palghar, Thane, Raigad, Ratnagiri and Sindhudurg. The study revealed that the soils

were very strongly acidic to slightly alkaline (pH 4.75 to 7.48) in reaction, non-saline to moderately saline (EC 0.07 to 12.80 dS m^{-1}) in nature. The overall concentration of Ca^{2+}, Mg^{2+}, Na^{+} and K^{+} varied from 6.66 to 205.3, 34.33 to 429.0, 1.56 to 267.02 and 0.007 to 1.19 meq L^{-1}, respectively. In case of anions, the concentration of CO_3^{2-}, HCO_3^{-} and Cl^{-} were in the range of 0.0 to 0.0, 0.46 to 2.0 and 7.5 to 417.5 meq L^{-1}, respectively. The SAR value ranged from 0.354 to 33.821 meq L^{-1} and RSC value were nil. The study further revealed that maximum value of electrical conductivity (12.80 dS m^{-1}) was recorded in Raigad district. On the basis of analysis of surface soil samples collected according to distance from sea/creek, it was inferred that as the distance increases from sea/creek the salinity was observed to be decreased.

CAK 10

Quality of Irrigation Water in Coastal Districts of Konkan Region of Maharashtra

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There is no source of good quality irrigation water during *rabi* season in coastal belt of Maharashtra. Therefore, the evaluation of water quality for irrigation purpose is of paramount importance in coastal Konkan region of Maharashtra. Hence, the present study was undertaken to assess the quality of ground water in coastal districts of Konkan region of Maharashtra. From five districts of the region, 218 ground water samples were collected from the creek/sea side to landside upto 10 km distance by using GPS instrument and were analysed for pH, EC, anions (CO_3^{2-}, HCO_3^{-}, Cl^{-} and SO_4^{2-}) and cations (Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}). In addition to this, water quality indices (SAR and RSC) were also computed. The pH and EC of water samples collected during post monsoon season ranged from 5.08 to 8.60 and 0.01 to 8.91 d Sm^{-1} with overall mean values of 7.26 and 2.05 d Sm^{-1}, respectively. Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) ranged from 0.13 to 15.86 and 0 to 44.10 with overall mean values of 2.21 and 1.29, respectively. Similarly, the pH and EC of the water samples collected during pre-monsoon season ranged from 6.34 to 8.90 and 0.01 to 13.79 d Sm^{-1} with overall mean values of 7.65 and 3.94 d Sm^{-1}, respectively. SAR and RSC ranged from 0.13 to 15.90 and 0 to 18.10 with overall mean values of 2.75 and Nil, respectively. According to AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture classification, about 34% water samples were found to be saline and 41% as good water. In post monsoon 58% water samples were found as saline and only 24% as good water.

CAK 11

Design and Development of Portable and Foldable Type of Solar Dryer for Coastal Region

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Portable and foldable type of solar dryer was designed with a view of economic condition in local area. Portable and foldable type of solar dryer was fabricated with wooden material and aluminum sheet. A 200-gauge polythene sheet was used as covering material on dome. The chimney was fabricated from thin iron sheet and was having diameter and height of 0.04 m and 0.34 m respectively. The dryer was used to evaluate drying of aonla candy, had capacity of 2 kg per batch of aonla candy having thickness of 6-7 mm. The dimensions of portable and foldable type solar dryer were 0.9 m length, 0.6 m wide and 0.7 m height. The collector area was 0.539 m^2 with drying cabinet size of 0.9 m x 0.6 m. The dryer being portable was easy for use as well as handling and transporting. It was also possible to separate the dome from mainframe, so that plastic cover on dome could be kept aside safely in off-season in order to avoid damage caused due to unfavorable atmospheric conditions. Dome of the dryer was foldable type and occupied minimum space. Total cost of construction of portable and foldable type solar dryer was Rs.1360. Two treatments of wet aonla pieces, sugar treated and without sugar were selected as a drying material. Portable and foldable type solar dryer was tested for its performance at without load and with load.

During no load testing maximum temperature achieved in the dryer was 63.3°C at 12.30 pm. The moisture content of 6 mm thickness aonla pieces which were treated with sugar reduced from 281.67 per cent (db) to 29.93per cent (db) in 600 minutes.While moisture content of amla pieces which were without sugar reduced from 718.33 per cent (db) to 58.55 per cent (db) in 600 minutes. The drying rate of aonla pieces which were with sugar and without sugar had its peak value 1.4126 and 1.6777 g water g^{-1} dry matter h^{-1} respectively during drying time interval of 8.30 to 9.30 of the day. Temperature reached in dryer was 15 to 20°C higher than atmospheric temperature. By using this dryer, one could dry the product within shorter period than open sun drying**.**

CAK 12

Effect of Integrated Nutrient Management on *Rabi* Sweet Corn in Lateritic Soil of Konkan

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An experiment was conducted to study the impact of integrated nutrient management on the performance of sweet corn at Agronomy Experimental Research Farm, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (MS). The results of the present investigation indicated that the growth and yields attributes of the plant *viz*., height, number of leaves dry matter accumulation per plant and cob length, cob girth, number of grain rows, number of grains per cob, weight of grains per cob, weight of cob and cob yield (q ha^{-1}), total biological yield (qha^{-1}) and green fodder yield (q ha^{-1}) were found to be significantly higher under 75 % RDN + 25 % N through PM at all the crop growth stages, during both the years of experimentation as well as in the mean of two years over rest of the nutrient management practices except dry matter accumulation at 30 DAS 100 % N as PM nutrient source was at par with 100 % N through PM. Number of cobs ha^{-1} was at par with 50 % RDN + 50 % N as PM level of nutrient source during all the three observations.

CAK 13

Status of Rice Diseases in Konkan Coastal Zone of Maharashtra

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The Konkan region of Maharashtra is the predominant rice growing belt of Maharashtra with an average productivity of 3.35 t ha^{-1}. The regions comprise five districts *viz.,* Thane, Palghar, Raigad, Ratnagiri and Sindhudurg. The total area under rice cultivation in *kharif* 2017 season in the region was 363441 ha. The farmers of the region cannot grow other crops than rice during *kharif* because of high rainfall and geographically low land. With the introduction of high yielding new varieties of rice and imbalance use of chemical fertilizers, there has been a perceptible change in the pattern of occurrence of several diseases. Hence, the survey for rice disease prevalence was undertaken during the cropping season of 2017. District wise diseases prevalence of rice was recorded and it was found that the incidence of leaf blast and neck blast was at medium range in Palghar, Thane, Ratnagiri and Sindhudurg district. However, it was low in Raigad district of Konkan region. Damage due to glumes discoloration (chaffy grains) was very severe in some fields of Palghar and Ratnagiri districts. False smut incidence was found at medium range in Raigad and Thane districts. Similarly, sheath rot incidence was also medium in these two districts and at low range in all other three districts. Bacterial leaf blight disease was medium in Raigad and Thane districts, whereas, it was not noticed in Sindhudurg district.

CAK 14

Effect of Establishment Techniques and Weed Management Practices on Yield and Economics of *Kharif* Rice under Lateritic Soil of Konkan

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The experiment was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri during *kharif* season of 2017. The results revealed that increase in grain yield recorded under recommended manual transplanting with puddling over dibbling on BBF with polymulch, transplanting by mechanical transplanter, transplanting by hand operated transplanter and seed sowing on flat bed with drum seeder was to the tune of 1.91, 2.93, 5.44 and 6.80 per cent respectively. While the grain yield and straw yield were significantly enhanced and recorded higher values under treatment of weed free check than weedy check and which was at par with the treatment of pre-emergence application of oxadiargyl @ 0.12 kg ha^{-1} + one hand weeding. It was observed that, treatment of seed sowing on flat bed with drum seeder with pre-emergence application of oxadiargyl @ 0.12 kg ha^{-1} + one hand weeding earned significantly highest net returns and B C ratio of (Rs. 16,328 ha^{-1}) and (1.32) over rest of treatments.

CAK 15

Response of Rice to Nutrient Application in the Farmers' Fields of North Konkan Region

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A field experiment was conducted with an aim to study response of nutrients on rice - rice cropping system during *kharif* and *rabi* seasons on 24 farmers' fields in the Ganje, Gundave and Dahisar villages of Palghar block and Sajan, Maan and Vakdupada villages of Vikramgad block in Thane (Palghar) district. Three farmers from each village were selected. The experiment was conducted in a randomized block design with seven treatments and 24 replications. The results of the experiments revealed that maximum yield of *kharif* rice Sahyadri (grain 60.87 q ha^{-1} and straw 73.56 q ha^{-1}) and *rabi* rice Karjat-3 (grain 46.36 q ha^{-1} and straw 59.51 q ha^{-1}) was recorded in the treatment receiving recommended dose of nitrogen, phosphorus and potassium and micro nutrient ($ZnSO_4$ @20 kg ha^{-1}). After harvest of both *kharif* and *rabi* season crops the physico-chemical properties of soil and major nutrients were determined. The results revealed that in both the season treatment with recommended dose of nitrogen, phosphorus and potassium for the component crops in the sequence exhibited significantly highest available N, P_2O_5 and K_2O (*kharif:* 320.81, 33.65, 279.89 kg ha^{-1} and *rabi*:332.48, 35.56, 284.54 kg ha^{-1}, respectively) than control and farmers practice except treatment receiving recommended dose of nitrogen, phosphorus and potassium and micro nutrient ($ZnSO_4$ @ 20 kg ha^{-1}).

CAK 16

Response of Coriander to Micronutrients in Lateritic Soils of Konkan Region

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In order to study the response of coriander to micronutrients in lateritic soils of Konkan region, the present investigation was undertaken. Coriander, variety Konkan Kasturi was taken as a test crop during *rabi* season of the year 2016 -2017 with a spacing of 30 x 10 cm and the gross plot size was 3.0 m x 3.0 m. The field experiment was laid out in randomized block design in three replications. The experiment included ten treatments comprising of soil application and foliar spray of $ZnSO_4$ and $CuSO_4$ in varying concentrations along with 100 per cent RDF. The highest

yield of 11.18 t ha^{-1} of coriander was obtained with the application of 0.5 per cent $ZnSO_4$ through foliar spray along with 100 per cent RDF with highest chlorophyll content of 2.54 mg g^{-1} and ascorbic acid content of 524.79 mg 100 g^{-1} of coriander. However, the yield of coriander (10.56 t ha^{-1}) with the soil application of $ZnSO_4$ @ 20 kg ha^{-1} along with 100 per cent RDF which is at par with the treatment of application of 05 per cent $ZnSO_4$ through foliar spray along with 100 per cent RDF had significantly superior *β-carotene* content of 2502.12 µg 100 g^{-1} in coriander. Thus, the application of $ZnSO_4$ @ 0.5 per cent foliar spray along with 100 per cent RDF or the soil application of $ZnSO_4$ @ 20 kg ha^{-1} along with 100 per cent RDF to coriander crop significantly increase the yield and improve the quality of coriander in terms of chlorophyll, ascorbic acid and *β-carotene* content.

CAK 17

Yield and Yield Attributes of Different Genotypes of Colocasia (*Colocasia esculenta* L. Schott) under Konkan Region of Maharashtra State

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Colocasia (*Colocasia esculenta* L. Schott) also known as '*edode'* or '*arvi' is* a tropical tuber crop belongs to the monocotyledonous family Araceae. It is grown throughout the tropics and subtropics for its tubers (corm, cormels and leaves) serves as staple source of diet for people around the world. The agro climatic conditions of the Konkan region are suitable for tuber crop production, where colocasia is considered to be an earliest domesticated in low lying tropics. There is diversity in the colocasia and some types are being preferred for consumption. In Konkan region of Maharashtra, the variability in morphological characters has been identified and collected and their evaluation in germplasm was initiated. The yield performance of selected sixteen genotypes of colocasia was assessed during *kharif* season of the year, 2016 at Central Experiment Station, Wakawali, Dapoli (Maharashtra). Sixteen genotypes of colocasia viz; Sanjivani, NDB- 9, M-12-429, Mahim, Devkibai Walanga, Sawantwadi, Muktakeshi, Kelva, BCC-11, M-9-111, Sree Pallavi, Khed Shiravali, Talsure, Ac-20, NDB-22 and Khopoli were evaluated in randomized block design with three replications. Highest number of cormels (26.20 $plant^{-1}$) was noticed in Khed Shiravali and it was at par with M-9-111 (25.53 $plant^{-1}$) whereas, the lowest number of cormels (4.53 $plant^{-1}$) was noticed in NDB-22 genotype. The maximum corm length (10.85 cm) was recorded by genotype NDB-9 while maximum corm diameter (5.51 cm) was recorded in M-9-111 genotype. The cormel length was highest (6.77 cm) in genotype Kelva and minimum cormel length (3.45 cm) was in Muktakeshi. NDB-22 recorded highest corm yield (8.00 t ha^{-1}), and cormel and total yield was maximum (20.48 t ha^{-1} and 26.15 t ha^{-1}) in M-9-111 genotype indicating cormel production also contributed in total tuber yield. The lowest total yield $plant^{-1}$ (247.60 g and 9.17 t ha^{-1}) was recorded in M-12-429 genotype. The potential of accumulation of food and corm development might be differed in different genotypes due to their genetic nature and also due to environment prevailed during the crop growth period and the genetic variation of the genotypes.

CAK 18

Diversification of Cropping Systems for Higher Production and Income Generation under North Konkan Coastal Zone

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Crop diversification has been well recognized as an effective strategy for achieving the objectives of food and nutritional security, income growth, poverty alleviation. The objective of the study was to identify appropriate

cropping systems with higher productivity and profitability to suit the specific needs of Konkan agro-ecological situations. A field experiment was conducted to identify remunerative cropping systems for Konkan region of Maharashtra State during 2016-17 at Regional Agricultural Research station, Karjat, Dist. Raigad**.** Eleven crops grown during *rabi* season after harvest of *kharif* rice were one cereal crop *viz.,* rice, one pulse crop *viz*., field bean, one oilseed *viz*., groundnut, five vegetable crops *viz*., brinjal, cabbage, okra, bottle gourd and Dolichos bean, two cash crops *viz*., water melon and sweet corn and one fodder crop maize. The experiment was conducted in a randomized block design with four replications. During *kharif* season maximum and significantly higher grain yield of rice variety, Karjat 9 was recorded under 'Rice-Groundnut' crop sequence (62.17 q ha^{-1}) compared to other crop sequences except 'Rice-Dolichos bean' (61.59 q ha^{-1}). During *rabi* season different crops were grown therefore, there is no any significance in comparing their yields, however, there yields are converted into REY to compare their significance. Maximum and significantly higher rice grain equivalent yield (295.79 q ha^{-1}) was obtained from *rabi* brinjal grown after *kharif* rice. The highest and significantly superior total rice equivalent yield (TREY) of 361.72 q ha^{-1} was recorded due to 'Rice-Brinjal' sequence followed by 'Rice-Watermelon' sequence (315.84 q ha^{-1}). 'Rice-Brinjal' crop sequence secured maximum and significantly higher gross returns (Rs. 5,31,729 ha^{-1}) and net returns (Rs. 3,23,725 ha^{-1}), respectively. 'Rice-Watermelon' crop sequence stood second and realized significantly higher net returns (Rs. 2,96,332 ha^{-1}) over rest of the cropping sequences. 'Rice - Groundnut' system recorded significantly the highest B:C ratio of 2.81 as compared to rest of the systems except 'Rice-Watermelon' (2.76) and 'Rice-Bottle gourd' (2.70) crop sequences. Maximum productivity (139.14 kg ha^{-1} day^{-1}) and gross monetary efficiency (GME) (Rs. 2045.30 ha^{-1} day^{-1}) were observed in 'Rice-Watermelon' system followed by 'Rice-Brinjal' sequence (137.54 kg ha^{-1} day^{-1} productivity and Rs. 2021.78 ha^{-1} day^{-1} GME). The data revealed that the total uptake of N, P and K under 'Rice-Groundnut' system was maximum and significantly higher as compared to rest of the systems. Maximum and significantly higher organic carbon content (1.37 %) of soil was observed after harvest of *rabi* Watermelon under 'Rice-Watermelon' crop sequence except 'Rice-Groundnut', 'Rice-Brinjal', 'Rice-Field bean', 'Rice-Dolichos bean' and 'Rice-Bottle gourd' sequences. Significantly higher available nitrogen (261.86 kg ha^{-1}) and P_2O_5 (30.31 kg ha^{-1}) were observed under 'Rice- Groundnut' system as compared to rest of the sequences except 'Rice-Field bean' and 'Rice-Dolichos bean' cropping systems. Significantly higher available K_2O content (270.82 kg ha^{-1}) of soil was observed due to 'Rice-Cabbage' system as compared to rest of the sequences except 'Rice- Sweet corn' sequence.

CAK 19

Response of Cowpea to Different Irrigation and Fertilizer Levels under Zero Tilled Condition in South Konkan Coastal Zone of Maharashtra

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Cowpea commonly known as "Lobia" is used as pulse, a fodder and green manure crop. In Konkan region of Maharashtra, pulses are mainly grown in *rabi* season in rice field after harvest of rice crop both on residual moisture. The reasons for the low yield of cowpea grown on residual moisture in zero tilled condition are that cowpea hardly receives any irrigation at critical growth stages during hot weather. Most suitable method and level of fertilizer application to crop grown on residual moisture need to be standardize. Therefore, to exploit high yielding potential of cowpea on residual moisture, better management of these aspects needs to be emphasis. A field experiment was conducted for three consecutive years commencing from, *rabi* 2011-12 to 2013-14 at Agronomy farm, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra to study the effect of irrigation and levels of fertilizer application on zero tilled cowpea (*Vigna unguiculata* L.). The experiment was laid out in a split plot design with three replications. The main plot treatments consisted of three irrigation levels, *viz.,* no irrigation (I_0), one irrigation at branching (I_1) and two irrigations at branching and pod filling stage (I_2). The sub plot treatments comprised six fertilizer levels *viz.,* no fertilizer (F_0), 25% RDF below seed placement (F_1), 50% RDF below seed placement (F_2), 75% RDF below seed placement (F_3), 100% RDF below seed placement (F_4) and 100% RDF through line application (F_5). The soil was sandy clay loam in texture, medium in available nitrogen (298.20 kg ha^{-1}), low in available phosphorus (11.80 kg ha^{-1}), moderately high in available potassium (249.35 kg ha^{-1}), medium in organic carbon (0.95%) and slightly acidic in reaction (pH 5.8). During experimentation potassic fertilizer not applied

because of their content in this soil is high. Results revealed that treatments where, application of two irrigations (at branching and pod filling stage) recorded significantly maximum values in respect growth as well as yield attributes resulting in higher grain (41.01 %) and Stover (35.54 %) yield over the control treatment i.e. treatment I_0. Application of 100% RDF below seed placement recorded significantly maximum growth as well as yield attributes resulting in higher grain (52.00%) and stover yield (52.00%) the control i.e. treatment F_0. Treatment combinations I_2F_4 (two irrigations at branching and pod filling stage + 100% RDF below seed placement) has given maximum net returns (Rs. 24687 ha^{-1}) and B: C ratio (1.51). It is recommended to grow cowpea under zero tilled condition during *rabi* season in south Konkan coastal region of Maharashtra with two irrigations (at branching and pod filling stage) along with 100% recommended dose of fertilizer (25:50:00 N and P Kg ha^{-1}) should be applied below seed for obtaining higher yield and profitability.

CAK 20

Improved Rice Varieties for Enhancement of Productivity in Konkan Coastal Zone of Maharashtra State

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The rice is a staple food grain crop of Konkan region of Maharashtra state. Rice is grown on 3.69 lakhs ha area with annual total rough and milled rice production of 15.70 and 10.83 lakhs t, respectively with an average productivity of rough and milled rice of 4.25 t ha^{-1} and 2.93 t ha^{-1}, respectively in Konkan region. Total 30 HYVs of rice varieties were released for commercial cultivation Konkan region for various agro-ecological situations which are playing pivotal role for increasing production and productivity of the region. The recently released HYVs of rice are briefed here. The rice variety Ratnagiri 7 (Red rice; RTNRR-4) was evolved through the mutant selection from MO17 at Agricultural Research Station, Shirgaon, Ratnagiri, Maharashtra. The above variety is mid-late in duration (122-125 days), semi-dwarf (100-110 cm plant height), short bold grain type. The variety showed 46.50, 21.40, 50.96 and 59.41% higher yield over the respective checks in station, state, agronomical and adaptive trials, respectively. Ratnagiri 7 **(**RTN RR-4) recorded 23.88%, 18.69% and 39.40% higher grain yield over IR-64, BPT-5204 and Kalanamak, respectively in AICRIP trials. RTN RR-4 consists of 28.50% (17.35 ppm) and 32.7% (7.9 ppm) high iron content over the check Bela (13.5 and 5.95 ppm) in brown and polished rice respectively. Ratnagiri 7 **(**RTN RR-4) consists of 42.82% (28.35 ppm) and 43.0% (24.25 ppm) high zinc content over the check Bela (19.85 and 16.95 ppm) in brown and polished rice respectively. It also having low glycemic index (53). RTN RR4 having High milling (64.17%) and head rice recovery percentage (60.65%) with good cooking quality. It recorded average yield of 4.5 to 5.0 t ha^{-1}. It showed resistant to stem borer, leaf folder and gall midge and moderately resistant to leaf blast, bacterial leaf blight**.** Therefore, the rice variety Ratnagiri 7 recommended for release for commercial cultivation in Konkan region of Maharashtra in the year 2017. The rice variety Ratnagiri-8 (IET 25493; RTN 28-1-5-3-2) was evolved from the cross between IR64 and Karjat 184 using former parent as female through pedigree method of selection at Agricultural Research Station, Shirgaon, Ratnagiri, Maharashtra. The above variety is mid-late in duration (135-138 days in *kharif*), semi-dwarf (102-110 cm plant height), medium slender and translucent kernel type. Ratnagiri 8 (IET-25493) rice variety on overall basis of three years testing across the 62 locations in the country had recorded 14.80%, 7.21%, 30.37% and 1.58% higher grain yield over checks, BPT 5204, WGL 14, Zonal check and local check, respectively in AICRP trials conducted during the 2015-2017. Ratnagiri 8 (IET 25493) is having medium slender grain type with translucent kernel. It has 5.4 mm kernel length, 2.0 mm kernel breadth and 2.7 LB ratio. It recorded high 75.8% hulling, 67.0% milling and 64.6% head rice recovery percentage. It is having intermediate amylose content (23.4%) and alkali spreading value (5.0). It is non-scented with excellent cooking qualities. Ratnagiri 6 rice variety showed moderately resistant to leaf blast and bacterial leaf blight diseases and moderately resistant to stem borer, leaf folder and gall midge insect pests at endemic sites. It recorded an average yield potential of 5.0 to 5.8 t ha^{-1}. Considering the consistent performance, yield superiority and excellent cooking and grain quality with wider adaptability over the locations and over three years testing, Ratnagiri 8 (IET 25493) is recommended for release for commercial cultivation for the zones IIIrd (Orissa and Uttar Pradesh), Vth (Chhattisgarh and Maharashtra), VIIth (Andhra Pradesh, Telangana) during AICRIP Rice Annual Workshop held at ICAR-IIRR, Hyderabad during 13-16 April, 2018.

CAK 21

Power Operated Paddy Weeder: A Suitable Machine for Lowland Cultivated Paddy in Konkan Region

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In Konkan region, paddy is the major crop cultivated under wet land condition. Hand weeding is widely adopted at present for paddy in Konkan region. It is costly, time consuming and involve drudgeries. Therefore, cost effective and efficient technologies are needed to be adopted by the farmers of Konkan region for getting advantages of agricultural mechanization. Manually operated cono weeders are being used in some of the pockets of Konkan. Its capacity is less (up to 0.12-0.15 ha day^{-1}) and its operation is also heavy due to its weight (7.8 kg). To reduce the drudgery involved in paddy weeding and enhance field capacity, the work was undertaken to develop a portable power operated paddy weeder. Its performance was also evaluated in field. The developed power operated paddy weeder consisted of engine, gear box, propeller shaft, rotor with blade and main frame and float. A petrol engine of 1.75 hp was selected as prime mover for the developed weeder. The final reduction of speed from engine to cutting unit (rotary blade) was reduced 200 rpm. The speed ratio of engine to cutting blade was 32.5:1. Two types of rotor were designed and developed *viz*. rotor with L shape blade and hexagonal serrated blade. One of the rotor blades consist of four "L" shaped blades connected in orthogonally opposite direction on a rotary flange which is attached to the rotator shaft. The hexagonal rotor with serrated blade was fabricated from 2 mm thick MS sheet of 150 mm length and 45 mm width. The rotor blade consists of six blades connected on a hexagonal rotor. The components *viz*. engine, gear box, rotor shaft, mudguard, float, handle *etc*. were assembled properly and final prototype was developed. The rotor with serrated blade has resulted into 9.41% higher weeding efficiency than L shape blade at 40 days after transplanting (DAT). Rotor with L shape blade resulted in to 1.02% minimum plant damage than serrated blade at 20 DAT. The maximum field capacity was found with L shape blade (0.0266 ha hr^{-1}) than serrated blade (0.0204 ha hr^{-1}) at 40 DAT which was 30.39% higher. The minimum fuel consumption of 0.576 L hr^{-1} was found using rotor with L shape blade at 40 DAT whereas serrated blade has given minimum fuel consumption as 0.646 L hr^{-1} at 40 DAT which is 10.83% less over serrated blades. Weeding point of view the weeder with serrated blade performed better in field. As compared manual weeding in paddy (30-60 labour days hr^{-1}), developed weeder is operated by only one person comfortably. The capacity of machine is 2 ha day^{-1} for a day of 10 hour. The cost of operation was found to be Rs. 4990 ha^{-1} and Rs.101.8 hr^{-1}. It indicated this developed machine to be more labour saving and economical also.

CAK 22

Efficacy of Earthworm Species for Preparation of Vermicompost from Coconut Coir Waste

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The investigation was conducted at Centre of Excellence on Mango, Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Coir waste as a main substrate and cow dung are used as a waste material in different combinations for preparation of vermicompost along with two species of earthworms *viz., Eudrilus euginae* and *Eisenia foetida*. The homogenized sample from each experimental pot collected at 30 days interval, processed and analyzed to monitor the changes in nutrient content. The results of the experiment showed that on composting the pH of all organic residues decreased slightly during composting. There was gradual increase in electrical conductivity of composting materials from 30 DAI to the 180 DAI of composting. Finally, significantly highest total nitrogen content (1.30%) was noted in coir waste: cow dung (20:80) combination compost and lowest total nitrogen content of (0.97%) was noted in 100 per cent coir waste. In case of phosphorus content coir waste: cow dung (20:80) combination was found to be significantly superior over rest of the treatments. The maximum total

phosphorus content (0.52%) was recorded in coir waste: cow dung (20:80) combination and minimum total phosphorus content (0.39%) was noticed in 100 per cent coir waste. On final day of composting maximum total potassium, content (0.83%) noted in coir waste: cow dung (20:80) combination treatment and lowest total potassium content of (0.57%) was noted in 100 per cent coir waste. There was gradual and considerable reduction in the C: N ratio of all the treatments with the advancement in period up to 180 days. Micronutrients also observed to be increased progressively. It was concluded that amongst the various combinations of organic residues evaluated, cow dung was found to be the best source for rapid composting followed by 20:80 combination of coir waste and cow dung. As far as the manurial value is concerned, 20:80 combination of coir waste and cow dung found to be the best combination from the point of macro and micro nutrient contents. Between the two species of earthworms, *Eudrilus euginae* species of earthworm found superior over *Eisenia foetida* species of earthworm in respect of most of the parameters studied. The manurial value of all the compost products improved due to vermicomposting.

CAK 23

Effect of Different Levels of NPK along with Soil and Foliar Application of Zinc and Boron on Yield of Cashew Nut (*Annacardium occidentale* L.) in Lateritic Soil of Konkan

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The effect of four levels of NPK (1.0**:**0.25**:**0.25, 1.0**:**0.50**:**0.50, 1.5**:**0.75**:**0.75 and 2.0**:**1.0**:**1.0 kg NPK per tree) with or without soil application of boron through borax @ 50g + zinc through zinc sulphate @ 125g tree^{-1} or foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} on yield, leaf nutrient status at various growth stages and on physico-chemical properties of soil at different growth stages of cashew nut variety Vengurla-4 were studied. The highest yield of cashew nut (10.36 kg tree^{-1}) per tree and number of nuts kg^{-1} were recorded with the application of recommended dose of fertilizer + soil application of boron through borax @ 50 g + zinc through zinc sulphate @ 125g tree^{-1} (T_6). Application of 1.0:0.50:0.50 NPK kg tree^{-1} + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{11}) recorded significantly higher total nitrogen and copper in cashew nut leaves, while Application of 2.0:1.0:1.0 NPK kg tree^{-1} + boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{13}) recorded significantly higher total micronutrient (*viz.*, Mn, Zn and B) in cashew nut leaves. In case of soils properties, application of 1.0:0.50:0.50 NPK kg tree^{-1} + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{11}) recorded significantly higher pH, EC, available iron, application of 1.5:0.75:0.75 kg tree^{-1} + boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{12}) exhibited significantly higher available phosphorus and copper, application of 2.0:1.0:1.0 NPK kg tree^{-1} + boron through borax @0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{13}) recorded significantly higher organic carbon and available Mn, while application of NPK @ 1.0:0.25:0.25 kg tree^{-1} + boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% tree^{-1} (T_{10}) showed significantly higher available nitrogen and zinc. However, the treatments T_6, T_{10}, T_{12} and T_{13} were at par with the application 1.0**:**0.50**:**0.50 kg NPK per tree along with spraying of foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% (T_{11}). By considering the higher yield of cashew nut, NPK and micro-nutrient (*i.e.* Fe, Mn, Cu, Zn and B) content in leaf at different growth stages of cashew (*i.e.,* at new emergence shoot stage, flowering stage, nut setting stage and at harvest) and availability of nutrients in the soil, application 1.0:0.50:0.50 kg NPK per tree along with spraying of foliar application of boron though borax @ 0.25% + zinc through zinc sulphate @ 0.5% was to be beneficial in lateritic soils of Konkan.

CAK 24

Indigenous Techniques for Desalinization in Coastal Saline Soils of Maharashtra State

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The coastal belt of Maharashtra state also known as Konkan region has 720 km of coastal length with 54 creeks. The

coastal saline soils to the tune of approximately 65645 ha were the result of periodical inundation of cultivable land by creek/sea water during high tides. Such periodical inundation renders the otherwise fertile soils progressively saline and in time make it completely unfit for growing any crop. The local tillage practices *viz.,* construction of embankment, *ulkatni, vindhani* and excavation of *chali* are generally followed in coastal saline soils. In *ulkatani*, the field is dug with crowbar or pick axe and big clods are turned upside down during the months of April, May to accelerate the process of desalinization with the first showers. In *vndhani* small pits of about 25 cm deep are dug at a distance of 30-45 cm apart. With the onset of monsoon, the rain water accumulates in these pits and leach the salts. *Chali* is a practice of excavation of peripheral drains of 60 cm wide and 30 cm deep along the bunds of plots. *Chali* functions as an internal drain as well as water storage. Rice is the only crop grown in coastal saline soils due to abundant rainfall during kharif season. The local practice of *Awatni i.e.,* superficial planting of seedlings along with mud ball is followed in coastal saline area. In this method circular or rectangular mounds are prepared in the field for rice nursery. Seedlings when ready for transplanting are uprooted keeping mud balls intact are thrown in the field. This method of planting avoids direct contact of roots of seedlings with the saline soils and thus minimizes seedling mortality.

CAK 25

Screening of Mango Varieties against Mango Hopper, *Idioscopus niveosparsus* Leth and Black Sooty Mould, *Capnodium mangiferae* Cooke under Coastal Konkan Conditions

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Mango is an important fruit crop and apart from Alphonso many different varieties of mangoes are being grown in Konkan region of Maharashtra. Mango hopper, *I. niveosparsus* is the major pest of mango causing severe yield losses. The mango hopper excretes honey dew on the plant parts, on which the black sooty mould is formed, subsequently *C. mangiferae* grows affecting the photosynthesis. The efforts were made to screen the promising mango varieties against mango hopper and black sooty mould during 2013-14 and 2014-15 at Regional Fruit Research Station, Vengurle, Maharashtra under the study. The results revealed that, out of 15 mango varieties screened none of the variety was found free from mango hopper and black sooty mould. The least incidence of mango hopper was recorded on the exotic variety Lily (10.66 hoppers panicle^{-1}) and the maximum incidence was recorded on variety Alphonso (18.55 hoppers panicle^{-1}). The peak incidence period of mango hopper ranged between 3rd SMW to 5th SMW in different mango varieties. The least growth of black sooty mould was observed on variety Lily (31.77%) and the maximum growth of black sooty mould was recorded in variety Alphonso (46.46%).

CAK 26

Effect of Mycorrhizae Inoculum on Soil Phosphorus Content and Growth of Mango and Cashew Grafts in Konkan Coastal Zone

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Mycorrhizae play a vital and vigorous role in growth and phosphate mobilization in many agricultural crops. Mycorrhizae help to these crops in mobilization and solubilisation of phosphorus content. Hence, in order to find out the efficient strain of mycorrhizae for mango and cashew fruit crops, the experiment was carried at Regional Fruit Research Station, Vengurle to study the effect of mycorrhizal inoculum on growth and phosphate solubilisation in Mango and Cashew grafts. Seventy two grafts of mango and cashew were maintained in each set for this study. The grafts having 2 kg capacity of polybag of uniform age and growth were used in the experiment. The mycorrhizal strains *Glomus intraradices* multiplies on guinea grass was used for inoculation. All recommended nursery management practices were followed during experimentation. The initial available phosphorus in soil was determined prior to inoculation of the mycorrhizae. The mycorrhizae inoculation (Vengurle and Goa strains) was done @ 100 g graft^{-1}. Estimation of available phosphorus in the soil was done by using Bray's method at 60, 120 and 180 days after inoculation of the mycorrhizal culture. Observations on growth *i.e*., length of shoots and roots of

grafts was also measured. The results of experiment indicated that, the Vengurle mycorrhiza strain i.e., *Glomus intraradices* which is isolated from the rhizosphere soil of mango and cashew was shown significant change in increasing phosphorus content in soil as well as growth parameters of mango and cashew grafts. Hence native strains were found to be effective for growth and phosphorus content in soil of mango and cahew.

CAK 27

Response of Hybrid Rice to Different Crop Establishment Methods and Fertilizer Sources under Konkan Upland Situation

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Field experiments were conducted to assess the response of hybrid rice to different crop establishment methods and fertilizer sources under Konkan upland situation on lateritic soil during *kharif*, 2009 and 2010. There were five main plot treatments comprised crop establishment methods viz., transplanting (T_1), pre-monsoon dibbling of seeds (T_2), dibbling of seeds on the onset of monsoon (T_3), transplanting of seedling by *thomba* method (T_4) and system of rice intensification technique (T_5) and three sub plot treatments comprised of fertilizer sources *viz*., RDF (120:60:60 NPK kg ha^{-1}) (F_1), placement of urea-DAP briquettes (F_2) and placement of Urea-suphala briquettes (F_3). Thus, there were 15 treatment combinations, replicated three times. Results revealed that rice crop established by transplantingrecorded significantly higher growth as well as yield attributes resulting into more grain and straw yield over all other crop establishment methods except *thomba* method and SRI technique.

CAK 28

Development of Temperature Control System to Improve the Performance of Solar Dryers in Coastal Region

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Drying is one of the most conventional methods used to preserve and store agricultural products. It works on the basis of reduction in water content in the product. It also helps to protect the product from fungal and microbial attacks. Over drying due to excess temperature and increasing the time for drying due to lower temperature is the limitation in solar dryers. Solar dryers work efficiently without any control strategy due to ambient solar intensity and less variations in temperature and humidity in regions apart from coastal regions. In coastal region, the variation in temperature and relative humidity is more fluctuating and uncertain. Hence, there is a need to cascade control system with solar dryer to maintain desired temperature and humidity in it. In order to identify the temperature variation, three different shaped cabinet dryers were studied from morning to evening with respect to solar intensity. The results were discussed in the paper. Analog as well as digital control strategies help in getting the desired environment inside solar dryers. Applying control strategy needs temperature measurement inside the solar dryer. Electrical sensor such as thermistor with electronic circuitry controls the exhaust fan. It will switch the exhaust fan ON or OFF as per the temperature inside solar dryer. Exhaust fan acts as a final control element in the proposed control system. The control of air temperature, using electronic control system, helps to improve the performance of solar dryers that will make it sustainable and feasible in coastal region.

CAK 29

Yield, Quality of Rice and Soil Fertility as Influenced by Application of Zinc and Sulphur in Medium Black Soil of Konkan

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A field experiment was conducted at agronomy farm, Regional Agricultural Research Station, Karjat, Dist. Raigad, Maharashtra during *kharif* 2017 using rice variety KJT-3. The experiment was laid out in a Randomized Block Design with twelve treatments replicated thrice. Significantly the highest rice grain (49.24 q ha^{-1}) and straw yield (55.64 q ha^{-1}) was recorded in the treatment where RDF + soil application of $ZnSO_4$ @ 15 kg ha^{-1} at the time of transplanting was applied which was at par with treatment receiving RDF + soil application of ZnO @ 30 kg ha^{-1} at the time of transplanting & 30 DAT and RDF + soil application of $ZnSO_4$ @ 30 kg ha^{-1} at the time of transplanting and 30 DAT. The quality parameter like length, breadth and amylose content were determined. Amylose content ranged between 24.54 to 30.84 % while grain type was MS and grain chalkiness were absent. Comparatively the higher nutrient concentrations of available N, P_2O_5 and K_2O were found in the treatment receiving RDF + soil application of $ZnSO_4$ @ 15 kg ha^{-1} at the time of transplanting. This treatment was found to gave highest rice grain yield per hectare with better grain quality parameter and favorable effects on soil characteristics.

CAK 30

Effect of Zinc and Sulphur Fortified Briquette Application on Yield and Quality of Rice in Medium Black Soils of Konkan

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A field experiment was conducted to study the effect of different briquettes fortified with zinc and sulphur on yield, nutrient content and quality of rice KJT-3 at agronomy farm, Regional Agricultural Research Station, Karjat, Dist. Raigad, Maharashtra during *kharif* 2017. The experiment was laid out with Randomized Block Design with eleven treatments replicated thrice. It was revealed from the study that grain yield, straw yield, quality parameters and organic carbon were improved significantly due to application of different briquettes fortified with zinc and sulphur compared to control. Among the various treatments application of Konkan Annapurna briquettes fortified with 10 kg $ZnSO_4$ registered significantly higher grain yield (52.98 q ha^{-1}), straw yield (61.91 q ha^{-1}), organic carbon (1.22 %) and better quality of rice.

CAK 31

Yield, Quality and Nutrient Uptake of Elephant Foot Yam as Influenced by Irrigation and Fertilizer Levels in Lateritic Soils of Konkan Region

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A field experiment was conducted during 2016-17 at research field of All India Coordinated Research Project on Tuber Crops, Central Experiment Station, Wakawali, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra to study the effect of irrigation and fertilizer levels on yield, quality and nutrient uptake of elephant foot yam. The soil of experimental field was sandy clay loam in texture and acidic in reaction. It was very low in available nitrogen and medium in available phosphorus and potassium with high organic carbon. The experiment was laid in split plot design. The main plot treatments comprised of three irrigation levels (I_1-Irrigation at 100% PE, I_2-Irrigation at 75% PE, I_3-Irrigation at 50% PE) and the sub-plot treatments comprised of four fertilizer levels (F_1-125% RDF, F_2-100% RDF, F_3-75% RDF, F_4-50% RDF). Thus, there were in all 12 treatment combinations, replicated thrice. Besides,

there was one control (C_1-check basin) treatment with recommended dose of fertilizer in combination of surface irrigation @ 60 mm depth after each 5 days of interval which was kept separated beside main and sub plot treatments. The results revealed that, the treatment irrigation at 100% PE through drip recorded significantly highest corm diameter (48.78 cm), corm weight (1.845 kg) and corm yield (35.0 t ha^{-1}) than rest of the irrigation levels under study. The increase in corm yield in treatment I_1 i.e. irrigation at 100% PE through drip was to the tune of 10.71, 14.89 and 8.52 per cent over the treatments I_2, I_3 and C_1, respectively. Similarly, the quality parameters like moisture (70.50), ash (1.83) and protein (3.88) per cent in corm were found significantly superior under the treatment irrigation at 100% PE through drip than rest of the irrigation levels. The statistically superior values of total uptake of N (1.33 kg ha^{-1}) and P (0.82 kg ha^{-1}) were recorded by the treatment irrigation at 100% PE through drip. In case of fertilizer levels, the treatment F_1 *i.e.,* 125% RDF was significantly superior in yield the yield attributes *viz.* corm diameter (49.38 cm), corm weight (2.094 kg $plant^{-1}$) and corm yield (34.3 t ha^{-1}). The increase in corm yield in treatment F_1 *i.e.,* 125% RDF was to the tune of 4.55, 8.72, 13.10 and 8.21 per cent over the treatments F_2, F_3, F_4 and C_1, respectively. Similarly, the quality parameters like moisture (76.67), ash (1.86) and protein (4.32) per cent in corm were found significantly superior under the treatment F_1 *i.e.,* 125% RDF than rest of the fertilizer levels. The statistically superior values of total uptake of N (1.42 kg ha^{-1}), P (0.84 kg ha^{-1}) and K (4.97 kg ha^{-1}) were recorded by the treatment F_1 *i.e.,* 125% RDF. Under different irrigation levels, the total water applied was 109.7 (I_1), 82.27 (I_2), 54.85 (I_3), respectively. While in surface irrigation (C_1) total water applied was 126.0 ha-cm. The treatment combination I_3F_1 recorded highest (586.8 kg ha^{-1} cm^{-1}) water use efficiency, while lowest (154.2 kg ha^{-1} cm^{-1}) was with surface irrigation. The highest B:C ratio was recorded by the treatment combination I_1F_1 *i.e.,* irrigation 100% PE through drip + 125 % RDF (1.82) followed by the treatment combination I_1F_2 *i.e.,* irrigation 100% PE through drip +100% RDF (1.77). The lowest B:C ratio was recorded by the treatment combination *i.e.,* irrigation at 50% PE through drip + 50% RDF (1.48). From the results it can be concluded that in lateritic soils of Konkan region for obtaining higher yield, better quality, efficient nutrient uptake and maximum B:C ratio in elephant foot yam, irrigation should be scheduled at 100 per cent PE (total water applied 109 ha.cm at alternate day after recession of monsoon) with 125 per cent of recommended dose of fertilizer (100:75:100 kg N, P_2O_5 and K_2O ha^{-1}) through soil application.

CAK 32

Response of Brinjal to Integrated Nutrient Management in Lateritic Soils of Konkan Region

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A field experiment conducted during summer 2016 on response of brinjal to integrated nutrient management in lateritic soils at Dapoli. The experiment was laid out in Randomized Block Design (RBD) comprising eleven treatment combinations replicated thrice and observations were recorded at 30, 60, 90 days after transplanting (DAT) and after harvest. The effect of different inorganic fertilizers and organic manures viz., FYM and vermi-compost either alone or in combinations on growth attributing characters, yield attributing characters and yield of brinjal (cv. Bandhtivare local) were studied. The growth and yield attributing characters of brinjal increased gradually from transplanting to harvest of the brinjal crop. The combined application of 25 % RDF through inorganics and 75% RDN through vermi-compost (T9) was found to be responsible for producing beneficial effect on growth attributing characters (*viz*., plant, number of leaves, number of branches, root length, fresh and dry weight of brinjal plant) and yield attributing character (*viz*., fruit diameter, weight of fruit, number of fruits and yield of brinjal plant) with exception of fruit length of brinjal which was seen maximum by the application of 50 % RDF + 50% RDN through vermicompost (T10) at all growth periods of observations. It was closely followed by the treatment (T6) 25 % RDF through inorganic fertilizers and 75 % RDN through FYM indicating integration is a need of future for growth and maximising yield of brinjal.

CAK 33

Effect of Integrated Nutrient Management on Yield and Nutrient Uptake by Chilli (*Capsicum annum* L.) in Lateritic Soil of Konkan, Maharashtra

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A field experiment was conducted at Vegetable Improvement Scheme, Pangari Block, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during *rabi* 2014-2015. The field experiment was laid out in Randomized Block Design comprising of thirteen treatments replicated thrice. Treatments comprised of T1 [25% N through FYM + 75% N through urea], T2 [50% N through FYM + 50% N through Urea], T3 [75% N through FYM + 25% N through Urea], T4 [25% N through vermicompost + 75% N urea], T5 [50% N through vermicompost + 50% N through urea], T6 [75% N through vermicompost + 25% N through urea], T7 [25% through N Poultry manure + 75% N through urea], T8 [50% through N poultry manure + 50% N through urea], T9 [75% N through poultry manure + 75% N through urea], T10 [25% N through groundnut cake + 75% N through urea], T11 [50% N through groundnut cake + 50% N through Urea], T12 [75% N through groundnut cake + 25% N through urea] and T13 [absolute control]. It was observed that the substitution of N through poultry manure to the extent of 50 per cent (and remaining 50 per cent through urea) was observed to be the best treatment amongst different combinations of organic manures with urea. It produced highest yield (green, dry matter of green chilli pod and stover) of chilli and weight of fruit per plant. The NPK uptake by pod and stover was also recorded maximum in combined application of poultry manure with urea. Maximum uptake of N (36.08 kg ha^{-1}) and P (3.40 kg ha^{-1}) was recorded with treatment T_8 i.e. application of 50% N through poultry manure and 50% N through urea while the maximum uptake of K (74.58 kg ha^{-1}) was recorded with treatment T_9 i.e. application of 75% N through poultry manure and 25% N through urea. The data regarding micronutrients uptake was found to be non-significant except total Mn and Zn uptake. The maximum total uptake (chilli pod + stover) of Fe (637.95 g ha^{-1}), Zn (1041.31 g ha^{-1}), and Cu (1259.12 g ha^{-1}) was recorded in the treatment T_9 receiving 75% N through poultry manure and 25% N through urea while the maximum Mn uptake (2434.36 g ha^{-1}) was observed in treatment T_8. The combined use of organics (farmyard manure, vermicompost, poultry manure and groundnut cake) along with the inorganic fertilizers increased nutrient use efficiency of crop. Integrated use of organic manures along with chemical fertilizers not only produced highest and sustainable crop yields but also enhanced the efficiency of added fertilizers.

CAK 34

Influence of Integrated Nutrient Management on Physico-Chemical Properties of Soil and Yield of Chilli (*Capsicum annum* L.) in Alfisols of Konkan Region of Maharashtra

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An investigation was carried out during 2014 and 2015 *rabi* season at Vegetable Improvement Scheme, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra state (India). The field experiment was laid out in Randomized Block Design comprising of thirteen treatments replicated thrice. Treatments comprised of T_1 [25% N through FYM + 75% N through Urea], T_2 [50% N through FYM + 50% N through Urea], T_3 [75% N through FYM + 25% N through Urea], T_4 [25% N through Vermicompost + 75% N Urea], T_5 [50% N through Vermicompost + 50% N through Urea], T_6 [75% N through Vermicompost + 25% N through Urea], T_7 [25% through N Poultry manure + 75% N through Urea], T_8 [50% through N Poultry manure + 50% N through Urea], T_9 [75% N through Poultry manure + 75% N through Urea], T_{10} [25% N through Groundnut cake + 75% N through Urea], T_{11} [50% N through Groundnut cake + 50% N through Urea], T_{12} [75% N through Groundnut cake + 25% N through Urea] and T_{13} [Absolute control]. Among the treatments, application of 50 % N through

Poultry manure and 50 per cent N through urea was recorded highest yield and yield contributing character such as green pod yield of chilli (128.01 q ha^{-1}), dry matter of green pod yield (11.22 q ha^{-1}), stover yield (15.28 q ha^{-1}) and weight of fresh fruit/ plant (345.63 g $plant^{-1}$). The different sources of organic manures and their combination with of inorganic fertilizer (urea) do not showed any significant effect on physico-chemical properties (pH, Electrical conductivity and organic carbon) of soil.

CAK 35

Effect of Intercropping and Planting Methods on Yield and Nutrient uptake by Sugarcane under Lateritic Soil of Konkan Region

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The present investigation entitled was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri during *suru* season of 2015. The trial was laid out in a randomized block design. There were seven treatments which were replicated thrice. The treatments mainly comprised of sole sugarcane with 90 cm spacing (T_1), sole PRS i.e. 60 x 60 – 120 cm (T_2), PRS + groundnut (T_3), PRS + sweet corn (T_4), PRS + cabbage (T_5), PRS + amaranthus (T_6) and PRS + green gram (T_7). Results revealed that treatment sole paired row planted sugarcane (60 x 60 –120 cm) produced higher yield as compared to the conventional method of planting (90 cm in furrows) under study. Among the different treatments of planting methods and intercropping systems, paired row planted sugarcane intercropped with green gram recorded highest cane yield (89.03 t ha^{-1}), highest number of millable canes (78251.67), green top yield (11.66 t ha^{-1}) and trash yield (9.15 t ha^{-1}). Under different intercropping systems, the intercrop sweet corn recorded highest yield (8277 kg ha^{-1}) and sugarcane equivalent yield (146.38 t ha^{-1}). The nutrient uptake by crop was significant with nitrogen and potassium, but it was non-significant in case of phosphorus uptake. The maximum nutrient uptake nitrogen (198.93 kg ha^{-1}), phosphorus (15.17 kg ha^{-1}) and potassium (289.47 kg ha^{-1}) recorded when paired row planted sugarcane intercropped with green gram. On the basis of results obtained during study, it can be concluded that the paired row planting method of sugarcane found to be more beneficial and profitable than their conventional planting (90 cm).

CAK 36

Phenolic Compounds in Plants and Agri-Industrial By-Products

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Phenolic compounds, ubiquitous in plants are an essential part of the human diet, and are of considerable interest due to their antioxidant properties. These compounds posses an aromatic ring bearing one or more hydroxyl groups and their structures may range from a simple phenolic molecule to that of a complex high-molecular weight polymer. The antioxidant activity of phenolic compounds depends on the structure, in particular the number and positions of the hydroxyl groups and the nature of substitutions on the aromatic rings. Fruits, vegetables and beverages are the major sources of phenolic compounds in the human diet. The food and agricultural products processing industries generate substantial quantities of phenolic-rich by-products, which could be the valuable natural sources of antioxidants. These compounds, one of the mostwidely occurring groups of phytochemicals, are of considerable physiological and morphological importancein plants. These compounds play an important role ingrowth and reproduction, providing protection against pathogens and predators, besides contributing towards the colour and sensory characteristics offruits and vegetables. Flavonoids constitute the largest group of plantphenolic, accounting for over half of the eight thousand naturally occurring phenolic compounds. Flavonoids are low molecular weight compounds, consisting of fifteen carbon atoms, arranged in a C6–C3–C6 configuration. While the use of naturally occurring phenolic compounds as food antioxidants is particularly interesting, practical aspects that need to be considered include extraction efficiency, availability of sufficient raw material, and toxicity or safety considerations. Major phenolic compounds with quantifiable data on their sources and potential applications as modifiers of food properties are reviewed.

CAK 37

Effect of Organic Manures and Inorganic Fertilizers on Soil Physico-Chemical Properties and Yield of Brinjal in Konkan Region

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A field experiment was conducted during summer 2016 to study the effect of organic manures and inorganic fertilizers on yield of brinjal and physico-chemical properties of soil in Konkan region at Dapoli. The experiment was laid out in Randomized Block Design (RBD) comprising eleven treatment combinations replicated thrice and observations were recorded at 30, 60, 90 days after transplanting (DAT) and after harvest. The effect of different inorganic fertilizers and organic manures *viz.,* FYM and vermicompost (VC) either alone or in combinations on yield of brinjal (*cv.,* Bandhtivare local) and physico-chemical properties of the soil were studied. The physico-chemical properties *viz.,* bulk density, particle density and mechanical composition of soil did not show a significant change in their status however, pH, EC, Organic C, showed significant improvement as a consequence of various treatment combinations. In general, physico-chemical properties of experimental plot represented a typical lateritic soil of Konkan. The results indicated that the maximum yield (27.04 kg plot^{-1} and 26.83 t ha^{-1}) was registered in the treatment where conjunctive use of 75 % RDN through organic (VC) and 25 % RDF through inorganic fertilizer (T_9) was done whereas minimum yield (13.44 kg plot^{-1} and 13.34 t ha^{-1}) was observed in the treatment where no fertilizer application was done i.e. control treatment (T_1). The application of 25 % RDF through inorganic fertilizers and 75 % RDN through vermicompost had shown its influence on yield of brinjal crop indicating integration is a need of future for sustaining soil fertility and maximising brinjal yield.

CAK 38

Performance Evaluation of a Domestic Solar Tunnel Dryer

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A solar tunnel dryer is designed and developed. The essential components of the dryer are air inlet (air vent), absorber box, drying tray, transparent dome, GI frame and chimney for discharging exit air. The wall of the solar drying system was made of Kaddapa. Inside the wall flat G.I. plate with black paint was used as an absorber. The glass wool and thermocol material then properly insulates the absorber and wall of the solar dryer. A door was provided to the dryer for easy loading and un-loading of product. A dome was then provided for the resting of the transparent thick plastic sheet. The UV polythene of 200-micron gauge was used to collect the solar energy heat. The vertical distance between two trays is 25 cm. The performance of the dryer is taken for No load test and load test with different fruits, vegetables and fish. The temperature attained inside the solar tunnel dryer was 10-15°C higher than the atmospheric temperature. Drying of grapes under solar tunnel dryer was achieved in less than 45 to 50 % time as required during open sun drying. Drying of three varieties of fish was also don and it was observed that the drying rate was higher for solar tunnel dryer compared to open sun drying. For variety Dhoma, drying rate for solar tunnel dryer was 55.65 g h^{-1} and for open drying 29.41 g h^{-1}; for variety Bangda, drying rate for solar tunnel dryer was 33.03 g h^{-1} and 26.49 g h^{-1} for open drying; for variety Kolambi, drying rate for solar tunnel dryer was 128.65 g h^{-1} and for open drying it was 35.67 g h^{-1}. For potato chips the drying rate by solar tunnel dryer was 14% higher than open sun drying.

CAK 39

Value Addition of Spices: A Boon to Coastal Farmers of Konkan Region of Maharashtra

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India is having 7517 km of costal border out of which Maharashtra occupied 720 km of costal border. India is the land of spices. The cultivation of spices under costal Konkan region of Maharashtra will boon to farmers for achieving higher returns. Black pepper, cardamom, nutmeg, turmeric, ginger, chilli etc. are the major spices grown under costal Konkan region of Maharashtra. The majority of the spices are shade loving and can be grown as intercrops in the gardens like arecanut, coconut, mango, cashew etc. Due to lack of proper knowledge about processing and value addition of these spices, costal farmers are fetching less prices in the market. The gap of primary and secondary processing of spices needs to be bridged for its improvement in quality. The diversification of the value-added products of the spices is necessary as per the demand from the domestic as well as global market. Beside this most of the spices are having nutraceutical values and used in the preparation of various medicines. The post-harvest handling, management, processing and value addition of these spices are having future prospectus considering the present scenario of international trade. The primary processing of the major spices includes washing, threshing, blanching, curing, drying, cleaning, grading and packaging. Some specialized practices like polishing in turmeric, garbling in cardamom etc. are followed for improving the quality of spice commodities. The care should be taken during post-harvest handling of spices so that processed products must be hygienic, free from any health hazards substances and contaminants. The various value-added products like white pepper, green pepper, canned green pepper, bottled green pepper, bleached cardamom, cardamom seed powder, encapsulated cardamom, nutmeg powder, jam, candy, butter, mace oil, turmeric powder, curcumin, ginger candy, ginger preserve, ginger paste, chilli powder, chilli oleoresin etc. are prepared from the spices grown under costal region of Konkan. The various innovative products like spice flavored chocolates, spice fragrance candles, bathing bars, beauty creams etc. are also prepared from the various spices. The popularization of these products among spices producing costal Konkan region farmers of Maharashtra will fetches betters returns to them which helps to improve their economical as well as social status.

CAK 40

Nutritive Value of Promising Varieties of Rice Grown in Konkan Region

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The investigation pertaining to the studies on the nutritive values of promising rice varieties grown in Konkan region under nutrient management was conducted during *kharif*, 2011 and 2012 at the farm of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri. A perusal of the data reveals that there were significant differences in protein content, crude fat, crude fiber, carbohydrate content and ash content of rice grain due to application of different nutrient management treatments. The maximum values of protein observed in the treatment T_{11} during first year of study. In the second year treatment T_{12} was significantly superior in both varieties of rice. The maximum values of crude fat and crude fiber in Sahyadri - 3 was observed in the treatment T_{12} (2.07 % and 0.81 %) during first year of study. In the second year, treatment T_2 (2.10 % and 0.82 %), which was significantly superior over rest of the treatments. The maximum values of carbohydrate observed in the treatment T_8 (82.15 % and 82.19 %), which was significantly superior to rest of the treatments during first year of study. In the second year treatment T_2 was significantly superior and recorded with highest carbohydrate value (82.06 % and 82.18 %) in both hybrids of rice. The maximum values of ash in both varieties of rice observed in the treatment T_4 (9.44 % and 9.46 %) during first year of study. In the second year, treatment T_8 was significantly recorded with highest ash content (9.59 % and 9.41 %). The maximum values of crude fat observed in variety Sahyadri – 4 in the treatment T_3 (2.05 %) during first year of study. In the second year, treatment T_2 (2.11 %) was significantly superior. The maximum values of crude fiber observed in variety Sahyadri -4 in the treatment T_{12} and T_{13} (0.81 %) during first year of study. In the second year, treatment T_2 (0.81 %) was recorded with highest values of crude fiber.

CAK 41

Effect of Different Growth Retardants and De-Topping on Growth and Yield of Okra (*Abelmoschus esculentus*) in North Coastal Konkan Region of Maharashtra

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A field experiment was conducted during the *kharif* season of 2013 at the khar land research station Panvel, Dist. Raigad, Maharashtra state. The aim of study was to evaluate the effectiveness of different growth retardants and de-topping on growth and yield of okra. The experiment was laid out in Randomized Block Design with seven treatments in three replications. The treatments were consisted of Pachlobutrazol spray @ 25ppm at 45 DAS (T_1), pachlobutrazol spray @ 50 ppm at 45 DAS (T_2), pachlobutrazol spray @100 ppm at 45 DAS (T_3), one cycocel spray @ 0.250 kg a.i ha^{-1} at 45 DAS (T_4), two cycocel spray @ 0.250 kg a.i ha^{-1} at 45 DAS and 60 DAS (T_5), de-topping at 35 DAS (T_6) and control (T_7). The de-topping at 35 DAS and foliar spray of pachlobutrazol and cycoceal significantly influenced on plant height, number of branches per plant, number of internodes per main stem, and fruit yield of okra. In case of fruit yield. de-topping at 35 DAS recorded significantly higher yield (12.08 t ha^{-1}) than the rest ones except the foliar spray of pachlobutrazol @ 100 ppm at 45 DAS (11.62 t ha^{-1}) which was at par with it. The lowest fruit yield (7.40 t ha^{-1}) was recorded from control (T_7).

CAK 42

Evaluation of Chilli (*Capsicum annuum* L.) Genotypes Grown under Konkan Agro-Climatic Condition

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Chilli (*Capsicum annuum* L.) is one of the important vegetable crops grown during *rabi* season in Konkan. Various local types are preferred for cultivation which have better market especially for pickle and other value addition. The field experiment was conducted at Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the *rabi* season of 2014-15. The Thirteen chilli genotypes Viz. T_1- DPL CA- 1.1, T_2- DPL CA- 2.1, T_3- DPL CA- 3.1, T_4- DPL CA- 4.1, T_5 - DPL CA- 5.1, T_6- DPL CA- 6.1, T_7- DPL CA- 10.1, T_8- DPL CA- 11.1, T_9- DPL CA- 13.1, T_{10} - DPL CA- 14.1, T_{11} - DPL CA- 15.1, T_{12} - DPL CA- 7.1 and, T_{13} - Konkan Kirti were replicated thrice in Randomized Block Design for evaluation. During investigation it was observed that number of branches, days required for horticultural and physiological maturity from pollination and days to first harvest varied non-significantly. Whereas plant height, number of leaves per plant and plant spread, all flowering characters, fruiting parameters, yield and yield attributing characters and chemical parameters varied significantly. Highest plant height (107.57 cm) was recorded by genotype $T_{11.}$ Highest number of branches (9.83) was recorded in genotype T_7. The maximum number of leaves (881.67) was recorded in genotype T_6. The highest plant spread (69.07 cm) was recorded in genotype T_{12}. Genotype T_6 and T_{13} took minimum days (27.67) for initiation of flowering as well as days to fifty per cent flowering (38.55). Highest fruit length (7.93 cm) observed in genotype T_8, whereas fruit diameter (1.47cm) in T_{11} and fruit weight (3.70 g) was highest in genotype T_1. Minimum days (60 days) for first harvest were recorded by genotypes T_6, T_7, T_{10}, T_{11} and T_{12}. Maximum harvesting span (54 days) was recorded in genotype T_7 and T_{10}. Highest number of pickings (8) was recorded in genotypes T_1, T_2, T_4, T_5, T_7, T_9, T_{10} and T_{13}. Genotype T_6 recorded maximum number of fruits (173.99) per plant. Overall yield (23.43 t ha^{-1}) was highest in genotype T_{11}. Maximum content of β – carotene (594.00 µg 100 g^{-1}) and capsaicin (0.254 mg 100 g^{-1}) where as ascorbic acid content was highest in T_{13} (160.8 mg 100 g^{-1}). On the basis of overall plant growth habit, flowering attributes, physical parameters, yield and yield attributing characters and chemical parameters out of 13 genotypes 6 promising genotypes *viz.,* $T_{11,}$ $T_{7,}$ $T_{9,}$ $T_{6,}$ T_{12} and $T_{10.}$ were selected for further studies.

CAK 43

Effect of Application of Different Levels of N, K and Zn on Nutrient Balance and Economics of Groundnut Crop

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A field experiment was conducted to study the effect of application of different levels of N, K and Zn nutrient balance and economics of groundnut crop at Irrigation Scheme, Pangari Block of C.E.S., Wakawali during *kharif* season of 2012 and 2013. The field experiment was laid out in split-split plot design comprising of 27 treatment combinations replicated in thrice. Main plots consisting of three levels of nitrogen application (N: 12.5, 25 and 50 kg ha^{-1}). In sub plot, treatment comprised of three levels of potassium (K_2O: 15, 30 and 45 kg ha^{-1}) and sub-sub plot treatment comprised of three levels of zinc application (Zn: 2.5, 5.0 and 7.5 kg ha^{-1}). In case of actual gain or loss of nutrient, the highest gain of available nitrogen, potassium and zinc were recorded in the $N_3K_3Zn_3$, $N_3K_2Zn_2$ and $N_3K_2Zn_2$ treatments combinations, respectively. The application of nitrogen at (50 kg ha^{-1}) recorded the maximum net return and benefit cost ratio in both the years. In the year 2012, the maximum net returns and B:C ratio were recorded in the treatment K_2 (K_2O: 30 kg ha^{-1}). While, the treatment K_3 (K_2O :45 kg ha^{-1}) recorded the highest net returns and B:C ratio in the year 2013. In respect to zinc levels the treatment Zn_2 (5 kg ha^{-1}) and Zn_1 (2.5 kg ha^{-1}) recorded the maximum net returns and B:C ratio in the year 2012. However, the highest net returns and B:C ratio were recorded with application of zinc at 7.5 kg ha^{-1} (Zn_3).

CAK 44

Growth, Yield attributes and Yield of Sugarcane as Influenced by Intercropping and Planting Methods under Lateritic Soil of Konkan Region

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The present investigation was conducted at Agronomy Farm, College of Agriculture, Dapoli. During *suru* season of 2015. The trial was laid out in a randomized block design. There were seven treatments which were replicated thrice. The treatments mainly comprised of sole sugarcane with 90 cm spacing (T1), Sole PRS (Paired row sugarcane) *i.e.,* 60 x 60 – 120 cm (T2), PRS + groundnut (T3), PRS + sweet corn (T4), PRS + cabbage (T5), PRS + amaranthus (T6) and PRS + green gram (T7). Results revealed that treatment sole paired row planted sugarcane (60 x 60 –120 cm) produced higher growth, yield attributes and yield as compared to the conventional method of planting (90 cm in furrows) under study. Among the different treatments of planting methods and intercropping systems, paired row planted sugarcane intercropped with green gram recorded highest cane yield (89.03 t ha^{-1}), highest number of millable canes (78251.67), green top yield (11.66 t ha^{-1}) and trash yield (9.15 t ha^{-1}). Under different intercropping systems, the intercrop sweet corn recorded highest yield (8277 kg ha^{-1}) and sugarcane equivalent yield (146.38 t ha^{-1}). Similarly, paired row planted sugarcane intercropped with green gram recorded significantly highest growth attributing characters (plant height, girth of sugarcane andnumber of tillers per clump) as well as various yield attributing characters (number of millable canes, number of internodes per cane, weight per millable cane, Trash weight per cane and green top weight per cane).

CAK 45

Influence of Application of Different Levels of N, K and Zn Fertilizers on the Nutrient Content of Groundnut in Lateritic Soils of Konkan

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Two years research experiment was undertaken during *kharif* seasons of 2012 and 2013 to investigate the influence of application of different levels of N, K and Zn fertilizers at Pangari Block, Central Experiment Station, Wakawali. The field experiment was laid out in split-split plot design comprising of 27 treatment combinations replicated in thrice. Main plots consisting of three levels of nitrogen (12.5, 25 and 50 kg N ha^{-1}). In sub plot, treatment comprised of three levels of potassium (15, 30 and 45 kg K_2O ha^{-1}) and sub-sub plot treatment comprised of three levels of zinc application (2.5, 5.0 and 7.5 kg Zn ha^{-1}). NPK and zinc were applied in the form of urea (46 % N), single super phosphate (16 % P_2O_5), muriate of potash (60 % K_2O) and zinc sulphate (21 % Zn) as per the treatments. The application of nitrogen at 50 kg N ha^{-1} (N_3) and potassium at 45 kg K_2O ha^{-1} (K_3) recorded maximum N, P, K, S, Zn and Cu content in groundnut crop at peg initiation, pod formation and at harvest stage during both the years. While application of zinc at 7.5 kg ha^{-1} (Zn_3) recorded highest K, S, Zn and Cu content in groundnut crop at all growth stages. On other hand, the micronutrient content (Fe and Mn) in groundnut crop showed non-significant result with application of different levels of N, K and Zn fertilizer in both years.

CAK 46

Waste Utilization of Underutilized Fruits: A Supplementary Processing Technique Profitable for Small Scale Processors of Konkan

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Underutilized fruits are those about it having lack of information of its post harvest management, its value-added products and its market potential. The fruits like Jamun, Jackfruit, Kokum, Cashew apple and Karonda have high nutritional and medicinal values but these are very seasonal and highly perishable. Many small-scale processors in Konkan region processed these fruits but these industries dose not functioning annually. The waste generated from these processing industries having potential to produce many healthy products which can be additional processing to run the industry throughout the year profitably. Only, 20% of the total production of Kokum is processed into various products e.g. Kokum Sarbat, Solkadhi, Juice, Amsul, Agal etc and the rest is wasted. The one fourth of the total fruit weight occupied by seed which is major waste of kokum processing. It contains 23-26 % oil very rich in stearic, oleic and stearic triglycerides and solid at room temperature can be utilized as cocoa butter replacer in confectionary industry. About 60% portion of the Jackfruit considered waste in the form of rind, seed and latex. Various value-added products can be prepared from these wastes. The peel can be utilized for the production of pectin, activated carbon, adsorbant, bio-hydrogen production, lignocellulosic biomass, etc. The seed can be used for food colour, feed, fast dissolving tablets, bio-energy i.e. ethanol production and the latex can be utilized for dental health. The effective and efficient utilization of wastes will reduce the cost of animal feeding thereby increasing farmer's profits, generate an array of value-added products and help in waste management and reduction of environmental pollution.

CAK 47

Response of Banana to Different Micro-irrigation Techniques and Irrigation Regimes in the Coastal Region of Maharashtra State

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Banana (*Musa spp*.) is important fruit crop grown traditionally in Konkan region. Due to urbanization there is potential market in Mumbai and nearby areas it become a cash crop in Konkan. Dr. B. S. Konkan Krishi Vidyapeeth has released banana variety *Safed Velchi* having white pulp and sweet in taste. Availability of irrigation water throughout the year is one of major limitation. Soils of Konkan region are poor water retentive capacity and also having low organic matter. However, banana crop needs frequent irrigation, maintenance of moisture near to root zone of crop is basic requirement for better growth and maximum yield of fruit. Therefore, the present investigation was undertaken to ascertain effects micro- irrigation methods under different regimes in lateritic soils of Konkan region of Maharashtra state during period of 2012-13 to 2014-15 throughout the year. The experiment was laid out in Randomized Block Design (RBD) consisting of nine treatments *viz*., T_1-drip irrigation 100% of ET, T_2-drip irrigation 85% of evapo-transpiration (ET), T_3-drip irrigation 70% of ET, T_4-drip irrigation 55% of ET, T_5-microjet irrigation 100% of ET, T_6- microjet irrigation 85% of ET, T_7-microjet irrigation 70% of ET, T_8-microjet irrigation 55% of ET, T_9-check basin irrigation and each treatment replicated thrice. Results revealed that the, higher values of growth characters were obtained when irrigation was given by microjet at 100 % of ET (T_5). Number of hands per bush (10.77), weight of 1st hand (0.962 kg) and number of fingers per bush (150.04) were influenced significantly and found maximum under treatment T_5. However, higher values of weight of bunch per plant (9.96 Kg) found in microjet irrigation at 100 % of ET. Significantly, except in microjet irrigation 85% of ET treatment, which remained statistically at par with T_5. Microjet irrigation at 100 % of ET produces significantly maximum fruit yield of banana *i.e*., 23.74 t ha^{-1} during investigation period. Maximum WUE was observed due to drip irrigation under treatment T_4, *i.e*., 0.38 t ha^{-1} cm^{-1} of water followed by the treatment namely T_3, T_2, T_8, T_1, T_7, T_6 and T_5. Economics of the treatment during investigation revealed that the treatment of microjet irrigation at 100 % of ET was found to be superior and exhibiting maximum net return of Rs. 97446 ha^{-1} followed by the similar method where irrigation was scheduled at 85 and 70 % of ET. Similar trend was observed in respect of B: C ratio which was found to be 1.38. Quantum of water applied 120.31 ha^{-1} cm^{-1} during the investigation period to the best treatment *i.e.,* treatment T_5. On the basis of quantity of water need to be scheduled for efficient maintenance of soil moisture on alternate day basis it was concluded that banana crop cv. *Safed Velchi* be grown in lateritic soil of Konkan region, with microjet irrigation and be irrigated on alternet day 13 to 15 L $plant^{-1}$ during October to January and 18.00 to 21.00 L $plant^{-1}$ during February to onset of monsoon for obtaining higher yield and profitability. The adoption of such technique could bring more area under irrigation, resulting in higher production of quality banana fruits.

CAK 48

Performance of Medium Slender Rice Hybrids in Konkan Coastal Zone of Maharashtra

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In spite of 30 HYVs rice varieties were released for commercial cultivation in Konkan region for various agro-ecological situations till today, the productivity of rice remained stagnant during last decade in the region. The large-scale adoption of rice hybrids along with proper crop management practices certainly is an alternative for increasing productivity of the region. In this regards fifteen medium slender F_1s were developed by utilizing eleven CMS lines of four different cytosterile sources and 12 effective restorers, by planting two single rows of 30 plants, placed at 20 x 15 cm in Randomized Block Design (RBD), replicated thrice were evaluated for commercial heterosis over medium slender HYV's two checks *viz*., Ratnagiri-6 and Palghar-1for seven yield and its component traits at Agricultural research station, Shirgaon Ratnagiri Maharashtra state during *kharif* 2017. The estimates of standard heterosis for grain yield $plant^{-1}$ (g) were highly significant and positive in 5, 6 & 5 hybrid combinations over better

parent, Palghar-1 (MS) and Ratnagiri-6 HYV quality checks, respectively. The maximum positive standard heterosis for grain yield plant^{-1} (g) over best medium slender HYV check, Ratnagiri-6 was observed in RTNRH 11 (110.6 %) followed by RTNRH 12 (68.5 %), RTNRH 13 (26.4%), RTNRH 14 (18.4%) and RTNRH 15 (17.4%). The maximum positive standard heterosis for grain yield was recorded in RTNRH 11 (162.2%) followed by RTNRH 12 (109.7%), RTNRH 13 (57.3%), RTNRH 14 (47.3%) and RTNRH 16 (46.1%) over the medium slender HYV's check Palghar-1. The range of standard heterosis for grain yield over best medium slender HYV's check, Ratnagiri-6 was -79.9% (RTNRH 25) to 110.6% (RTNRH 11) and check Palghar-1 was -75.0 (RTNRH 25) to 162.2% (RTNRH 11). The range of standard heterosis for days to 50 % flowering over best medium slender HYV's check, Ratnagiri-6 was -7.34% (RTNRH 24) to 4.95% (RTNRH 20), plant height (cm) -22.07 % (RTNRH 22) to 16.67% (RTNRH 16), productive tillers -31.58% (RTNRH 18) to 66.67% (RTNRH 22), panicle length (cm) -9.3% (RTNRH 24) to 51.5% (RTNRH 13), fertility (%) -9.6% (RTNRH 21) to 6.5% (RTNRH 14) and straw yield (g) -76.67% (RTNRH 25) to 246.75% (RTNRH 11). Maximum values for positive heterosis was observed over best check Ratnagiri 6 for traits *viz*., grain yield (42.0 g; RTNRH 11), productive tillers (13; RTNRH 11), panicle length (25 cm; RTNRH 12, 13 and 14), fertility (94%; RTNRH 22) and straw yield (53.4g; RTNRH 25) and maximum negative values for days to fifty percent flowering (99 days; RTNRH 18) and plant height plant height (81 cm; RTNRH 23 and 24). Hybrids with positive and significant SCA effects for grain yield were produced by 6 hybrids. Among the hybrids, four hybrids *viz*., RTNRH 11**,** RTNRH 12**,** RTNRH 13 and RTNRH 15 exhibited both of their parents found to be good combiner. Among the four cytoplasmic genetic male sterile lines, W.A (RTN-1A) line gave top yielding hybrid followed by W.A (KJTCMS 5A) and ARC (RTN-2A). In the present study, 5 hybrids expressed significant standard heterosis for grain yield among these, 3 hybrids viz., RTNRH 11 **(**110.6%), RTNRH 12 **(**68.5%) and RTNRH 13 **(**26.4%) exhibited highest performance for grain yield, and most of the related traits could be utilized for commercial cultivation after extensive testing in state and national trials.

CAK 49

New Medium Slender Cytoplasmic Male Sterile Lines Developed in Maharashtra State

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Development of medium slender rice hybrid and medium slender grain CGMS lines is of prime importance. Two effective maintainers for the WA cytoplasmic sources were identified and successfully converted into local lines through back crossing at Agricultural Research Station (ARS), Shirgaon Maharashtra. ARS, Shirgaon has already developed 20 CGMS lines with five diverse cytoplasm sources which were designated as RTN1A to RTN 20A during 2000 and registered to NBPGR. However, for development of medium slender rice hybrid, medium slender CGMS line is needed. Hence the back-cross breeding programme was formulated to develop the medium slender CGMS line during *kharif* 2012-2016. Lines with complete pollen sterility identified from BC-8 to BC-10 generations were designated as RTN 21A (cytoplasm of RTN-8A is transferred in to HHZ10-DT8-DT1-DT-1 background) and RTN 22A (cytoplasm of RTN-2A is transferred in to CR-2916-10-2-1 background) during 2012-2016. These lines, along with IRRI-bred CGMS lines IR-58025 A, were evaluated for their agronomical and floral traits and natural out crossing potential during *kharif* 2017. The experiment was laid out in randomized block design with three replications during the 2017 wet season. Plants were transplanted at 20 x 20 cm spacing with plot size of 4 m^2. Five plants from the central row in each replication were observed. To study their natural out crossing potential, these CGMS lines were planted adjacent to the corresponding maintainer lines. Good flowering synchrony was achieved. Seed set was attained without restoring to any supplementary pollination techniques. Data on ten characters were statistically analyzed. RTN-21A is a mid-late duration (125-130 days) rice CGMS line with Assam Rice Collection (ARC) cytoplasm and having medium slender grain type, dwarf nature, moderate vigour (10-12 tillers plant^{-1}) high spikelets panicle^{-1} (175), good stigma (77.82%) and panicle exertion (75.40 %). It showed 100 % pollen and spikelet sterility with 65.24 % out crossing. RTN-22A is of mid-late duration (125-130 days) rice CMS line having medium slender grain type with Assam Rice Collection (ARC) cytoplasm. It is of dwarf in nature having medium vigour (10-15 tillers hill^{-1}), high spikelets panicle^{-1} (210), good stigma (73.8%) and panicle (72.8%) exertion. It recorded 100% pollen and spikelet sterility with around 68.10% out crossing. These new CGMS lines showed superiority over the check IR-58025A line in all most all the important floral traits. The WA cytoplasm through different donor CGMS lines are transferred by conventional back cross breeding into commercially popularly grown rice varieties/lines, which are having good grain qualities. These lines could be used for developing new rice hybrid combinations with good grain and cooking qualities.

CAK 50

Response of Groundnut to N, K and Zn Application in Lateritic Soils of Konkan

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The present investigation was conducted at Irrigation Scheme, Pangari Block of CES, Wakawali during *kharif* seasons of 2012 and 2013. The field experiment was laid out in split-split plot design comprising of 27 treatment combinations replicated in thrice. Main plots consisting of three levels of nitrogen (N: 12.5, 25 and 50 kg ha^{-1}). In sub plot, treatment comprised of three levels of potassium (K_2O: 15, 30 and 45 kg ha^{-1}) and sub-sub plot treatment comprised of three levels of zinc application (2.5, 5.0 and 7.5 kg Zn ha^{-1}). The application of nitrogen at various levels i.e. 12.5, 25 and 50 kg ha^{-1} and zinc applied from 2.5 to 7.5 kg ha^{-1} showed significant positive influence on growth and yield attributing characters *viz*., height of plant, shelling percentage and test weight in groundnut. The pod and haulm yield of groundnut as well as quality parameters like protein, oil methionine in kernel were recorded higher by the treatment N_3 (N:50 kg ha^{-1}) and Zn_3 (Zn:7.5 kg ha^{-1}) treatment respectively. Similarly, the potassium applied at 45 kg ha^{-1} (K_3) recorded increase in plant height, yield attributes, haulm and pod yield as well as protein and oil content in kernel. Where, the interaction effect of N x K, the treatment combination N_3K_3 recorded the maximum positive results in case haulm and pod yields.

CAK 51

Influence of Sowing Time on Growth and Yield of Ridge Gourd in North Konkan Region of Maharashtra

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Ridge gourd (*Luffa acutangula*) is a monoecious cucurbitaceous vegetable which is widely cultivated in Konkan region of Maharashtra. It is cultivated by farmers especially during Kharif season when rainfall is high which many times affects seed germination and crop stand. Moreover, the fruits of rainy season become ready for harvesting during July when the market rates are prevailing low due to production glut. In this view, it is essential to standardize the sowing time so as to obtain maximum returns to the farmers. Therefore, the experiment was laid out to know the effect of sowing time on fruit yield of ridge gourd (Variety Konkan Harita). The experiment was laid out at Vegetable Improvement Scheme Farm of Agricultural Research Station, Palghar, Dist. Palghar during the years 2009 to 2012. The sowing dates were treatments as every fortnight of April, May and June months. The length of vines was highest (6.05 m) when sowing was done in second fortnight of June (T_6). The first harvesting was done after 45.07 days in treatment T_1 (First fortnight of April) while it was delayed in treatment T_6 (64.31 days). The maximum number of fruits per vine (8.73) was recorded when sown in first fortnight of June (T_5) followed by T_4 (Sowing in second fortnight of May). The yield per vine and per hectare was the highest (1.19 kg $vine^{-1}$ and 99.44 q ha^{-1}, respectively) in T_5 and it was at par with T_4 (1.12 kg $vine^{-1}$ and 93.85 q ha^{-1}, respectively).

CAK 52

Study of Arecanut Based Cropping System in Coastal Region of Konkan

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To achieve optimum utilization of resources and to enhance the productivity per unit area of arecanut garden, an experiment was conducted by taking the shade loving tuber and spice crops as intercrops in arecanut plantation at Arecanut Research Station, Shrivardhan in Raigad district during 2013-14 to 2015-16. Different eight tubers and spice crops were planted as intercrops in 2.7 m x 2.7 m well established arecanut garden with three replications. From the pooled analysis of three consecutive years, it was observed that the intercropping system of *Xanthosoma* produced the highest dry arecanut yield of 39.12 q ha^{-1} which was significantly superior over rest of the arecanut intercropping system except arrowroot intercropping. The highest tuber yield of 114.09 q ha^{-1} was recorded by elephant foot yam intercropping system which was significantly superior over rest of the intercropping system. The total yield (Arecanut yield + arecanut equivalent yield) of 56.47 qha^{-1} was reported in elephant foot yam intercropping system which was significantly highest than rest of the intercropping except ginger (55.85 q ha^{-1}) and turmeric (52.67 q ha^{-1}) intercropping system. The economics of different intercropping systems in arecanut revealed that the elephant foot yam intercropping realized the highest net returns of Rs. 2,32,675/- ha^{-1} followed by ginger intercropping system (Rs. 2,23,028/- ha^{-1}) and turmeric intercropping system (Rs. 2,08,479/- ha^{-1}). The C:B ratio was also showed the similar trend. The land equivalent ratio was numerically highest in *Xanthosoma* intercropping system (1.72) while net return of Rs. 1293/- per day was reported highest in elephant foot yam intercropping system. All intercropping systems and sole arecanut was recorded net positive gain in available N and P in soil over initial N and P status except sole arecanut in regards to available N in soil. However, in case of available K, the only elephant foot yam and colocasia reported net gain of available K and rest of the intercropping systems and sole arecanut showed net negative balance over initial values of soil.

CAK 53

Utilization of Waste Heat for Production of Power Based on Seebeck Principle

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In recent era increasing concern of environmental issue and emission of gases, in particular global warming and the limitations of energy resources has resulted in extensive research into novel technologies of generating electrical power. Thermoelectric power generators (TEG) has emerged as a promising alternative green technology due to their distinct advantages. It converts waste-heat energy into electrical power by maintaining temperature difference at the two sides of the plate. If the temperature difference maintains large enough, some Seebeck - effect devices can produce a few volts. Numerous such devices can be connected in series to increase the output voltage or in parallel to increase the maximum deliverable current. Large arrays of Seebeck - effect devices can provide useful, small-scale electrical power. Waste heat generated by renewable energy sources such as cooking biomass stove, gasifier can be used for power generation using thermoelectric power generator (TEG). Experiment shows that single TEG can generate upto 2.31 watt power by connecting number of TEG in series, we can generate the sufficient amount of power for charging the batteries. In this way, the heat energy being generated from the renewable energy equipment can be tapped to produce the power.

CAK 54

Study of Correlation Between Plant Canopy Volume, Leaf Area Index and Yield of Alphonso Mango Trees

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Economy of South Konkan mainly depends on horticulture in which mango crop-based industry is playing a major role. Location specific study on pruning and maintenance of canopy has an important role in success of mango plantation under high density planting and rejuvenation of old orchard which is also aa present concern for farmers. Optimized light distribution within canopy and its interaction with different parts is important for maximizing photosynthesis, flower bud formation, fruit growth and colour development. Hence, it is essential to study correlation between plant canopy volume, leaf area index and yield of Alphonso mango. This experiment was carried out in uniformly grown mango orchard of 35 years old. LAI was measured by using LAI - 2200 Plant Canopy Analyzer (LI-COR Inc. Lincoin, NE). Maximum yield (48.76 kg tree^{-1}) was recorded in group of trees where average plant canopy volume was 155.02 m^3 with LAI of 1.259 whereas, minimum yield (23.74 kg tree^{-1}) was recorded in group of trees where average plant canopy volume was 139.31 m^3 with LAI of 1.206. It was observed that plant canopy volume, LAI and yield are interrelated with each other and estimation of yield is possible from the correlation relationship of yield with plant canopy volume and leaf area index.

CAK 55

Potential of Farm Pond in *Khar* Land Area for Integrated Fish Farming in Maharashtra

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The coastal saline soils, locally called "*Khar Lands*" in Konkan, are the problematic soils of the region. The repeated ingress of saline creek water as well as upward rise of salts due to low ground water table during hot season make these soils unsuitable for cropping. As the size of farm holding is small, separate surface dug out ponds to meet the demands of individual farmers land are considered more feasible considering the socioeconomic condition. The study indicated that added advantage of reclaiming an area up to radial distance of 27 m. there by leaching salts from soil profile. The study has also revealed that the initial pond water salinity of 14.5 ppt in April 1994 was reduced to 1.0 ppt in April 2000. Being high water holding capacity of soil and water is retained for 7-8 months, which has advantage to take a crop like leafy vegetables and growing fishes like Indian major carps, *Lates calcarifer*, *Cyprinus carpio,* etc., and prawn species like *M. rosenbergii* to generate the additional income. Further this water can be utilized for growing horticulture crops like coconut and vegetables on bunds with protective irrigation in coastal saline soils. The results revealed that there is a vast potential for the culture of sea bass (*Lates calcarifer*), freshwater prawn (*Macrobrachium rosenbergii*), Indian major carps and also seed production for short duration in farm ponds.

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