वार्षिक प्रतिवेदन
Annual Report
2011-2012

भाकृअनुप
ICAR

गोवा के लिए भा.कृ.अनु.प. का अनुसंधान परिसर
(भारतीय कृषि अनुसंधान परिषद)

ओल्ड गोवा ४०३ ४०२, गोवा, भारत

ICAR RESEARCH COMPLEX FOR GOA
(Indian Council of Agricultural Research)

Old Goa - 403 402, Goa, India

With Best Compliments From

Prof. (Dr.) Narendra Pratap Singh
Director

ICAR Research Complex for Goa
Old Goa, - 403 402, Goa, India

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Preface

It gives immense pleasure in presenting the Annual Report of ICAR Research Complex for Goa, Goa for 2011-12. The year 2011-12 has been action-packed in several ways and the Annual Report highlights the significant research achievements of the various sections (Resource Management &Integrated Production, Crop Improvement & Protection, Horticulture, Animal Sciences and Fisheries) along with the Institutional activities.

The major research activities undertaken during the year under report were soil and water conservation studies in mango and coconut, standardization of cultivation of organic rice, development of integrated farming system models for up land and low land situations for the small and marginal farmers, identification of rice varieties for salt tolerant situation, evaluation of bio-control agents for management of bacterial wilt in brinjal, germplasm collection in horticultural crops of Goa, evaluation of gerbera varieties under poly house, evaluation of hybrid cashew, standardization of use of probiotics and un-conventional feeds (brewer's dried grains) in the livestock and poultry ration, development of model for cultivation of green fodder with intercrop approach in cashew field, development of crossbred (Goa Local X Large White Yorkshire) pigs. Besides, this Institute has initiated work to promote Agro-Eco-Tourism in the state. A software marker express 1.0 has been developed to expertise the use of RAPD, ISSR primers and to design ISCAR primers

In the year under report, the Institute has organized a number of workshops, seminars and transfer of technology programmes. The eminent personalities visited this Institute during this year include Shri. Sharad Pawar, Honourable Union Minister of Agriculture and Food Processing, Government of India, Shri Sripad Naik, Honourable Member of Parliament, North Goa (Lokh Sabha), Shri. Pratapsingh Rane, Honourable Speaker, Government of Goa, Dr. A. K. Singh, DDG (NRM); Dr. Vijay Mehta Former Vice-Chancellor, Konkan Krishi Vidyapeeth, Dr. K. Pradhan Former Vice-Chancellor, Orissa University of Agriculture and Technology Shri. V.V. Sadamate, Advisor (Agri.), Planning Commission etc. The Institute has conducted 10 workshops and seminar this year. Besides, 27, 42, 5 and 3 research articles, conference abstracts, popular articles and book chapters, respectively have been published by the Scientist of this Institute. As publisher, this Institute published 12 publications during this year.

I place on record my gratitude to Dr. S. Ayyappan, Hon'ble Secretary, DARE and Director General, ICAR for the encouragement and guidance extended. I am immensely grateful to Shri Rajiv Mehrishi, Special Secretray (DARE) and Secretary (ICAR) and Dr. A. K. Singh, Hon'ble DDG (NRM) for his constant inspiration and sustained interest on the activities and progress of this Institute. Our sincere thanks are also due to Dr. P. S. Minhas, ADG (S&WM) for providing timely support to the Institute. I am thankful to all the scientists and staff members for their important contribution in the development of the Institute. I sincerely acknowledge the efforts made by the members of the editorial and publication committee of the Annual Report for effective compilation and edition of the report.

(*Narendra Pratap Singh*)
Director

Contents

Executive Summary

ICAR Research Complex for Goa, conducts strategic and applied research under five functional sections viz. Resource Management and Integrated Production, Crop Improvement and Protection, Horticulture, Animal science and Fisheries. Technologies developed are transferred to the farming community through its own scientists and the staff of Krishi Vigyan Kendra (KVK), North Goa. The highlights of the research achievements of this Institute for the year 2011-2012, are presented.

Resource Management and Integrated Production

A field trial on standardization of management practices for organic production of rice revealed significantly higher grain yield (4.17t/ha) with the rice variety Karjat-3 as compared to Revathy (3.46 t/ha) and Pusa Sugandh-5 (2.69 t/ha) indicating its superiority. Among the nutrient sources on equivalent N basis, FYM application recorded significantly superior yield (4.35 t/ha) as compared to rest of the nutrient sources except Glyricidia and Eupatorium application (3.88 t/ha). Further 100% NPK (100:50:50 kg/ha) application recorded significantly lower yield (3.68 t/ha) as compared to FYM application. AICRP on Integrated farming systems was continued for the development of two models one each for upland and lowland situations. Cashew (variety Bhaskara) + Pine apple (Variety Giant Kew) system in the upper elevation yielded a productivity of over 650 kg/ha cashew nuts with a mean nut yield of 3.2 kg/ tree. The apple yield of the cashew crop was over 8.3 t/ha with a mean apple weight of 49 kg/tree. The high yielding arecanut variety Mangala interspersed with intercrop of tissue cultured banana (Grand Naine) gave a yield of 3.6 t/ha of banana with a mean bunch weight of 12 kg/tree. The system generated a recyclable resource of 317 kg including weeds, bund grass and banana waste in 0.5 ha during rainy season in about three months period. The resources were effectively recycled by utilizing 200 kg of cow-dung through a vermi-compost unit of size 35 m2 resulting in 400 kg good quality vermi-compost.

The fertility status of the soil is monitored through collection of representative sample from all the three subsystems viz. cashew based system, coconut based system and arecanut based system after one year of experimentation and was compared with the initial status. It was observed that there was an increase in both the average bulk density of the soil (from 1.06 g/cc to 1.20g/cc) and the particle density of the soil (from 2.30 to 2.76 g/cc) over the entire plot. During the period, the porosity of the soil has also increased from 54 to 55.9%. The potassium content of the soil has however decreased from 317.3 to 284.6 kg/ha over a period of one year on the overall plot basis.

The lowland IFS model is being developed with selection of profitable rice based crops and integration with dairy and fisheries. During kharif, rice (variety Naveen) was grown in the entire experimental area (4000 sq.m) and during rabi, four rice based intercrops viz., cowpea (local selection) and groundnut (TG 37A), brinjal (Local cultivar Agassaim) and sweet corn (Hybrid Sugar 75) were taken up. The lowland IFS System was monitored for changes in soil fertility over a period of one year in different rice based cropping systems viz., rice- cowpea, rice – groundnut, rice- brinjal and rice-sweetcorn. It was observed that there was a decrease in the average bulk density of the soil (from 1.39 g/cc to 1.29 g/cc) whereas the particle density of the soil increased from 2.34 to 2.55 g/cc over the plot. The porosity of the soil was found to increase from 40.8% to 49.28% during the period.

Production of quality seeds was continued under Mega project on seed production in agricultural crops and fisheries. During kharif 2011, foundation seed production of rice (varieties Naveen and Karjat-3) at the Institute farm resulted in 3.50 tonnes of quality seeds while during rabi rice variety Karjat-3 is expected to yield 1.50 tonnes of quality rice seed. About 250 kg Groundnut (variety TG 37A) TL seed was produced during kharif 2011 which served as a seed chain for rabi production with Directorate of Agriculture, Government of Goa and another 200 kg seed was produced during rabi.

Three local cowpea selections have been multiplied during rabi 2011-12. Further, a multiplication cum demonstration block of high yielding forage grasses was established at the Institute farm for root slip multiplication.

Soil samples were collected from different mine reject sites and analysis was carried out. Data revealed that mine dump soils are strongly acidic in soil reaction (pH 4.46- 5.08), normal in soil salinity (EC < 0.08 dSm¯1), low in available nitrogen (112.0 -156.8 kg/ha), phosphorus (6.13-13.02 kg/ha) and potassium status (14- 114 kg/ha) and poor in organic carbon (0.06 – 0.45 per cent) content. Various soil and water conservation measures were evaluated for major horticulture crops of the region viz. mango and coconut. The soil loss was minimum recorded in the treatment of continuous contour trenches with Vetivaria zizanoides and was followed by 7.8 t/ha in staggered contour trenches with Vetivaria zizanoides as compared to higher soil loss of 17.8 t/ha under control treatment.State wide survey of soil sampling and GPS aided mapping of soil properties was conducted. The average pH of the soils of South Goa district was found to be 4.89, with a minimum of 3.38 from a sample collected from Xelvona village (Taluka Quepem) and a maximum of 7.82 from Issorcim village(Taluka Marmugao). The average Electrical Conductivity of the soils of South Goa district was found to be 0.08 dSm-1 , with a minimum of 0.005 dSm-1 from Dharbadora (Taluka Sanguem) and a maximum of 4.65 dSm-1 from Cavelossim (Taluka Salcete).

Crop Improvement and Protection

A total of 16 land races of rice belonging to Goa state and adjoining regions were collected along with the associated traditional knowledge. They are evaluated along with improved cultivars under different rice ecosystem of the State. Twenty three rice genotypes/varieties including local land races and improved cultivars were collected and evaluated in Randomized Block Design (RBD) with three replications during *Kharif* 2011-12 under rainfed shallow lowland ecology. Among the entries tested, highest grain yield was recorded by Pusa-44 (7.66 t/ha) followed by Swarna (*Sub*-1) (7.42 t/ha), TRC-2005-1 (6.98 t/ha) and Akshayadhan (6.71 t/ha). Overall, Pusa-44, Swarna (*Sub*-1) and TRC-2005-1 found promising.

A total of twenty four rice lines including local land races and improved cultivars were evaluated during *Rabi* 2011-12 under irrigated ecology in Randomized Block Design (RBD) with three replications. Among the entries tested, none of the varieties were significantly superior to the check variety Jaya, however, variety Naveen (7795.83 kgs/ha) followed by Akshayadhan (7535.11 kgs/ha), Chandan (7449.02 kgs/ha), Karjat-3 (7305.43 kgs/ha), Pusa-44 (7162.91 kgs/ha and Karjat-7 (7056.01 kgs /ha) recorded numerically higher grain yield compared to check variety Jaya (6927.08 kgs/ha). Overall, Naveen, Akshayadhan and Chandan found promising.

Under All India Co-ordinated Rice Improvement Project, thirty four rice cultures belonging to Coastal Saline Tolerant Variety Trial including 3 check entries namely CST 7-1 (Coastal saline), Jaya (Yield check) and local check Korgut were evaluated in farmers' field at Chorao Island, North Goa under Coastal Saline situations with soil having EC 2.68 to 5.95 dSm^{-1} and pH 5.26 – 5.54. Highest yield was recorded by entry RP Bio 4919-60-13 (2449 kg/ha) followed by RP Bio 4919-37-13 (1879 kg/ha), RP Bio 4919-63-7 (1782 kg/ha), RP 4949-250-10-3-2-1-1-1 (1672 kg/ha) and NDRK 50016 (1608 kg/ha).

A total of twenty six rice genotypes/cultures belonging to Salinity Tolerant Breeding Network trial (STRASA project) were evaluated under coastal salinity condition with soil EC ranging from 2.16 to 5.25 dS/m and pH from 5.00 to 5.34. Grain yield was highest in CSR - 2K- 219 (1827.584 kgs) followed by RP 4353-MSC-38-43-6-2-4-3 (1818.09), NDRK 11-4 (1675.93 kgs) and NDRK 11-1 (1675.49 kgs) which is numerically superior compared to check entries CSR-36 and CSR-27, which yielded respectively, 1651.13 kgs and 1628.59 kgs and significantly superior compared to national check CST 7-1 (1020.67 kgs) and local check 1097.90 kgs.

In Cowpea, four selections from local germplasm collections *viz*., Nadora Bardez-4, Alsondo Local, Sangolda Local and DU-4 were identified as suitable under residual moisture conditions in rice fallows.

Screening of antagonistic bacteria and *Trichoderma* was carried out *in vitro* against major soil borne pathogens. Effective antagonistic bacteria and *Trichoderma* were shortlisted and selected for further studies. Compatibility study of nine selected isolates of *Trichoderma* with the commonly used fungicides revealed that eight isolates were compatible with Ridomil MZ, Mancozeb and copper oxychloride. Two hundred and thirty two *R. solanacearum* isolates collected from different states are being maintained in the culture collection. All the isolates are of biovar 3 type except 10 isolates which are biovar 6; and all isolates belong to Phylotype I. Pathogenicity of the isolates was tested on eggplant, tomato and chilli. More than 90% of the isolates are pathogenic to all the three hosts.Twenty diverse *R. solanacearum* strains were selected for multilocus sequence typing (MLST) analysis. All the gene products were sequenced and the sequences were deposited in the gene bank. Bio-PCR was standardized for detection of *R. solanacearum*. Bacterial cells of *R. solanacearum* as low as 50 per gram of artificially infested soil could be detected by this method. At the same time the method was useful to detect presence of *R. solanacearum* from eggplant (wilt affected and healthy asymptomatic) and weeds. Based on the inhibition of *R. solanacearum* in plate bioassays, 10 xylem residing bacteria were taken for glasshouse evaluation. Three antagonistic xylem residing bacteria were found to promote growth in eggplant.

Crosses were made between Surya and Agassaim to develop a population. Seedlings from the crossed seeds were raised along with the resistant and susceptible parent lines for collection of seeds of next generation and for further evaluation.

Field evaluation of talc formulation of antagonistic bacteria for the management of bacterial wilt suggested that the bio-control treatments recorded less disease and higher yield. Based on the encouraging results, we selected three antagonistic bacteria for demonstration in the farmer's field. In addition one consortium of two antagonistic bacteria was also evaluated. Seven field demonstrations in three vegetable growing villages were conducted. Reduced incidence of bacterial wilt was recorded in the bio-agents treated plots compared to untreated control plots in all the demonstrations.

A new insect pest called pin-hole borer or ambrosia beetle *Platypus parallelus* (Fabricius) (Coleoptera: Platypodidae) has been identified and recorded on pruned cashew plantations.

Horticulture

ICAR RC, Goa and NBPGR RS, Thrissur collaborative team collected 53 accessions of germplasm of vegetables, tubers and ornamental crops during the state wide exploration trip. Six best performing individual plants were selected different habit/color of crossandra and are multiplied and evaluated. Characterization of 10 red amaranthus and 1 green amaranthus accessions were completed. An accession ICAR Goa, Amar 07 recorded high leaf shoot ratio of 5.6 after one month of sowing and was free from nematode infestation. Open or self pollinated seeds of best performing individual selected amaranth plants were generated. Seed multiplication of four new marigold accessions completed. Of these ICAR Goa Yellow Elavarasi (Te03) performed best with good yield of flowers. Indigenous orchid species native to Goa collected by previous workers were conserved.

An experiment was laid out with fruit crops in three replications in Coconut-glyricidia system with kokum, jackfruit, lemon successfully. Coconut-gliricidia based cropping system: Gliricida plants in the system produced 6.4 shoots each shoot attaining a length of 167 cm and had 47 leaves. Dry weight of leaves in a shoot was 44 gm with 66 % moisture content. Black pepper, ornamental sweet potato, rambutan, and aonla were added as component crops and they were established in the plot. Ornamental sweet potato (Akshaya) plants were found to establish well in

summer season with less water in laterite soil. These plants grew fast (7 to 13 cm per day) and found to be good as ornamental plant under Goa conditions. One plant has produced a big sized single edible tuber weighing 2.6 Kg. Colcocasia and marigold were evaluated and found suitable in the system. A block of arecanut cultivar Hirehalli Dwarf was established at a high density of 0.5 m x 0.5 m and the performance is monitored. Red amaranthus, okra were grown in interspaces in juvenile plants. Shoot cuttings from Potato cv "Kufri Jyoti" tubers were planted and evaluated in the interspaces. Single plants producing many (252) tubers or large sized (31.5 g) tubers were selected and stored for evaluation in next season.

Three cashew hybrids, H-11/05, 31/05 and H-21/05 shoed precocious bearing while H-27/05 was the last to flower. Three promising cashew accessions namely, Tiswadi-3 (G-CS-4-5), Ganje-2 (GCC-94/2)and KN-2/98 (G-CS-7-7) and one dwarf genotype,Gb-2 (G-CS-4-9) were submitted for registration with NBPGR, New Delhi. Tiswadi-3 is a promising high yielding genotype bearing jumbo nut size (9.48g) with higher shelling percentage (28.82%). The orange coloured apples are bigger in size with 72.0% juice contents. The jumbo nuts yield export grade kernels of W180 – W210 counts. Ganje-2 is another promising selection for higher nut yield (15-18kg/tree) with bold nuts and bigger yellow apples (96.5g). The nuts yield a kernel out-turn of 29.5 % of export grade W210 – W240 counts. KN-2/98 is the third promising selection for higher nut yield having bold nut features (8.2g) with 29.59% of kernel out turn of W210- W240 counts. Conical shaped red apples are bigger in size (105.0) with 71.14% juice contents. The latter two selections have bunch bearing habit. GB-2 was identified for its dwarf statured growth habit with intensive branching and higher nut yield. The nuts are of medium size having shelling of 29.83%. Yellow coloured apples are medium in size. During the year, Priyanka, Bhaskara, V-8 and Tiswadi-3 recorded nut yield of 0.85, 1.1, 0.98 and 0.98 kg/tree of nut yield as aginst the corresponding nut yield of 0.35, 0.95, 0.55 and 0.21 kg/tree in the previous year.

Among the nutmeg genotypes, mean weight of the fresh fruit varied from 27.81g in NMG-10/E4 to 58.1g in NMG-3/C1 with 5.4 and 9.6g of nut weight, and 0.81g and 1.26 g of mace weight respectively on dry weight basis. Other genotypes namely, NMG-7/D5 and NMG-5/D1 recorded higher fresh fruit weight of 49.23 and 42.68g with dry nut weight of 8.46 and 7.65g and dry mace weight of 1.23 and 1.15g respectively.

The mango germplasm bank, comprising of a total of 114 varieties of Mango currently holds local (77), Hybrid (15) and Introduced (12) varieties. The promising selection of mango "Cardozo Mankurad" was registered with NBPGR, New Delhi and was assigned the Registration No. INGR 11023 and National Identity No. IC0587716. Grafts of this selection are prepared for establishing the progeny orchard for further multiplication on large scale. Mkd-1/11 Achut mango accession was located in Priol village, the matured fruits of which are of medium size (315.85g). The ripe fruits develop brilliant yellow skin colour uniformly through out the surface. The yellowish orange pulp has aromatic sweet taste (21.2 ^{o}B). Pulp is slightly fibrous on stone side. Skin is thin. Fruits come to maturity in the month of March.

Propagation of elite kokum types identified was attempted during the current year. Rootstocks were raised during June 2011 uniformly from seeds of Konkan Amruta, the first released variety from BSKKV, Dapoli. During April to August 2011, grafting was attempted in 12 elite types viz., Borim TC, Parashte 3, Kharekhazan 1, Savoikamini 1,2,3, Kasarpal 5, 8, 11, Hedode 1, Thane 1 and 4. Among these, Borim TC, Kharekhazan 1, Savoi kamini 3, Kasarpal 5, 11 and Thane 4 are some of the profuse bearers identified in the study. Others like Hedode 1, Savoi kamini 1 and Parashte 3 (which is a profuse bearer also) are early bearers, whose crop get over well before onset of monsoon. Percentage of grafting success varied from 0 to 78. Nine papaya varieties including three local types (Co-2, C0-7, Pusa Nanha, Surya, Red Lady, RCTP-1, Local 1, Local 2 and Local 3) were evaluated. Local-3 papaya variety recorded fruit weight (2.0 Kg) on par with Red Lady.

The highest yield of 315.96t/ha of brinjal fruits was recorded in 10/BRLVAR-6 followed by check (Pb Sadabahar). The highest fruit yield of 21.07t/hectare was recorded in SM-6-6 of brinjal with lowest wilt incidence (11.67%). Seven brinjal varieties (Surya, Swetha, Utkal Madhuri, Arka Nidhi, Singhnath, Bholanath and SM-6-6) gave promising results for bacterial wilt resistance after artificial inoculation of the pathogen under pot conditions.The highest red ripe chilli recorded in KA-2 (10.87 t) followed by 09/CHIVR-8 (10.37 t).

Four gerbera varieties *viz.*, Blessings (White), Forza (Red), Malibou (Pink) and Scope (Yellow) were evaluated under naturally ventilated poly-house at Goa. Flower yield, flower stalk length, flower stalk diameter and number of petals/ flower were highest in Blessings. Dendrogram was constructed based on banding pattern of 30 varieties/types of heliconia using the RAPD markers and cluster analysis. The 30 varieties of heliconia formed two major clusters A and B. The main cluster A comprised of heliconia types belonging to *psittacorum* group and their hybrid derivatives.

A videoconference facility has established at the institute. A new software Marker express 1.0 to analyse the nucleotide sequences for the optimal choice of RAPD or ISSR markers was developed. It also offers the facility of designing iSCAR primers for the given set of sequences.

Based on the secondary data collected from the farmers, it was found that most of the post-harvest operations in rice were manual and resulted in a lot of losses. Microclimatic parameters of shade net tunnel and naturally ventilated gerbera polyhouse were statistically analysed with single factor Anova, which showed that there was no significant effect of structure on the various microclimatic parameters. The average transmittivity of the naturally ventilated poly house and shade net tunnel were was 15.75% and 10.05% respectively.

The average plant temperature in the shade net tunnel was 31.2 ^{O}C and that in the naturally entilated gerbera polyhouse was 31.6 ^{O}C. The average temperature realised in the poly tunnel with no ventilation between 10 AM and 5 PM was 47.2 ^{O}C during the month of march in 2012. A fan or a dehumidification system is necessary to reduce the relative humidity. Further studies on the microclimate of the shadenet house and naturally ventilated poly house as affected by vent size and location and air exchanges using ultra sonic anemometers are needed to make a suitable greenhouse structure design for Goan climate. The high temperature inside the polytunnel indicate a great potential for using them as dryers. Mechanisation of small and marginal farmers of South Goa was intitated under the tribal sub-plan program.

Animal Sciences

Impact of micro environmental changes on milk yield of cows after intervention was investigated. Effect of change of RH on daily milk yield in Sahiwal, cross breed cows was significant ($P < 0.05$) and drop of daily milk yield was 16 g, 22 g and overall value of 19 g per % increase of RH. But after implementation of cooling arrangement as well as white painting of outside of roof and black painting of inner surface of the roof of dairy shed, it was observed that effect of change of RH was non-significant and reduction of milk yield was lower ie 5 g, 15 g and 2 g respectively. Average daily gain was reduced significantly by 6.51g, 12.50g, 16.78g and 14.84g in four breeds of rabbit respectively per unit rise of air temperature before intervention. However, after implementation of cooling arrangement by ceiling fans reduction of growth was 4.88 g, 8.46 g, 11.70 g and 12.76 g in these breeds of rabbit respectively per unit rise of air temperature. Survey of dairy farmers in Goa revealed that the daily total milk yield was in the range of 51-75 lit / day (30.00%) in North Goa in contrast to upto 25 lit / day in South Goa (40.00 %). Daily average milk yield was 7.6-10.0 lit / day (31.66 %). Most common reproductive disorder was repeat breeding (33.34 %). Most common disease in Goa was reported to be mastitis (31.67 %).

Based on the study of nutrional interventions on dairy cows, it was concluded that feeding of

only mixture of maize grain and cotton seed cake as home-made concentrate mixture to dairy animals is not a profitable venture. Hydroponics technology involves growing of plants without soil. One unit of hydroponics was established at ICAR Research Complex for Goa, Old Goa. It has the production potential of 600 kg of green fodder daily in seven days. It was concluded that the hydroponically sprouted maize grain was more nutritious than the conventional green fodder maize.

During 2011, two outbreaks of enterotaxaemia like syndrome with two deaths were reported. Seroconversion of vaccinated animals was monitored. A total 157 samples were collected from different locations in Pernem and Bicholim talukas. The samples comprised of faeces, environmental swabs and milk samples. About 34 isolates of clostridia spp. were isolated. The isolated were characterized for phenotypic characteristics. Enterotoxin gene was detected in 16 strains.

Total seven male piglets (9 Goa Local, 2 crossbreed and 8 Large White Yorkshire) were castrated at different age. In case of Large white Yorkshire tesesticular dimensions at two months age were , length 2.66 cm,1.32cm and 7.44cm. Dimensions of testicle in crossbreed piglets at 2 and 3 month age were length1.85cm and 3.45 ms, width 1.21cm and 2.45cm and circumference 5.3cm,7.85cm. 12 numbers of boars (6 Large White Yorkshire, 2 Duroc and 4 crossbred) are selected and trained for semen collection. A total of 34 semen ejaculates were collected by hand glove method. it was found that the Tris buffer was not suitable to preserve the boar semen as most of the sperm cells in the stored semen lost their motility within 24 hours of storage. Observations indicated that BTS extender can be used for short term storage of boar semen and Trixcell buffers is suitable for long term storage.

Body weight gain was higher ($p<0.5$) in vanaraja chicks with supplementation of prosol @0.2g/ litre of DW at 13 weeks of age. Feed intake was not affected by the supplementation of probiotics through DW. However, chicks given 0.2 g prosol/ litre of DW consumed less feed compared to those given other levels of supplemental probiotics. The feed conversion ratio (FCR) was improved ($p<0.5$) in chicks given prosol through DW @0.2g/litre compared to all other groups including the control group. Cost benefit analysis indicated that the cost of production per bird for highest level of inclusion of probiotics i.e. prosol was higher than those given other levels of prosol including the control group. Results indicated that supplementation of probiotics, Biovet @ 1.0g/Kg diet was profitable in terms of higher percentage of net profit (51.55). Supplementation of biovet through drinking water @ 0.5g/litre is beneficial in terms of improvement in egg weight, shell quality, fertility and hatchability. Brewers' dried grain can be incorporated up to a level of 5 % in the diet of Japanese quail layers by partial replacement of maize, soybean meal and de-oiled rice bran for improvement in egg production performance and higher profit margin. Preliminary study indicated that cowpea leaves and pods can be fed to vanaraja laying hens for more income generation due to significant reduction in feed cost.

About 200 seafood samples and 89 samples from mangrove areas (sediment and water) were analyzed isolation of *Listeria* and *Salmonella* using specific media. Twenty five *Listeria* and 39 *Salmonella* strains were isolated. *Listeria* and *Salmonella* strains were further characterized for virulence associated genes. An ELISA based assay using listeriolysin O antigen has been developed. Peptide as antigen were synthesized and used in standardization of assays. Two peptides showed promising results. A significant achievement of the project is the establishment of well characterized repository of the strains of *Listeria* isolated from 12 states of India. We have archived all the strains at this centre as well as submitted to National Veterinary Type Culture Facility, NRC Equines, Hisar under ICAR.

Fishery Science

The highest catch obtained using PFZ advisories were 15 tons for Indian mackerel, 30 tons for oil sardine, 10.0 tons for Horse mackerel, 7.5 tons for tuna and 5.0 tons for seer fish. The time of receiving the PFZ advisories to the boat owners plays an important role and affects the

quantity of the catch. It was observed that if fishing was carried out on the first day of receiving PFZ advisory, then the amount of fish catch was more than the following days. The percentage of the fish catch on the first day was found to be 63.1 % which reduced to 31.1 % on the second day and 5.8 % on the third day. The reduction in the percentage of the catch is mainly because the pelagic fishes are highly migratory and the shoals drift very quickly. Thus, it is obvious that the fishing on the day one is highly profitable. A unique pattern was observed for the availability of fish species with respect to the depth of its occurrence. Oil sardine were more prominent at a depth between 15 to 30 m whereas Indian mackerel were caught more frequently from 30 to 50 meter depth. Larger fish species mainly seer fish and tuna were caught beyond 50 m.

Using the breeding, nursery and seed raising facilities available, 73 breeding sets of eight varieties of ornamental fishes including egg layers and live bearers were put. About 60,000 spawn were produced and about 15,000 salable seed are available. To overcome low survivability, the breeding and nursery tanks were upgraded with the provision of continuous aeration and water circulation facilities. The brood stocks of ten varieties are being raised from the young ones.

Agro-Eco-Tourism

The existing agro-eco-tourism centers of Goa were surveyed using a survey proforma. The impacts of the agro-eco-tourism were analysed form the survey data. Attempts were made to develop a model at the institute. Farmers were also asked to rate the possible benefits of agro-eco-tourism development in their rural areas. The most frequently added economic benefit was “increased income” The most frequently added social or cultural benefit was “educate people where food comes from.”

Introduction

Goa is a small state located in Konkan coast of India. Goa is India's smallest state by area, 4th smallest by population but is richest with a GDP per capita 2.5 times that of the national average. It is a renowned international tourist destination for its beaches, places of worship and world heritage architecture. Goa is blessed with a unique climate of 18-35^{0}C temperature, 2500 – 4000 mm annual rainfall with high humidity, it is a biodiversity hot spot and best suited for integrated farming system including Agriculture, Horticulture, Animal Husbandry and Fisheries. However, due to lucrative tourism and mining industry and increasing labour costs, agricultural and allied activities have taken the back seat in the state.

ICAR Research Complex for Goa, the only organization in Goa to look after the agricultural research needs of the state, has taken up the challenge of attracting the future generation to agriculture and allied activities. The Institute was established as a Regional Station by the Indian Council of Agricultural Research, New Delhi in April, 1976 under the administrative and technical control of Central Plantation Crops Research Institute, Kasaragod. After functioning at different Government farms, it was finally shifted to its present location at Old Goa in 1982. In order to intensify further the transfer of technology and to impart grass root level vocational training, a Krishi Vigyan Kendra was established at the Research Complex in 1983. Keeping in mind the ever-growing needs of agricultural research, education and extension of the state of Goa; ICAR, New Delhi upgraded the Research Complex to a full fledged Institute in April, 1989. In all, the Research Complex has 53.37 ha land of which 33.67 ha was acquired during 1987. The Research Complex carries out strategic and applied research in Resource Management & Integrated Production, Crop Improvement & Protection, Horticulture, Animal Sciences and Fisheries.

The Institute is headed by the Director, who is supported by 20 Scientists, 19 Technical, 21 Administrative and 32 Supporting staff, making the total staff strength of the Complex to 93. Besides, one Scientific, 11 Technical, 2 Administrative and 2 Supporting staff functions under the KVK of the Institute.

Mission

- Introduction and improvement of all potential crops and various species / breeds of livestock and scientific exploitation of various aquatic resources for improving fish production.

Mandate

- To conduct strategic and applied research on potential agricultural and horticultural crops, livestock and fisheries for improving productivity and post harvest management
- To disseminate improved technology developed
- To act as a centre for training in updated technologies
- To collaborate with national and international Institutes/ agencies in developing and transferring new technologies
- To generate nucleus planting materials
- To provide consultancy services
- To act as a repository of information on Western Ghat Agriculture System.

Staff Position as on March 31, 2012

Category	Sanctioned post	Posts filled	Posts Vacant
RMP	01	01	-
Scientific	20	19	01
Technical	19	17	02
Administrative	21	17	04
Supporting	32	27	05
Total	93	81	12

* Four posts (redeployed to Ranchi Regional Centre of the ICAR RC for Eastern Region)

The Organogram

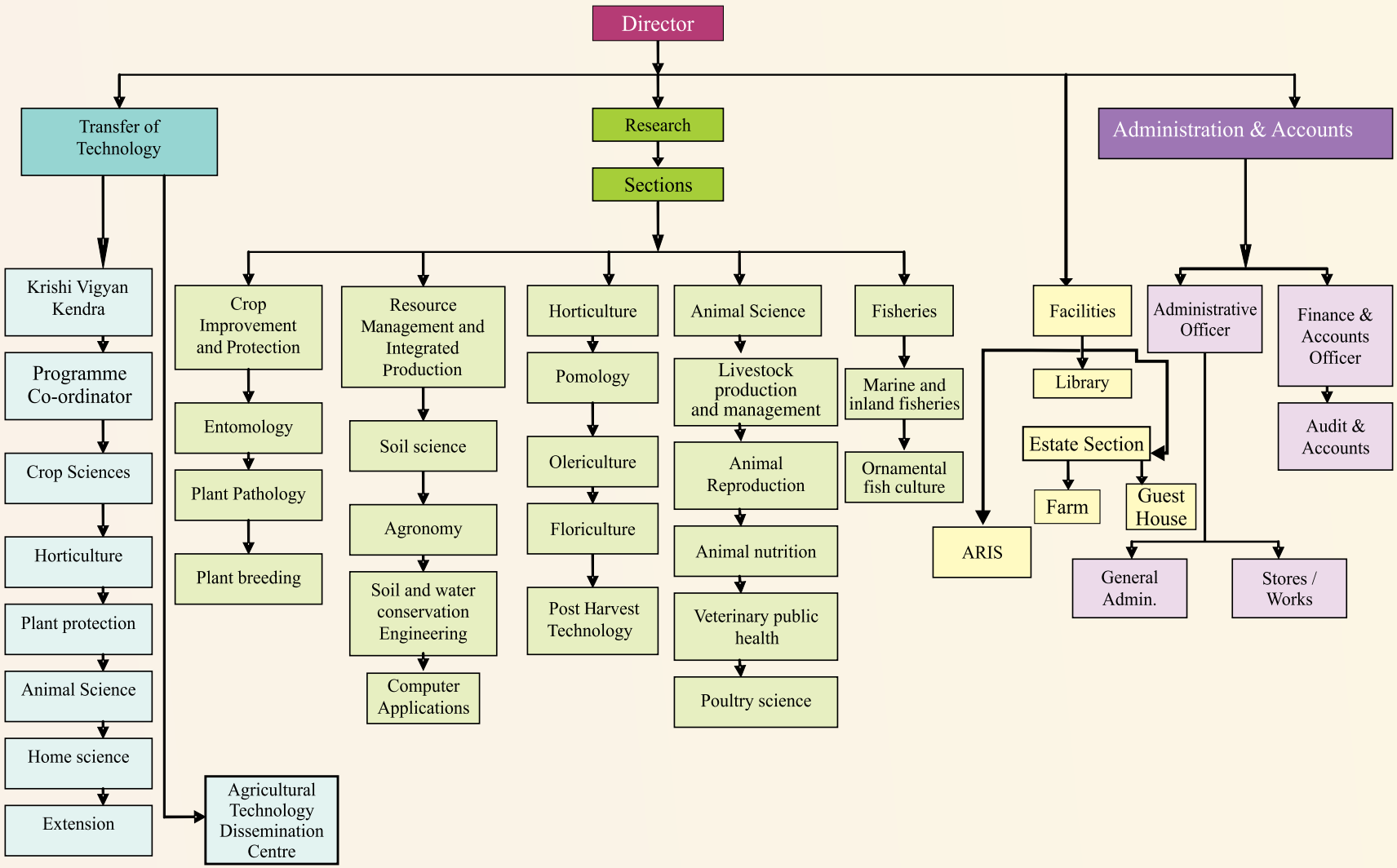


Fig. Organizational setup

Financial Statement (2011-12)

(₹. in lakhs)

Head	Allocation					Expenditure				
	Plan	Plan Scheme	Non plan	Deposits Schemes	Total	Plan	Plan Scheme	Non plan	Deposits Schemes	Total
Establishment Charges	-	85.66	386.00	50.60	522.26	-	85.08	382.28	11.68	479.04
OTA	-	-	0.06		0.06	-		0.06		0.06
HRD	2.00	0.50	-	0.75	3.25	2.00	0.75			2.75
TA	8.00	3.57	4.00	14.47	30.04	8.00	3.04	4.00	4.00	19.04
Other Charges	40.00	30.71	142.05	95.49	308.25	40	30.61	142.05	21.81	234.47
R & M Works	-	-	637.89	-	637.89	-	-	637.89	-	637.89
Total	50.00	120.44	1170.00	161.31	1501.75	50.00	119.48	1166.28	37.49	1373.25

Resource Generation

Head	Amount (₹. in lakhs)
Sale of Farm Produce	16.30
Sale of publications and tender forms	0.61
Standard licence Fees	4.43
Interest earned on loans & advances	1.26
Interest earned on STDR	0.62
Training	1.40
Miscellaneous receipts	4.20
Total	28.82

Weather Report

The trend of different weather parameters e.g. air temperature, rainfall, evaporation, wind speed, relative humidity, bright sunshine hour etc recorded at ICAR research complex Goa at 0734 hr, 0830 hr and 1434 hr are as follows:

Air temperature

The mean monthly maximum temperature varied from 30.1 ^{0}C in the month of September to 37.4 ^{0}C in the month of February. February was the hottest month. Maximum temperature recorded highest for a single day was 38.9^{0}C on 25th and 27th of February and lowest 21.5 ^{0}C on 12th September. The mean monthly minimum temperature recorded varied from 18.2 ^{0}C in the month of January to 23.9 ^{0}C in the month of May and October. Minimum temperature recorded lowest 15.1 ^{0}C on 16th December and highest 25.6 ^{0}C on 29th and 30 th of May.

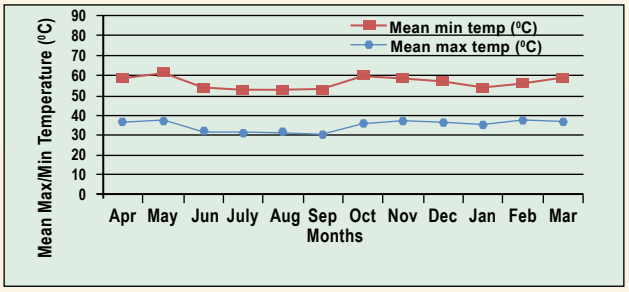


Fig. Max and Min Temperature variation at ICAR Research Complex, Goa during 2011-12

Rainfall and rainy days

Total rainfall received during January to December at ICAR research complex old Goa was 3435.0 mm distributed over 127 days. Yearly rainfall was about 702.9 mm less than last year (2010). Highest amount of rainfall for a single day was recorded 152.6 mm on 3rd August.

Evaporation

Evaporation was measured by a USDA – Class A pan evaporimeter. Total evaporation was highest 168.6 mm in the month of March 2012. Evaporation recorded in a single day was highest 7.6 mm on 14th May and lowest 0.6 mm on 31st July. Evaporation was higher than the rain fall during April and May and October to March month whereas rainfall was higher than the evaporation during rest of the month.

Table . Meteorological data for 2011 to 2012 Recorded at ICAR (R C) Ela old Goa

Parameter	Months											
	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Mean max temp (^{0}C)	36.5	37.3	31.8	31	31.2	30.1	36.1	36.9	36.6	35.5	37.4	36.9
Mean min temp (^{0}C)	22.3	23.9	22	21.3	21.7	22.7	23.9	22	20.1	18.2	18.8	21.9
Mean morning R.H. (%)	85.1	81.8	91.4	93.2	92.1	91	86	79	77.9	85.3	83.2	89.3
Mean afternoon R.H. (%)	55.5	52.8	79.9	83.9	81	72.9	60.4	43	39	42.5	39.5	58.4
Mean wind speed (Km/hr)	4.2	4.9	5.3	4.2	4.1	3.4	3.1	4.1	3.6	3.9	3.8	4
Total sunshine hours	253.6	245	61.5	29	40.3	127.2	221.7	257.6	268.5	285.4	269.5	7.3
Total rain (mm)	3.9	7.7	879.6	114.5	899.1	529.1	68	13.4	0	0	0	0
Total rainy days	2	2	28	31	22	8	3	0	0	0	0	0
Total evaporation (mm)	153.1	187.1	116.6	83.7	86.7	117.8	135.7	154.1	163.4	161.1	152.1	168.6
Mean evaporation (mm)	5.1	6	3.8	2.7	2.8	3.9	4.3	5.1	5.2	5.1	5.2	5.4

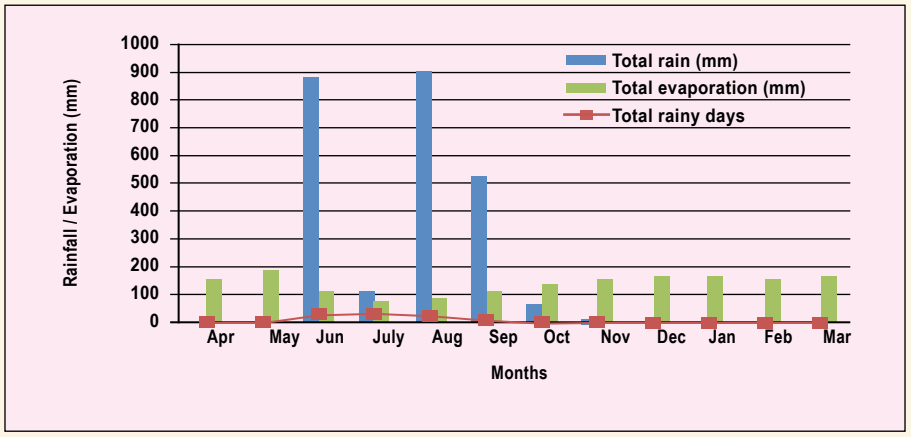


Fig. Variability in the trend of rainfall, evaporation and rainy days

Wind speed

Mean monthly wind speed ranged from 3.1 km/hr in the month of October to 5.3 km/hr in the month of June. Wind speed recorded in a single day was highest 7.3 km/hr on 18th July and lowest 1.9 km/hr on 9th October.

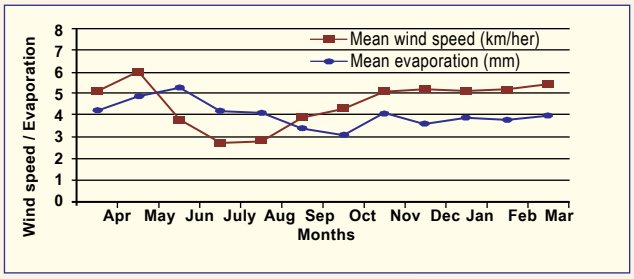


Fig. Correlation of evaporation with wind speed

Sunshine hour

The mean sunshine hour at ICAR Goa ranged from 0.9 hrs in the month of July to 9.2 hrs in the month of January and February. The highest was recorded 11.3 hrs / day on 6th May and lowest 0.1 hrs/day on 6th June.

Soil temperature

In the morning hour, the mean soil temperature ranged from 23.9 to 32.1 ^{0}C and from 26.3 to 34.7 ^{0}C at 5cm and 10 cm depth of soil, respectively. In case of sub surface soil the mean temperature ranged from 27.7 to 35.8 ^{0}C at 20 cm depth of soil.

In the afternoon hour, the mean soil temperature ranged from 35.2 to 47.5 ^{0}C and from 31.8 to 40.6 ^{0}C at 5cm and 10 cm depth of soil, respectively. In case of sub surface soil, the mean temperature ranged from 29.5 to 38.3 ^{0}C at 20 cm depth of soil.

Relative humidity

Relative humidity at 0734 hrs at ICAR Goa was highest 97 % on 9th June and 24th July and the lowest 45 % on 14th January. Relative humidity recorded in the evening at 1434 hr was varying from 20% on 16th of January to 93% 5th June, 17th June 2nd July 3rd August and 7th of September June, July.

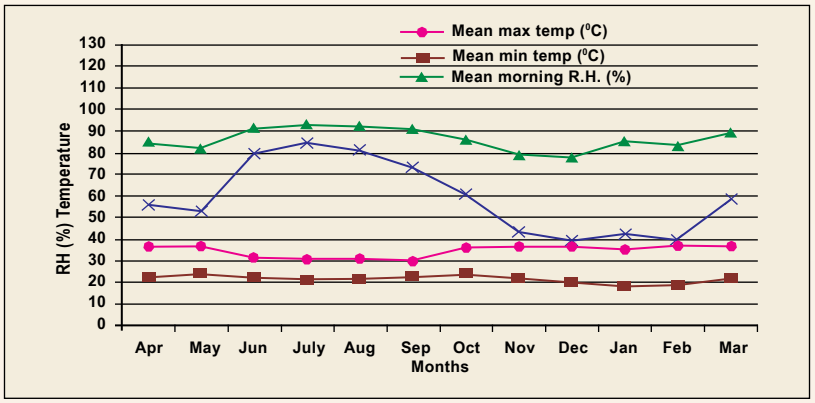


Fig. Relative humidity trend with respect to temperature

ICAR RC Goa

Annual Report 2011-12

Research Achievements

- Resource Management and Integrated Production
- Crop Improvement and Protection
- Horticulture
- Animal Science
- Fishery Science
- Agro- Eco – Tourism
- Externally Funded Projects

Resource Management and Integrated Production

Project : Development and Evaluation of Soil and Water Conservation Measures and Land Use Systems for Sustainable Production of Major Horticultural Crops in Goa *(PI: R. R. Verma)*

Various soil and water conservation measures were evaluated for major horticulture crops of the region viz. mango and coconut. Under mango system, highest mean plant height of mango (4.19 m) was recorded in the treatment of Continuous Contour Trenching (CCT) + Vegetative barrier followed by 3.89 m in Staggered Contour Trenching (SCT) + Vegetative barrier against the lowest height of 3.25 m in control plot. Similarly, higher mean girth of mango (51.6 cm) was recorded under CCT + vegetative barrier followed by 47.4 cm in SCT + vegetative barrier while the lowest 43.2 cm was recorded in control treatment.

Study on runoff and soil loss under different soil and water conservation measures in mango system revealed that continuous contour trenches with V*etivaria zizanoides* and staggered contour trenches with V*etivaria zizanoides* reduced the runoff by 46 and 36 per cent, respectively. The soil loss was minimum recorded in the treatment of continuous contour trenches with V*etivaria zizanoides* and was followed by 7.8 t/ha in staggered contour trenches with V*etivaria zizanoides* as compared to higher soil loss of 17.8 t/ha under control treatment.

Soil and water conservation measure viz. circular trenches, half moon terraces including one control treatment were evaluated under coconut system. Record of plant growth parameters showed that the maximum coconut plant height under circular trenches (3.37 cm) followed by half-moon terraces (2.12 cm) whereas least plant height was recorded under control treatment (1.87 cm). Similarly, maximum coconut plant girth was recorded under the circular trenches (66.25 cm) followed by half-moon terrace (40.16 cm) and minimum was recorded under control treatment (29.17). The number of leaves recorded were 7.83, 5.66 and 5.17 under circular trenches, half-moon terraces and control, respectively.

Performance of mango under continuous contour trenches with Vetivaria zizanoides treatment

A view of circular trench in coconut

Project: Rehabilitation of Mine Reject Soils (*PI : R. R. Verma*)

Survey of different mine sites were conducted during the year for identification of suitable plant species for mine rehabilitation programme. The plant species identified for rehabilitation of mine dumps are: *Acacia mangium*, jamun, cashew, vetivaria, lxmitaru, tamarind, aonla, ber, jatropha, neem, drumstick, guava, pineapple, mango, *Glyricidia*, kokum etc. Further geo-net product of coconut coir is also identified as a material suitable for stabilization of mine dumps and establishment of new plantation in the mine reject soils.

Soil samples were collected from different mine reject sites and analysis was carried out. Data revealed that mine dump soils are strongly acidic in soil reaction (pH 4.46- 5.08), normal in soil salinity (EC < 0.08 dSm^{-1}), low in available nitrogen (112.0 -156.8 kg/ha), phosphorus (6.13-13.02 kg/ha) and potassium status (14- 114 kg/ha) and poor in organic carbon (0.06 – 0.45 per cent) content.

Table. Soil properties of Minescape mine site I, at Revona village in South Goa

Mine reject dump site	pH	EC (dSm^{-1})	O.C. (%)	Available Nitrogen (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
I stage from bottom	4.52	0.05	0.075	145.6	10.87	36
II stage from bottom	4.74	0.01	0.15	145.6	10.30	30
III stage from bottom	4.53	0.01	0.45	156.8	13.02	78

Table. Soil properties of Minescape mine site II, at Sulkarna village in South Goa

Mine reject dump site	pH	EC (dSm^{-1})	O.C. (%)	Available Nitrogen (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Un-stabilized mine dump	4.46	0.012	0.13	156.8	8.65	42
Newly stabilizing mine dump with Geo-net	5.08	0.014	0.06	219.2	5.86	114
Clay mine dump	4.63	0.080	0.08	112.0	6.13	14

Acacia Mangium

Jamun

Cashew

Lasmitaru

Active mining area

Use of soil cover

Project : Standardisation of Management Practices for Organic Rice Production (*PI: B. L.Manjunath*)

Standardisation of management practices for organic production in rice is essential to enhance the returns for the farmer through premium price for the quality rice in the market and to offset the spiraling cost of production. The nutrient sources for the practices of organic cultivation varies with availability of local manurial resources and as such it is necessary to identify both the source and its quantity to meet the nutrient requirement of rice. The price premium vary widely with different varieties especially in organic rice. Red kernelled medium bold grain type is preferred for parboiling in the region while scented fine grain rice fetch high price in the market. As such, the promising varieties were evaluated for their suitability for organic production in the study. Further, the long term impact on soil and the sustainability of returns assumes major significance. Keeping these points in view, the study was conducted during the year.

Field experiment was continued for the third year in a Split–plot design with three replications involving rice varieties as main plot treatments and nutrient sources as sub-plot treatments. The selected rice varieties in each group of red kernelled (Revathy), medium duration (Karjat-3) and scented (Pusa Sugandh-5) were included for the study keeping in view their market potential. The nutrient sources were selected based on the local availability and feasibility of application and the quantity was based on equivalent N basis.

The crop was managed with recommended package of practices and all the relevant growth and yield parameters were recorded and the data analysed. The soil was analysed after rice crop for its fertility status both in terms of nutrient status as well as microbial count.

Rice varieties varied in their growth habit significantly, with Pusa Sugandh-5 being taller (112 cm) as compared to Karjat-3 (90.8 cm) and Revathy (96.9 cm). The variety Karjat-3 recorded significantly higher productive tillers (11/hill) as compared to Revathy (9.7/hill) and Pusagandh-5 (7.9/hill). Further, Karjat-3 and Pusa Sugandh-5 recorded significantly higher dry matter production (13.6 and 12.7 g/hill, respectively) over Revathy (10.14 g/hill). The harvest index of both the red kernelled (Revathy) and high yielding medium duration (Karjat-3) were although on-par (0.40 and 0.42, respectively), were found superior to Pusa Sugandh-5 (0.35).Although, the scented variety Pusa Sugandh-5 recorded significantly lowesr panicles number per unit area (190/m^2), the length of the panicles were longer in the variety (24.8 cm). In contrast, the high yielding medium duration rice variety Karajt-3 recorded more panicles per unit area with medium length panicles (23cm). The scented rice variety Pusa Sugandh-5 recorded significantly lengthy panicles (24.8cm) as compared to Karjat-3 (23cm) and Revathy (22 cm).

Different nutrient sources resulted in significantly higher growth parameters in rice. With application of FYM on equivalent N basis resulting in higher productive tillers (10.3 tillers/ hill) similar to 100 % NPK application (10.47 tillers / hill). Application of *Glyricidia* and Eupatorium on equivalent N basis resulted in enhanced plant height (103cm) significantly differing from the control (92.4cm). Although recommended fertilizer application resulted in increased panicle number per unit area (255.6/m^2) significantly differing from the control (215.8 /m^2), was found to be at par with rest of the nutrient sources except vermicompost application. Although, significantly higher panicle length was recorded with FYM and fertilizer application (23.9 and 23.8cm, respectively), they were at par with rest of the nutrient sources except vermi compost (22.8cm) and the control (22.7cm).

Significantly higher grain yield (4.17t/ha) was recorded with the rice variety Karjat-3 as compared to Pusa Sugandh-5 (2.69 t/ha) indicating its superiority. Among the nutrient sources, FYM application on equivalent N basis recorded significantly superior yield (4.35 t/ha) as compared to rest of the nutrient sources except *Glyricidia* and

A view of the field trial on standardization of nutrient management practices for organic rice production

Increased harvest by FYM application in scented rice Pusa Sugandh- 5

Eupatorium application (3.88 t/ha). It is interesting to note that 100% NPK (100:50:50 kg NPK/ha) application recorded significantly lower yield (3.68t/ha) as compared to FYM treatment.

Straw yield although did not differ statistically among the varieties, application of 100% NPK recorded relatively higher straw yield (6.07 t/ha) as compared to rest of the treatments except FYM application, indicating the supremacy of the latter.

Effect on stem borer incidence

The impact of different nutrient sources was assessed for incidence of the common insect pest, stem borer in terms of dead heart symptoms. Although non-significant differences were observed for the pest incidence both among the varieties and the nutrient sources, relatively Karjat-3 recorded the least insect damage (0.50 dead hearts/m^2) as compared to Revathy (0.56 dead hearts /m^2) and Pusa Suagndhi-5 (0.66 dead hearts /m^2). Further, among the nutrient sources, FYM application on equivalent N basis recorded the least dead heart symptoms (0.45 dead hearts /m^2) followed by recommended NPK application (0.50 dead hearts /m^2).

Changes in soil fertility

The impact of different nutrient sources was assessed on soil fertility parameters. Although, significant differences were not observed in most of the soil fertility parameters, organic carbon content differed significantly due to nutrient sources. Application of FYM and *Glyricidia* + Eupatorium on equivalent N basis found to enhance soil organic carbon significantly (1.56% O.C. both) as compared to application of recommended fertilisers alone (1.24%) or control (1.25%). However, no significant differences were observed on available nitrogen, phosphorus and potassium contents in soil after the crop harvest. Further, interaction effect between the varieties and the nutrient sources was also non significant.

Influence on soil microbial population

Although no significant differences were observed in the microbial population due to nutrient sources after two years of cropping, application of *Sesbania rostrata* on equivalent N basis influenced higher microbial growth in soil in terms of bacteria (18.2 x 10^5 CFU/g), actinomycetes (12.00x10^4 CFU/g) and fungi (11.61x10^3 CFU/g). The higher microbial growth in the treatment may be attributed to the free living nitrogen fixers both in stem and root nodules of *Sesbania* coupled with addition of sufficient quantities of easily decomposable organic matter that might have served as a substrate for the microbial growth.

Crop Improvement and Protection

Project : Breeding High Yielding Salt Tolerant Rice Varieties for Coastal Saline Soils (*PI: Manohara, K. K*)

This project aims at the development, evaluation and dissemination of better salt tolerant rice genotypes for coastal saline soils of Goa and adjoining regions.

Crosses have been initiated between high yielding salinity susceptible rice varieties *viz*., Karjat-3, Naveen, Jyothi and Pusa-44 with tolerant low yielding local landrace Korgut. Reciprocal crosses of these above cross combinations were generated and the F_1 seeds were harvested to take up their sowing during the *kharif* 2012-13.

Project : Collection, Evaluation and Characterization of Rice Germplasm of Western Region (*PI: Manohara, K. K*)

The project aims at collection, conservation, evaluation and characterization of local land races along with the introduced rice varieties under different rice ecosystems prevailing in and around Goa State.

Survey and collection of rice germplasm of western region

A total of 16 land races of rice belonging to Goa state and adjoining regions *viz*., Damgo, Mudgo, Belo, Kala Belo, Walio, Korgut, Kendal, Red Kochri, White Kochri, Saalsi, Kolio, Shidde and Panyo from Goa, Budda and Jaddu batta from Karnataka and Pokkali from Kerala were collected and the traditional knowledge associated with the each of the accession was gathered from the contributing farmers. These lines were evaluated both during *kharif* and *rabi* seasons for their characterization.

Evaluation of rice varieties for rainfed shallow lowland situations in Goa, *Kharif*, 2011-12

Rainfed shallow lowland ecosystem constitutes the predominant ecosystem during *Kharif* which accounts for about 50% (27,000 ha) of the total rice area. Jaya is the ruling variety grown in the region and the yield level is decreasing due to various biotic and abiotic stresses. A set of 23 rice genotypes/ varieties including local land races collected in Goa and adjoining regions and improved cultivars from different rice breeding Institutes across India were evaluated during *Kharif* 2011 to identify an alternative variety to Jaya. The experiment was laid out at the Institute farm, B-Block, in Randomized Block Design (RBD) with three replications. Days to fifty per cent flowering (DFF) ranging from 55 days (Kochri White) to 114 days (Swarna Sub-1), Plant height (PHT) ranging from 95 cm (Karjat-7) to 188 cm (Pokkali), panicles per hill (NPT) ranging from 7.33 (Swarna Sub-1) to 12.60 (Kolio) and grain yield ranging from 1064 kg/ha (Kochri White) to 7662 kg/ha (Pusa-44).

Among the 23 entries evaluated, Pusa-44 recorded highest grain yield of 7.66 t/ha followed by Swarna (*Sub-1*) (7.42 t/ha), TRC-2005-1 (6.98 t/ha) and Akshayadhan (6.71 t/ha) and showed significantly higher yield compared to check variety Jaya (5.93 t/ha).

Evaluation of rice varieties for irrigated situations in Goa, *Rabi*, 2011-12

Irrigated rice ecosystem constitutes about 18,000 ha of rice area during *rabi* season. In order to identify suitable rice varieties for the irrigated situations, a set of 24 rice genotypes/varieties including local land races and cultivated varieties were evaluated during *Rabi* 2011-12.

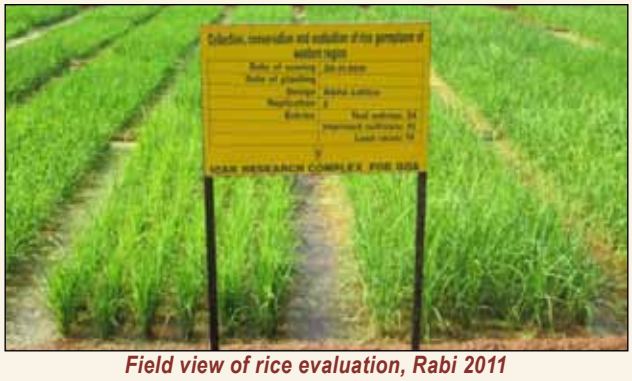
Table. Mean performance of the top 10 entries under rainfed shallow lowland situation

Entries	DF 50% F	Plant height (cm)	Panicles /hill	Grain yield (kg/ha)
Pusa 44	102.00	100.40	8.67	7662.50
Swarna (*Sub*-1)	114.00	109.60	7.33	7429.86
TRC-2005-1	107.33	115.67	10.87	6986.81
Karjat-3	97.33	102.07	10.13	6912.50
Akshay-adhan	101.67	132.40	10.13	6716.67
Naveen	95.33	126.60	10.93	6584.03
Chandan	92.00	105.40	10.00	6400.00
Jaya (Check)	94.33	106.33	9.60	5939.58
Karjat – 7	88.67	95.80	10.33	5374.31
Mudgo	95.00	154.20	10.27	5356.94
Mean	92.84	136.53	10.26	4982.04
SE (m)	1.01	5.24	1.21	368.62
CD (0.05)	2.04	10.56	2.44	742.91
CV (%)	1.33	4.70	14.45	9.06

The experiment was laid out at the Institute farm, B-Block, in Randomized Block Design (RBD) with three replications. Days to fifty per cent flowering (DFF) ranging from 77 days (Saalsi) to 117 days (Swarna Sub-1) with a mean of 93 days, Plant height (PHT) ranging from 76 cm (Pusa-44) to 155 cm (Korgut) with a mean of 115.10 cm, panicles per hill (NPT) ranging from 10.33 (Pokkali) to 19.07 (Karjat-3) with a mean of 13.56 and grain yield ranging from 3.29 t/ha (Korgut) to 7.79 t/ha (Naveen) with a mean yield of 5.99 t/ha. Among the 24 entries evaluated, none of the varieties were significantly superior to the check variety Jaya, however, varieties Naveen (7795.83 kgs/ha) followed by Akshayadhan (7535.11 kgs/ha), Chandan (7449.02 kgs/ha), Karjat-3 (7305.43 kgs/ha), Pusa-44 (7162.91 kgs/ha and karjat-7 (7056.01 kgs /ha) recorded numerically higher yield over the check variety Jaya (6927.08 kgs/ha).

Table. Mean performance of the top 10 entries under irrigated condition

Entries	DF 50% F	Plant height (cm)	Panicles / hill	Grain yield (kg/ha)
Naveen	95.33	105.07	11.87	7795.83
Akshay-adhan	102.00	111.73	12.00	7535.11
Chandan	95.00	86.87	12.87	7449.02
Karjat – 3	98.00	78.67	19.07	7305.43
Pusa – 44	103.00	75.87	11.93	7162.91
Karjat – 7	97.67	79.07	15.87	7056.01
Jaya (Check)	97.00	82.07	12.93	6927.08
TRC-2005-1	108.67	89.13	15.00	6888.89
Swarna (*Sub*-1)	117.33	84.13	11.67	6798.61
Jyothi	97.33	85.67	11.53	6426.91
Mean	93.29	115.10	13.56	5996.61
SE (m)	1.31	5.42	1.85	623.00
CD (0.05)	2.64	10.91	3.73	1254.02
CV (%)	1.72	5.77	16.74	12.72



Field view of rice evaluation, Rabi 2011

Promising rice variety - Naveen

Project : Plant Disease Management by Bacterial, Fungal Agents and other Non-conventional Methods under Coastal Ecosystem (*PI: R. Ramesh*)

Twenty one bacterial isolates, 27 *Trichoderma* isolates and five fungal plant pathogens are used in this study. *Trichoderma* isolates were obtained from NBAII, Bangalore (10) and from IISR, Calicut (15) in the PhytoFuRa project. List of bacterial isolates was finalized based on the earlier inhibition assays against fungal pathogens. Bacterial isolates are from our own collection. Following plant pathogens were selected for this year's study.

Pathogen	Disease	Crop
Rhizoctonia solani	Root rot	Chilli
Fusarium oxysporum f.sp. *solani*	Root rot	Chilli
Macrophomina phaseolina	Root rot	Mango
Sclerotium rolfsii	Seedling rot	Mango
Fusarium oxysporum f.sp. *niveum*	Wilt	Water melon

Antagonistic properties of selected isolates of *Trichoderma* and antagonistic bacteria were tested *in vitro* as per the standard methods.

To check the compatibility of selected *Trichoderma* cultures with commonly used fungicides (Carbendazim, Mancozeb, Ridomil MZ and Copper oxychloride) an experiment was conducted as per the standard method. *Trichoderma* isolates were grown on PDA media and their morphological characteristics were observed based on the methods described elsewhere. Similarly, antagonistic bacteria were characterized.

Identification of promising bio-control or plant growth promoting agents against major soil-borne plant pathogens

Results of *in vitro* testing of antagonist bacteria against *Sclerotium rolfsii* revealed that all 21 isolates inhibited the pathogen. Out of 21 isolates, 10 isolates showed above 70% inhibition. Similarly 7 isolates showed 55-65% inhibition against *Rhizoctonia solani* and 12 isolates showed 50-60% inhibition against *Macrophomina phaseolina*. 12 isolates showed 50-60% inhibition against *Fusarium oxysporum* f.sp. *solani* and 9 isolates showed more than 60% inhibition against *Fusarium oxysporium* f.sp. *niveum*. However EB 66, EC 18, EC 14, K1, B1 showed inhibition of 60% and above against all the pathogens. Out of 27 *Trichoderma* cultures 7 isolates namely Pf 2, Pf3, Pf 10, Pf 13, TA 23, TVS 08 effectively inhibited pathogen growth.

Compatibility of selected *Trichoderma* cultures with commonly used fungicides

Compatibility was studied of nine selected isolates *Trichoderma* cultures with the above fungicides. Results revealed that eight isolates were compatible with Ridomil MZ, Mancozeb and copper oxychloride.

Characterization of effective antagonistic bacteria and *Trichoderma*

Trichoderma isolates were grown on PDA media and their morphological characteristics were observed after four days. *Trichoderma* isolates were morphologically characterized on the basis of its growth in diameter, colour, sporulation and pigmentation. Most of the isolates produced typical olive green colour and covered the entire plate within 4-5 days. Microscopic observations of mycelia and spores were recorded. Colony morphology, Gram reaction and other biochemical characters of antagonistic bacteria were studied and the details are documented for future use in the disease management.

Antagonistic bacteria and the species of *Trichoderma* effectively inhibited the growth of five important plant pathogens in the lab studies. Morphological and other biochemical characterization of the isolates was carried out. Selected *Trichoderma* isolates could be used along with fungicides for the disease management as they are compatible.

Horticulture

Project : Horticultural Plant Genetic Resources of Goa *(PI: V. Arunachalam)*

ICAR RC, Goa and NBPGR RS, Thrissur collaborative team collected 53 accessions of germplasm of vegetables, tubers and ornamental crops during the visit. High degree of variability in chillies of Goa was found. Wide range of plants are used by Gowli tribes at Piyamal hamlet of Gaon Dongri village of Canacona taluk (4 in greater yam, 4 in sweet potato and one each in lesser yam, potato yam, elephant foot yam, cocoyam and colacasia were collected, majority from Gowli and Kulmi hamlets.

Horticultural plant germplasm in tribal hamlet of South Goa

Among vegetables, 11 samples in Chinese spinach (10 red and 1 green), two in spleen amaranth, 3 in okra (local types), 4 in chillies, 4 in drum stick and 3 in vegetable cowpea were collected.

Variability of chilli in Goa

Among ornamentals, red and yellow forms in crossandra, orange and yellow forms in marigold and one each in barleria and cocks comb were collected. Besides, species diversity in *Jasminum* comprising *J. sambac, J. grandiflorum* and *J. auriculatum* were also collected. Three different (dark red, yellow and blue) color variants of crossandra were collected. Six best performing individual plants were selected different habit/color of crossandra and are multiplied and evaluated. Blue, tall yellow, dwarf yellow and dark red are named as ICAR Goa Neel Abholi (Goa Neel), ICAR Goa Halduve Elavarasi Abholi (Goa Elavarasi), ICAR Goa Halduve Nana Abholi (Goa Nana) and ICAR Goa Rattan Abholi (Goa Rattan) respectively.

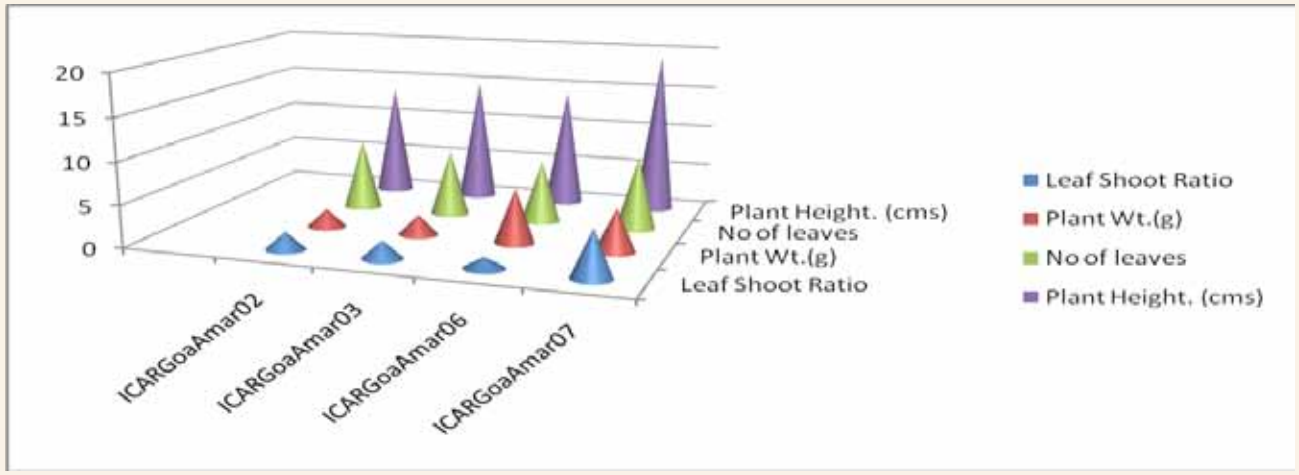


Fig. Promising Red amaranth accessions at Goa

Variability of colour in crossandra germplasm of Goa

Germplasm of vegetative propagated crops sweet potato, Dioscorea, Elephant foot yam, jasmine and crossandra were planted for multiplication.

An accession of Elephant foot yam germplasm

An accession of Colocasia germplasm

Characterization of 10 red amaranthus and 1 green amaranthus accessions were completed. An accession ICARGoaAmar07 recorded high leaf shoot

An accession of Dioscorea germplasm

An accession of Okra germplasm

ratio of 5.6 at one month of sowing and was free from nematode infestation. Open or self pollinated seeds of best performing individual selected amaranth plants were generated.

An accession of Amaranthus germplasm –ICAR Goa Amar 07

Conservation of orchid germplasm

Production of self/open pollinated seeds in amaranthus

Performance of marigold accessions at Goa

Seed multiplication of four new marigold accessions completed. Of these ICAR Goa Yellow Elavarasi (Te03) performed best with good yield of flowers. Indigenous orchid species native to Goa collected by previous workers were conserved.

Project : Coconut/Arecanut based Cropping Systems for Goa (*PI: V. Arunachalam*)

Coconut based cropping systems

An experiment was laid out with fruit crops in three replications in Coconut-glyricidia system with kokum, jackfruit, lemon successfully. Coconut-gliricidia based cropping system: Gliricida plants in the system produced 6.4 shoots each shoot attaining a length of 167 cm and had 47 leaves. Dry weight of leaves in a shoot was 44 gm with 66 % moisture content. Black pepper, ornamental sweet potato, rambutan, and aonla were added as component crops and they were established in the plot.

Coconut - glyricidia - ornamental sweet potato system

Performance of colocasia in coconut garden

Ornamental sweet potato (Akshaya) plants were found to establish well in summer season with less water in laterite soil. These plants grew fast (7 to 13 cm per day) and found to be good as ornamental plant under Goa conditions. 0.7 to 2 tender shoots 7.2 to 21.8 leaves were produced in an area of 30 cm^2. Each leaf attained a dry weight of 0.2 g and moisture content of 46 to 70 %. One plant has produced a big sized single tuber weighing 2.6 kg. Colcocasia and marigold were evaluated and found suitable in the system.

Edible tubers from ornamental sweet potato Akshaya

High density plantation of dwarf areca and component crops

A block of arecanut cultivar Hirehalli Dwarf was established at a high density of 0.5 m x 0.5 m and the performance is monitored. Red amaranthus, okra were grown in interspaces in juvenile plants. Shoot

Tuber of ornamental sweet potato Akshaya

Dwarf areca block

Shoot cutting from tubers of potato - Kufri Jyoti

cuttings from Potato cv "Kufri Jyoti" tubers were planted in the interspaces. Single plants producing many (252) tubers or large sized (31.5 g) tubers were selected and stored for evaluation in next season.

Project : Integrated Strategies through Classical and Modern Techniques for Crop Improvement in Cashew and Spices (*PI: A. R. Desai*)

Evaluation of 1st set of Hybrids

The evaluation of first set of 12 cashew hybrid-seedlings is under progress from 2006-07. Observations on growth performance of the hybrids during the current season indicated vigorous growth habit of hybrids H-31/05, H-22/05 and H21/05 which showed higher tree height and canopy spread. The highest tree height of 4.10 m was recorded in H-31/05 followed by H-22/05 (3.80m) and H-21/05 (3.5m). Similar trend was also observed with respect to collar girth and canopy spread. Three hybrids, H-11/05, 31/05 and H-21/05 showed precocious bearing while H-27/05 was the last to flower.

The hybrids namely, H-13/05, H-27/05 and H-30/05 started yielding from current year The nut yield of the hybrids in the current season varied from 0.32 kg/tree (H-13/05) to 4.8 kg/tree(H-31/05). Although the H-31/05 recorded the highest raw nut yield, the mean nut size was very small. The other hybrids, H-21/05, H-11/05, H-22/05 and H-12/05 recorded the higher nut yield of 3.12, 2.10, 1.95 and 1.85 kg/tree respectively with corresponding mean nut weight of 8.26, 7.86,8.88 and 7.56 g. All the hybrids except H-14/05 and H-30/05, recorded more than 28 per cent shelling.

Apple and nuts of the promising cashew hybrid H-21/05

Table. Nut yield trend of first set of hybrids

Hybrid	Av. Nut Wt. (g)				Nut yield (kg/tree)				Shelling (%)		
	2008	2009	2010	2011	2008	2009	2010	2011	2009	2010	2011
H- 5/05	-	-	7.2	7.6	-	-	0.09	0.88	-	-	28.63
H- 14/05	-	8.4	8.1	8.25	-	-	0.1	0.65	-	-	27.45
H- 11/05	8.1	7.9	8.0	7.86	0.31	0.78	0.55	2.10	28.4	28.7	29.05
H- 12/05	-	8.2	7.8	7.56	-	0.26	0.15	1.85	-	-	29.65
H- 13/05	-	-	-	7.88	-	-	-	0.32	-	-	28.33
H- 21/05	8.8	8.2	8.3	8.26	0.85	1.9	1.25	3.12	28.8	28.4	29.2
H- 22/05	-	8.9	8.59	8.88	-	0.18	0.15	1.95	-	-	29.33
H- 23/05	-	7.8	7.5	7.66	-	0.21	0.16	0.78	-	-	28.80
H- 27/05	-	-	-	7.35	-	-	-	0.75	-	-	28.10
H- 29/05	-	-	7.4	7.68	-	-	0.08	0.90	-	-	28.68
H- 30/05	-	-	-	7.55	-	-	-	0.35	-	-	27.80
H- 31/05	7.6	6.9	7.0	7.11	1.4	2.75	1.0	4.80	29.1	28.6	28.14

The mean kernel weight varied from 2.0g (H-29/05) to 2.62g (H-22-/05)with kernel grade in the range of W240 to W180 counts. Other promising hybrids, H-21/05 and H-1105 recorde the mean kernel weight of 2.43 and 2.26g respectively with W210 kernel grade. Apple size was observed be bigger in H-22/05 (100.4g) having juice contents of 69.7% and total soluble solids of 12.4 °B, while the corresponding values were 90.55g, 70.3% and 11.8 °B in H-21/05 and 69.4g, 69.4% and 11.0 °B in H-1105.

Evaluation of local bold nut cashew genotypes

An evaluation trial of bold nut cashew genotypes selected from the local germplasm accessions, was initiated from 2008-09 with Randomized block design having two replications. The experiment comprised of 14 genotypes namely, Valpoi-1, Valpoi-2, Valpoi-3, Bardez-3, Bardez-9, Tiswadi-7, Tudal-1, Tudal-3, Mayem-1, BKL-1, BKL-2, FMGDI-1, Tiswadi-3 and Balli-1/ Goa-1 (Check). The results on growth performance indicated that the accession Valpoi-2 showed vigorous growth with maximum tree height of 4.7m with collar girth of 6ocm and canopy spread of 5.9m (NxS) and 5.2m (ExW), but still continued in juvenile phase. Whereas, other accessions namely, Valpoi-1, Valpoi-3 and Tiswadi-3 with medium vigorous growth habit also remained in juvenile phase.

On the other hand, the genotypes namely Bardez-9, Tiswadi-7, Mayem-1, BKL-1, BKL-2 and Goa-1 showed first flowering and fruit set. Mean nut weight of the genotypes was in the range 8.1g (Goa-1)-10.43g (Bardez-9) with 29.6 and

Apple, nuts and kernels of Mayem -1 cashew accession

Apple, nuts and kernels of Bardez -9 cashew accession

Table. Growth performance of bold-nut genotypes of cashew

Genotype	Height (m)	Girth (cm)	Canopy spread (m)		Year of flowering	Mean nut wt (g)	Mean apple wt. (g)
			N x S	E x W			
Valpoi-1	3.1	36	2.8	2.9	-	-	-
Valpoi-2	4.7	60	5.9	5.2	-	-	-
Valpoi-3	3.1	36	2.8	26	-	-	-
Bardez-8/98	3.3	40	4.25	3.85	2011	-	-
Bardez-9	3.4	39	2.75	3.3	2011	10.43	117.5
Tiswadi-3	3.4	40	3.7	4.16	-	-	-
Tiswadi-7	4.0	35	2.95	2.54	2011	8.22	86.7
Tudal-1	2.8	33	3.2	2.5	2011	-	-
Tudal-3	3.6	35	2.4	4.6	2011	-	-
Mayem-1	4.1	45	5.9	6.8	2011	8.30	80.35
BKL-1	3.3	40	3.0	2.6	2011	8.52	95.8
BKL-2	2.9	38	2.7	2.9	2011	8.46	93.6
FMGDI-1	2.6	38	3.1	2.8	2011	-	-
Goa-1 (Check).	4.1	50	5.2	4.2	2011	8.1	79.4

Apple, nuts and kernels of Tiswadi - 7 cashew accession

27.8 per cent shelling and corresponding apple weight of 79.4g and 117.5g respectively. Tudal-1, Tudal-3, Bardez-8/98 and FMGDI-1 also flowered but did not show fruit set subsequently during the season.

Collection and characterization of local nutmeg germplasm

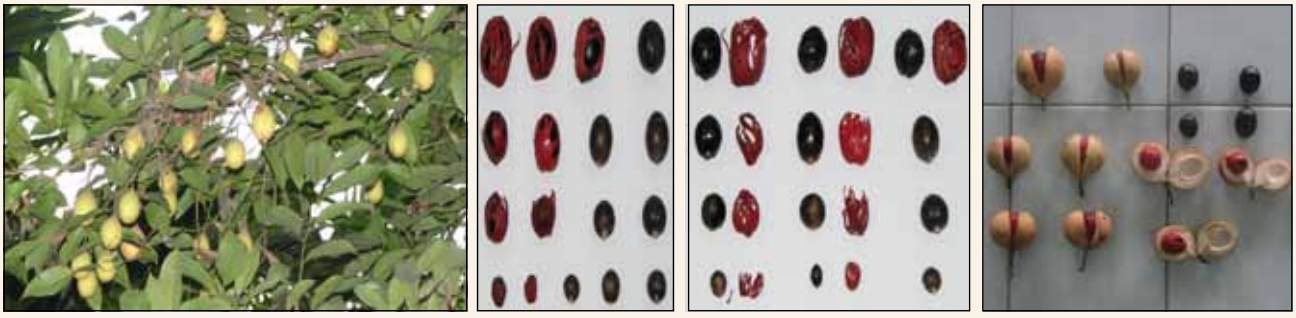
Nutmeg is an important tree spice being cultivated commercially in traditional arecanut gardens in Goa. The fruits of nutmeg trees produce two types of spices, dark brown coloured seed nut and red coloured mace, the aril encapsulating the seed. The trees existing in traditional gardens are of seedling origin and hence have tremendous variability with respect to sex of tree, nut yield/ tree, fruit size and shape, yield and quality of mace and bearing behavior, etc. Fourteen seedling genotypes of nutmeg collected from local sources are being maintained in Germplasm collection under intercropping situation in coconut garden. Clones of introduced varieties namely "Konkan Swad" are also maintained. The collection includes one male genotype and other female genotypes from Lamgao, Narve (Bicholim), Khandolla (Marcella) and Arla Keri(Ponda) villages.

Among the genotypes, mean weight of the fresh fruit varied from 27.81g in NMG-10/E4 to 58.1g in

Khandola-1, A promising new genotype with higher yield and bigger fruit size

NMG-3/C1 with 5.4 and 9.6g of nut weight, and 0.81g and 1.26 g of mace weight respectively on dry weight basis. Other genotypes namely, NMG-7/D5 and NMG-5/D1 recorded higher fresh fruit weight of 49.23 and 42.68g with dry nut weight of 8.46 and 7.65g and dry mace weight of 1.23 and 1.15g respectively. Besides this, three new genotypes of nutmeg with higher yield and good quality were located in Arla Keri, Khandolla (Ponda Zone) and Lamgao (Bicholim) and clones

Keri-1, A promising new genotype selected for higher yield and bigger fruit size



Cross-section of the variability in local nutmeg genotypes

were added to germplasm collection.

Coconut based mixed cropping system

A new experiment was initiated in the existing coconut garden (9m x 9m spacing) of Benaulim and Clangute local varieities, to establish a model of coconut based mixed farming system / intercropping system. The objective is to study and enhance the economic feasibility of the coconut garden with multiple intercropping options. Intercrop-components included nutmeg (local genotypes, and Cv. Konkan Swad), Banana (Local varieties viz. Saldattim, Myndoli, Velchi, Savarbonim and introduced varieties like Nendran, Red banana, Robusta) Black pepper (Cvs.Paniyur-1, Karimunda and Local selections), Betel vine, Cinnamon (Cv.

Local germplasm of black pepper identified in Kulaagars

Project : Management of Mango Germplasm with Special Emphasis on Collection and Evaluation of Variability in Manakurad and Hilario Mango Varieties for Selection of Elite Clones (*PI: A. R. Desai*)

Germplasm collection

The mango germplasm bank, comprising of a total of 114 varieties of Mango currently holds local (77), Hybrid (15) and Introduced (12) varieties. The promising selection of mango "Cardozo Mankurad" was registered with NBPGR, New Delhi and was assigned the Registration No. INGR 11023 and National Identity No. IC0587716. Grafts of this selection are prepared for establishing the progeny orchard for further multiplication on large scale.

A new mango block of Mankurad variants has been established during the period of report, the ceremonial planting of which was done by the members of the Parliamentary Standing committee on Agriculture on 27June 2011

Cardozo Mankurad variety registered with NBPGR, New Delhi

New collections

Five new mango genotypes of Mankurad (3 Nos.) and Hilario (2 No.) were identified and collected clonally for further evaluation.

New collection	Bearing habit	Av. Fruit Weight (g)	Skin colour of ripe fruit	Pulp %	TSS (°B)	Fibreness
Mkd- 1/11Achut	Early, alternate	315.85	Brilliant yellow	75.62	21.2	Slightly on stone
Mkd – 2/11Malik	Mid season, alternate	305.25	Yellow	72.45	19.8	scanty
Mkd – 3//11Dilip	Mid season, alternate	428.45	Yellow	75.5	22.4	Present on stone and below skin
Hilario-1/11 Duler	Mid season	278.55	Yellowish orange	73.45	22.8	Scanty
Hilario-2/11 Bardez	Late, alternate	308.20	Yellow with pink tinge on shoulder	74.85	23.6	Scanty

Mankurad Assolna

Mankurad Achut

Mkd-1/11 Achut was located in Priol village, the matured fruits of which are of medium size (315.85g). The ripe fruits develop brilliant yellow skin colour uniformly through out the surface. The yellowish orange pulp has aromatic sweet taste (21.2 °B). Pulp is slightly fibrous on stone side. Skin is thin. Fruits come to maturity in the month of March. Fruits of Mkd-2/11- Malik are also of medium size (305.25g), however, with scanty fibreness in the yellowish orange pulp. Fruits attain maturity by April. Slightly bigger sized fruits of Mkd-3/11-dilip are having orange pulp with slight fibres below the skin as well as on stone. All the three selections are alternate bearers.

Hilario types, viz. 1/11-Duler and 2/11-Bardez bear small to medium sized fruits with 73.45 – 74.85 % of fibreless pulp contents with sweet taste (22.8-23.6 °B). The flesh colour is deep yellow. The skin of the fruits in both types is smooth, yellowish orange with pinkish rosy tinge in the latter.

Hilario

Project : Breeding of brinjal for high yield and resistance to bacterial wilt through conventional and molecular approaches (*PI: M. Thangam*)

Out of many varieties evaluated, seven varieties *viz.,* Surya, Swetha, Utkal Madhuri, Arka Nidhi, Singhnath, Bholanath and SM-6-6 were short-listed after artificial inoculation of the pathogen under pot conditions. These varieties showed resistance at high concentration of the inoculum (*Ralstonia solanacearum*). All seven varieties listed above showed promising attributes such as wilt resistance, fruit length and weight, yield and consumer acceptability.

Glimpes of bacterial wilt resistant varieties evaluated during 2011-12

Project : Standardization of production technologies for flowers and vegetables (*PI: M. Thangam*)

Evaluation of new gerbera varieties under polyhouse was initiated with four varieties *viz.*, Blessings (White), Forza (Red), Malibou (Pink) and Scope (Yellow).

Important flower characters like flower stalk length, flower stalk diameter, flower diameter, number of petals per flower and number of flowers per plant recorded significantly differences among the varieties. Highest number of flowers per plant (46.30/year) was recorded in Blessings followed by Forza (41.20/year) and the lowest number of flowers per plant was recorded in Malibou (39.40/ year). In addition to flower yield, other important traits like flower stalk length, flower stalk diameter and number of petals/flower were highest in Blessings. Scope variety produced large flowers and with a longest flower diameter of 12.41 cm.

Details of heliconia types and related genera used in diversity analysis

Sr. No.	Botanical name	Variety/Type
H-1	*Heliconia bihai*	Lobster Claw One
H-2	*Heliconia psittacorum*	Golden Torch
H-3	*Heliconia psittacorum*	Lady Di
H-4	*Heliconia rostrata*	---
H-5	*Heliconia psittacorum*	Choconiana
H-6	*Heliconia psittacorum* x *Heliconia spathocircinata*	----
H-7	*Heliconia bihai*	Lobster Claw Two
H-8	*Heliconia chartacea*	Sexy Pink
H-9	*Heliconia wagneriana*	---
H-10	*Heliconia spp*	Pink
H-11	*Heliconia psittacorum*	Petra orange
H-12	*Heliconia psittacorum*	Guyana
H-13	*Etlingera elatior*	Red Torch
H-14	*Etlingera elatior*	Pink Torch
H-15	*Tapeinochilos ananassae*	Indonesian Ginger
H-16	*Heliconia psittacorum*	H-02
H-17	*Heliconia psittacorum*	Alan carle
H-18	*Heliconia psittacorum*	Sassy
H-19	*Heliconia psittacorum* x *Heliconia spathocircinata*	Tropics
H-20	*Heliconia psittacorum*	Adrian
H-21	*Heliconia psittacorum*	St. Vincent red
H-22	*Heliconia psittacorum*	Kenya red
H-23	*Heliconia psittacorum*	Tagami
H-24	*Heliconia psittacorum* x *Heliconia spathocircinata*	H-01
H-25	*Heliconia psittacorum*	H-05
H-26	*Heliconia psittacorum*	Kawauchi
H-27	*Heliconia psittacorum*	---
H-28	*Heliconia chartacea*	Temptress
H-29	*Heliconia bihai*	---
H-30	*Musa spp*	---

Table. Performance of new gerbera varieties under polyhouse

Gerbera varieties	Leaf area	Leaf length	Leaf width	Stalk length	Stalk diameter	Disc diameter	No of petals	Flowers/ year
Blessings	128.23	25.56	9.86	65.68	0.56	12.41	78.89	46.3
Forza	141.26	21.43	11.20	58.42	0.45	11.88	86.45	41.2
Malibou	162.81	21.99	13.88	66.24	0.44	11.66	89.37	39.4
Scope	199.26	31.28	12.76	57.45	0.51	11.99	62.89	39.7
CD (5%)	25.12	2.99	1.21	4.99	0.04	0.62	11.21	4.56
CV	11.19	9.98	7.23	6.86	5.88	3.56	8.25	4.24

Varieties/Types in Heliconia

No of types : 25
Torch lilly : 2
Musa spp : 1
Indonesian ginger : 1
Design : RBD
Replications : Three

Dendrogram

Dendrogram was constructed based on banding pattern of 30 varieties/types of heliconia using the RAPD markers and cluster analysis. The 30 varieties of heliconia formed two major clusters A and B. The main cluster A comprised of heliconia types belonging to *psittacorum* p and their hybrid derivatives. The cluster B comprising of other species like *H. chartacea, H. bihai* and *H.wagneriana*. Other related genera like *Etlingera elatior* and *Tapeinochilos ananassae* grouped separately from heliconia.

Project: Survey, collection, introduction and evaluation of kokum and other Garcinia species (*PI: S. Priya Devi*)

Kokum (*Garcinia indica*) exhibits genetic diversity owing to its cross-pollinating nature and seedling origin, thus deserving a systematic study. Early bearers and profuse yielders were identified through surveys. Propagation of elite types identified was attempted during the current year. Rootstocks were raised during June 2011 uniformly from seeds of Konkan Amruta, the first released variety from BSKKV, Dapoli. During April to August 2011, grafting was attempted in 12 elite types viz., Borim TC, Parashte 3, Kharekhazan 1, Savoikamini 1,2,3, Kasarpal 5, 8, 11, Hedode 1, Thane 1 and 4. Among these, Borim TC, Kharekhazan 1, Savoi kamini 3, Kasarpal 5, 11 and Thane 4 are some of the profuse bearers identified in the study. Others like Hedode 1, Savoi kamini 1 and Parashte 3 (which is a profuse bearer also) are early bearers, whose crop get over well before onset of monsoon. Percentage of grafting success varied from 0 to 78.

Propagation of elite accessions of kokum

Project: Survey, collection and evaluation of fruits available / grown in agro-forest areas of Goa (*PI: S. Priya Devi*)

Evaluation of three Aonla varieties (Krishna, Kanchan and NA-7) was continued this year. As per RAC recommendation, two varieties (NA-10 and Chakaiya were included in the trial this year. Evaluation of sapota varieties viz. DHS-1, DHS-2, Kalipatti, Cricket Ball, Co-3 and PKM-1 is under progress. Evaluation of grape fruit varieties viz. Marsh seedless, Red blush and Star Ruby is continued. Observations like plant height, number of primary branches and canopy spread were recorded and average drawn for the above experiments. Other than these, observations were also recorded in West Indian Cherry and Ribbed cherry types in Cherry block. Besides, in Karonda block, ornamental karonda was included in July 2011. Konkan lemon plants were also planted in the field for evaluation.

Evaluation of papaya varieties

An evaluation trial was laid out with nine papaya varieties including three local types. The treatments are Co-2, Co-7, Pusa Nanha, Surya, Red Lady, RCTP-1, Local 1, Local 2 and Local 3.

Varieties Surya, RCTP -1 and Local -2 took 294 days for first harvest, whereas Co-2 took a maximum of 342 days for first harvest. As its name implies, Pusa Nanha was the most dwarf recording 83 cm height at 1 m height. Co-7 recorded the lowest stem girth of 17.83 cm, whereas, RCTP -1 recorded the highest value of 33.50 cm. similarly, var Co-7 had the lowest number of leaves (8.67) and Pusa Nanha had the highest value of 22 leaves during harvest.

Local -3 papaya variety recorded fruit weight on par with Red Lady. Fruit length ranged from 11.87 cm in Pusa Nanha to 24.04cm in Local 3.Flesh thickness ranged from 2.27 cm in Co-7 to a maximum of 3.53 cm in Red Lady. TSS ranged from as low as 6.64 in Co-7 to 15.90 in Red Lady. Pulp colour varied from yellow to Red orange.

Ribbed Cherry

Red Lady

West Indian Cherry

Local 3

Table. Vegetative characters of papaya varieties

Trt/ parameters	Days to first harvest	Height of first bearing (cm)	Stem girth at 1 m (cm)	No. of leaves during first harvest
Co-2	342	168.50	33.00	17.50
Co-7	308	156.30	17.83	8.67
P Nanha	334	83.00	22.00	22.00
Surya	294	185.25	25.25	13.75
Red Lady	318	137.50	19.83	11.00
RCTP	294	225.50	33.50	15.00
Local 1	327	177.33	26.00	14.00
Local 2	294	183.40	21.25	12.40
Local 3	325	196.30	25.33	14.50

Table. Fruit characters of papaya varieties

Trt/ parameters	Weight (kg)	Length (cm)	Flesh thickness (cm)	No. of seeds	TSS (° Brix)	Flesh colour
Co-2	1.62	19.50	3.04	1400	12.30	Yellow
Co-7	1.04	19.50	2.27	1020	6.64	Yellow
P Nanha	0.95	11.87	2.92	262	9.90	Yellow
Surya	0.89	14.50	2.36	1200	11.24	D orange
Red Lady	2.03	26.70	3.53	466	15.90	D orange
RCTP	1.94	23.32	2.76	861	11.50	Yellow
Local 1	1.47	20.37	2.52	463	10.5	Lt orange
Local 2	1.88	18.49	2.68	965	10.2	Orange
Local 3	2.08	24.04	2.66	643	9.95	Orange

Evaluation of acid lime varieties

Seeds of acid lime varieties Vikram, Pramalini, Kasi Pentla, Sai Sharbati, Tenali and PKM-1 were sown in Aug/September 2011.

Evaluation of Pomegranate varieties

Air-layers of varieties viz. Bhagwa, Mridhula, Ganesh and cuttings of Jalore Seedless, G-137, Arahta, P-23, P-26 were procured from MPKV, Rahuri in October 2011. Severe mortality was noticed in G-137, Arahta, P-23 and P-26.

Project : Estimating Post Harvest Crop Losses for Goa (*PI: M.J.Gupta*)

The data on post-harvest losses in Paddy for Goa was collected this year. The data collection was done in two parts *viz.* primary data by observation and secondary data by enquiry. For primary data two villages each from north and south Goa *i.e.* total of four villages were chosen randomly namely *Amona*, *Dongrim*, *Morpirla* and *Karvem*. From these four villages two farmers in each village were chosen and data on losses at each stage harvest, threshing and storage were collected by observation on farmer's field and farm. The storage data will be collected periodically. For secondary data a total of 10 villages, five from north Goa district and five from south Goa district were randomly chosen. Five farmers from each village were then randomly chosen for secondary data collection. Different survey schedules used are:

Secondary data

a) Schedule 2A for losses at producer level by enquiry
b) schedule 2B for assessment of harvest and post-harvest losses at producer level (storage) by enquiry

Primary data

a) Schedule 1 for details of the households selected,
b) Schedule 2C for assessment of losses at farm level (by observation), and
c) Schedule 2 D for assessment of losses during storage at farm/trader/processing unit level for paddy (by observation)

The data was collected through repeated visits to the villages at various stages through personal visit. The data collection till March was completed only for 8 villages, two villages had not finished processing their paddy i.e. storage was scheduled in April only. Data at trader level is being collected form *Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit* and the rice mills at various locations in Goa. The experiment will be completed by April, 2013.

Details of farmers chosen

The majority of the famers chosen i.e. 56 per cent had operational holding size between 1-less than 5 acres, 29% per cent famers had less than 1 acre land holding, remaining 9 per cent had 5 to less than 10 acres of operational holding and 6% more than 10 per cent operational holding.

Post-harvest losses

Based on the secondary data collected from the farmers, it was found that most of the post-harvest operations were manual and resulted in a lot of losses.

The study is in progress and the statistics for various losses will be summarized at the end of the study. But it is evident that the vagaries of monsoon and lack of labour are the two major problems faced by Paddy famers. The other problems are inaccessibility of the farms and the small size of operational holdings, which have forced the farmers to carry out various harvest and post-harvest operations manually. Thus mechanization of these small land holders will be the biggest challenge faced by the state to boost the falling number of paddy farmers.

Various post harvest operations on farmer's field.

Table. Method of post-harvest handling and processing up to storage

Unit operations	Method followed	Equipment used	No. of farmers from sample (30)	Reason for losses as stated by farmers
Harvesting	manual	Sickle	29	Over maturity, labour problem, rains during harvest, waterlogging hence machinery access not existing
Collection	Stacked on field	Manual	30	Rats, birds, cattle
Threshing	Manual (Treading by feet)	Men	24	Inaccessible field
	Treading by tractor	Tractor	5	-
	Thresher	Multi crop thresher	1	-
Winnowing	manual	Natural wind and woven bamboo winnower	29	Poor and varying wind speeds, too many immature grains
	Mechanical	Multi crop thresher	1	
Drying	Sun drying	Plastic sheets	30	Crows, birds, cattle and rain
Packaging and storage	Woven plastic bags or gunny bags	-	29	rats
	Piled in room	-	1	Rats and insects, no medicine added except in rice where boric acid is added
Transport	Manual/mechanical	Manually on head/Rickshaw/ tractor trailer	30	-
Parboiling	batches	In brass pots using rice husk as fuel	30	Overcooking at bottom, immature rice
Milling	Mechanical	Traditional rice mills	30	Too many immature grains in rice, clearance of rollers is not correct

Project : Design of Protected Cultivation Structures for Year Round Utilization in Western Region (PI: M.J. Gupta)

Three existing structures at the institute *viz*. a shade tunnel; a shade net house and a naturally ventilated double span poly house were compared for their micro climatic parameters. Pending the establishment of the solar dryer, the microclimate of poly tunnel existing at the institute with no ventilation was also analysed to see what the thermal potential of a greenhouse-type solar dryer under Goan conditions was. Diurnal variation of temperature and humidity of greenhouse air as compared to ambient air was recorded using a HTC HD-304 Temperature & Humidity meter with a range of -30°C -100°C for temperature and 0-100% for humidity sensor, solar radiation inside and outside using a TES 1332 digital lux meter with a range of 0.2 -200 kilolux range and the plant temperature inside the greenhouse using a MS6550B Infrared thermometer with a operating range of -10 to 50°C was recorded. Temperature and humidity inside the three structures viz. shade net tunnel, naturally ventilated poly house and poly tunnel was recorded continuously at hourly intervals using a Lascar Electronics EL-USB- 2 LCD temperature (range -35 to 80 °C) and humidity(0-100% R.H. range) dataloggers. The thermal and humidity profiling of the shade net house and naturally ventilated greenhouse were also recorded using Lascar Electronics EL-USB- 2 LCD temperature (range -35 to 80 °C) and humidity (0-100% R.H. range) dataloggers as compared to ambient conditions and analysed. All data were recorded in replications of 3 and analyzed using one way Anova.

Microclimatic parameters of shade net tunnel and naturally ventilated gerbera polyhouse were statistically analysed with single factor Anova, which showed that there was no significant effect of structure on the various microclimatic parameters. The average transmittivity of the naturally ventilated poly house and shade net tunnel were was 15.75% and 10.05% respectively . The average plant temperature in the shade net tunnel was 31.2°C and that in the naturally ventilated gerbera polyhouse was 31.6 °C.

Comparison of microclimate of shade-net house, naturally ventialted poly house and poly tunel of the three structures with reference to average temperature and humidity recorded at hourly intervals for several days and analyzed with single factor anova showed that the effect of structure was very predominant in the poly tunnel

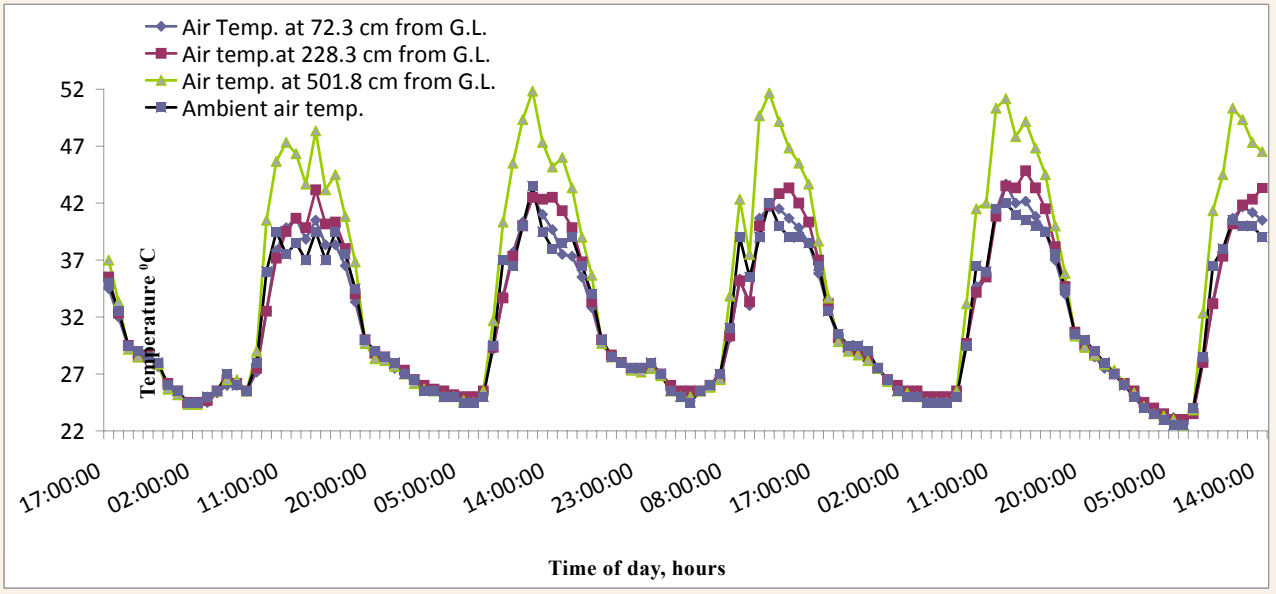


Fig. Temperature profile in naturally ventilated polyhouse

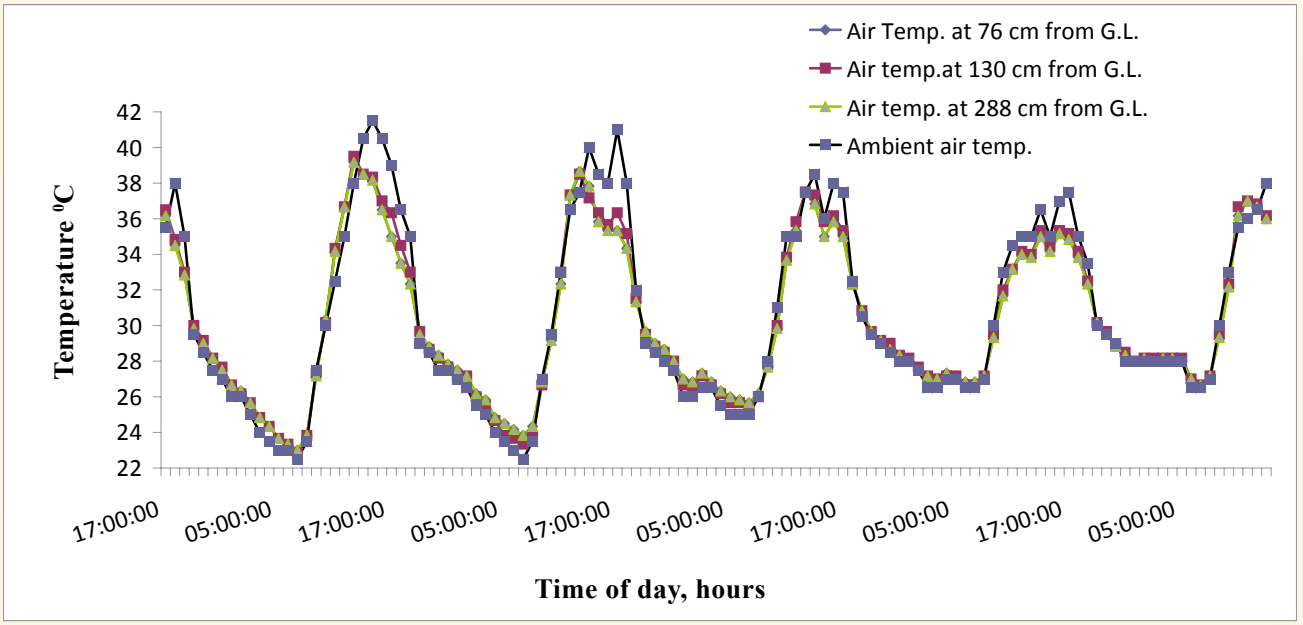


Fig. Temperature profile in shadenet house

which showed that the average relative humidity and average temperature was significantly affected by its shape as compared to shade net house and naturally ventilated poly house. But analysis of the temperature and humidity of shade-net house and naturally ventilated polyhouse showed that there was no significant effect of structure on average hourly temperature and humidity.

Comparison of temperature and humidity profiles in shade net house and naturally ventilated gerbera poly house at three different height showed that there was significant effect of height on the microclimate of a naturally ventilated poly house while there was no effect of height on the average microclimate of a shade net house. Hence we conclude that the ventilation or the area of openings and their size has a significant effect on the temperature of the protected structures and the uniformity of the plant microclimate.

Exploring the potential of greenhouse-type solar dryer

The average temperature realised in the poly tunnel with no ventilation between 10 AM and 5 PM was 47.2 ^{O}C during the month of march in 2012. The maximum average temperature achievable was 51.5 ^{O}C. The average relative humidity was 75.25% with maximum going to 97.15 % and minimum being 29.75 %.Again the average humidity between 10 AM and 5 PM was around 43 % because the poly tunnel had no ventilation. A fan or a dehumidification system is necessary to reduce the relative humidity.

Average microclimate of the shade net tunnel, shade net house and naturally ventilated poly house are not significantly different. However there is build up of temperature with height in the naturally ventilated poly house. It is worth investigating to see if the vent location and opening size need to be modified to provide suitable and uniform microclimate. Further studies on the microclimate of the shadenet house and naturally ventilated poly house as affected by vent size and location and air exchanges using ultra sonic anemometers are needed to make a suitable greenhouse structure design for Goan climate. The high temperature inside the polytunnel indicate a great potential for using them as dryers.

Animal Sciences

Project ; Impact of Microclimatological Changes on Livestock Production and Ameliorative Measures through Managemental Intervention (*PI : S. K .Das*)

Impact of micro environmental changes on milk yield of cows after intervention

Effect of change of RH on daily milk yield in Sahiwal, Cross Breed (CB) cows was significant ($P < 0.05$) and drop of daily milk yield was 16 g, 22 g and overall value of 19 g per % increase of RH. But after implementation of intervention ie cooling arrangement as well as white painting of outside of roof and black painting of inner surface of the roof of dairy shed, it was observed that effect of change of RH was non significant and reduction of milk yield was lower ie 5 g, 15 g and 2 g respectively. Effect of change of maximum temperature on daily milk yield in CB cows was highly significant ($P < 0.01$) and reduction of yield was 316 g per unit increase of daily maximum temperature before implementing intervention. However, after applying intervention effect of change of maximum temperature on daily yield was found to be non - significant in CB cows and reduction of yield was 66 g only. Thus implementation of intervention benefited to overcome adverse effect of micro climatological changes on daily milk yield of cows.

Monthly milk yield was reduced by 1.002 kg, 1.769 kg in Sahiwal and CB cows with an overall value of 1.639 kg per unit rise of monthly air temperature before intervention. However, reduction in milk yield was very less, only 72 g and 82 g in Sahiwal and CB cows with overall value of 8 g per unit rise of monthly air temperature after intervention. Because cows experienced less stress due to change of air temperature in modified housing and managemental condition. Similarly monthly milk yield was reduced by 127 g, 492 g per unit increase of monthly THI in Sahiwal and CB cows with an overall value of 185 g before intervention. However, monthly milk yield was reduced by 58 g, 191 g in Sahiwal and CB cows per unit increase of monthly THI with an overall value of 64 g after intervention indicating comfort of animal in modified housing and managemental condition. Thus, it would be inferred that the modification in housing and management had reduced the heat stress and thereby decreased the milk drop due to change of microenvironment.

Microenvironment in dairy shed of 2011 while compared with that of 2010, it was revealed that overall mean air temperature in 2011(26.87 ^{0}C) was lower than that of 2010 (27.64 ^{0}C). Overall mean RH was lower in 2011 (79.71) than that in 2010 (82.17). Overall mean THI was slightly lower in 2011 (79.34) than that in 2010 (79.38). Overall mean maximum temperature was lower in 2011 (30.15) than that in the year 2010 (30.79). Overall mean minimum temperature was lower in 2011 (23.48 ^{0}C) than that in 2010 (24.56 ^{0}C). It might be due to arrangement of electric fans inside shed and roof modification.

Impact of micro environmental changes on productive performances of rabbit after intervention

Reduction of live weight in NZW, SC, GG and BB rabbit per unit increase of maximum temperature was highly significant and it was 85.90 g, 93.98 g, 116.45 g and 101.43 g respectively before intervention. However, the reduction in live weight in NZW, SC, GG and BB rabbit per unit increase of maximum temperature was much lower ie 29.96 g, 40.04 g, 58.46 g and 83.88 g respectively after intervention ie arrangement of cooling by ceiling fans. So, modified management has helped to reduce the adverse impact of maximum temperature on live weight of rabbit. It was revealed that average daily gain was reduced significantly by 6.51g, 12.50g, 16.78g and 14.84g in NZW, SC, GG and BB rabbit respectively per unit rise of air temperature before intervention. However, after implementation of intervention ie cooling arrangement by ceiling fans reduction of growth was 4.88 g, 8.46 g, 11.70 g and 12.76 g in NZW, SC, GG and BB rabbit respectively per unit rise of air temperature . So, this lesser reduction of growth was due to implementation of intervention.

So, cooling arrangement by ceiling fans in rabbit shed caused lesser heat stress and reduced the decline in growth. Study of comparative micro environmental parameters in rabbit shed between two years revealed that overall mean air temperature in 2011 (28.30 0C) was lower than that in 2010 (28.75 0C). Overall mean maximum temperature was lower in 2011 (32.22 0C) than that in 2010 (32.35 0C). Same trend was noticed in case of minimum temperature.

Project : Effect of Dairy Housing on Microenvironment and Productive Performances of Cow (*PI: S. K. Das*)

Survey was done on management system, type of house, hygienic condition of house, orientation of shed, type of roof, roofing material, height of roof, type of floor, floor material, arrangement of animal inside shed, floor space provision, ventilation system, cooling system, breed of animal, feeding status and health status of animal etc. Pernem, Bicholim and Ponda taluka of North Goa district and Salcette, Sanguem and Canacona taluka of South Goa district; in total six talukas were considered for this study. Ten farmers consisting of very large, large, medium, small and marginal from each taluka was considered and in total sixty farmers were interviewed for collecting information.

Maximum farmers belong to small category (41.66 %) ie having cattle in the range of 6-10. 76.66 % farmers are rearing cattle in the intensive system of management. Most common type of dairy house was concrete semi open (86.67 %). In 56.66 % shed floors were concrete having rough surface with proper slope. In North Goa roof of the shed was mostly made of asbestos with proper height and proper inclination (40.00 %). However in South Goa roof of the shed was made of GI sheet mostly with proper height and proper inclination (33.33 %). So considering both the districts asbestos roof was found to be most common in Goa (25.00 %). Most common orientation of dairy house was east and west (53.34 %). 65.00 % farmers followed standard floor space provision. Ventilation system in 50.00 % cattle house was good. Most common cooling system was manually by splashing cold water on the body surface of cow two times (63.33 %). 23.34 % farmers arranged electric fans besides manual cooling. In 46.66 % dairy house hygienic condition was good**.** Arrangement of cattle inside shed was mostly tail to tail (63.33 %). Overall preference for feeding dry roughage to cattle was for paddy straw (41.67 %). 45.00 % farmers were providing animals hybrid Napier (CO3 variety). Most common type of concentrate fed to cattle is High energy pellet. Daily total milk yield was in the range of 51-75 lit / day (30.00%) in North Goa in contrast to upto 25 lit / day in South Goa (40.00 %). Daily Av Milk Yield was 7.6-10.0 lit/ day (31.66 %). Most common reproductive disorders were repeat breeding (33.34 %). Most common disease in Goa was reported to be mastitis (31.67 %).

Cow maintained in stanchion stall at farmers field.

Project : Survey on the Feeds and Feeding Practices of the Livestock in Goa (*PI: P. K. Naik*)

Constraint analysis of dairy farmers of Goa with respect to feeds and feeding practices

In continuation of the survey work made last year (66 farmers and 1170 animals), more farms (about 25 farmers and 300 animals) were visited to analyze the constraints of dairy farmers with respect to feeds and feeding practices, so that research plan will be made accordingly to solve the problems. The constraints are (a) standardization of the feeding of green fodder to economize the milk production; (b) Need of technology for preservation of green fodder without preservatives in high rainfall areas; (c) Evaluation of the mixture of maize grain and cotton seed cake as home-made concentrate mixture on dairy animals; (d) Feeding strategies for high yielding dairy animals and (e) Need of simple method to improve the nutritional value of poor quality roughages and to prepare feed blocks using poor quality roughages.

Project : Nutritional Interventions for Optimization of Economical Milk Production in Goa (*PI: P. K. Naik*)

Evaluation of the mixture of maize grain and cotton seed cake as home-made concentrate mixture on dairy animals

Eight lactating dairy cows were divided into two groups i.e. Control Group (CG) and Treatment Group (TG) of four animals in each, based on body weight (BW) and daily milk yield. For the CG group, a two ingredient based standard concentrate mixture (CM_{M+SBM}) containing maize grain 70 and soybean meal 30 parts by weight was prepared. While, for the treatment group, complete replacement of soybean meal was made by cotton seed cake (CSC) by preparing concentrate mixture (CM_{M+CSC}) containing maize grain 70 and cotton seed cake 30 parts by weight. Besides, 2 parts by weight mineral mixture and 1 part by weight common salt were added in both types of CM. Randomly, animals of the CG were offered daily 4 kg CM_{M+SBM} along with 5 kg green fodder and *ad lib.* jowar straw; while in TG, to make the ration isonitrogenous, extra 1.2 kg CSC was offered along with 4 kg $CM_{M+CSC,}$ 5 kg green fodder and *ad lib.* jowar straw. The feeding trial was conducted for a period of 90 days. The CP% (13.55 vs 22.47) and EE% (1.72 vs 3.40) of CM_{M+CSC} was lower ($P<0.05$) than CM_{M+SBM}. The total roughage intake (4.67 vs 5.49; kg/ day) including the jowar straw (3.67 vs 4.49; kg/ day) in group TG was lower than the CG. The total DM intake (kg/ day) of TG (9.86) was higher than the CG (9.49), but the DM intake (kg/ day) per 100 kg BW was similar between the groups (3.09 vs 3.12) During the study, the milk yield (5.34 vs 5.36 lit/ day; 5.50 vs 5.52 kg/ day) and 4% FCM yield (5.76 vs 5.77 kg/ day) of the animals of the CG was similar ($P>0.05$) to the animals of TG. Further, there were no differences ($P>0.05$) in the milk compositions between the animals of the groups, but were within normal range. The cost (`) of the feed in TG (130.48/ day) was higher than the CG (120.94). The cost of milk was similar in both the groups based on the 4% FCM yield. There was higher net loss of ₹ 9.22 per animal per day due to feeding of mixture of maize grain and CSC as home-made concentrate mixture on dairy cows. It was concluded that feeding of only mixture of maize grain and cotton seed cake as home-made concentrate mixture to dairy animals is not a profitable venture.

Production of green fodders by hydroponics technology

Hydroponics technology involves growing of plants without soil. Under Rashtriya Krishi Vikas Yojana (RKVY) scheme of Govt. of India, 11

Hydroponics Green Fodder Production Unit at ICAR Research Complex for Goa, Old Goa

Trays containing sprouted maize seeds in different rows of racks inside green house

units of hydroponics green fodder production units have been established at different dairy cooperative societies of Goa including one unit at ICAR Research Complex for Goa, Old Goa. In all the units hydroponics green fodders are being produced regularly in green houses under controlled environment and are being fed to the dairy animals. The green house has production potential of 600 kg of green fodder daily in seven days.

Hydroponics green fodder looking like a mat consisting of roots, seeds and plants

Soaking time of only 4 hours is sufficient for maize seed and soaking of total seeds of a particular day in bulk is beneficial from management point of view. Soaked seed produced from 1.25 kg un-soaked maize seed is loaded in one tray of approximate size of 90 cm length and 32 cm width. Hydroponics green fodders look like a mat consisting of roots, seeds and plants. About 3.5 kg and 5.5 kg hydroponics green fodders were produced from each kg of yellow maize and white maize, respectively.

Approximate cost of production of hydroponics green fodder from white maize (₹ 4/-) was lower than yellow maize (Rs.5/-) due to more biomass production. In comparison to conventional green fodders, hydroponics green fodders contained more crude protein and less crude fiber. Intake of hydroponics green fodder by dairy animals was up to 20 kg/ animal/ day. Dry matter digestibility of hydroponics green fodder maize based ration was higher than conventional green fodder (Hybrid Napier) based ration in dairy cows and heifers. As green fodders is an integral part of dairy ration, in situations, where fodders can not be grown successfully or progressive modern dairy farmers with elite dairy herd can produce hydroponics green fodder for feeding their dairy animals.

Nutrient changes with the growth of hydroponics fodder maize

Samples of maize fodder (*Zea maize L.*)

grown on hydroponics system were collected from M/s. Greentech Organic Hydroponics Systems Manufacturers, Ahemedabad, Gujarat at different stages of growth up to the attainment of the optimum growth (7 days). The samples were analyzed for chemical composition and were compared with the green fodder maize (*Zea maize L.*) grown on conventional practices for test of significance. There was differences ($P<0.05$) in the chemical compositions of the maize fodder between different stages of growth in hydroponics system and grown in conventional practices. The Crude Protein (CP) content of the maize seed was 8.60%, which remained similar up to 2nd day (9.14%) of growth in the hydroponics system. The CP content showed an increasing trend and remained highest ($P<0.05$) on 7th day of growth (13.57%) in hydroponics system. Up to 3rd day of growth of the fodder maize in hydroponics system, the CP content was lower than the CP content (10.67%) of the fodder maize grown under conventional practices, but from 4th day on wards, the values of the former remained higher ($P<0.05$) than the later. The EE of the maize seed was 2.56% and remained similar up to 5th day of growth (3.06%) and was similar ($P>0.05$) to the fodder maize (2.27%) grown under conventional practices. The EE content of fodder maize on 7th day (3.49%) was highest ($P<0.05$) among fodder maize at different stages of growth in hydroponics system and under conventional practices. The CF content of the maize seed on 0 day was 2.50% and increased ($P<0.05$) up to 14.07% on 7th day of growth in hydroponics system but was lower ($P<0.05$) than the fodder maize grown under conventional practices (25.92%). The NFE content of the maize seed decreased to its maximum level at 7th day (66.72%) of growth in hydroponics system and was higher ($P<0.05$) to maize fodder grown under conventional practices (51.78%). There was an increasing trend in the TA content of the hydroponics fodder maize with the advancement of the period, but all value were lower ($P<0.05$) than the TA content of the conventional fodder maize (9.36%). However, the AIA values (0.02-0.33%) of the hydroponics fodder maize were similar ($P>0.05$) and lower ($P<0.05$) than the AIA content (1.40%) of the fodder maize grown under conventional practices. It was concluded that the hydroponically

Project : Studies on Prevalence of Clostridia in Bovines, Farm Environment and Foods (*PI: S.B. Barbuddhe*)

Unusual type of flaccid paralysis has been reported in animals in some of the parts of Goa particularly during monsoon season. The objective of the study was to study clostridial diseases as one of the cause of the paralysis and muscular degeneration.

During 2011, two outbreaks of enterotaxaemia like syndrome with two deaths were reported. Seroconversion of vaccinated animals was

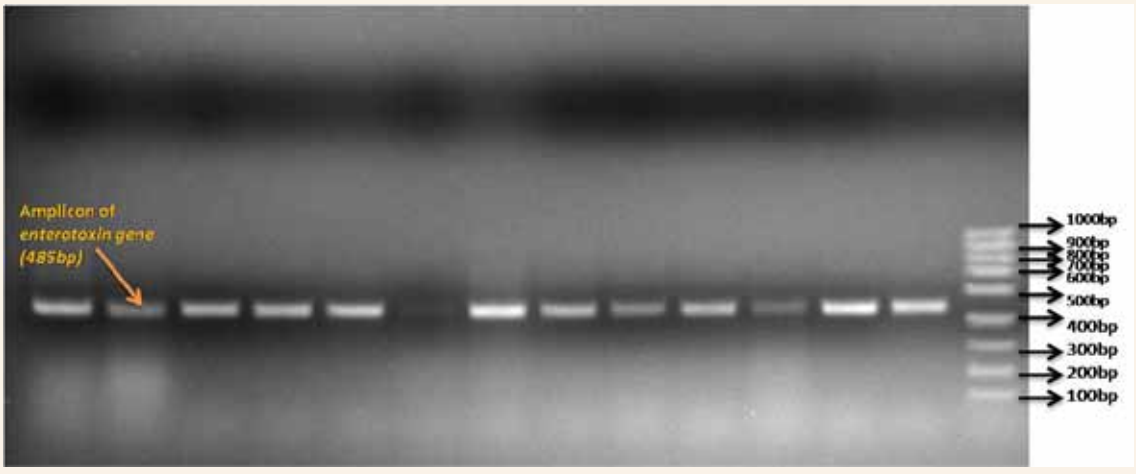


Fig. Detection of enterotoxin A gene in clostridial isolates.

monitored. A total 157 samples were collected from different locations in Pernem and Bicholim talukas. The samples comprised of faeces, environmental swabs and milk samples. Isolation of *Clostridium* sp. from the collected samples was attempted with the use of Robertson's cooked meat medium and SPS Agar. The isolates were characterized for *Clostridium* sp. By morphological and biochemical analysis. A total of 34 isolates of clostridia spp. were isolated. The isolates were characterized for phenotypic characteristics. Enterotoxin gene was detected in 16 strains.

Project : Assessment Of Early Sexual Maturity In Goa Local Male Pigs Through Spermigoram and In Vivo Pregnancy (*PI: E.B.Chakurkar*)

Total seven male piglets (9 Goa Local, 2 crossbreed and 8 Large White Yorkshire) were castrated at different age. In case of Goa Local, castration was done at one month, two month, three months and five month age (one piglet at every age group). In clase of Large White Yorkshire one piglet was castrated at two month of age where as in case of crossbreeds one piglet at two months age and one at three month age was castrated. Average dimensions of testicle in Goa Local male were as follows.

In case of Large white Yorkshire testicular dimensions at two months age were , length 2.66 cm,1.32cm and 7.44cm. Dimensions of testicle in crossbreed piglets at 2 and 3 month age were length1.85cm and 3.45 ms, width 1.21cm and 2.45cm and circumference 5.3cm,7.85cm.

There was appearance of few immature sperm cells in epidedymal washings from one month in case of Goa Local piglets but motility of spermatozoa was from third month. In case of Large White Yorkshire sperm cell appeared at two months in head of epidedymis having proximal protoplasmic droplet indicating immature sperm cell.

In case of crossbred piglets viable motility of sperms was there at three month age when epidedymal washing was diluted with buffer.

Table. Average dimensions of testical in Goa local male pig

Parameter	30 days	60 days	150 days
Weight of testis	2.238± 0.369	7.867±1.382	43.000±0.20
Weight of epididymis	0.588±0.072	1.717±0.300	7.750±1.150
Length of testicles	1.516±0.160	2.917±0.310	5.5±0.00
Width of testis	0.959±0.100	1.828±0.271	3.025±0.175
Thickness of testis	0.848±0.065	1.733±0.253	2.350±0.45
Circumference of testis	3.926±0.357	6.650±0.484	11.50±0.300

Project : Evaluation and Preservation of Boar Semen
(*PI: M. Karunakaran*)

12 numbers of boars (6 Large White Yorkshire, 2 Duroc and 4 crossbred) are selected and trained for semen collection. A total of 34 semen ejaculates were collected by hand glove method. The reaction time of boars for collection of semen varies from 2 to 10 minutes. Average volume of the semen ejaculate was 137 ml with range of 60 to 250 ml. The average sperm cell concentration in the ejaculate was 390 million/ ml with a range of 170 to 730 million/ ml. The average progressive forward motility of the sperm cells at immediate collection was 75.55 per cent with the range of 70 to 90 per cent.

Preservation of boar semen

Attempts were made to preserve the collected semen at 17 °C using different semen extenders such as Tris buffer, BTS, IVT and Trixcell buffers. Semen was diluted at 1: 4 ratios of semen and extenders. Tris buffer with the composition of tris hydroxymethyl amino methane 3.028 g, fructose 1.250 g, citric acid 1.655 g and distilled water to make up the volume 100 ml was prepared and used to preserve the boar semen at 17 °C. But it was found that the Tris buffer was not suitable to preserve the boar semen as most of the sperm cells in the stored semen lost their motility within 24 hours of storage.

IVT buffer with the composition of glucose 3.0 g, sodium bicorbonate 24.3 g, potassium chloride 2.40 g, cysteine 0.05 g in 1000 ml of distilled water also used for preservation of boar semen. BTS buffer containing 37 g of glucose, 6.0 g of sodium citrate, 1.25 g of EDTA, 1.25 g of sodium bicarbonate, 5.0 g of BSA, 6.5 g of Tris, 4.1 g of citrate, 0.1 g of

Table. Seminal parameters of collected boar semen

Breed	Large White Yorkshire	Duroc	Crossbred	Total
No. of ejaculates	14	10	10	34
Volume of ejaculates (ml)	80 (60-100)	200 (150-250)	160 (120-200)	137.77 (60-250)
Sperm cell concentration (millions/ml)	230 (170-280)	560 (470-730)	455 (390-520)	390 (170-730)
Sperm cell motility- immediate collection (%)	75	76.66	75	75.55

Table. Progressive forward motility of sperm cells (%) preserved in BTS buffer at17°C.

Progrssive forward motility	Large White Yorkshire (3)	Duroc (4)	Crossbred (2)
Day 0	80	80	80
Day 1	10	40	60
Day 2	5	30	30
Day 3		20	30
Day 4		20	5
Day 5		10	
Day 6		10	
Day 7		10	

Semen collection by digital pressure method

Assessment of sperm cell morphology

cysteine in 1000 ml of distilled water also used for preserving boar semen at 17 °C.

Observations indicated that BTS extender can be used for short term storage of boar semen and Trix cell buffers is suitable for long term storage. Final conclusion can only made after completing more sample storage and success of AI.

Table. Progressive forward motility of sperm cells (%) preserved in Trixcell buffer at17°C.

Progrssive forward motility	Large White Yorkshire boar semen (4)	Duroc boar semen (3)	Crossbred boar semen (3)
Day 0	73.33	76.66	75
Day 1	50	60	65
Day 2	36	40	50
Day 3	26.66	26.66	35
Day 4	16.66	20	35
Day 5	11.66	20	30
Day 6	8.33	10	25
Day 7	6.66	10	25
Day 8		6.66	20
Day 9		6.66	15
Day 10		6.66	7.50
Day 11		5	5


Project : Effect of Supplementation of Feed Additives (Probiotics, Enzymes and Yeast) on the Performance and Economics of Production of Broilers, Layers and Backyard Poultry (*PI: B. K. Swain*)

Effect of supplementation of probitic Prosol on the performance and economics of production in Vanaraja chicks

Vanaraja chicks (72 Nos, 3 weeks old) were randomly distributed into 4 equal groups (duplicated into 3 groups of 6 chicks each) in wire mesh floored cages. Control diet was prepared with ground maize 50 %, SBM, 25 %, de-oiled rice bran 21.84 %, DCP, 1.11 %, Limestone, 1.24 %, mineral mix, 0.15 %, common salt, 0.5 %, L-Lysin HCl, 0.03 %, DL-Methionine, 0.09 %, Vitamin Mix., 0.04 %. The treatment groups were given Prosol (mixture of probiotic organisms) @ 0, 0.1, 0.2 and 0.3 g/ Litre of drinking water (DW) daily.

Body weight gain was higher ($p<0.5$) in chicks with supplementation of prosol @0.2g/litre of DW at 13 weeks of age. Feed intake was not affected by the supplementation of probiotics through DW. However, chicks given 0.2 g prosol/litre of

Table. Effect on growth performance

Parameter	Treatments				SEM
	T_0	$T_{0.1}$	$T_{0.2}$	$T_{0.3}$	
Body wt. gain (kg)	1.418^{a}	1.429^{a}	1.458^{b}	1.445^{ab}	0.059
Feed intake (kg)	6.054^{ab}	6.197^{b}	5.965^{a}	6.137^{b}	0.034
FCR	4.270^{b}	4.336^{b}	4.092^{a}	4.247^{b}	0.032

Means bearing different superscripts in a row differ significantly ($P<0.5$)
FCR- Feed conversion ratio, SEM-Standard Error of Mean, T_0 – No Prosol (Control), $T_{0.1}$ –Prosol @ 0.1g/litre of D.W.(D.W.=Drinking water), $T_{0.2}$ – Prosol @ 0.2g/litre of D.W., $T_{0.3}$ – Prosol @ 0.3g/litre of D.W.

Table. Cost benefit analysis

Parameter	Treatments			
	T_0	$T_{0.1}$	$T_{0.2}$	$T_{0.3}$
Feed intake, kg/bird	6.05	6.20	5.96	6.14
Feed cost/kg (₹)	16.41	16.41	16.41	16.41
Cost of probitic/bird (₹)	0	1.19	2.33	3.50
Total feed cost/bird with cost of probiotic (₹)	99.29	102.93	100.13	104.26
Cost of chick (₹)	19	19	19	19
Total cost of production including maintenance (₹)	125.28	128.93	125.97	131.90
Body weight gain (kg)	1.418	1.429	1.458	1.445
Income from sale of bird (₹)	141.8	142.9	145.8	144.5
Misc. income (₹)	9.00	9.10	9.30	9.25
Total income (₹)	150.8	152.0	155.10	153.75
Net profit per bird (₹)	25.52	23.07	29.13	21.85
Net profit (%)	20.37	17.89	23.12	16.57

T_0 – No Prosol (Control), $T_{0.1}$ –Prosol @ 0.1g/litre of D.W.(D.W.=Drinking water)
$T_{0.2}$ – Prosol @ 0.2g/litre of D.W., $T_{0.3}$ – Prosol @ 0.3g/litre of D.W.

DW consumed less feed compared to those given other levels of supplemental probiotics. The feed conversion ratio (FCR) was improved ($p<0.5$) in chicks given prosol through DW @0.2g/litre compared to all other groups including the control group. Cost benefit analysis indicated that the cost of production per bird for highest level of inclusion of probiotics i.e. prosol was higher than those given other levels of prosol including the control group. The net profit was higher in group given prosol @ 0.2g/litre of DW compared to all other groups. It was concluded that supplementation of probiotics i.e. Prosol @ 0.2g/litre of DW was beneficial in terms of higher body weight gain, better FCR and more net profit.

Effect of supplementation of probitic 'Biovet' on the performance, carcass characteristics and economics of production in broilers

Day old broiler chickens (120 Nos) were randomly distributed into 4 equal groups (duplicated into 3 groups of 10 broiler chicken each) in wire mesh floored cages. Four experimental diets were formulated by supplementing 0, 0.5, 1.0 and 2.0 g of probiotic and yeast (Biovet) per kg of control diet at starter phase (1-3 weeks) and finisher phase (4-6 weeks) containing 23.49 % crude protein & 2900 Kcal/Kg metabolizable energy (ME) and 19.54 % crude protein & 3000 Kcal/Kg ME, respectively. The standard management practices were followed in rearing the broilers throughout the experimental period.

At the end of the 6th week, one male from each replicate was slaughtered to study the different carcass characteristics. The organs weights like heart, liver, gizzard, thymus, spleen etc were recorded and expressed as relative weight (weight of organ/eviscerated weightx100). The data pertaining to various parameter were analyzed statistically.

Body weight was higher ($p<0.5$) in broilers fed diet supplemented with Biovet @1.0g/Kg at 6 weeks of age. Similar body weight gains were recorded for all other treatments. Feed intake and FCR were not affected by the supplementation of probiotic Biovet at all the levels. However, the FCR of broiler fed Biovet @ 1.0 g/Kg diet was better than the other groups. The eviscerated weight was higher ($p<0.5$) in broilers fed Biovet @ 1.0 g/Kg diet compared to that of control and other groups. Relative weight of breast decreased ($p<0.5$) at higher level (2.0g/Kg) of probiotic supplementation. The relative weight of breast of other probiotics fed groups was similar to that of control group. Relative weight of thigh was similar across all the groups. Broiler diet supplemented with Biovet @2.0g/Kg had significantly ($p<0.5$) higher relative weight of drumstick. Biovet supplementation had no effect on relative weights of back, neck, wing, abdominal fat, caeca and relative weights of liver, heart, spleen and thymus. Addition of Biovet increased the cost of both starter and finisher diet marginally. The cost of finisher diet was found to be more than

Table: Effect on growth performance, carcass characteristics and organ weights

Parameter	Treatments				SEM
	T_0	$T_{0.5}$	$T_{1.0}$	$T_{2.0}$	
Body wt. gain (kg) *	1.783^{ab}	1.760^{a}	1.930^{c}	1.820^{ab}	0.027
Feed intake (kg)	3.73	3.60	3.70	3.74	0.030
FCR	2.097	2.052	1.918	2.051	0.034
Eviscerated yield (%)*	76.53^{a}	76.55^{a}	80.22^{b}	76.39^{a}	0.63
Breast	27.79^{b}	26.24^{ab}	28.06^{b}	23.91^{a}	0.64
Drumstick*	13.58^{ab}	13.30^{ab}	12.37^{a}	14.35^{b}	0.30
Gizzard*	2.20^{ab}	2.45^{bc}	2.07^{a}	2.57^{c}	0.07

*Means bearing different superscripts in row differ significantly ($P<0.5$)
SEM-Standard Error of Mean; T_0 – Without Biovet; $T_{0.5}$ –Biovet @ 0.5g/kg feed; $T_{1.0}$ – Biovet @ 1.0g/kg feed; $T_{2.0}$ – Biovet @ 2.0g/kg feed.

Table: Cost benefit analysis

Parameter	Treatments			
	T_0	$T_{0.5}$	$T_{1.0}$	$T_{2.0}$
Cost of feed/kg (₹)	19.56	19.90	20.47	20.69
Total cost of feed	72.96	71.64	75.74	77.38
Cost of chick, medicine and management (₹)	29.50	29.50	29.50	29.50
Total cost (₹)	102.46	101.14	105.24	106.88
Income from bird (@ ₹ 80 /kg live wt	146.40	144.80	158.40	149.40
Net profit per bird (₹)	43.94	43.66	53. 16	42.52
Net profit (%)	42.89	43.17	50.51	39.78

T_0 – Without Biovet; $T_{0.5}$ –Biovet @ 0.5g/kg feed; $T_{1.0}$ – Biovet @ 1.0g/kg feed; $T_{2.0}$ – Biovet @ 2.0g/kg feed.

the cost of starter diet. Total feed cost was higher for probiotic supplemented group. The average weight of bird was higher in case of feed added with Biovet @1.0g/Kg. Due to this, the income from sale of bird also increased for groups fed with Biovet @1.0g/Kg leading to higher net profit per bird. Results indicated that supplementation of probiotics, Biovet @ 1.0g/Kg diet was profitable in terms of higher percentage of net profit (51.55).

Table. Effect of biovet (probiotic, prebiotic) on performance and hatchability of laying Japanese quails

Parameter	Treatments				SEM
	T_0	$T_{0.5}$	$T_{1.0}$	$T_{1.5}$	
Egg Production (dozen)	2.85^{a}	2.78^{a}	2.74^{ab}	2.66^{b}	0.024
Feed consumption (kg)	1.82	1.84	1.83	1.84	0.004
Feed conversion ratio (kg feed/ dozzen egg)	0.641^{a}	0.660^{ab}	0.672^{ab}	0.694^{b}	0.007
Feed conversion ratio (kg feed/kg egg mass)	5.627	5.618	5.870	5.975	0.068
Egg weight (g)	9.49	9.81	9.51	9.62	0.064
Egg quality characteristics					
Egg contents (%)	86.74	86.65	85.44	85.32	0.284
Albumen (%)	53.83	53.35	53.05	51.35	0.419
Yolk (%)	31.91	32.06	32.03	33.97	0.366
Shell (%)	12.96^{a}	14.09^{bc}	13.92^{b}	14.54^{c}	0.210
Shape index	77.64	78.42	78.02	79.18	0.382
Shell thickness (mm)	0.217^{a}	0.227^{b}	0.235^{bc}	0.242^{c}	0.004
Shell memb thickness (mm)	0.047^{a}	0.050^{ab}	0.052^{bc}	0.062^{c}	0.002
Hatchability fertile egg (%)	90.42^{a}	95.10^{c}	92.88^{b}	90.08^{a}	0.621
Hatchability % (total egg set)	78.92^{b}	88.58^{d}	82.50^{c}	75.83^{a}	1.443
Hatchability % (fertile egg set)	88.22^{b}	93.91^{c}	89.56^{b}	84.88^{a}	0.988

Means bearing different superscripts column wise differ significantly ($P<0.05$)

Table. Cost benefit analysis

Parameter	Treatments			
	T_0	$T_{0.5}$	$T_{1.0}$	$T_{1.5}$
Feed consumed per quail bird (kg)	1.823	1.835	1.830	1.835
Cost of feed/kg (₹)	18.09	18.09	18.09	18.09
Total Cost of feed + Feed Supplement	32.98	34.93	36.57	38.39
Cost of quail layer (₹)	25	25	25	25
*Total cost(₹)	57.98	59.93	61.57	63.39
Income from sale of eggs (₹)	34.20	33.36	32.88	31.92
Income from sale of culled quail (₹)	25	25	25	25
Total income (₹)	67.20	66.36	66.08	64.92
Net profit (₹)	9.22	6.43	4.31	1.53
Profit (%)	15.90	10.73	7.00	2.38

*Includes cost of electricity, medicine and labour

It is concluded that Probiotic (Biovet) supplementation @ 1.0g/Kg diet was found to be effective in improving the performance and economics of production in broilers.

Effect of Biovet on Performance, Egg quality characteristics and Hatchability in Quail Breeders

Two hundred forty (Seven week old, average weight of 160 gram (male) and 200 g, female) breeding Japanese quails were randomly distributed into 4 groups having 4 replicates of 15 quails each in a female : male ratio of 2:1. Control diet was prepared with maize powder 50 %, SBM, 29 %, deoiled rice bran 11.5 %, DCP, 1.50 %, Limestone, 7.50 %, mineral mix, 0.15 %, common salt, 0.5 %, DL-Methionine, 0.01 %, Vitamin Mix., 0.02 %.

The treatment groups were given Biovet (Prebiotic and probiotic) @ 0, 0.5, 1.0 and 1.5 g/ Litre of drinking water (DW) daily for a period of 8 weeks (7–15). During 7-15 weeks the average intake of water was 100 ml per quail. At 15 weeks of age hatchability study was carried out.

One hundred and fifty eggs from each group were collected during the last week of the study. One hundred twenty five eggs were selected from each group and set in the incubator. The number of hatched chicks were recorded for three days after 17th day of incubation and hatching period. Then the remaining non-hatched eggs were cracked, and fertile, unfertile eggs and embryonic deaths were recorded. The hatchability characteristics were calculated by the following formulae.

Fertility= Number of fertile eggs/number of total eggs set x 100
Hatchability (fertile eggs set)=Number of hatched chicks/number of fertile eggs set x 100
Hatchability (total eggs set)=Number of hatched chicks/number of total eggs set x 100

Egg production, egg weight, feed intake, egg albumen and yolk percent were not affected by supplementation of biovet through DW. The feed conversion ratio (Kg feed/Kg egg mass) were similar for all groups.

However, feed conversion ratio (Kg feed/ dozen egg) was significantly reduced in quails given biovet @ 1.5g/litre DW. The egg shell %, shell thickness, fertility and hatchability were significantly ($P<0.05$) improved in quails given 0.5-1.0 g biovet/litre of DW.

It was concluded that supplementation of biovet through drinking water @ 0.5g/litre is beneficial in terms of improvement in egg weight, shell quality, fertility and hatchability.

Effect of feeding brewers' dried grain on the performance of Japanese Quail Layers

Japanese quail layers (135, 9 weeks old) were distributed equally in to 3 groups with 3 replicates of 15 layers each. A basal diet based on maize-soybean meal-deoiled rice bran was formulated. Subsequently 2 test diets were formulated by incorporating BDG at 5 and 10 % level. All the diets were fed *ad libitum* to 3 replicates of 15 laying quails throughout the experimental period of 18 weeks. Replicate wise egg production was recorded daily. Average egg weight and replicate wise feed intake was recorded at weekly interval. Feed conversion ratio was calculated as the ratio between feed consumed and dozen egg produced. The egg quality characteristics (% of albumen, yolk and shell, shape index and shell thickness) were measured at every 15 days interval and average values were considered.

Egg production, feed conversion ratio and egg weight were significantly improved (P<0.05) by the inclusion of 5 % BDG by replacing maize, soybean meal and DORB in control diet. The feed consumption and percentages of egg contents, albumen, yolk and shell and shape index were similar across all the treatments. The net profit in quails fed 5 % BDG was higher than those fed control diet. However, the shell thickness was decreased (P<0.05) due to inclusion of BDG.

Feeding of BDG in breeding Japanese quail

Table. Effect of feeding brewers' dried grain on performance and egg quality characteristics of Japanese quails

Parameter	Treatments			SEM
	T_0	T_{10}	T_{20}	
Egg Production (dozen)	4.99[b]	5.68[c]	4.04[a]	0.748
Feed consumption (g)	3868.8	3873.6	3890.2	46.19
Feed conversion ratio	0.776[b]	0.685[a]	0.963[c]	0.127
Egg weight (g)	1077[a]	12.37[b]	10.47[a]	0.250
Egg quality characteristics				
Egg contents (%)	84.93	86.30	84.87	0.343
Albumen (%)	50.66	51.04	50.28	0.317
Yolk (%)	35.21	36.50	35.26	0.347
Shell (%)	14.90	15.11	14.71	0.182
Shape index	78.64	76.42	78.02	0.382
Shell thickness (mm)	0.234[a]	0.215[b]	0.207[b]	0.004

Means bearing different superscripts column wise differ significantly (P<0.05

Table. Cost benefit analysis

Parameters	Treatments		
	T_0	T_{10}	T_{20}
Feed consumed per quail (kg)	3.868	3.874	3.890
Cost of feed/kg (₹)	14.08	11.93	16.10
Total cost of feed (₹)	54.47	46.20	62.62
Cost of quail chick (₹)	20	20	20
*Total cost (₹)	81.97	73.70	90.12
Income from sale of eggs (₹)	35	35	35
Income from sale of eggs (₹)	59.88	68.16	48.48
Misc. income (₹)	8	8	8
Total income (₹)	102.88	111.16	91.48
Net profit (₹)	20.91	37.86	1.36
Profit (%)	25.50	51.37	1.51

*Includes cost of electricity, medicine and labour

It was concluded that brewers' dried grain can be incorporated up to a level of 5 % in the diet of Japanese quail layers by partial replacement of maize, soybean meal and de-oiled rice bran for improvement in egg production performance and higher profit margin.

Effect of feeding cow pea leaves and pods on the performance of Vanaraja laying hens

An experiment was conducted to study the effect of cow pea leaves and pods on performance of Vanaraja laying hens during a period of 6 weeks. 25 weeks old, 12 laying hens were randomly distributed into 3 equal groups (duplicated into 2 groups of 2 laying hens each) on wiremesh floored cages. Control group was fed standard layer mash @ 250g/day. First experimental group was given 150g layer mash/day and 175 g fresh cow pea leaves and pods/day. Second experimental group was fed 125g layer mash/day and 250 g fresh cow pea leaves and pods per day. The standard management practices were followed in rearing the layers throughout the experimental period. Data were recorded on weekly feed intake, daily egg production and egg weight. The feed efficiency was calculated as

Vanaraja layers fed cowpea leaves and pods

either feed intake in Kg/dozen egg produced or feed in take in Kg/Kg egg mass produced. The feed cost per dozen egg produced for each group was also calculated.

Significant (P<0.05) reduction in egg production (dozen) was observed in group fed 250g cow pea leaves and pod/day. However, laying hens fed 150g of fresh cow pea leaves and pods produced eggs similar to that of control group. Egg production record (kg mass) followed the similar trend as that of egg production in dozen. The egg weight was not affected by the feeding of cow pea leaves and pods. Feed intake was significantly (P<0.05) reduced based on the dry matter intake. Feed efficiency (feed intake in kg/dozen egg) was significantly improved (P<0.05) in 1st group fed cow pea leaves and pods @ 150g/day. Feed efficiency (Feed intake in kg/egg production in kg) followed the similar trend. Feed cost to produce dozen egg was significantly lower (P<0.05) for both the experimental groups fed cow pea leaves and pods. Preliminary study indicated that cow pea leaves and pods can be fed to vanaraja laying hens for more income generation due to significant reduction in feed cost.

Project : Prevalence and Persistence of Pathogens of Public Health Significance from Culture and Capture Fisheries Environment (*PI: S.B. Barbuddhe*)

The objective of the study was to isolate *Salmonella* and *Listeria* from capture and culture fisheries environment. A total of 200 seafood samples and 89 samples from mangrove areas (sediment and water) were analyzed isolation of *Listeria* and *Salmonella* using specific media. For isolation of *Salmonella* sp samples were enriched in tetrathionate broth and incubated at 37^{0}C for 12 h then each of samples was streaked on Brilliant green agar plates and further incubated for 24 h at 37^{0}C. Peculiar colonies suspected for *Salmonella* were subcultured and subjected to further various biochemical characterization. Isolation of *Listeria* from the samples was attempted as per ISO 11290-1, 2.

The isolated pinpoint grayish-green colonies surrounded by black zone of esculin hydrolysis were presumed as *Listeria*. Morphologically typical colonies were verified by Gram's staining, catalase reaction, tumbling motility at 20–25^{O}C, methyl red-Voges Proskauer (MR-VP) reactions, CAMP test with *S. aureus* and *R. equi*, nitrate reduction, and fermentation of sugars (rhamnose, xylose, and a-methyl-D-mannopyranoside). The isolates were further tested for their phospholipase C activity. Twenty five *Listeria* and 39 *Salmonella* strains were isolated. *Listeria* and *Salmonella* strains were further characterized for virulence associated genes.

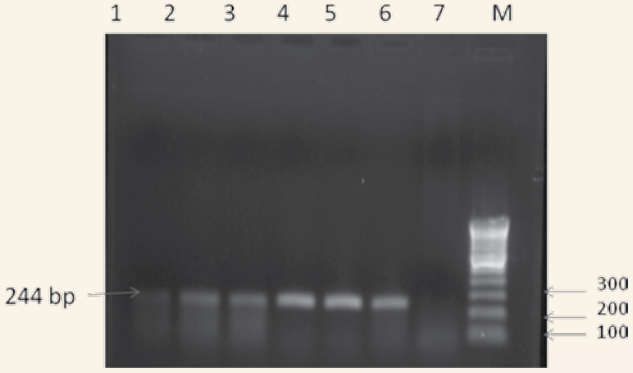


Fig. Detection the inv gene in Salmonella species isolated from mangrove areas
Lanes: 1-5 positive samples, lane 6: positive control, lane 7: negative control, lane M: DNA ladder

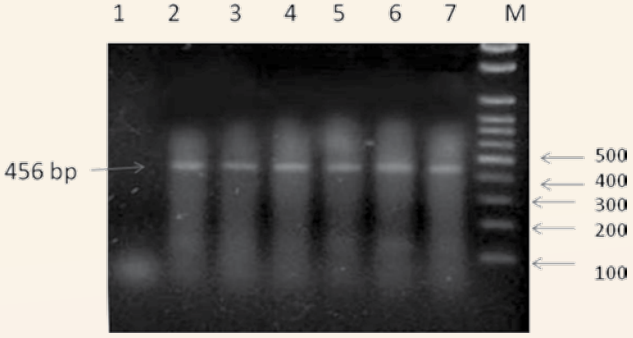


Fig. Detection the hlyA gene in Listeria moncytogenes isolated from seafood samples.
Lane 1: negative control, Lanes 2-6 positive samples, lane 7: positive control, lane M: DNA ladder

Fishery Science

Project : Digitalized Database of Aquatic and Fisheries Resources of Goa (*PI: S. Subramanian*)

The Web-based information system is taken up to digitally document all the information available from secondary sources on various aquatic and fisheries resources of Goa. The system is linked to backend MySQL server with PHP scripting language is combined or embedded with HTML of a web page, to form the front-end of the relational database. Secondary information is collected, collated and uploaded into database for easy access and retrieval. The system is also designed for updating, modifying or correcting data periodically.

The present database is named as FRoG (Fisheries Resources of Goa) along with related information so it enable for easy access to students, planners, and researchers. User can get instant information on marine and inland fisheries information and species-wise details of fisheries resources available in Goa state. Information on aquatic resources is provided as static information, that of fisheries resources is provided as dynamic form. The static information include over-view of fisheries of Goa in the context of West coast, important species-wise marine production, details of fishing vessels and gears operated, export of fish and fish products from Goa, district-wise fish landings, inland fish varieties and landings, , reverine, estuarine and mangrove systems of Goa, primary production in estuaries, culture fisheries details in Goa, available culture technologies, besides others. The system features comprehensive searched information on commercially and biologically important species with common name, scientific name, various biological and fisheries aspects, etc. Upon clicking on the specific record, information of the selected species will be displayed to the user along with the image. System has the provision for all database manipulations like adding new records, updating records and deleting unwanted records.

FRoG (Fisheres Research Resoruces of Goa website

Indian mackerel

Oil sardine

Mud crab

Green mussel

Tiger Prawn

Sea bass

Important Marine and Brackishwater fish species

Agro- Eco- Tourism

Project: Agro-eco tourism : Impact and popularization
(*PI: SB Barbuddhe*)

Farming sector, tourism industry and farm business can be linked symbiotically by Agro-Eco Tourism. It can secure a multifunctional, sustainable and competitive agriculture, maintain the landscape and the countryside, contribute to the vitality of rural communities, respond to consumer concerns and demands regarding food quality and safety, environmental protection, animal welfare, etc. The objectives of the study were to survey the existing agro-tourism units of Goa and to develop a model at institute farm. The existing agro-eco-tourism centers were surveyed using a survey proforma. The impacts of the agro-eco-tourism were analysed form the survey data. Attempts were made to develop a model at the institute.

On an average, approximately 90 percent of tourists and agro-eco-tourism operator farmers said that agro-eco-tourism is an economic growth opportunity for Goa's rural regions. This study did not include a full tourism impact analysis but were compiled some potential concerns and benefits perceived about agro-eco-tourism by farmers. Since Goa is renowned tourist destination both main stream tourism and the agro-eco tourism can be complimentary.

There are several short comings and opportunities to agro-eco-tourism development, farmers also cited some economic, environmental and socio-cultural consequences that may result from tourism development. The list of possible rural concerns and benefits of agro-eco-tourism development is compiled.

Farmer Responses: Concerns with Developing Agro-eco-tourism

Following issues were concerning to the respondents:

Economic concerns
Inflated property values and inflated price of local goods/services

Social or cultural Concerns
Disruption of rural lifestyle and availability of seasonal work

Environmental concerns
The top social or cultural concern cited was "false image of farming" and the most frequent environmental concern was "litter and trash".

Constraints

- The survey of the existing units by this institute revealed critical aspects of looking at agro-eco tourism include unclear definition, since different components make up the agro-tourism products. Definition needs to be endorsed at a national as well as global level.

- Agro-eco-tourism destinations are not always convenient and at times conducted in isolated areas. In such cases, lack of transport and back up services, awareness among both farmers and tourists about the potential benefits, basic information for financing such projects /entrepreneurs, integration into the whole tourism economy, market intelligence research on agro-eco-tourism, etc are the major impediments.

- The absence of any formal training programmes pertinent to agro-eco-tourism sector is the cause for the slow percolation of its potent results among both marketers and consumers alike. The present status of agro-eco-tourism is the result of some enthusiastic farmers who have faced lots of initial hurdles in encashing the economic and ecological benefits while delivering goods and services to agro-eco tourists.

- Local government needs to recognize potentiality of agro-eco-tourism industry

Benefits of agro-eco-tourism development

Farmers were also asked to rate the possible benefits of agro-eco-tourism development in their rural areas. The most frequently added economic benefit was "increased income" The most frequently added social or cultural benefit was "educate people where food comes from."

Farmer Responses: Benefits to Developing Agro-eco-tourism

Economic benefits

Economic diversification, job creation in rural areas, more tourists in area and business benefit in rural community

Social or cultural benefits

Preservation of rural lifestyle, increased awareness of rural heritage, increased awareness of agriculture issues by general public and improvement of community facilities and services

One of the major advantages of agro-eco-tourism is to involve local people in the venture. As all the activities envisaged therein relate to outdoors, basic services for the same are to be provided locally. This has thrown opportunity for the people to engage themselves in self employment in form of providing local transport, eateries, and other provisions or even to act as guides and conductors for field excursions.

Since local people have thorough knowledge and understanding of terrain, landscape, local routes, cultural practices etc, given the adequate training and motivation they can act as good partners in promoting agro-eco-tourism activities. Moreover, besides visiting the places, people are also interested in knowing local customs, traditions and practices so as to have a glimpse into social fabric of people as a part of touristic experience.

Development of Agro-Tourism Model at Institute Farm

Efforts have been initiated to develop a model agro-tourism unit at the institute farm. A number of fruit trees and spices have been planted. The block is being developed as multi-storey cropping model. A vermi-compost and floriculture units have also been installed in the block. A trail to walk around has been put in place.

The empty space was used to grow vegetables, turmeric and ginger. Efforts will be made to use the facility to give first hand information about agri-tourism to visiting farmers and school children.

A view of plantation in ATDC premises

Salient recommendations arising out of the research finding are summarized below.

- Agro-eco-tourism brings major primary sector Agriculture closer to major service sector tourism. This convergence is expected to create win-win situation for both the sectors.
- Goa's agro-eco-tourism industry has a substantive product and market base. Goa should explore enhancing and enlarging its existing products and developing new markets.
- Agro-eco-tourism may provide a means to expand existing agricultural operations, diversify or supplement income, or acquire new skills. From the perspective of Goa's rural communities, agro-eco-tourism may be a vehicle to land preservation, local revitalization, and job creation.
- Agro-eco-tourism is an effective instrument to showcase the agricultural technologies. The agro-eco-tourism sites can help in dissemination of proven agricultural technologies.
- It is a place for collection of high value specialty nursery planting material.
- Ago-eco-tourism can help to preserve rural landscapes, rural heritage
- The majority of agri-tourists were foreigners and city dwellers. Concerted efforts are required to create awareness of the concept among domestic tourists.
- It is indeed a need to include agro-eco-tourism centres on tourist map of the state and to link it with mainstream tourism.
- All tourism development must be researched, planned, and managed within the context of the possibilities of positive and negative impacts for sites and regions.

Intercropping of ginger in coconut garden

A view of low cost vermi-compost unit

Propagation of Elephant foot Yam

Externally Funded Projects

Project : Stress Tolerant Rice for Africa and South Asia: Salinity Tolerant Breeding Network trial, Kharif, 2011 (*PI. N. P. Singh*)

The experiment consisting of 26 rice genotypes/ cultures, was laid out in farmers' field at Chorao village of North Goa representing coastal salinity in Randomized Block Design (RBD) with three replications. The soil EC ranged from 2.16 to 5.25 dS/m and soil pH from 5.00 to 5.34.

Days to fifty per cent flowering ranging from 85.66 (CSR - 2K- 255) days to 132.33 (CR 2218-64-1-327-4-1) with a mean days of 101.55, plant height ranging from 83.13 cm (RAU -1428-13-7) to 141.96 cm (korgut, local check) with a mean height of 110.16 cm, where as productive tillers ranging from 3.73 (RAU -1428-13-7) to 7.53 (CSR 36) with a mean of 5.23. Grain yield was highest in CSR - 2K- 219 (1827.584 kgs) followed by RP 4353-MSC-38-43-6-2-4-3 (1818.09), NDRK 11-4 (1675.93 kgs) and NDRK 11-1 (1675.49 kgs) which is numerically superior compared to check entries CSR-36 and CSR-27, which yielded respectively, 1651.13 kgs and 1628.59 kgs and significantly superior compared to national check CST 7-1 (1020.67 kgs) and local check 1097.90 kgs.

Field view of salinity tolerant breeding network trial

Table. Performance of top 10 entries in STRASA, (STBN), *Kharif*, 2011

Genotypes	Days to 50% flowering	Plant height (cm)	Productive tillers/hill	Grain yield (kg/ha)
CSR - 2K- 219	99	127	5.70	1827.58
RP 4353-MSC-38-43-6-2-4-3	115	111	5.33	1818.09
NDRK 11-4	109	117	5.60	1675.93
NDRK 11-1	109	118	5.47	1675.49
CSR - 2K- 242	100	112	6.90	1623.96
RP 4631-146-19-1-1-2-3	113	112	4.40	1465.50
RAU-1-16-48	108	91	6.00	1405.59
PNL 9-1-2-7-4-6-1	107	98	5.53	1261.85
NDRK 11-5	98	106	4.53	1247.86
CSR - 2K- 262	113	113	5.67	1220.00
Check (CSR 36)	110	114	7.53	1651.13
Check (CSR 27)	104	111	5.90	1628.59
Check (CST 7-1)	121	107	6.00	1020.67
Local Check (Korgut)	96	142	5.77	1097.90
Mean	101.55	110.16	5.23	1030.72
SE (m)	3.64	9.40	0.70	138.78
CD (0.05)	7.31	18.89	1.41	278.75
CV (%)	4.39	10.45	16.37	16.49

Project : Preparation of GPS and GIS Based Model Soil Fertility Maps for the State of Goa (*PI: Ram Ratan Verma*)

Project entitled preparation of GPS and GIS based soil fertility maps for the selected districts of the country funded by Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, has been implemented in both North Goa and South Goa districts of the State of Goa through collaboration with project coordinating center, Indian Institute of Soil Science, Bhopal. As per the technical programme provided by the project coordinating center IISS, Bhopal, 42 villages were selected from the North Goa and 26 villages were selected from the South Goa districts of the State and 10 representative soil samples were collected from each selected village representing different categories of the farmers (resource rich, medium and poor) and cropping systems. Out of the 680 soil samples collected from the State, 260 soil samples represent different talukas of South Goa and 420 soil samples represent different talukaS of the North Goa district. Collected soil samples from the selected villages of the State are being analyzed through standard analytical methods in the Institute soil science laboratory for soil major, secondary and micronutrients. All representative soil samples were collected on GPS coordinates basis which includes latitude and longitude position of the soil sampling site so that in future any change in soil fertility level can be monitored again through soil sampling and analysis from the same site with the help of GPS data. After completing soil analysis in the laboratory, nutrient wise soil fertility maps will be developed. Analysis of soil samples collected from South Goa district revealed the soil fertility status as follows:

The average pH of the soils of South Goa district was found to be 4.89, with a minimum of 3.38 from a sample collected from Xelvona village (Taluka Quepem) and a maximum of 7.82 from Issorcim village (Taluka Marmugao). The average electrical conductivity of the soils of South Goa district was found to be 0.08 dSm^{-1}, with a minimum of 0.005 dSm^{-1} from Dharbadora (Taluka Sanguem) and a maximum of 4.65 dSm^{-1} from Cavelossim (Taluka Salcete) .The average available nitrogen in the soils of South Goa district was found to be 211.08 kg/ha, with a minimum of 56 kg/ha from Xelvona village (Taluka Quepem) and a maximum of 621 kg/ha from Sirlim village (Taluka Salcete). The average available Phosphorus in the soils of

Table . Typical soil analysis report with geographical conditions of soil sampling sites of Cumbarjua Goa

Latitude	Longitude	pH	EC (dSm^{-1})	Avail. Nitrogen	Avail. P_2O_5 (kg/ha)	Avail. K_2O	Cu	Mn	Fe
							(ppm)		
15°30'24.4"	073°57'22.4"	4.52	0.001	229.6	23.29	1156	0.40	9.66	141.22
15°30'22.2"	073°57'19.6"	4.28	0.000	190.4	25.09	262	0.40	6.86	187.12
15°30'21.5"	073°57'23.4"	4.71	1.306	240.8	16.88	1090	0.40	8.08	144.82
15°30'31.9"	073°57'26.2"	4.35	1.592	201.6	5.31	902	0.40	10.36	80.86
15°30'31.3"	073°57'24.4"	4.99	0.059	268.8	6.87	570	0.40	119.9	58.16
15°30'28.8"	073°57'06.4"	4.68	0.021	218.4	11.26	168	4.66	33.46	194.36
15°30'25.8"	073°57'09.4"	4.84	0.020	196.0	9.18	140	4.98	13.86	115.42
15°30'21.3"	073°57'13.8"	4.64	0.022	190.4	22.48	126	1.98	7.04	199.5
15°30'26.6"	073°56'56.7"	4.50	0.108	240.8	9.80	226	0.40	28.9	177.32
15°31'04.0"	073°56'41.4"	4.78	0.077	168.0	13.83	390	3.88	45.84	174.24


A view of representative soil sampling for analysis of various parameters

South Goa district was found to be 18.48 kg/ha, with a minimum of 1.23 kg/ha from Padi village (Taluka Quepem) and a maximum of 112 kg/ha from Sirlim village (Taluka Salcete) .The average available Potassium in the soils of South Goa district was found to be 255 kg/ha, with a minimum of 14 kg/ha from Cavelossim (Taluka Salcete) and a maximum of 1106 kg/ha from Nuvem village (Taluka Salcete) .The average organic carbon in the soils of South Goa district was found to be 1.37 per cent , with a minimum of 0.12 per cent from Cavelossim (Taluka Salcete) and a maximum of 3.99% from Issorcim village(Taluka Marmugao).

Project : Outreach project on Phytophthora, Fusarium and Ralstonia diseases of horticultural and field crops (*PI: R. Ramesh*)

Two hundred and thirty two *R. solanacearum* isolates collected from different states viz. Goa, Kerala, Karnataka, and Andaman Islands are being maintained in the culture collection. Pathogenicity of the isolates was tested on eggplant, tomato and chilli. Multi Locus Sequence Typing (MLST): Twenty diverse strains were selected based on the egl sequence tree, geographical location and host for MLST analysis. Five chromosomal housekeeping genes namely *gapA* (Glyceraldehyde 3-phosphate dehydrogenase oxidoreductase), *ppsA* (Phospphoenol pyruvate synthase), *gdhA* (Glutamate dehydrogenase oxidoreductase), adk (Adenylate kinase) and *gyrB* (DNA gyrase subunit B) and one megaplasmid based virulence gene *fliC* (Flagellin protein) was included in the study along with *hrp*B (Transcriptional regulator) and *egl* (endogulcanase). Sequencing was carried out by using automated DNA sequencer (ABI PRISM™ 310 Genetic Analyser from Applied Biosystems Inc).

All the sequences were deposited with NCBI, USA. Based on the sequence similarity of ITS region among our isolates, specific primers were designed for selective identification of our *R. solanacearum*. One forward primer and two reverse primers were designed for validation. In addition, primers used for ITS amplification and sequencing were also used. PCR cycle and conditions were standardized for a combination of the 5 primer pairs given below:

Primer pair no.	Primer Pairs	Expected size (bp)
1	Rs-Ind-FP and Rs-Ind-RP1	260
2	Rs-Ind-FP and Rs-Ind-RP2	268
3	Rs-Ind-FP and Rs-ITS-R	386
4	Rs-ITS-F and Rs-Ind-RP1	451
5	Rs-ITS-F and Rs-Ind-RP2	459

Bio-PCR was done with 759/760 primers and primer pair 1 for detection of *R. solanacearum* as described by Lin *et al*., 2009.

Crosses were made between Surya and Agassaim as per the standard method and the seeds were collected the crossed fruits. Resistant variety 'Surya' and susceptible variety 'Agassaim' were inoculated and plant samples were collected after and interval of 0 h, 6 h, 12 h, 24 h, 36 h and 48 h for induction of defense compound study. Samples were analyzed for the peroxidase activity, polyphenol oxidase activity, phenol content, protein content. Induction of PR Proteins was checked by SDS-PAGE.

Field experiments were laid out to evaluate the efficiency of the biocontrol agents in reducing bacterial wilt in eggplant. Nursery was treated with talc formulation of three biocontrol agents @ 50g m^{-2} area. One treatment of consortium (EB69+ Rs-08-72) was also included based on the compatibility study. Seedlings raised in the treated nursery and control nursery (not treated with biocontrol agents) were planted in the field in January 2011. The plants were drenched with the biocontrol suspension (50g lit^{-1}) @ 50ml/plant. Appropriate controls were maintained. Further, nursery treated seedlings were planted in other locations in the farmers field. Seedlings were drenched after transplanting in these fields also.

Diversity of *R. solanacearum*

R. solanacearum isolates (232) were collected from different crops i.e. Brinjal, chilli and tomato from Goa (74 different places, 149 isolates); Karnataka (15 different places, 18 isolates), Kerala (11 different places, 20 isolates), Maharashtra (15 different places, 19 isolates) Andaman islands (25 places, 25 isolates). Isolation of the pathogen was done on TZC medium. All the isolates were preserved in water stocks and in 30 % glycerol stored at -70 °C.

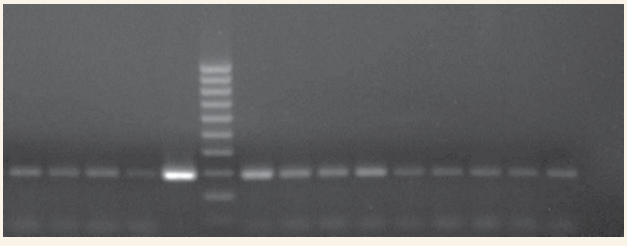
Phylogenic characterization indicated that all isolates are Phylotype I and majority of the isolates belonged to biovar 3 while 10 isolates which form biovar 6. Pathogenicity study indicated that more than 90 per cent of the isolates were pathogenic to all the three hosts. Incidence of wilt started very early in case of tomato (3-4 days after inoculation in case of some isolates). In chilli, only few isolates caused wilting symptoms.

Twenty diverse *R. solanacearum* strains were selected for MLST analysis. All the gene products were sequenced and being analysed. All the sequences were deposited in the gene bank and accession numbers were obtained.

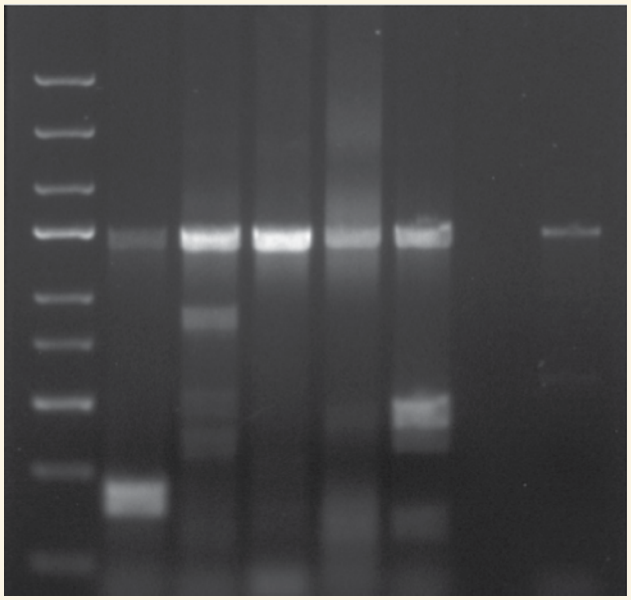
Diagnostics

Based on the sequence similarity of ITS region among our isolates, specific primers were designed for selective identification of our *R. solanacearum*. PCR cycle and conditions were standardized for a combination of the 5 primer pairs. PCR was done with genomic DNA of commonly found soil bacteria namely *Pseudomonas* spp, *Bacillus* spp., *Listeria* spp, *Klebsiella* spp. *Enterobacter* spp, *Burkholderia* spp. and uncultured bacterium to check the specificity of the primers towards *R. solanacearum*. Primer pair 1 also amplified the ITS region of Phylotype III strain WW386 but not of the Phylotype II and Phylotype IV strains.

Bio-PCR was stadardized with 759/760 primers for detection of *R. solanacearu*m. Bacterial cells of *R. solanacearum* as low as 50 per gram of artificially infested soil could be detected by this method. At the same time this method was useful to detect presence of *R. solanacearum* from eggplant (wilt affected and healthy asymptomatic) and weeds (*Amaranthus albus*).



Bio-PCR was also standardized using the primer pair 1 and could detect *R. solanacearum* from artificially infested soil. In another set of experiments, amplification of 16s rRNA gene was included as an internal positive control (IPC) along with the 759/760 primers and the primer pair 1 to avoid false negatives.



Host resistance

M Rs

Common soil bacteria

Development of suitable mapping population (F_1)

We have selected Surya cultivar of brinjal for further work. Crosses were made between Surya and Agassaim to develop F_1 population. Seedlings from F_1 cross seeds were raised along with the resistant and susceptible parent lines.

Studying the mechanism of host resistance

Resistant variety 'Surya' and susceptible variety 'Agassaim' were inoculated with 10^8 CFU/ml of moderately virulent *R. solanacearum* strain Rs-09-100. Phenol content was high at 0 h but was found to reduce later till 48h. In contrast the expression of peroxidase and polyphenol oxidase increased with time after inoculation of the pathogen. But, no induction of new protein was observed after performing SDS PAGE in either of the hosts.

Disease management

Based on the inhibition of *R. solanacearum* in plate bioassays, 10 xylem residing bacteria were taken for glasshouse evaluation. Three antagonistic xylem residing bacteria were found to promote growth in eggplant and are under study to determine their ability to control wilt.

Field evaluation of talc formulation of antagonistic bacteria for the management of bacterial wilt suggested that germination was good in the antagonistic bacteria treated nursery compared to control. Consortium treated nursery was superior to the individual treatments. All the growth parameters are better in the antagonistic treated nursery compared to control. In the field, the biocontrol treatments recorded less disease and higher yield. Based on the encouraging initial results in the laboratory, glasshouse and experimental field conditions, we selected three antagonistic bacteria for the field demonstration in the farmer's field. In addition one consortium of two antagonistic bacteria was also evaluated. Seven field demonstrations in three vegetable growing villages were conducted. Reduced incidence of bacterial wilt was recorded in the biocontrol treated plots compared to untreated control plots in all the demonstrations.

Taleigao

Surlabhar

Field demonstrations of the management of bacterial wilt in brinjal using antagonistic bacteria

All the *R. solanacearum* isolates are biovar 3 and belong to Phylotype I. More than 90% of the isolates are pathogenic to all the three hosts. A high level of sequence similarity in ITS region was observed among our isolates. Bacterial cells of *R. solanacearum* as low as 50 per gram of artificially infested soil could be detected by Bio-PCR. At the same time this method was useful to detect presence of *R. solanacearum* from asymptomatic weeds. Reliability of the test was improved by inclusion of an internal positive control (IPC). Field evaluation of biocontrol agents indicated that treatment with antagonistic bacteria reduces the wilt incidence and the reduction in the disease incidence varies with the locations- may be due to the differences in the pathogen load. Individual antagonist is as efficient as consortium and study requires refinement for maximum efficiency.

Project : Indo-German Consortium for Epidemiology and Comparative Genomics of Listeria (*PI : S.B. Barbuddhe*)

A total of 25 *Listeria* strains were added to the culture collection during the period under report. The isolates were further characterized for their antibiotic, biocide and heavy metal resistance.

An ELISA based assay using listeriolysin O as an antigen has been developed. Peptides as antigen were synthesized and used in standardization of assays. Two peptides showed promising results.

A significant achievement of the project is the establishment of well characterized repository of the strains of *Listeria* isolated from almost 12 states of India. We have archived all the strains at this centre as well as submitted to National Veterinary Type Culture Facility, NRC Equines, Hisar under ICAR.

Data from our studies have also revealed the presence of possible new species of *Listeria* that are probably indigenous to the Indian subcontinent. These strains have 16S rDNA sequences that are *Listeria*-specific but exhibit unusual fermentation properties.

Project : Validation Of Potential Fishing Zone Advisories Along Goa Coast With An Attempt To Study The Possible Advantage Of PFZ Advisories For Different Types of Fishing Activities (*PI: S. Subramanian*)

Potential Fishing Zone (PFZ) forecast information brought out by INCOIS (Indian National Centre for Ocean Information Services), Hyderabad, are utilized for validation from Malim (Panjim), Marmagoa (Vasco), and Cutbona (Betul) fish landing centers. The PFZ advisories are released daily during the cloud free days and are transmitted through FAX /Email, Electronic Display Board and Mobile SMS (Short message) to the landing centers. Validations of PFZ advisory are conducted through selected groups of active fishermen located at the above mentioned centers. During 2011-12, a total of 74 PFZ advisories were received for Goa coast, of which 47 were validated. The remaining 37 could not be validated as the PFZ markings were either off Goa coast or far away (100 to 200 m depth and beyond). A total of 125 field visits were made during the year and a total of 331 fishing feedbacks were received from the boat operators. The validation percentage of PFZ advisories received for the coast of Goa was 100 % during this year. As the PFZ advisories were found to be more useful to purse seine operations, catches of purse seine were taken for consideration for the study.

Experiments were conducted by comparing catches by identical purse seine vessels fishing on the same day in the PFZ notified area and non notified areas including their economics. Biological aspects such as length, weight, gut content and gonad condition, as well as proximate analysis of two major species namely Indian mackerel (*Rastrelliger kanagurta*) and oil sardine (*Sardinella longiceps*) landed at the jetties were recorded.

Out of 74 PFZ forecasts validated during the period under report, as per the feedback received from 331 purse seine operators utilizing the advisory, 100 per cent boats reported availability of fish. Out of the 148 Non PFZ feedback responses recorded during year, the purse-seine fish catches ranged from 500 kg to 1.5 tons in the non PFZ area which was less than the catches from boats using PFZ advisory with an exception of cat fish that yielded 10.0 tons.

The highest catch obtained using PFZ advisories were 15 tons for Indian mackerel, 30 tons for oil sardine, 10.0 tons for Horse mackerel, 7.5 tons for tuna and 5.0 tons for seer fish.

The major fish species caught during the period were Indian mackerel, (*Rastrelliger kanagurta*), oil sardine (*Sardinella longiceps*), tuna (*Katsuwonus pelamis*), Seer fish (*Scomberomorus guttatus*) and Horse mackerel (*Megalapsis cordella*). The other species were lesser sardines (*Sardinella fimbriata)*, Cat fish (*Arius maculates*), Red snapper (*Lutjannus malabaricus*) and solar shrimps.

Out of the 331 feedback received this year, 160 were of Indian mackerel, 117 of oil sardine, 25 of seer fish, 12 of tuna, 9 of horse mackerel, 4 of cat fish, 2 of solar prawns and one each of lesser sardine and red snapper.

Indian mackerel formed the major part of the total fish landing at the three jetties contributing to around 48.3 % of the total catch. Oil sardine ranked second by contributing 35.3 % followed by Seer fish (7.5 %). Tuna was found to be less this year contributing to around 3.6 % and Horse mackerel around 2.7 %. Solar prawns that appeared soon after the ban period in early August were also less during the year contributing to around 0.6 % to the total fish catch. Other fishes like Red snapper, lesser sardines formed a smaller portion of catch and contributed to around 0.6 per cent.

Table. Month-wise availability of major fish species

Month	Common name of the fish species landed at the jetties
April, 11	Indian mackerel, Oil sardines, Tuna, Horse mackerel, Lesser sardines
May, 11	Indian mackerel, Oil sardines, Tuna, Horse mackerel
June, 11	Indian mackerel, Oil sardines, Horse mackerel
July, 11	Indian mackerel, Oil sardines
August, 11	Indian mackerel, Seer fish, Tuna, Solar shrimps, Red snapper, Cat fish,
September, 11	Indian mackerel, Oil sardines, Seer fish
October, 11	Indian mackerel, Oil sardines, Seer fish, Tuna
November, 11	Indian mackerel, Oil sardines, Seer fish
December, 11	Indian mackerel, Oil sardines, Seer fish
January, 12	Indian mackerel, Oil sardines, Seer fish
February, 12	Indian mackerel, Oil sardines, Seer fish
March, 12	Indian mackerel, Oil sardines

The time of receiving the PFZ advisories to the boat owners plays an important role and affects the quantity of the catch. It was observed that if fishing was carried out on the first day of receiving PFZ advisory, then the amount of fish catch was more than the following days. The percentage of the fish catch on the first day was found to be 63.1 % which reduced to 31.1 % on the second day and 5.8 % on the third day. The reduction in the percentage of the catch is mainly because the pelagic fishes are highly migratory and the shoals drift very quickly. Thus, it is obvious that the fishing on the day one is highly profitable.

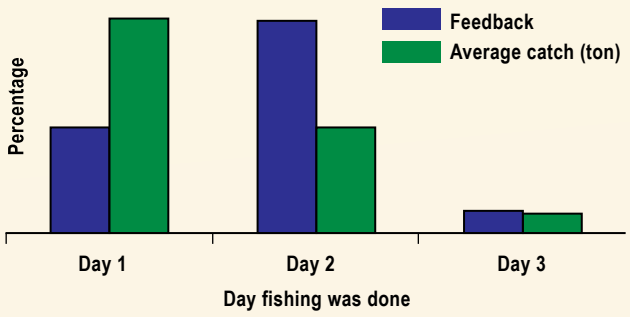


Fig. Percentage of feedback and related fish catch on different days of receiving the PFZ advisory

Economics of operation of identical vessels operated simultaneously within and outside PFZ areas

Studies were conducted to compare the fish catch using PFZ forecasts in PFZ notified areas and fish catch in Non Notified area by identical purse seine vessels i.e., 60-65 ft length and 6 cylinder capacity, on the same day. A total of 23 experiments were conducted during the year and the results are given below:

1. From all the 23 experiments conducted during 2011-12, it was observed that the fish catch was higher in PFZ area than that in the non PFZ area. The CPUE ranged from 1.0 to 15.0 tons in PFZ area and from 0.2 to 7.0 tons in non PFZ area. Similarly, the profit to the boat owners was higher in the catches obtained in PFZ area than that of the non PFZ area catch. The value of fish catches ranged from ` 0.76 to 10.93 lakhs in PFZ area and from ` 0.08 to 2.87 lakhs in non PFZ areas.

2. The highest value of CPUE obtained in PFZ areas where 10.0 tons each for Indian mackerel, 15.0 tons of Oil sardine, 4.5 for seer fish and 4.0 for Tuna to 0.3 ton of Mackerel , 0.3 tons of Oil sardine , 0.2 for seer fish and 1.0 tons of Tuna.

3. The fish catch in PFZ area was 2 to 10 times more than that of the non PFZ areas. The highest difference recorded in the experiment conducted on 7th June, 2011, when 7.0 ton of oil sardine was caught in PFZ area while 0.7 tons of the same was caught in the non PFZ area. When the difference was low (i.e. 2 times) as recorded in the experiment conducted on 19th January 2012, 1.0 ton of seer fish was obtained in PFZ area compared to 0.5 tons of the same in non PFZ area.

4. The difference in net profit between in PFZ and non PFZ catches were ranging from ₹ 6.39 lakhs when the difference was highest to ₹ 0.66 lakhs when the difference was lowest.

5. The highest CPUE of Indian mackerel in PFZ area was 10.0 tons that fetched a profit of ₹ 7.78 lakhs whereas in non PFZ are it was 2.0 ton with a profit of ₹ 1.39 lakhs. The difference in the net profit was ₹ 6.39 lakhs which was 5.5 times higher than the PFZ area.

6. Similarly the highest CPUE for oil sardine in PFZ area was 15.0 tons and fetched a profit of ₹ 6.45 lakhs, whereas in non PFZ it was 7.0 tons with a profit of ₹ 2.87 lakhs. The difference in the net profit was ₹ 3.58 lakhs.

7. Profit margin on species caught depended on the price prevailing in the market. Indian mackerel fetched ₹ 80/- per kg and oil sardine Rs.50/- per kg during September to November, 2011. From December, 2011 to February, 2012, the prices showed a variation and ranged from ₹ 80- 100/- per kg for Indian mackerel and ₹ 50 to 60/- per kg for oil sardines. Seer fish pieces ranged from ₹ 200-375 /- per kg depending upon its availability in the local market. The value of tuna was ₹ 80/- and remained constant throughout the year. PFZ advisory catches actually helped to realize more profit in locating high value fish in PFZ area and also helped in getting better value of low value fish because of the comparatively higher catch in the PFZ area.

8. The distance traveled by vessels using PFZ advisory was more than 30 km whereas vessels not using PFZ advisories did not travel beyond 30 km.

Length and weight frequency of major species caught in PFZ

The length and weight ranges of major species of fish viz., Indian mackerel and Oil sardine, sampled from purse seine catches relating to the PFZ forecast during the period under report for the coast of Goa were recorded by collecting fortnightly samples. During months when PFZ forecast was not available, samples particularly for oil sardine and mackerel, were taken fortnightly from fish landing centers and market, to have continuity of year round data.

The size of Indian mackerel ranged from 14.4 to 25.8 cm for the year. Larger size mackerels were found mostly during January, 2012 (15.0 to 25.8 cm) followed by July (18.2 to 24.4) and August (19.4 to 22.9 cm). Smaller sized mackerels were encountered during the month of June, 2011 (16.0 to 20.0 cm). Weight of mackerel ranged from 31.1 to 177.8 g. The weight was found to be highest during July and August, 2011, (74.4 to 177.8 g) and lowest during September, 2011 ranging from 31.1 to 99.5 g. It was also observed that a direct relationship existed between the length and weight of the Mackerel during the entire year.

The length of The Oil sardine ranged from 10.9 to 20.0 cm. The largest size of Oil sardine was found during June, July, August, October and November ranging from 15.4 to 20.0 cm. The smaller size sardines were found in April with a length ranging from 10.9 to 17.8 cm. The weight of the sardine ranged from 10.1 to 75.5 g. The lowest weight was seen in month of April, 2011 which showed an increasing pattern with maximum weight in Month of December, 2011. Not much variation in the length and weight of oil sardine was observed during the year. It was also observed that a direct relationship existed between the length and weight of the Oil sardine as in Mackerel during the entire year.

The average condition factor for the Indian mackerel and oil sardine during the year was 1.2 and 1.0, respectively. The results indicated that the average condition factor of the fish did not deviate from the standard value of 1.1 for Indian mackerel and 0.9 for oil sardine and the health of both fishes was good.

Gonadal condition of mackerel and oil sardine

Condition of gonads was recorded for the two major species namely oil sardine and mackerel in terms of maturity stages to know its relationship to breeding and season.

In Indian mackerel, the ripe stage of gonad ready for spawning was present during July, August and in month of May. In oil sardine, the ripe stage was observed from June to August, 2011. This season is declared as the "ban period" for fishing along the Goa coast for breeding and better recruitment of stock. The spent stage of gonads was seen in the month of September in both the species. In month of October, maturing gonads were observed in both Oil sardine and Mackerel indicating the redevelopment of gonad in different stages. It may also be noted that the recovery stage after the spent stage was not recorded in the any of the catches for Oil sardine and Mackerel during any of the months. Similarly, fully spent gonads were also not seen in any of the month particularly in breeding season in the pelagic waters.

Depth wise availability of fish species

A unique pattern was observed for the availability of fish species with respect to the depth of its occurrence. Oil sardine were more prominent at a depth between 15 to 30 m whereas Indian mackerel were caught more frequently from 30 to 50 meter depth. Larger fish species mainly seer fish and tuna were caught beyond 50 m.

Conclusions

1. PFZ forecast is useful to pelagic gears like the purse seine vessels.

2. The boats using PFZ forecast complete the fishing activities within one to two days where those not using PFZ advisories take more than two days and can even last for more days .The average time taken to complete one fishing trip (from landing centre to fish catch site and back to the landing centre) including search time was 34.00 to 52.50 hours for purse seine vessels not using PFZ advisories where as it was 16.00 to 24.00 hours for vessels using PFZ advisories, saving fuel of 25,000 to 40,000/- per trip.

3. A pattern in the availability of fish was observed. The oil sardine was caught at a depth of around 20 to 30 m, Indian mackerel from 30 to 50 m, seer fish and tuna beyond 50 m.

4. Shifting feature of the PFZ forecast helped the fishermen to get a reasonably good catch even on the second day of the forecast when fished in the direction of the shift.

5. Fishing at the end of the PFZ advisory yielded a low catch whereas yielded maximum when fished in the middle of the advisory.

6. Direction of the PFZ is also important to get a good catch. Fishing carried out on the opposite side of the direction of moving PFZ yields a smaller catch. For example, fishing carried out on the western side of the PFZ that is shifting towards the east will yield a lesser catch.

7. Fishing in a loop made by PFZ advisory fetches a good catch.

8. Fishing in between two close PFZ advisories yields a reasonably better catch.

9. During cloudy days when PFZ advisory was not received, it was observed that boats would venture in the sea to fish based on their earlier experience. The fish caught during this period was less and fetched a low profit.

Project : Seed Production in Agricultural Crops and Fisheries
(PI: B.L.Manjunath)

Agricultural crops

As per the seed production programme envisaged in major field crops of the region, seed production in different crops was undertaken. Keeping in view, the local demand for seeds of various crops and the target fixed by the council, seed production was undertaken during *kharif* 2011 both in Institute farm and in farmer's fields. The details of crops and varieties are as follows:-

An area of 1.0 ha was grown under rice seed production during the *kharif* season at the Institute farm covering the important high yielding medium duration rice variety Karjat-3 where there is a local demand for seed. All the package of practices were followed and the observations recorded.

Further, newly introduced rice variety 'Naveen' which was proven promising for the local situations was multiplied in an area of one acre and the seeds produced were distributed both to Directorate of Agriculture and Goa Bhagayatdar Society.

Details of high yielding varieties of rice seed production

Rice varieties	Karjat -3, Naveen
Area covered	1.4 ha
Targeted production	30.0 Q
Target achieved	45.0 Q
Targeted customer	Directorate of Agriculture, Goa Bagayatdar Society

Foundation seed of high yielding rice variety Naveen

A close up view of the seed set in rice variety Naveen

Rice seed production during *rabi* season

The lowlying rice fields which was inundated with water in an area of about 5000 sq. m was brought under cultivation of rice during *rabi* season with the high yielding rice variety Karjat-3, where there is local demand for seed.

Details of rice seed production during *rabi* season

Rice variety	Karajat-3
Area of seed production	0.40 ha
Targeted production	20 Q
Target achieved	15 Q
Targeted customer	Directorate of Agriculture, Krishi Vigyan Kendra, North Goa and FLD of the Institute

Karjat-3 - Seed multiplication during rabi/summer season at the Institute farm

Groundnut seed production

Considering the high potential for groundnut, efforts were made to multiply promising high yielding groundnut varieties which suit local environmental conditions. The Foundation seed material produced during *kharif* by mid November is being advised for sowing in r*abi* season in paddy fallows as storage of seeds during *kharif* is difficult in the region owing to humid conditions prevailing in the State.

High yielding groundnut (Variety TG 37 A) under multiplication during rabi season

During the *kharif* season of 2011, seed production of proven high yielding variety of groundnut TG-37A was taken up in an area of about 0.5 ha under sloping upland situations. During *rabi,* high yielding groundnut variety TG-37A was taken up in rice fallows, the details of which are as follows:

Details of groundnut seed production

	Kharif	*Rabi*
Variety	TG 37A	TG 37A
Class of seed	Foundation	TL
Area of seed production	0.4 ha	0.10 ha
Targeted production	4.0 Q	1.5 Q
Target achieved	3.2 Q	1.5 Q

Cowpea seed production

Improved local cowpea selections which are known for their bold size, preferred taste and attractive market price were multiplied during the year, in an area of about 3000 sq.m. The seeds were sown separately with a wider spacing of 75 cm and selections were made keeping in view the number

Local cowpea selection DU-3 under seed multiplication

of pods/plant, pod length, seeds per pod, etc. The selections multiplied during the year included

1. Alsondo-1 (Determinate type)
2. Nadora Bardez-4 (Indeterminate type)

Nadora Bardez -4 multiplied at the Institute farm

3. Dulape Utorda-3 (Indeterminate type)
4. Mahakhajan Pernem-2

The selections are being purified and being harvested.

High yielding Forage seed production

The proven forage varieties evolved at the IGFRI, Regional Centre, Dharwad which were introduced are being multiplied for further distributions to the farmers. The introductions multiplied during the year included high yielding varieties/ hybrids viz. IGFRI-7, GFRI-3, DHN-6, *Pennisetum* trispecific hybrid, Co-3 and Co-4.

High yielding hybrid napier being multiplied for supply of root slips

Fisheries

Breeding and nursery raising methods developed were employed for seed production of both egg layers and live bears of freshwater ornamental fishes such as Gold fish (normal, Shubunkin, red cap, black moor), Koi carp, Gourami, Angel, Sword tail, Guppy and Molly. Formulated feeds and live feeds were produced using techniques evolved by the Institute for feeding various stages of the fish.

Using the breeding, nursery and seed raising facilities available, 73 breeding sets of eight varieties of ornamental fishes including egg layers and live bearers were put. About 60,000 spawn were produced and about 15,000 salable seed are available.

To overcome low survivability, the breeding and nursery tanks were upgraded with the provision of


Gold fish


Red cap


Black Moor


Blue Gourami


Sword Tail


Guppy

Ornamental fishes

continuous aeration and water circulation facilities. The brood stocks of ten varieties are being raised from the young ones.

Popular freshwater ornamental fish species

With the locally available feed ingredients including fish waste, chicken waste, mussel meat and low value prawn waste and based on the nutritional requirement of the ornamental fishes, maintenance feed, growth feed and brood stock feed with crude protein raging from 30 to 40 per cent were produced, costing ₹ 80 to 300/- per kg. Packets of 50 g and 100 g were sold to the public.

Maintenance, growth and brood stock feeds for ornamental fishes

A 24 tank public aquarium with breeding facilities and auto filtration, aeration and illumination is being created which will serve the purposes of seed production, brood stock raising, awareness and training. Two aquarium tanks (one each in Main building and ATDC) were set up and ornamental fish maintained. Live feeds including green water, Spirulina and Moina were also produced and fed to different stages of ornamental fishes depending on their mouth size and nutritional requirement. Water-supply and aeration system were also provided with back up generator.


Formulated fish feeds

Project : All India Co-ordinated Rice Improvement Project (Coastal Saline Tolerant Variety Trial, CSTVT), Kharif 2011 (*PI: Manohara, K. K.*)

The coastal saline tolerant variety trial consisted of 34 rice cultures including 3 check entries namely CST 7-1 (Coastal saline), Jaya (Yield check) and local check Korgut. The trial was conducted in farmers' field at Chorao Island, North Goa. Soil EC ranged from 2.68 to 5.95 dS/m and soil pH from 5.26 – 5.54. The trial was laid out in RBD design with three replications.

Days to 50 % flowering ranged from 90 days (CSR-RIL-102) to 108 days (CR 2213-5-3), Plant height ranged from 95.3 cm (RP 4949-250-10-3-2-1-1-1) to 135.8 cm (CR 2213-5-3), where as panicles / m^2 ranged from 101 (CR 2472-1-6-2-1) to 452 (RP Bio 4919-37-13). Among the test entries, the top 5 ranking entries are RP Bio 4919-60-13 (2449 kg/ha), RP Bio 4919-37-13 (1879 kg/ha), RP Bio 4919-63-7 (1782 kg/ha), RP 4949-250-10-3-2-1-1-1 (1672 kg/ha) and NDRK 50016 (1608 kg/ha).

Field view of coastal salinity variety trial, Kharif, 2011-12

Table. Performance of top 10 entries in AICRIP (CSTVT), Kharif 2011

Designation	Days to 50 % flowering	Plant height (cm)	Panicles/m^2	Grain yield (kg/ha)
RP Bio 4919-60-13	105	120	314	2449
RP Bio 4919-37-13	103	128.8	452	1879
RP Bio 4919-63-7	106	124	351	1782
RP 4949-250-10-3-2-1-1-1	101	95.3	399	1672
NDRK 50016	95	104.6	378	1608
RP Bio 4919-458	106	129.9	287	1585
RP Bio 4919-467	100	116.7	314	1528
NDRK 50021	102	113.7	420	1526
IBDAM 300-007	96	113.8	388	1517
GNV 05-01-1	106	104.1	239	1450
Jaya (Yield Check)	103.5	107.8	351	1641
Korgut (Local Check)	94.5	129.2	293	1015
CST 7-1 (Coastal saline check)	101.5	107.1	341	995
Mean	100.49	113.12	304.42	1169.47
SE (m)	3.52	7.95	55.47	168.02
CD (0.05)	7.16	16.18	112.86	341.83
CV (%)	3.50	7.03	18.22	14.37

Project: National Network Project on Arid Legumes: Evaluation of Cowpea IVT (South) lines, Rabi, 2011-12 (*PI: Manohara, K. K.*)

This trial comprising 12 cowpea lines for their evaluation under residual moisture conditions under rice fallows. The trial was laid out in Randomized Block Design with three replications. Entry DC-15 recorded highest grain yield of 2.68 t/ha followed by KBC-5 of 2.62 t/ha and the third highest was recorded by PTB-1 with a yield of 2.52 t/ha. Further, entry DC-15 (2.68 t/ha) and KBC-5 (2.62 t/ha) recorded significantly higher yield compared to better check variety KBC-2 (2.20 t/ha).

Field view of Cowpea trial, Rabi 2011-12

Table. Mean performance of the Cowpea entries in National Network on Arid Legumes, IVT (South), Rabi-2011

Entries	Days to maturity	Plant height (cm)	Pods per plant	Grain yield (kg/ha)
CPD-83	79.67	10.00	4.80	1786.67
KBC-5	81.00	11.67	7.27	2620.83
DC-15	80.00	12.11	7.85	2683.33
GC-810	77.67	12.67	8.98	2491.67
CPD-119	79.67	13.00	8.57	2129.17
GC-815	82.00	15.89	3.72	1483.33
GC-817	82.67	10.56	6.39	1391.67
PTB-1	80.67	15.44	6.52	2524.17
VS-15-3-1	62.00	6.89	3.35	1691.67
RC-101 (Check)	79.67	11.55	7.43	2032.50
KBC-2 (Check)	79.00	12.89	8.14	2204.00
GC-3 (Check)	64.00	8.67	5.13	1420.83
Mean	77.33	11.78	6.51	2038.32
SE (m)	2.82	1.65	0.68	172.99
CD (0.05)	5.84	3.42	1.42	358.75
CV (%)	4.46	17.12	12.87	10.39

Project : All India Co-ordinated Research Project on Vegetable Crops (*PI: M. Thangam*)

AICRP varietal trial in brinjal (Long) IET

Nine entries including one local check (Agassaim) were included in the trial. Other standard checks were Pb Sadabahar and BCB-11. The highest yield of 315.96t/ha was recorded in 10/BRLVAR-6 followed by check (Pb Sadabahar). With respect to other traits, earliest flowering was noticed in 10/BRLVAR-2 (37 days), more number of fruits per plant (19.95 in Pb Sadabahar) and highest yield per plant was recorded in 10/ BRLVAR-6 (1.32kg).

AICRP varietal trial in Chilli IET and AVT-I

In chilli, IET trial comprising of 6 entries along with three checks including one local check were evaluated for yield and yield contributing traits. The highest red ripe chilli per hectare was recorded in standard check KA-2 (12.03 t) followed by 10/ CHIVAR-6 (11.18 t). In case of AVT-I, out of 11 entries evaluated, the earliest flowering was noticed in KA-2 (34 days) followed by LCA-334 (36 days). The highest red ripe chilli recorded in KA-2 (10.87 t) followed by 09/CHIVR-8 (10.37 t).

AICRP bacterial wilt resistance trial in brinjal-IET

Six entries with two resistant and one susceptible check *viz.,* Arka Nidhi, SM-6-6 and Local Check respectively were evaluated for wilt incidence and yield traits. The wilt incidence ranged from 11.67 to 33.22 per cent under sick plot evaluation. The highest fruit yield of 21.07t/hectare was recorded in SM-6-6 with lowest wilt incidence (11.67%). In case of AVT-I trial, the wilt incidence ranged from 10.83 to 35.78 percent with a yield range of 13.67 to 20.81 t/hectare.

Project : All India Co-ordinated Research Project on Cashew (PI: A.R.Desai)

Germplasm collection, conservation, evaluation, characterization and cataloguing

A total of 76 local germplasm accessions of cashew are being maintained in the institute which are represented in the following broad groups. utilized in crop improvement programmes.

- Jumbo bold nut types : 14 accessions
- Bold nut types : 26 accessions
- Medium nut and high yielders : 12 accessions
- Remaining 21 : high yielders/ cluster bearers irrespective of nut size
- Dwarf canopy types : 3 accessions

Total germplasm collection : 76

Germplasm Registration

Applications in the prescribed formats were submitted to register three promising cashew accessions namely, Tiswadi-3 (G-CS-4-5), Ganje-2 (GCC-94/2)and KN-2/98 (G-CS-7-7) and one dwarf genotype,Gb-2 (G-CS-4-9), with NBPGR, New Delhi. Tiswadi-3 is a promising

Tiswadi-3 cashew selection

high yielding genotype bearing jumbo nut size (9.48g) with higher shelling percentage (28.82%). The orange coloured apples are bigger in size with 72.0% juice contents. The jumbo nuts yield export grade kernels of W180 – W210 counts.

Ganje-2 is another promising selection for higher nut yield (15-18kg/tree) with bold nuts and bigger yellow apples (96.5g). The nuts yield a kernel out-turn of 29.5 % of export grade W210 – W240 counts. KN-2/98 is the third promising selection for higher nut yield having bold nut features (8.2g) with 29.59% of kernel out turn of W210- W240 counts. Conical shaped red apples are bigger in size (105.0) with 71.14% juice contents. The latter two selections have bunch bearing habit. GB-2 was identified for its dwarf statured growth habit with intensive branching and higher nut yield. The nuts are of medium size having shelling of 29.83%. Yellow coloured apples are medium in size.

GB-2, a dwarf canopy type cashew genotype

Table. Salient characteristic features of the selected four cashew genotypes

Salient features	Tiswadi-3	GNJ-2	KN-2/98	GB-2
Tree Height (at 10th year)	5.8 m	8.8 m	4.5 m	5.5*
Branching Pattern	Extensive	Extensive	Extensive	Extensive
Growth habit	Semi spreading	Spreading	Upright & Compact	Upright & open
Season of flowering	Dec – Mid Feb.	Dec –Mid March.	Dec. – Feb.	Jan. March
Duration of flowering	70 – 80 days	80 – 105 days	75-95 days	80-90
Season of Harvest	Mid Feb. - April	Feb. - May	Mid Feb. – May	Mar.-May
No. nuts per panicle	1.16	4.6	3.6	3.53
Av Nut Weight.(g)	9.2 - 9.6	8.2	8.2	7.2
Number of Nuts / kg	105 – 110	130-140	120-125	140-150
Shelling (%)	28.82 - 29.55	29.5	29.59	29.83
Av. Kernel weight (g)	2.26 - 2.52	2.26- 2.38	2.68	1.44
Kernel grade Counts / lb	W 180 – W 210	W 210 – W 240	W 210 – W 240	W320-W240
Apple Colour	Yellowish orange	Yellow	Red	Yellow
Apple Shape	Cylindrical	Rounded	Conical	Pear shaped
Av. Weight of apple (g)	110 – 120	94.0	107.5g	61.53
Juice Contents (%)	68.2 – 72.0	69.17	71.14	68.5
TSS contents (^{O} B)	11.5	12.2	13.8 ^{O} B	12.5
Total nut yield at 10th year (kg/tree)	10.5	12.15	11.5	15.5*

*at >30 years of age

Bearing of Ganje-2 cashew selection with apples, nuts and kernels

Evaluation of new hybrids / varieties introduced from other research stations

The growth of all varieties was observed be satisfactory in the evaluation trial comprising of 7 cashew varieties viz. Vengurla-8, from RFRS, Vengurla; Dhana, Raghava, Priyanka from Cashew Research Station (Keral Agricultural University); Bhaskara from DCR, Puttur and Ullal-3 from Cashew Research Station, Ullal, Karnataka with Tiswadi-3 as check. In the current season also, the trees of all the varieties were severely affected by Tea mosquito bugs. During the year, Priyanka, Bhaskara, V-8 and Tiswadi-3 recorded nut yield of 0.85, 1.1, 0.98 and 0.98 kg/tree of nut yield as aginst the corresponding nut yield of 0.35, 0.95, 0.55 and 0.21 kg/tree in the previous year. Nut and apple size were observed to be stable over two seasons.

Project : All India Co-ordinated Research Project on Pigs (*PI: E. B. Chakurkar*)

As per the discussions in the AICRP meet at Guahati, 75 % crossbred pigs were produced by crossing the50percent crossbreed pigs with pure large white Yorkshire male. Seventy four piglets of this breed were produced and 16 were maintained for the experimental purpose. As management part, foggers are installed in pig unit to reduce the heat stress. For identification of animals microchips are procured. Boar Semen collection was standardized.

Performance of animals

Traits / Characters	M	F	Total
Litter size at birth (no.)			
Local	3.5	3.66	7.16
Large White Yorkshire	4.75	5	6.5
Goa Local x LWY	4.75	3.53	7.62
Litter size at weaning (no.)			
Local	2.5	2.83	5.33
Large White Yorkshire	2.87	3.75	6.62
Goa Local x LWY	3.30	3	6.30

Model of integrated farming is developed by incorporating tuber crops, vegetable and fruit crops, medicinal plants and biogas in the backyard of pig unit. Performance studies for economics of crossbreed pig production in farmers condition was evaluated. Stock of Goa Local, Large white Yorkshire, 50 % crossbred is maintained as per infrastructure availability.

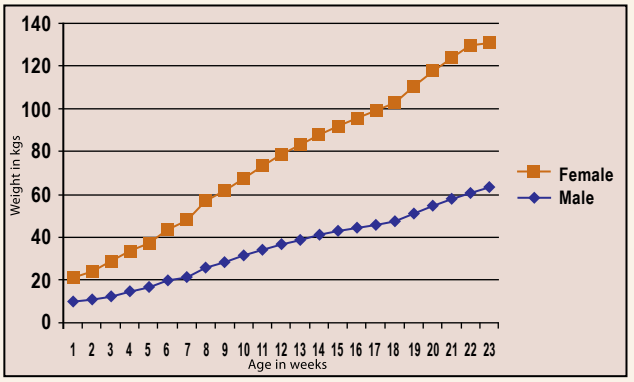


Fig. Growth rate of 75% crossbreed male and female pigs

Specific managemental practice

Electronic microchip identification system is procured and will be commissioned to overcome problem of physical loss of numbers and maintain records properly.

Measures taken to minimize mortality

1. Managemental measures: Foging/misting is fixed in the pig unit to reduce heat stress.
2. Prophylactic measures: Regular deworming, iron injections to piglets and is regularly followed to reduce the mortality.
3. Disposal of diseased carcass: Diseased carcasses were buried properly by taking all hygienic precautions.

Nutritional experimentation (Use of location specific economic ration along with detail feed composition of different category of feed)

An experiment was conducted to study the effect of inclusion of brewers' dried grains (BDG) in starter feed of 50% crossbred (Goa Local X Large White Yorkshire) pigs. Twelve 50% crossbred (Goa Local X Large White Yorkshire) piglets (avg. 23.23 kg body weight) were divided into three groups of four animals in each and fed randomly three isonitrogenous starter (creeper) feeds without BDG (BDG_0) and with the inclusion of 25% BDG (BDG_{25}) and 50% (BDG_{50}) for a period of 110 days. The DM intake as percent BW was similar among the groups and ranged from 4.92-5.88. There was no difference ($P>0.05$) in the total body weight gain (42.08-48.10 kg) and average daily gain (382.50-437.27 g) among the groups. However, the feed conversion efficiency in BDG_{50} group (6.77) was higher ($P<0.05$) than the BDG_0 (5.47) and BDG_{25} (5.72) groups, which were similar ($P>0.05$. It can be concluded that brewers' dried grains can be incorporated in the starter feeds of 50% crossbred pigs (Goa Local X Large White Yorkshire) up to 25% level without affecting the palatability, growth rate and feed conversion efficiency.

Adoption of integrated farming systems

Use of surrounding area near pig unit is utilised to develop integrated system of cultivation of tuber crop like tapioca, elephant foot yam, discordia, vegetables like snake- gourd, bitter- gourd, amaranths. Medicinal plants like aloevera, tulasi and mint were also planted. This was developed for demonstration to farmer to earn additional income using pig manure.


Vegetable and papaya production in backyard of pig unit



Tapioca produced in backyard of the pig unit

Survey on market of pork production

Farmers growing pigs generally do not slaughter but sell to commercial butchers who regularly slaughter and sale at their own outlet in different towns and cities. Local production of pork is limited due to restriction on scavenging, tourism and high labour cost. Pork also is being imported from neighbouring states but quality is unknown. Pork of local pigs or crossbreed having less fat is used for making sausages which is a popular pork product.

Pork market survey

Project : All India Co-ordinated Research Project on Integrated Farming Systems (*PI: N.P.Singh*)

As per the objectives, field survey was completed in all the 10 talukas of Goa to characteriz the existing farming systems covering 144 using a structured schedule developed by Project Directorate of Farming Systems Research (PDFSR) Modipuram.

The salient features of the survey results are as follows:

- Cashew, coconut, arecanut and rice are the predominant crops in the region.
- Among the agricultural enterprises, dairy is the predominant enterprise followed by poultry.
- One third of the farmers are educated up to high school level.
- The average land holdings (in per cent) in Sanguem taluka are highest among all talukas of Goa.
- The total gross returns and cost of production of crops and different allied enterprises are highest in Ponda taluka.
- The total net returns from crops and different allied enterprises are highest in Canacona taluka.
- Average benefit cost ratio from crops as well as from enterprises in case of farmers from Tiswadi taluka is more as compared to other talukas.

Based on the survey results and the agro-climatic conditions of the region, the land topography, crops and cropping systems and the socioeconomic feasibility, two Integrated farming system models one each for upland (plantation crop based) and lowland (rice based) are being developed with the feasible cropping systems and their integration with allied agri-enterprises.

Model 1. Upland (Plantation crops based) integrated farming system model

The upland model is being developed with the predominance of plantation crops suitable to the region viz., cashew on the hill slopes, coconut in the middle elevation and arecanut in lowlying areas. The feasible intercrops under each of the plantation crops and their integration with poultry, piggery, and vermi composting are being evaluated.

A panoramic view of the upland IFS model being developed

Cashew + Pineapple (in contour trenches)- The ideal land use for slopping uplands with shallow gravelly soils

Intercropping of elephant foot yam (variety Gajendra) in coconut- an introduction

All the crops have been managed with recommended package of practices. The observations are being recorded on all the growth and yield parameters. Cashew (variety Bhaskara) + Pine apple (Variety Giant Kew) system in the upper elevation yielded a productivity of over 650 kg/ha cashew nuts with a mean nut yield of 3.2 kg/tree. The apple yield of the cashew crop was 8.3 t/ha with a mean apple weight of 49 kg/tree. The intercropped pine apples have started yielding. The middle terrain of the plot measuring about 0.12 ha is planted with local coconut cultivar Benaulim selections and inter cropped with elephant foot yam (variety Gajendra). Further the feasibility of growing papaya (variety Surya) in the line of coconut are being evaluated. The high yielding arecanut variety Mangala interspersed with inter crop of tissue cultured banana (Grand Naine) has yielded 3.6 t/ha of banana fruits with a mean bunch weight of 12 kg/tree.

The upland IFS unit generated a recyclable resource of 317 kg including weeds, bund grass and banana waste in 0.5 ha during rainy season in about three months period. The resource was effectively recycled by utilizing 200 kg of cowdung through a vermi-compost unit of size 35 m^2 resulting in 400 kg good quality vermicompost. Two integrated structures one each for poultry and piggery which were constructed through CPWD and have been made functional. The integration of poultry (Gramapriya) in the system was initiated using cashew apple waste as a feed ingredient for poultry. The results indicated a mean egg production of 12 eggs/day with a batch of 25 layers. The mean body weight increase in the cross bred (Local x large white yorkshire) integrated piggery was 496 g/piglet/day over the initial weight.

The soil fertility status of the experimental plots

Mixed croping of papaya (variety Surya) in coconut (Benaulim selections) in the upland IFS model

Arecanut + banana – A viable crop combination prevalent in the local Kulagars being evaluated

Integrated piggery (Local x large White Yorkshire) in the upland IFS Unit

Integrated poultry unit through the recycling of cashew apple waste in the poultry diet

is being monitored at regular intervals. The impact of addition of recycled manures and the use of crop residues as mulch on soil fertility parameters and the water availability is being assessed.

The fertility status of the soil was monitored through collection of representative sample from all the three subsystems viz. cashew based system, coconut based system and arecanut based system after one year of experimentation and was compared with the initial status. It was observed that there was an increase in both the average bulk density of the soil (from 1.06 g/cc to 1.20g/cc) and the particle density of the soil (from 2.30 to 2.76 g/cc) over the entire plot. During the period, the porosity of the soil has also increased from 54 to 55.9%. The average pH of the soil was improved from 5.41 to 5.66 over one year period. The average organic carbon content of the soil decreased from 2.06 to 1.72 and further, the available nitrogen content of the soil also decreased from 327.6 to 228 kg/ha. However, the phosphorus content of the soil has increased from 11.53 kg/ha. to 31.94 kg/ha. The potassium content of the soil however decreased from 317.3 to 284.6 kg/ha over a period of one year on the overall plot basis.

The organic carbon content of the soil was fairly higher (2.48%) in cashew + pine apple system, while it was relatively lower (1.13%) in arecanut + banana system over a period of one year. The available nitrogen content of the soil followed a similar trend as that of organic carbon with cashew system plot recording higher level available nitrogen (292 kg/ha) while the arecanut system plot recording lower status (168 kg/ ha). However, the available phosphorous content of the arecanut system was relatively higher (39.94 kg/ha) over cashew (31.79 kg/ha) followed by coconut (24.46 kg/ha). The potassium content of the soil was however decreased drastically in arecanut system (from 412 kg/ha to 280.0 kg/ha) as compared to other two systems over a period of one year indicating the necessity for additional application.

Model II. Rice based IFS model for lowlands of the region

The lowland IFS model is being developed with selection of profitable rice based crops and integration with dairy and fisheries. During *kharif,* rice (variety Naveen) was grown in the entire experimental area (4000 sq.m) and during *rabi,* four rice based intercrops viz., cowpea (local selection) and groundnut (TG 37A), brinjal (Local cultivar Agassaim) and sweet corn (Hybrid Sugar

A bumper crop of rice (variety- Naveen) during kharif, 2011 under rice based farming systems

A field view of the different rice based crops during rabi/ summer season

Hybrid Sweetcorn- A demand driven early remunerative cash crop

75) were taken up.

Rice-brinjal and rice-sweet corn under protective irrigation and rice-groundnut and rice-cowpea under residual moisture situations were compared for the system productivity. It was observed that rice-sweet corn system gave the highest system productivity (22.7 t/ha rice grain equivalent yield) followed by rice-brinjal system (20.8 t/ha rice grain equivalent yield) under protective irrigation which were significantly more productive as compared to rice-cowpea (10.16 t/ ha rice grain equivalent yield) and rice-groundnut systems (9.56 t/ha rice grain equivalent yield) under residual soil moisture conditions.

High yielding forage grass, hybrid napier, IGFRI-3 was grown on the field bunds to provide feed for the integrated dairy unit. The area available for planting of forage grass was 162 m^2 from an experimental field of 4000 m^2. The grass was established with staggered planting under protective irrigation which resulted in the mean yield of 725 kg/ harvest. On an average five harvests are possible which will provide green grass supply to the integrated dairy unit throughout the year.

The soil fertility status of lowland IFS system was monitored for changes in soil fertility over a period of one year in different rice based cropping systems *viz*., rice- cowpea, rice –groundnut, rice-brinjal and rice-sweet corn. It was observed that there was a decrease in the average bulk density of the soil (from 1.39 g/cc to 1.29 g/cc) whereas the particle density of the soil increased from 2.34 to 2.55 g/cc over the entire plot. The porosity of the soil was also found to increase from 40.8 to 49.28 per cent. The average pH of the soil showed a decreasing trend from 6.01 to 5.75 over a period of one year. The mean organic carbon content of the soil showed an increasing trend and the available nitrogen content of the soil increased from 154.9 to 211.5 kg/ha. The phosphorus and potassium

Rice- groundnut (under residual soil moisture), a suitable system for sustainance of soil fertility

Brinjal (Local cultivar Agassaim) with high yield potential

content of the soil was also found to increase from 21.1 kg/ha to 36.12 kg/ha and from 188 to 232.11 kg/ha, respectively.

Among the various systems analysed for soil fertility status, rice- cowpea system recorded significantly lower bulk density (1.25 g/cc) as compared to other cropping systems which was followed by rice-sweetcorn system (1.26 g/cc). The available nitrogen content of the soil also significantly differed among the cropping systems evaluated especially with rice-sweetcorn system (307 kg/ha). Further the available potassium content of soil in rice-cowpea system was found to be higher (233 kg/ha) and significantly differing from the rest of the cropping systems except rice-groundnut system (226 kg/ha). Rest of the soil parameters viz., particle density, porosity, pH, EC, organic carbon and available phosphorus did not differ significantly among the cropping systems

Rice- cowpea (local selection) with potential for higher yields

Project : Upscaling of Homestead Farming in the Different Farming Systems of Goa (*PI: B.L.Manjunath*)

During the year, a new Project funded by NABARD, with a total outlay of Rs.10.63 lakhs was initiated to upscale the existing farming systems. A survey was conducted to characterize the existing homestead situations of Goa and based on the critical gaps, different interventions were identified.

- The farmers were selected representing the different holding categories in the approved four talukas of Goa (representing both North and South Goa districts). A total of twenty farmers were selected for implementation of the Project.
- Existing situations of homestead gardens of Goa was characterised through field survey using a structured schedule.
- Detailed studies were made on the existing homestead situations and on the technologies that can be intervened.
- Gaps in the existing production technology were identified for each of the farmers based on the prevailing situation and the need of farm family.
- Suitable interventions were identified to meet the identified production gaps.
- A training programme on different aspects of homestead farming was organised to create awareness among the beneficiaries.
- High yielding varieties of seeds/planting material in different crops were procured from the reliable sources and the technology implemented in the farmers field.

Introduced high yielding chilli variety on demonstration in homestead gardening

- The relevant growth and yield observation are being recorded periodically and the technologies intervened are being assessed in farmers field.
- Some of the common technological interventions include vegetable cultivation, fruit crop cultivation like mango, banana, papaya, chickoo, guava, etc.
- Integration of poultry components with the systems is in progress

High yielding local brinjal at farmers field.

Project: Improving Livelihood Status of Tribal Communities of the Goa through Development and Demonstration of Water Harvesting Tanks (Jalkunds) (*PI: Ram Ratan Verma*)

Tribes in Goa are an integral part of their cultural heritage. The chief tribes in Goa include Gowdas, Kunbis, Velips and Dhangars. Development of these groups could be achieved by providing them with livelihood opportunities. The soils of the regions are lateritic and acidic in nature, poor in soil fertility status and water holding capacity with varying slope upto 42 per cent. Currently lands are used for cultivation of plantation crops, vegetable and field crops. The region experiences high rainfall during the rainy season but face the severe drought during the rest of the period. In the situation water harvesting during the rainy season and its judicious use in off season for crop production can play an important role for improving the livelihood of tribal people of the region through enhancing the crop production and productivity. Keeping these points in view, a project was started in Gaondogrim village of Cancona taluka in South Goa district. Majority of the in habitants of the selected village were tribal people. The project started with the objective to develop and demonstrate water harvesting tanks (Jalkunds) in the area of tribal communities. Under the project, six tribal beneficiaries were selected and on their field rain water harvesting tanks (jalkund) with a dimension of 6 meter length, 3 meter width and 1.5 meter depth were constructed. Constructed Jalkunds were

A view of the different stages in construction of water harvesting ponds

plastered provided cushning with locally available paddy straw and lined with 250 GSM silpaulin polifilm. Farmers participation have been ensured so that they are able to learn how to develop a new rain water harvesting Jalkund. The developed Jalkund will have the capacity of harvesting rain water to about 2700 litres which can be utilized for the cultivation of vegetable crops. The monetory benefit of the farmers can be enhanced by taking rabi crop using harvested rain water from the rainy season. Simultaneously ecology of the region can be enriched by the judicious use of the harvested rain water and the soil erosion can be also reduced to some extent.

Project : Eco-friendly Plates and Cups from Areca Leaf Sheath Wastes of Goa (*PI : V Arunachalam*)

Three machines each with two units of areca leaf plate/cup making were purchased. Self help groups are being identified for distribution in areca growing locations.

Leaf plate / cup making machines

Plates / cups designed

Project : Distribution of Vegetable, Flower and Spice Seeds to Tribal Farmers of South Goa (*PI: V Arunachalam*)

Seeds of Green Long variety of cucumber, Pusa summer prolific long variety of bottle gourd were distributed to the tribal farmers of Canacona. Seeds of Methi , Palak, Cluster bean, Onion was given to the farmers: Keshav Mhalyo Velip, Chandrakant Bhiso Velip, Datta Mhalyo Velip of the village Kindalkatta Gaoundongri. Seeds of Alsando, Methi and Raddish were given to the farmer Sudhakar Shanu Gaonkar of the village Ziltawadi Gaoundongiri. Seeds of Raddish, Palak were given to the farmer Vasant Ganesh Gaonkar of the village Shristal Gaoundongiri.Seeds of Palak and Methi were given to the farmer Arjun Govind Velip of the village Badsare Gaoundongiri.

Seeds of Pusa Narangi Gainda, ICAR Goa Yellow Elavarasi (Te-03) marigold varieties were given to the following farmers: Ratan Anand Velip of the Village Mahawada Paingin, Canacona: Karina Keshav Velip, Divyu Dutta Velip, Keshav Mhalyo Velip, Bindiya Bankelo Velip, Suchiner Sandeep Velip, Suchetra Chandrankant Velip , Suvidha Satish Velip and Shabu Narayan Velip of the village Kindalkatta Gaoundongiri.

Project : Naturally Ventilated Greenhouse for Seedling Production and Crop Cultivation for Providing Livelihood Opportunities for Tribal of Goa (*PI: M.J.Gupta*)

One naturally ventilated greenhouse being built on a women tribal farmer's field. The SHG in that village will be trained in vegetable and flower cultivation under protected cultivation using this structure.

Project: Agricultural Mechanization Program for Small and Marginal Tribal farmers of Goa (*PI: M.J.Gupta*)

Eight sets of following equipment suitable for small farmers have been acquired for distribution to tribal farmers' groups in southern Goa. Impact assessment will be done after this.

a) Power tiller with accessories
b) Weed cutter
c) Mini rotary tiller
d) Power reaper

Total cost of each set ₹ 21,23,885/-

Project: Improving the Livelihood Security of the Tribal People of Goa through Dissemination of Animal Nutrition Technologies (*PI: P. K. Naik*)

Under the Central Government sponsored scheme known as 'Tribal Sub-Plan (TSP)', the project 'Improving the Livelihood Security of the Tribal People of Goa through Dissemination of Animal Nutrition Technologies' was implemented to ensure direct benefits to individuals or families belonging to the Scheduled Castes or Scheduled Tribes. A group of farmers was selected as the beneficiaries. The following interventions have been initiated to improve their livelihood security.

Fodder cultivation

Shri Rajesh Yesso Gaude, Priol, Ponda, Goa runs a dairy farm with about 20 dairy cows. But, he was not able to produce green fodder due to one or other reason. He was supplied with planting

Farmer taking the fodder planting material from the Institute

Established fodder plot in farmer's field

material of improved perennial fodder variety like CO-3 and CO-4 to cultivate and produce sufficient fodders. Now, he is able to produce sufficient green fodder by cultivating the planting materials in three acres of land.

Development of infrastructure for complete feed block preparation

Goa is not only shortage of concentrates and green roughages, but also dry roughages. There is no sufficient space for storing of paddy straw and karad grass available with the farmers and therefore gets destroyed in the field. Jowar straw is imported from the neighbor states. Therefore, basic infra structures facilities like one feed block making machine, one chaff cutter, one feeds and fodder mixer and limited renovation materials have been provided to the tribal farmers, so that the volume of the dry roughage material can be compressed and will be easily stored for in small space for long time

Development of infrastructure for preparation of feed block at farmer's field

to feed their animals. Further, complete feed block can be prepared by mixing calculated concentrate and dry roughage and compressing through the above machine. Through this, the farmers can also start a new private enterprise.

Project : Economic upliftment of tribal community by introduction of improved livestock and poultry germplasm in the tribal area of Goa (*PI: E.B.Chakurkar*)

Rural poultry farming was promoted in the village Amona under the Taluk Bicholim in Goa to ensure direct benefit to individual farmers or farmer family belonging to scheduled caste. A group of famers was selected as the beneficiaries.

A training programme was conducted on "Backyard Poultry Farming" by Dr. B. K. Swain, Senior Scientist (Poultry Science) which included demonstration of different management practices, feeding in the backyard system of management, disease control etc. Six number of shelters (6ftX5ft) with asbestos roof were built in the Amona village in the backyard of all the six beneficiaries for use as night shelters for the laying hens. The birds were kept inside the night shelter during night time with provision of light which was provided through fitting of electric bulb. The night shelter was provided for the comfort of birds in addition to prevent theft and attack from predators. Twenty No. of Gramapriya birds, 20 weeks old (17 hens and 3 cocks) were distributed to each farmer along with layer mash for a period of 1 month. Feed was supplied in order to supply adequate nutrition to the birds during the initial period because acclimatization of birds to the new situation takes time. The farmers were instructed to leave the birds outside in their backyard after 15 days. After 15 days farmers left their birds outside for 2-3 hours daily which was beneficial in terms of good exercise and collection of feed in the form of fallen grains, green grasses and insects from the backyard. Each farmer got about 6-8 eggs on an average daily in the initial period which added to their income. The beneficiary farmers were provided with deworming medicine and antibiotics for prevention of diseases like coccidiosis and diarrhoea.. After undertaking this programme under the TSP fund of ICAR, farmers were benefitted through getting additional income from selling of eggs and providing supplementary nutrition to the family members since egg is a good protein source with high biological values. Because of very good egg size with attractive colour it fetched good price in the market. In this way there was economic upliftment of the farmer through more income generation.

ICAR RC Goa

Annual Report 2011-12

Institutional Activities

- Transfer of Technology
- Education and Training
- Awards and Recognition
- Ongoing Projects
- Human Resource Development
- Publications
- Workshops, Seminars and other Events
- Committees and Meetings
- Infrastructure Development
- Visitors
- Personnel

Transfer of Technology

Demonstration of rice varieties

Demonstration plots were laid out at the Institute farm, B-Block, comprising 15 rice varieties in three groups representing medium duration, aromatic and salt tolerant rice varieties. Jaya, Karjat-3, Naveen and Akshayadhan representing high yielding medium duration rice varieties; Pusa Basmati-1, Pusa Sugandh-5 and PB-1121 representing scented rice group and Korgut, CST 7-1, CSR-27, CSR-36, Amalmana, CSR-23, Bhutnath, Sumati under salt tolerant rice group.

Demonstration plot of rice at Institute field

Front Line Demonstrations in rice

The performance of high yielding variety of rice-Naveen against ruling variety Jaya/ Jyoti in was demonstrated in farmer's fields during kharif, 2011 in Pilerne village of Bardez taluka in Goa. A total of 10 farmers with different holding size were selected for demonstration of the rice variety.

Demonstration of rice variety Naveen at farmers field

Periodical field visits were made and on the spot assessment was made by discussion with farmers. The yield of both the high yielding variety and the local check was assessed through crop cuttings and the results showed a superiority of 50 per cent increased yield in rice variety Naveen against the check varieties.

Popularization of Groundnut var. TG-37A

Total 19 demonstrations were conducted at farmer field of Dhargal and Agassaim villages covering an area of 5.50 ha. An average of 23.9 q/ha was observed in the demonstrated variety.

Demonstration of groundnut variety TG-37 A at farmers field

Scientific cultivation of Groundnut cv. TG-37-A and quality seed production

The improved variety TG-37A was demonstrated in an area of 2.00 ha at 8 farmers fields of Goa Velha, Pilar and Bhironda village. It was observed that yield increased by 22.81 % with B:C ratio of 2.90 in against 2.77 of check.

Performance of TG37 A groundnut variety

Popularization of Groundnut cv. "Asha"

The Groundnut variety Asha was demonstrated in an area of 1.3 ha at 17 farmers fields of Bhironda and Shigao village. It was observed that yield increased by 47.8% with B:C ratio of 3.93 in against 2.43 of check.

Demonstration of groundnut variety Asha

ICM in Cowpea cv Alsando-1

The Cowpea variety Alsando-1 was demonstrated in an area of 5.5 ha at 28 farmers fields of Amona, Goa Velha, Chodan and pillar village. It was observed that yield increased by 26 % with B:C ratio of 3.75 in against 3.65 of check.

Performance of cowpea variety Alsando -1

Popularization of Black Gram cv. DU-1

The Black Gram variety DU-1 was demonstrated in an area of 4.5 ha at 9 farmers fields of Amona, Goa Velha, Dhargal and Bhironda village. It was observed that yield increased by 39.97% with B:C ratio of 4.16 in against 3.02 of check.

Perfromance of Black Gram cv. DU-1

Popularization of Rice "Naveen"

The Rice variety Naveen was demonstrated in an area of 5.5 ha at 35 farmers fields of Amona, Goa Velha, Taleigao, Pillar, Chodan and Bhironda village. It was observed that yield increased by 30.26 % with B:C ratio of 3.15 in against 3.05 of check.

Field day on rice variety Naveen

Popularization of Rice "Akshaydhan"

The Rice variety Akshaydhan was demonstrated in an area of 2.5 ha at 13 farmers fields of Bastora village. It was observed that yield increased by 43.45% with B:C ratio of 3.24 in against 2.84 of check.

Demonstration of rice variety Akshaydhan

Front line demonstration on cashew production

Five Front line demonstration plots are established in Kakoda, Raia, Shiroda, Khandola and Calangute under the development programme supported by Directorate of Cashew and Cocoa Development (DCCD), Kochi, Kerala. Multiple high yielding varieties namely, Goa-1, Vengural-4 and Bhaskara were planted in each plot of one hectare area and the plots are progressing in second year of growth. Two new plots were also identified Vadaval, Bicholim and Batim (Tiswadi) for taking up FLDs in the ensuing season.

A view of FLD of cashew in farmers field

Demonstration trial on foliar application of nutrients to cashew

Demonstration trials on foliar application of water soluble grade fertilizer were taken up in farmers' fields jointly with Zuari Industries Ltd. Goa, three farmers' fields each in South Goa and North Goa districts, besides an observational trial in the Institute's farm. Preliminary results indicated significant improvement in Vengurla - 4, Goa-1, KN-2/98 varieties. No. nuts per panicle (6.77), No. of leaves per current twig (12.33) were high as against the corresponding values of 4.3 and 7.64 in water sprayed control, with three major flushes of flowering. The trees performed better despite weather fluctuations.

Improvement of nut set by foliar application of nutrients in Vengurla-4 variety

Integrated crop management in Onion

The Onion variety Pusa Madhavi was demonstrated in an area of 0.25 ha at 5 farmers fields of Amona, Pillar and Goa Velha village. It was observed that yield increased by 26 %.

Demonstration of onion variety Pusa Madhavi

Management of Root Rot in Chilli

The management on root rot in chilli was demonstrated in an area of 1.0 ha at 15 farmers fields of Dhulapi village. It was observed that the disease incidence was 1.79 % in against 8.54 % in check with yield increase of 82.4 % and B:C ratio of 4.52 in against 2.41 of check.

Demonstration of root rot management in chilli

Assessment of Neem based pesticides on infestation of aphids in radish

A total of ten trials covering an area of 1.50 ha in Dhulapi village were conducted during rabi 2011-12 to assess the effect of neem based pesticides on infestation of aphids on radish. It was observed that the infestation was reduced to half yield increase of 30 % with B:C ratio of 3.82 in against 2.02 of check.

Aphid infestation in radish

Assessment of Marigold varieties under agro climatic condition of Goa

An area of 0.25 ha was covered to assess the performance of Marigold Var. Pusa Narangi and Pusa Basanti at 5 farmers in Pilar, Goa Velha and Amona villages during rabi 2010-11. As variety was sensitive to rain it performance was not up to the mark, therefore some new varieties will be tested accordingly under OFT on Marigold for the year 2012-13.

View of performance of marigold varieties

Egg production performance of Gramapriya

Gramapriya a backyard poultry for egg production was evaluated and performance was studied both in Institute farm and farmers field and was found as a viable backyard poultry for egg under farmer's condition which improved the economic condition of the farmer.

Performance of Gramapriya

- Body weight after 10 weeks-1.2 Kg
- Feeding –locally available cereals, vegetable and kitchen waste
- Egg production up to 72 weeks-180-200 eggs
- Colour of egg-Brown
- Average egg weight-54-56gram
- Net income-Rs450-500/bird

Gramapriya layers in the night shelter of farmers field

Field Trial on Supplementation of indigenously prepared Bypass Fat

Indigenous technology was developed for the preparation of bypass fat in large scale. Field trial was conducted on the crossbred dairy animals of Shri Ladoo Paresakar, Mandre, Pernem. Milk yield increased by 1-2 lits/ animal/ day on daily supplementation of 300 g indigenously prepared bypass fat/ animal.

Infertility Camp

Infertility camp was conducted in association with Goa State V&AHS at Concolim on 15 February, 2012. 120 cross bred cows were examined for infertility problems. 15 cows were repeat breeders, 3 cows had endometritis, 3 cows suffered with cystic ovarian degeneration problem. Blood samples and vaginal swabs were also collected bacteriological examination. Guidelines to handle infertile cases were given. Cystic ovarian cases were advised to use luteinizing hormone followed by prostaglandins on 7th to 10th day. Farmers were also advised on improvement on the feeding practices to replace

EDUCATION AND TRAINING

Education

- Evaluated Theses of Ph.D student in discipline of Agronomy at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during January 2012. ***(N.P. Singh)***
- Acted as external examiner for evaluation of two Ph.D thesis on cocoa in the discipline of Spices & Plantation Crops, Horticultural College and Research Institute, TNAU, Coimbatore (***V. Arunachalam***)
- Acted as External Examiner for conducting the final oral examination of Ph.D student on 10 June, .2011 in the Department of Horticulture, UAS, Dharwad ***(A. R. Desai)***
- Acted as External Examiner for conducting Qualifying Examination of M.Sc. Student on 30th June.2011 of Horticulture Department, UAS Bangalore ***(A. R. Desai)***
- Acted as major guide to B.Tech. (Hons.)-Biotechnology student, Miss. Anjali Sharma of Department of Biotechnology, Lovely Professional University, during 2011-2012 on "Genetic Diversity and phylogenetic relationship Studies in Heliconia and related genus Using RAPD Marker" (***M. Thangam***)
- Acted as major guide to B.tech (Bioinformatics) student Mr. K. Karthik of the Department of Molecular Biotechnology, TNAU, Coimbatore during 2011 on "Computational genomics of evoluation and reconstruction of anthomynia pathway in *Solanaceae*" (***V. Arunachalam***)

Lectures delivered by the Scientist

Date	Lecture Topic/Programme	Participants	Venue
S Subramanian			
26.3.2012	Use of PFZ forecast for effective marine fishing	Boat owners and fishermen	ICAR RC, Goa
30.03.2012	Ornamental fish rearing, breeding, nursery raising of seeds and feed formulation	Students	Carmel College, Nuvem Goa
V. Arunachalam			
04.04.2011	Post harvest handling, storage of field and horticultural crops	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
15.04.2011	Scope of cut flower and loose flower production under open field condition- A profitable venture during	Trainees	ICAR RC, Goa
19.09.2011	Abiotic stress management of horticultural crops	Trainees	KVK, ICAR Goa
B. L. Manjuanth			
16.08.2011	Rice varieties suitable for Goa and hybrid rice cultivation	Progressive farmers	FTC, Old Goa
16.09.2011	Rice varieties suitable for Goa and rice based cropping systems	Progressive farmers	FTC, Old Goa
16.11.2011	Rice varieties suitable for Goa and rice based cropping systems	Progressive farmers	FTC, Old Goa
24.11.2011	Nutrient management in Plantation crops	Agriculture Officers of Assam	KVK, ICAR Goa

03.03.2012	Scope for Homestead farming in Goa	Progressive farmers	ICAR RC Goa
26.03.2012	Seed production in groundnut and pulses	Progressive farmers	KVK,ICAR Goa
B. K. Swain			
07.05.2011	Backyard Poultry Farming	Trainees	KVK,ICAR Goa
19.09.2011	Rural Poultry: Subsidiary Enterprise for Farmers	Trainees and Progressive farmers	KVK,ICAR Goa
09-03.2012	Backyard poultry for profitable homesteads	Trainees	KVK,ICAR Goa
P. K. Naik			
04.05.2011	Feeding and Management of Dairy Animals	Trainees	KVK,ICAR Goa
04.02.2012	Hydroponics Technology for Sustainable Milk Production in Goa	Progressive farmers	Goa Dairy, Curti, Ponda, Goa
A. R. Desai			
20.10.2011	Improved production technology for pineapple	Trainees at workshop on konkan conclave	Donapaula Goa
23.11. 2011	Scientific cultivation of cashew	Trainees and progressive farmers	KVK,ICAR Goa
26.11.2011	Improved production technology for oilpalm	Trainees and progressive farmers	KVK,ICAR Goa
M. Thangam			
15.04.2011	Scope of cut flower production under protected structures-A review	Trainees and progressive farmers	ICARRC, Goa
05.05.2011	Protected cultivation of flower and vegetable Crops	Trainees	KVK,ICAR Goa
19.09.2011	Protected cultivation of flower crops for higher remuneration	Trainees	KVK,ICAR Goa
08.11.2011	Role of tuber crops in achieving food security	Trainees	ICAR, Goa
23.11.2011	Flower crops as intercrops in plantation crops	Trainees	KVK,ICAR Goa
S. Priyadevi			
21.09.2011	Flower culture	Trainees at Workshop on Kitchen gardening	ICAR Goa

Trainings

Training programmes organized by the Institute

Sl No	Name of the Training	Venue	Period
1.	Backyard poultry farming for income generation	ICAR RC, Goa	February 25, 2012
2.	Homestead Farming	ICAR RC, Goa	March 7, 2012
3.	Seed and Planting Material Production	KVK, ICAR Goa	March 26 – 28, 2012

Awards and Recognition

Dr. Narendra Pratap Singh

- Confered with Fellow of Society of Extension Education, Agra during 6th National Extension Education Congress held at Goa during 17 - 19 December, 2011.

Dr. V. Arunachalam

- Selected as Associate Editor (Agriculture), Open acess Books, Versita Publishing, Warsaw, Poland.

Dr. S. B. Barbuddhe

- Deputed to Germany during 13-25 February, 2012 to visit Institute of Medical Microbiology, Justus-Liebig University, Giessen to discuss the work carried out under the Indo-German project and to discuss the research activities under ICMR sponsored Indo-German project sanctioned jointly to the German Laboratory and MAFSU, Nagpur.
- Nominated as Member of Board of Studies in Zoology, Goa University.

Dr P. K. Naik

- Awarded Dr. K. Pradhan Young Scientist Award in the field of Animal Nutrition and Feed Technology for research work on 'A Study on the Preparation and Feeding of By-pass Fat to High Yielding Dairy Animals' in the 14th Biennial Conference of the Animal Nutrition Society of India at GBPUA&T, Pantnagar during November 3-5, 2011.

Dr. R. Ramesh

- Selected for DBT- CREST award (Cutting Edge Research Enhancement and Scientific Training Awards) 2010-11. Currently under deputation since 08-10-2011 at Department of Plant Pathology, University of Georgia, Athens, United States.

Ongoing Research Projects

Institute Projects

Sr. No.	Project Title	PI	Co - PI	Duration
	Resource Management and Integrated Production			
1.	Development and evaluation of soil and water conservation measures for sustainable production of major horticultural crops in Goa.	RR Verma	BL Manjunath	2008-13
2.	Rehabilitation of mine reject soils	RR Verma	V Arunachalam	2011 -14
3.	Standardization of management practices for organic rice production	BL.Manjunath	RR Verma R Ramesh	2009 -14
	Crop Improvement and Protection			
4.	Breeding high yielding salt tolerant rice varieties for coastal saline soils	KK Manohara	RR Verma	2010-15
5.	Collection, evaluation and characterization of rice germplasm of Western region	KK Manohara		2010-14
6.	Genetic enhancement of cowpea for yield and seed quality parameters	KK Manohara		2010-14
7.	Plant disease management by bacterial, fungal agents and other non- conventional methods under coastal ecosystem	R.Ramesh		2011 –14
	Horticulture			
8.	Horticultural plant genetic resources of Goa	V Arunachalam	M Thangam	2011-14
9.	Coconut / Arecanut based cropping system for Goa region	V Arunachalam	S Priya Devi	2011-16
10.	Integrated strategies through classical and modern techniques for crop improvement in cashew and spices.	AR Desai		2009-14
11.	Management of mango germplasm with special emphasis on collection and evaluation of variability in Mankurad and Hilario mango varieties for selection of elite clones	AR Desai	S. Priya Devi	2011-16
12.	Survey, collection, introduction and evaluation of kokum and other *Garcinia* species	S Priya Devi	M Thangam	2005 -14
13.	Evaluation of commercial cultivars of fruit crops under the agro- climatic conditions of Goa	S Priya Devi		2006 -14

14.	Breeding of brinjal for high yield and resistance to bacterial wilt through conventional and molecular approaches	M. Thangam	R Ramesh	2009-14
15.	Standardization of production technologies for flowers and vegetables under protected structures (Polyhouses) and under coconut plantations.	M. Thangam		2007-13
16.	Estimating post harvest crop losses for Goa	Mathala Gupta		2011-14
17.	Design of protected cultivation structures for year round utilization in western region	Mathala Gupta	M. Thangam	2011-14
	Animal Sciences			
18.	Impact of microclimatological changes on livestock production and ameliorative measures through managemental intervention	SK Das		2010-13
19.	Effect of dairy housing on microenvironment and productive performance of cows	SK Das	M Karunakaran SB Barbuddhe	2010-13
20.	Assessment of early sexual maturity in Goa local male pigs through spermiogram and in vivo pregnancy	EB Chakurkar	M Karunakaran	2011-14
21.	Evaluation and preservation of boar semen	M Karunakaran	EB Chakurkar	2011-14
22.	Survey on the feeds and feeding practices of the livestock in Goa	PK Naik	BK Swain M Karunakaran	2009 – 13
23.	Nutritional interventions for optimization of economical milk production in Goa	PK Naik	EB Chakurkar SK Das	2010 – 14
24.	Prevalance and persistence of pathogens of public health significance from culture and capture fisheries environment	SB Barbuddhe	S Subramanian	2010 -13
25.	Studies on prevalence of Clostridia in bovines, farm environment and foods	SB Barbuddhe		2010 -14
26.	Effect of supplementation of feed additives on the performance and economics of production of broilers, layers and backyard poultry	BK Swain	PK Naik	2009 -13
27.	Utilization of palm oil and other unconventional feed resources for efficient poultry production	BK Swain		2009 -13
	Fishery Science			
28.	Digitalized database of aquatic and fisheries resources for Goa	S Subramanian		2008 – 12
	Agro –Eco- Tourism			
29.	Agro-eco tourism : Impact and popularization	SB Barbuddhe	M Thangam	2010-12

Externaly Funded Projects

Sr. No	Project Title	PI	Co-PI (s)
	DBT		
1.	Indo German consortium for epidemiology and collaborative genomics of *listeria*	SB Barbuddhe	EB Chakurkar BK Swain
	INCOIS		
2.	Validation of potential fishing zone advisories along Goa coast with an attempt to study the possible advantages of PFZ advisories for different types of fishing activities.	S Subramanian	
	ICAR		
3.	Seed production in agricultural crops and fisheries	BL Manjunath	S Subramanian KK.Manohara
4.	*Phytopthera*, *Fusarium* and *Ralstonia* diseases of horticultural and field crops	R Ramesh	M. Thangam
5.	Preparation of GPS and GIS based model soil fertility maps for the state of Goa	RR Verma	
6.	Stress tolerant rice for Africa and South Asia	NP Singh	KK Manohara
7.	All India co-ordinated rice improvement project	KK Manohara	
8	National network project on arid legumes	KK Manohara	
9.	All India co-ordinated project on cashew	AR Desai	
10.	All India co-ordinated project on vegetables	M. Thangam	
11.	All India co-ordinated research project on integrated farming system	NP Singh	S Subramanian SK Das EB Chakurker BL Manjunath BK Swain AR Desai S Priyadevi RR Verma
12.	All India co-ordinated project on pigs	EB Chakurkar	PK.Naik

	NABARD		
13	Upscaling of homestead farming in the different farming systems of Goa	BL Manjunath	
	Tribal Sub Plan Programmes		
14.	Improving livelihood status of tribal communities of the Goa through development and demonstration of water harvesting tanks (Jalkunds)	RR Verma	
15.	Naturally ventilated greenhouse for seedling production and crop cultivation for providing livelihood opportunities for Tribal of Goa	MJ Gupta	
16.	Agricultural mechanization program for small and marginal tribal farmers of Goa	MJ Gupta	
17.	Eco-friendly plates and cups from areca leaf sheath wastes of Goa	V Arunachalam	
18.	Improving the livelihood security of the tribal people of Goa through dissemination of animal nutrition technologies	PK Naik	
19.	Economic upliftment of tribal community by introduction of improved livestock and poultry germplasm in the tribal area of Goa	EB Chakurkar	

Human Resource Development

Participation in Conference / Seminar/ Symposia/ Workshops

Date	Name	Programme	Venue
April 5-6, 2011	Dr. N.P. Singh Dr. Manohara K.K.	Planning workshop for the project "Stress tolerant rice for Africa and South Asia	NASC Complex, New Delhi
April 6, 2011	Dr. R. Ramesh	PMC meeting of DBT Project on Development of INM Package for commercially important plantation crops	TERI, New Delhi
April 8-11, 2011	Dr. N.P. Singh Dr. B.L. Manjunath Dr. Manohara K.K.	46th All India Rice Group Meeting	DRR, Hyderabad
April 29 – May 1, 2011	Dr. M. Thangam	6th Konkan Fruit Festival	Campal, Panaji Goa
May 6-7, 2011	Dr. S. Priya Devi	3rd National Seminar on Kokum	Goa University, Bambolim Goa
June 6-7, 2011	Dr. N. P. Singh	National seminar on effect of industrialization and changing lifestyle on land and ocean environment	NIO, Donapaula Goa
June 13, 2011	Dr. S. Subramanian	Peer review meeting of PFZ Validation Projects	INCOIS, Hyderabad
June 21-24, 2011	Dr. N. P. Singh Dr. V. Arunachalam Dr. A.R.Desai Dr. S. Priya Devi	Global Conference on Mango: Augmenting Production and Utilization of Mango: Biotic and Abiotic Stresses	CISTH, Lucknow
August 26-27, 2011	Dr. S.B.Barbuddhe	Workshop to formulate a DBT-Network on Brucellosis Translational Research Programme in India	National Institute of Immunology, New Delhi
September 11-13, 2011	Dr. S.B.Barbuddhe	Second International Conference on Holistic Medicine	Kottayam, Kerala
September 19-20, 2011	Dr. S.K.Das Dr. R. Ramesh Dr. R. Maruthadurai	National stakeholders' consultation on climate change	CRIDA, Hyderabad
September 19-20, 2011	Dr. B. L.Manjunath	Review meeting of Mega Seed Project in Agricultural crops and Fisheries	NASC Complex, New Delhi
October 1-2, 2011	Dr. N.P.Singh Dr. V. Arunachalam	Sixth national symposium on Noni	Chennai
October 20, 2011	Dr. V. Arunachalam Dr. A.R.Desai	Konkan Conclave 2011	Donapaula Goa

November 2-4, 2011	Dr. S.K.Das	International symposium on "Advances in Physiologic research for sustainable development of livestock and poultry production	WBUAFS, Kolkata
November 3-5, 2011	Dr. P.K.Naik	14th Biennial Conference of ANSI on Livestock Productivity Enhancement with Available Feed Resources	GBPUA&T, Pantnagar,
November 10-11, 2011	Dr. B.L. Manjunath	International Seminar on Organics- Beyond Agriculture in the New Vistas	Banglore
November 22, 2011	Dr. S. Subramanian	Meeting of Administration and Finance Division of ICAR Institutes	NASS Complex, New Delhi
December 9, 2011	Dr. R. Maruthadurai	ICAR challenge programme on Insect Borers	NBAII, Bangalore
December 17-19, 2011	Dr. N.P. Singh Dr. S. Subramanian Dr. S.K.Das Dr. V. Arunachalam Dr. B.L.Manjunath Dr. E.B.Chakurkar Dr. B.K.Swain Dr. S.B.Barbuddhe Dr. P.K.Naik Dr. M. Thangam Dr. R.R. Verma Dr. Manohara K.K. Dr. A.R.Desai Dr. M.J.Gupta Dr. M.Karunakaran Dr. R. Maruthadurai	6th National Extension Education Congress	NIO, Donapaula, Goa
December 22-24, 2011	Dr. B.K.Swain	International symposium on rural employment generation and nutritional security through poultry production	Patna
December 23-24, 2011	Dr. N.P. Singh Dr. A.R.Desai	National Expert Consultation on Cashew	DCR, Puttur
December 25-27, 2011	Dr. R. Maruthadurai	National group meeting of scientists of AICRP on Cashew	DCR, Puttur
December 27-29, 2011	Dr. N.P.Singh Dr. B.L.Manjunath	Biennial Group Meeting of AICRP on Integrated Farming Systems	CARI, Port Blair
January 13-14, 2012	Dr. S.B.Barbuddhe	Annual meeting of ZTM-BPD - cum-Workshop	CIRCOT, Mumbai
January 13-16, 2012	Dr. M. Thangam	30th AICRP on Vegetable Crop	GBPUAT, Pantnagar

January 16-17, 2012	Dr. S. Subramanian	Inception meeting of the ICAR Mega SEED Project	MPUAT, Udaipur
February 7-9, 2012	Dr. N.P.Singh Dr. E.B. Chakurkar	International Conference on climate change, sustainable agriculture and public leadership	New Delhi
February 9-10, 2012	Dr. S.B.Barbuddhe	Seminar on Emerging foodborne pathogens	St. Xaviers College, Mapusa Goa
February 16-17, 2012	Dr. N.P. Singh Dr. B.L.Manjunath	National Seminar on Coastal Agro-ecosystem	NIO, Donapaula Goa
February 27-29, 2012	Dr. M.J.Gupta	International Grain Storage Symposium	G.B. Pant UAT, Pantnagar
March 3-4, 2012	Dr. M. Thangam	Annual Review meeting of Phytofura	IIHR, Bangalore
March 6, 2012	Dr. V. Arunachalam	2nd Horticulture Industry Meeting	IIHR, Bangalore
March 6, 2012	Dr. N.P. Singh Dr. S.B.Barbuddhe	83rd Annual General Meeting of ICAR Society,	NASC Complex, New Delhi
March 20-21, 2012	Dr. M.J.Gupta	National Workshop on Post Harvest Management and value addition of underutilized fruits	CIPHET, Ludhiana,
March 24-25, 2012	Dr. S.K.Das Dr. V. Arunachalam Dr. A.R.Desai Dr. M. Thangam Dr. M.J.Gupta	National seminar on Indian agriculture : preparedness for climate change	NASC Complex, New Delhi

Trainings attended

Date	Name	Programme	Venue
March 28 – April 6, 2011	Dr. V. Arunachalam	National training on current approaches and bioinformatics applications in agricultural research	CTCRI Thiruvanthapuram
August 4-6, 2011	Dr. N. P. Singh	Training on employers prospective on labour related laws	NAARM, Hyderabad
September 6-16, 2011	Dr. R. R. Verma	8th Advance level training in soil testing, plant analysis and water quality assess	IARI, New Delhi
December 13-14, 2011	Dr. V. Arunachalam	Training cum workshop on installation of software under Strengthening the statistical computing of NARS	UAS, Bangalore
March 20-26, 2012	Dr. A.R.Desai	Hands on training on Plant DNA Fingerprinting techniques and application of microsatellite based markers in molecular breeding	NBPGR, New Delhi

List of Publications

Research Articles

Asolkar Trupti, A R Desai, and N.P. Singh. (2011). Molecular analysis of cashew genotypes and their half-sib progeny using RAPD marker. *Biotechnol. Bioinf. Bioeng.* 2012, 2(1):289-297

Barbuddhe S.B., Malik S.V.S., J. Ashok Kumar, Kalorey, D.R., and Chakraborty, T. (2012). Epidemiology and management of listeriosis in India. *International Journal of Food Microbiology.* 154: 113-118.

Chavhan SK, Kalorey DR, Nagdive AA, Purohit HJ, Barbuddhe SB, Kurkure NV. (2012) Molecular characterization of intercellular adhesion gene in Staphylococcus aureus isolated from bovine mastitic milk. Trop Anim Health Prod. 44(2):247-252.

Das S. K. (2012) Study on the different factors affecting mortality pattern of rabbit in India. Indian Journal of Animal Research, 46 (1): 89-91.

D'Costa D., Bhosle S.N., Dhuri R.B. Kalekar, S., Rodrigues, J., Doijad, S.P. and Barbuddhe, S. B. (2012) The occurrence and characterization of *Listeria* species isolated from milk production chain. *Milchwissenchaft,* 67: 43-46.

Doijad, S. P., Barbuddhe S.B., Garg, S., Kalekar, S., Rodrigues J., D'Costa, D., Bhosle, S. and Chakraborty, T. (2011). Incidence and genetic variability of *Listeria* species from three milk processing plants. *Food Control,* 22:1900-1904.

Kalekar, S., Rodrigues J., D'Costa, D., Doijad, S. P., Jangam, A. K., Malik S.V.S., Kalorey, D.R., Rawool, D.B., Hain T., Chakraborty, T. and Barbuddhe S.B. (2011). Genotypic characterization of *Listeria monocytogenes* isolated from humans in India. *Annals of Tropical Medicine and Parasitology*. 105(5):351-358.

Manju, K.P. and Arunachalam, V. (2011) Bioinformatic prediction of SNP markers in WRKY sequences of palms. Cord (Asia Pacific Coconut Community). 27(2), 17-25.

Manju, K.P. Manimekalai, R. and Arunachalam, V. (2011) Microsatellites in palm (Arecaceae) sequence. Bioinformation 7(7): 347-351

Maruthadurai R., R. D. Gautam and P. Mahesh (2011) Kairomonal effect of host body washing on the egg parasitoid *Trichogramma brasiliensis* (Ashmead) (Hymenoptera: Trichogrammatidae). *Journal of Biological Control,* 25 (4): 298–304.

Maruthadurai R. and R.D. Gautam (2011) Hydrocarbon profile of *Earias vittella* and *Spodoptera litura. Annals of plant protection sciences* 19(2): 282-285.

Maruthadurai, R. R.D. Gautam and Archana (2011) Behavioural response of *Trichogramma chilonis* ishii (Hymenoptera: Trichogrammatidae) to kairomones**.** *Indian journal of Entomology,* 73(3): 247-252

Mohanta, K. N. and S. Subramanian, (2011). Effect of protein and lipid levels on growth and nutrient utilization of freshwater angelfish *Pterophyllum scalare. Isr. J. Aquacult.,* (IJA:64.2012.756).

Mohanta, K.N. and Subramanian, S., and Korikanthimath, V. S. (2012). Effect of dietary protein and lipid levels on growth, Nutrients utilization and whole body composition of blue gourami *Trichogaster trichopterus* fingerlings. *Journal of Animal Physiology and Animal Nutrition* (DOI: 10.1111/j.1439-0396.2011.01258.x.).

Mohanta, K.N. and Subramanian, S., and Korikanthimath, V. S. (2012). Replacement of fish meal protein by surumi by-product 2 in the diet of blue gourami *Trichogaster trichopterus* fingerlings. *Journal of Animal Physiology and Animal Nutrition* (DOI: 10.11.11/j.1439-0396.2011.01237.x.).

Naik, P. K., Chakurkar, E. B., Manjunath, B. L., Swain, B. K. and Singh, N. P. (2011). Production potential of fodder maize as intercrop with cashew. *Indian Veterinary Journal*, 88 (8): 130.

Naik, P. K., Swain, B. K., Chakurkar, E. B. and Singh, N. P. (2012). Assessment of potential animal and poultry feed resources in Goa. *Animal Nutrition and Feed Technology*, 12: 127-133.

Premkrishnan, B.V. and Arunachalam, V. (2012) In Silico RAPD Priming Sites in Expressed Sequences and iSCAR Markers for Oil Palm. Comparative and Functional Genomics Hindawi Publishing Corporation, Volume 2012, Article ID 913709, 5 pages doi:10.1155/2012/913709.

Ramesh, R., Anthony, J., Jaxon, T.C.D., Gaitonde, S. and Achari, G. (2011). PCR based sensitive detection of *Ralstonia solanacearum* from soil, eggplant, seeds and weeds. *Archives of phytopathology and plant protection*. 44: 1908- 1919. DOI:10.1080/03235408.2010.516087

Sathishkumar, R, Lakshmi, P.T.V, Annamalai, A, Arunachalam, V. (2011) Mining of simple sequence repeats in the Genome of Gentianaceae. Pharmacognosy Research, 3(1): 19-29.

Shome, B.R. Das Mitra, S., Bhuvana, M., Krithiga, N., Velu, D., Shome, R., Isloor, S., Barbuddhe, S.B. and Rahman, H. (2011) Multiplex PCR assay for species identification of bovine mastitis pathogens. *Journal of Applied Microbiology*. 111:1349-1356.

Singh T. R., Gupta A., Riju A., Mahalaxmi M., Seal A. and Arunachalam V. (2011) Computational identification and analysis of single nucleotide polymorphisms and insertions/deletions in expressed sequence tag data of *Eucalyptus*. *J. Genet*. **90**, e34–e38.

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2011). Effect of probiotics on the performance of Gramapriya chicks. *Indian Veterinary Journal* , 88(10):51-53.

Swain, B.K. and Chakurkar, E.B. (2011). Effect of replacing soybean meal by fish meal in growing Vanaraja chickens. *Indian Veterinary Journal* ,88(4):44-45.

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2011). Effect of probiotic and yeast supplementation on performance, egg quality characteristics and economics of production in Vanaraja layers. *Indian Journal of Poultry Science*. 46 (3) : 313-315

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2012). Effect of feeding brewers' dried grain on the performance and carcass characteristics of Vanaraja chicks. *Journal of Applied Animal Research, DOI:10.1080/09712119.2011.645036.*

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2012). Effect of combined supplementation of probiotic and Yeast on Growth, Carcass Characteristics and Economics of Production in Broiler Chickens. *Animal Nutrition & Feed Technology,12:103-110.*

Paper Presented/ Conference Abstracts

Arunachalam V (2012) Ornamental and tuberous sweet potato for climate change mitigation. "National Seminar on Indian Agriculture: Preparedness for climate change" poster presented on 24-25 Mar 2012 held at NASC Complex Auditorium New Delhi.

Barbuddhe, S.B. (2011). Rabies. Guest lecture on occasion of World Veterinary Day, Maquinez Palace, Panaji, Goa 30 April, 2011.

Barbuddhe, S.B. (2011). Future trends in brucellosis. Invited talk delivered at Model Training course on "Comprehensive approaches for the diagnosis and control of brucellosis in the country" at Project Directorate on Animal Disease Monitoring and Surveillance, Hebbal, Bangalore on 7th September, 2011.

Barbuddhe, S. B. and Chakraborty, T. (2011). Epidemiology of human listeriosis in India. Oral presentation at Second International Conference on Holistic Medicine (ICHM-2011), during 11-13 September 2011 in Kottayam, Kerala.

Barbuddhe, S.B. (2012). Overview of zoonotic infections. Presentation at Carmel College for Women, Nuvem, Goa on 3 February, 2012.

Barbuddhe, S.B. (2012). Emerging foodborne pathgogens : an overview. Paper presented at Seminar on "Emerging foodborne pathogens" organized by St. Xaviers College, Mapusa during 9-10 February, 2012.

Chakurkar E.B., Naik P.K., Swain B.K., Karunakaran M. and Singh N. P. (2011). Comparative performance of crossbred pigs reared under scientific feeding practices and field conditions in Goa. *In: Proceedings of 6th National Extension Education Congress on 'Emerging Models on* Technology *Application for Agri-Rural Development'* held at ICAR Research Complex for Goa, Old Goa, India, December 17-19, 2011, P. 365.

Das S. K. and Singh N P (2011). "Effect of micro environmental changes on pig production" Presented in the poster session entitled "Sustainable livestock and poultry Production" of the XX th Annual Conference of SAPI and International symposium on "Advances in Physiologic research for sustainable development of livestock and poultry production" held at WBUAFS, Kolkata during 2 nd - 4 th November, 2011.

Das S. K. and Singh N P (2011). "Effect of micro environmental changes on rabbit production" Presented orally in the session – I ie Climate Change: Ground Realities" of the 6 th National Extension Education Congress on "Emerging Models of Technology Application for Agri - Rural Development held at ICAR - RC for Goa, Ela, Goa during 17-19 th December, 2011.

Das S. K, Karunakaran M, Barbuddhe S B and Singh N P (2012). "Performances of dairy cows under improved housing and management". Presented in the poster session of National Seminar on "Indian Agriculture Preparedness for climate change" held at New Delhi during 24 – 25 th March, 2012.

Desai A R., (2011). Improved production technology for Pineapple in Konkan region. The invited talk was delivered in the Workshop on Konkan Conclave 2011 organized by Agricultural & Processed Food Products Export Development Authority (APEDA) and Goa Chambersof Commerce & Industry on the topic "Various food loss and facilities available for Agricultural Exports" on 20th Oct. 2011.

Desai A. R and N.P Singh. (2011). "Impact of weather changes on cashew in Goa" . This was poster presented in the National Seminar on Indian Agriculture Preparedness for Climate Change" held at New Delhi during 24-25 March 2012.

Doijad S.P., Garg S., Poharkar K., D'Costa D., Kalekar S., Rodrigues J., Bhosle S. and S.B. Barbuddhe. (2011). Biofilm formation ability of Listeria monocytoegenes isolates from food processing units. Paper presented at International Conference of Microbial Diversity for Sustainable Development Chandigarh, Panjab, India.

Gaitonde, S., Ramesh, R. and Achari, G. (2011). Pathogenic characterization of *Ralstonia solanacearum* strains from Goa. IPS (West zone) Symposium on "Recent trends in disease management of horticultural crops". 19-20 October 2011 held at BSKKV, Dapoli, Maharashtra, India pp. 120 (abs).

Gaitonde, S. and Ramesh, R. (2011). Genetic characterization of *R. solanacearum* strains from Goa. Symposium on "Microorganisms and Plant health", 4-5, November 2011 held at Guwahati University, Assam. India pp.16 (Abs)

Gaitonde, S. and Ramesh, R. (2012). Determining the diversity and management of *Ralstonia solanacearum* strains from Goa'. Symposium on "Role of microbes in Agriculture, Health and industry", 26-27, March 2012 held at Department of Biotechnology, Alagappa University, Karaikudi, TN. pp 42 (Abs).

Gupta, M.J. (2012). A Systems approach for postharvest handling and commercial processing of underutilized fruits of Goa. Paper presented at National Workshop on Post Harvest Management and value addition of underutilized fruits, CIPHET, Ludhiana, 20-21, March 2012.

Gupta, M.J. (2012). Protected Cultivation for Nutrition-Sensitive Climate Change Mitigation in India. Paper presented at National Seminar on Indian Agriculture Preparedness for Climate change, Indian Society for Agricultural Sciences, New Delhi, 24-25 March, 2012

Gupta, M.J. and Priya Devi, S. (2012). Post Harvest Handling and Processing of Unexploited fruits Specific to Goa. Presented at 46th Annual Convention of Indian Society of Agricultural Engineers (ISAE) & International Grain Storage Symposium, G.B. Pant University of Agriculture and Technology, Pantnagar, 27-29, February, 2012.

Manjunath B. L. and N.P. Singh, 2012. Plantation crop based integrated farming system for coastal areas, In: *Sovenier cum abstract book of National Seminar on Technologies for Improving Productivity of Spices and Plantation Crops,* organized by Central Agricultural Research Institute, Port Blair during 27-28 February,2012: 45-53.

Manjunath B.L. and N. P Singh, 2012. System approach in agriculture for climate change mitigation, In: *Summaries of National Seminar on Indian Agriculture; Preparedness for Climate Change,* organized by Indian Society of Agricultural Sciences in New Delhi during 24-25 March, 2012: 182-184.

Musale V., Doijad S.P., Poharkar K., D'Costa D. and S.B. Barbuddhe. (2011). Emergence of resistance of L. monocytogenes toward antibiotics usd in current therapies. Paper presented at International Conference of Microbial Diversity for Sustainable Development Chandigarh, Panjab, India

Naik, P.K., Chakurkar, E. B., Swain, B. K. and Singh, N. P. (2011). Effect of graded levels of brewers' dried grain based starter feed on the performance of 50% crossbred (GLXLWYS) pigs. *In: Proceedings of 1st National Conference of Indian Academy of Veterinary Nutrition and Animal Welfare on 'The significance of Veterinary Nutrition for Health and Production of Animals of Agro-ecological Importance'* held at College of Veterinary Science and Animal Husbandry, IGKVV, Anjora, Durg, Chhattisgarh, India, September 24-25, 2011.

Naik, P. K., Dhuri, R. B., Chakurkar, E. B., Swain, B.K. and Singh, N. P. (2011). Status of dairy farmers and dairy animals in Goa. *In: Book of Abstract of 14th Biennial Conference of Animal Nutrition Society of India on 'Livestock Productivity Enhancement with Available Feed Resources'* held at GBPUA&T, Pantnagar, Uttarakhand, India, November 3-5, 2011, Pp. 9-11.

Naik, P. K**.,** Dhuri, R. B., Swain, B.K., Chakurkar, E. B. and Singh, N. P. (2011). Traditional feeding practices of dairy animals and chemical compositions of dairy rations in Goa. *In: Proceedings of 6th National Extension Education Congress on 'Emerging Models on* Technology *Application for Agri-Rural Development'* held at ICAR Research Complex for Goa, Old Goa, India, December 17-19, 2011, P.338.

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Priya Devi S. (2011) A review of research and development on kokum in Goa, since 2005. In abstracts of 3rd National Seminar on Kokum organized by Western Ghat Kokum foundation at Goa University from 6th to 7th May, 2011. p 12-13

Ramesh, R. (2011). Status and management strategies for bacterial wilt of solanaceous crops. IPS (West zone) Symposium on "Recent trends in disease management of horticultural crops". 19-20 October 2011 held at BSKKV, Dapoli, Maharashtra, India pp. 23-24 (invited talk).

Ramesh, R., Gaitonde, S., Achari, G. and Singh, N.P. (2011). Demonstration of bacterial wilt management in eggplant using antagonistic bacteria. "6th National Extension Education Congress", 17-19, December 2011 held at ICAR Research Complex for Goa, Old Goa, Goa India pp 382-383.

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Singh N P and A R Desai. (2011). "Cashew Production in Goa : Research and Prospects". An Invited Paper presented in "National Expert Consultation on Cashew : Challeenges and strategies for Higher Productivity and Quality of Cashew" held at DCR, Puttur during 23-24 Dec. 2011.

Singh, N.P. Desai, A.R., Thangam,M, Priya Devi, S. and Arunachalam, **V.** (2011) History and Status of research of mango genetic resources at Goa state, India. Global Conference on Mango: Augmenting Production and Utilization of Mango : Biotic and Abiotic Stresses" at The Lifestyle Hotels Pvt. Ltd, Kanpur Road, Lucknow. from 21-24 June 2011, page8

Subramanian S., Janhavi K and Singh N. P. (2011) Studies on the advantages of application of Potential Fishing Zone forecasts on purse seine fishing off the coast of Goa. Abstract No: FR-O-23 in the Technical session on "Fishery Resources, Recreational Fisheries and Sustainable Management" at 9th Indian Fisheries Forum held from 19th -23rd December, 2011, organized by CMFRI, Kochi, at Chennai, Tamil Nadu.

Subramanian S., Janhavi K., Tejaswini P., Anil F., Neelam K. and Korikanthimath V. S. (2012). Comparative studies on the fish catch by identical purse seine vessels in the Potential Fishing zone notified and Non notified areas off Goa coast. Abstract :38 p. Workshop on "Coastal ocean colour : A perspective for satellite applications in the Indian ocean". organized by INCOIS, Hyderabad, at Goa, on 19th to 21st March, 2012.

Subramanian S., Janhavi K., Tejaswini P., Anil F., Neelam K and Singh N. P. (2012). Studies on validation and application of Potential Fishing Zone (PFZ) forecast along the coast of Goa with specific reference to day of fishing, distance from shore, species and shifting features. Abstract: 39 p. Workshop on "Coastal ocean colour : A perspective for satellite applications in the Indian ocean", organized by INCOIS, Hyderabad, at Goa, on 19th to 21st March, 2012.

Subramanian S., Tejaswini P., Janhavi K., Anil F., Neelam K. and Singh N. P. (2012). Studies on the length, weight, gut content, gonadal condition and proximate composition of Indian mackerel (*Rastrelliger kanagurta*) and Oil sardine *(Sardinella longiceps)* off Goa coast and their relevance to the condition of the fish in the context of Potential fishing zone forecast. Abstract: 53 p. Workshop on "Coastal ocean colour : A perspective for satellite applications in the Indian ocean", organized by INCOIS, Hyderabad, at Goa, on 19th to 21st March, 2012.

Subramanian S. (2012). Studies on the application and advantage of potential fishing zone (PFZ) forecast and their refinement for different types of fishing activities along Goa coast (XII plan presentation). Coastal ocean colour: Paper presented at "A perspective for satellite applications in the Indian Ocean. INCOIS, Hyderabad. 19th to 21st March, 2012. Goa.

Swain, B. K., Naik, P. K., Chakurkar, E. B., Singh, N.P. (2011). Effect of combined supplementation of probiotic and Yeast on Growth, Carcass Characteristics and Economics of Production in Broiler Chickens. In Souvenir/ Campendium of 28th Annual Conference & International Symposium of Indian Poultry Science Association (IPSACON-2011) at Bihar Veterinary College, Patna during December 22-24, 2011P65.

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2011). Effect of Supplementation of Different Levels of Vitamin E and Selenium on the Performance and Immunity of Gramapriya White Growing Chicks. *In: Book of Abstract of 14th Biennial Conference of Animal Nutrition Society of India on 'Livestock Productivity Enhancement with Available Feed Resources'* held at GBPUA&T, Pantnagar, Uttarakhand, India, November 3-5, 2011, Pp. 317-318.

Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2011). Effect of different protein sources on the performance of Vanaraja chicks. *In: Proceedings of 6th National Extension Education Congress on 'Emerging Models on* Technology *Application for Agri-Rural Development'* held at ICAR Research Complex for Goa, Old Goa, India, December 17-19, 2011, P. 356.

Thangam, M., S. Priya Devi, SA. Safeena, V. Arunachalam and N.P.Singh (2012). Under utilized crops based crop diversification for emerging climate resilient horticulture. Presented as poster in National seminar on Indian agriculture: preparedness for climate change organized by Indian Society of Agricultural Science during 24-25, March, 2012, Pp 73-75.

Vasishtha A., Poharkar K., D'costa D., Doijad S. and S. B. Barbuddhe. 2011. Identification and Characterization of Clostridium spp. from raw food and environment. Paper presented at International Conference of Microbial Diversity for Sustainable Development Chandigarh, Panjab, India.

Popular/ Technical Articles

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Institute as Publisher

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Reports	
Annual Report (2010-2011) pp.1-118	P. K. Naik, V. Arunachalam, B. K. Swain and B. L. Manjunath
Vision 2030 (2011) pp 1-28	N. P. Singh and S. B. Barbudde,
Books / Proceedings	
Sixth National Extension Education Congress pp1-100	N.P.Singh, S.B. Barbuddhe, J.C.Chauhan,. and A.K.Singh
Technical Bulletins	
35 (1977-2011) Years of Research in Animal and Poultry Nutrition; ICAR Research Complex for Goa. Scientific Review No. 25, Pp. 1-82	P. K. Naik, B. K. Swain, E. B. Chakurkar and N. P. Singh
Technology package for improved sugarcane production in Goa Technical Bulletin No 26. pp 1-33	Manjunath, B.L., H.R. Prabhudesai and N.P.Singh
Nutrition of common freshwater ornamental fishes Technical Bulletin No 27. pp 1-55	K. N. Mohanta and S. Subramanian
Extension Folders	
Management of pepper wilt diseases in the plantation. Extension Folder No. 43	R. Ramesh
Gowatil Duvatwa Janawarancha Aahara Wa Aahara Padhawati. Extension Folder No. 44.	P. K. Naik, E. B. Chakurkar, B. K. Swain and N. P. Singh
Technology for Production and Feeding of Hydroponics Green Fodder. Extension Folder No. 45.	P. K. Naik, R. B. Dhuri and N. P. Singh
Technology for Preparation and Feeding of Bypass fat (Rumen Protected Fat) to dairy animals. Extension Folder No. 46	P. K. Naik and N. P. Singh
News Letter	
Vol. XIII. No.1 pp1-6	S. B. Barbuddhe
Vol. XIII. No.2 pp1-6	S. B. Barbuddhe

Workshops, Seminars and Other Events

Workshop cum training programme on Floriculture: An attractive prospect for revenue generation in Goa

A Workshop cum training programme on Floriculture: An attractive prospect for revenue generation in Goa was held at the Institute on 15 April, 2011. Dr. N. P. Singh, Director of the Institute presided over the function. Mr. Satish Tendulkar, Director of the Department of Agriculture, Govt. of Goa and Mr. A. Sandilya, Regional Manager, NABARD ,Dr. Anjali Parasnis, Head, Western Region, TERI, Mumbai, Dr.V.Arunachalam, Principal Scientist (Horticulture) and Dr. M. Thangam, Senior Scientist (Horticulture) and Organising Secretary were also present on the occasion. Dr. N. P. Singh emphasized the need for setting up of hi- tech floriculture by availing subsidies from the State and Central schemes. Satish Tendulkar explained the different schemes given by the Goa Government and explained the potential of different cut and loose flowers suitable for Goa Climate. The participants were taken to the floriculture units and the technologies developed by the Institute were demonstrated. The following recommendations were made.

Inaugural function of training on floriculture

Recommendations

- Request to the concerned department for setting up centralized procurement facility especially for high value crops like flowers in Goa
- Request to change the subsidy procedure especially when the land is not on the name of the beneficiary
- Possibility of announcing support price for the flower crops as in cereals and plantation crops instead of subsidy to the specific group of farmers who don't have the land on their own.
- Farmers friendly land reforms like contract farming, tenancy issues and providing government support for the progressive and interested farmers were suggested
- Requesting the department and ICAR for intensive training and demonstration facility for the benefit of needy farmers

Training programme on Pest and disease management in major spice crops of Goa

State level training programme on Pest and Disease Management of major spice crops of Goa was held at the Institute on 20 April, 2011. Shri Pratapsingh Rane, Honorable Speaker Government of Goa, presided the function and Shri. Shripad Naik Honorable Member of Parliament (North Goa) was the chief guest. Shri. Madhav Sahakari, Managing Director, Goa Dairy was the special Invitee.

Shri. Pratapsingh Rane said that Goans grow spices traditionally in the areca nut gardens. He said the pest and diseases need to be managed to get economic yield and suggested that pepper may be grown as sole crop. He emphasized that complete calendar of operations for black pepper cultivation need to be developed and disseminated among the farmers.

Shri. Shripad Naik, congratulated ICAR Research Complex for Goa or doing need based programmes for the farmers. He suggested that Government Institutions should help the farmers to get profit from farming.

Dr. R. Ramesh, Senior Scientist (Plant Pathology) and the coordinator of the training programme proposed vote of thanks.

Inaugural function of the training on pest and disease management

In the technical session, scientists from Indian Institute of Spices Research, Calicut delivered talks on the management of diseases, insect pests and nematodes in important spice crops. A film on the diseases of black pepper and their management was shown to the farmers. Over 75 farmers attended the training.

Union Minister of Agriculture Visits the Institute

Shri Sharad Pawar, Honorable Union Minister of Agriculture and Food Processing Industries, Government of India, visited the Institute on 18 May, 2011. Shri. Pratapsingh Rane, Honourable Speaker of Goa Legislative Assembly and Shri. Sripad Naik, Honourable Member of Parliament were also present during the visit. The function was attended by Scientists of the Institute, Officials from Development Departments and Progressive farmers.

Shri Sharad Pawar, Honble. Union Minister addressing the staff

The Honourable Minister interacted with the Scientists , officials and farmers. The areas requiring attention and support of the Government of India for the agricultural development of Goa was also discussed.

Visit of Study Group of Parliamentary Committee on Agriculture

The Study Group of the Parliamentary Standing Committee on Agriculture under the chairmanship of Shri. Basudeo Acharia, Honourbale Member of Parliament along with other seventeen members visited the Institute during 27-28 June, 2011.

Visit of Parliamentary Standing Committee on Agriculture

The committee was welcomed by Dr. N.P.Singh, Director of the Institute. The committee had discussions on cultivation of genetically modified food crops –prospects and effects with the representatives of the Government of Goa and stake holders including farmers, development of fisheries in Goa with the representatives of the Government of Goa and fisherman and minimizing of post harvest crop losses with the officials during their visit to ICAR Research Complex for Goa. The committee was apprised of various Institute activities during their visit.

National Workshop on Molecular subtyping of Microbes using Pulsed Field Gel Electrophoresis

A national workshop on "Molecular subtyping of microbes using Pulsed Field Gel Electrophoresis" was organized at ICAR Research Complex for Goa, Old Goa during August 20-23, 2011 for the benefit of teachers/researchers/

officers of Veterinary, Medical and Agricultural Universities, private research and development organizations having a background in the field related to molecular microbiology. The workshop was inaugurated by Dr. Earnest D'costa, Deputy Director, Deratment of AH&VS, Government of Goa. Dr. N.P.Singh, Director of the Institute presided over the function. Sixteen participants from different parts of the country participated in the workshop. A training manual was released on the occasion. The workshop was blended with lectures and practicals. Lectures explaining the other techniques of molecular detection, subtyping and analysis were delivered. The practical sessions were designed to provide excellent opportunity for the participants to gain hands on experience about pulsed field gel electrophoresis. The experience enriched the knowledge and built a confidence among the participants besides broadening their research aptitude.

DDG (NRM) visits the Institute

Dr. A. K. Singh, DDG (NRM), ICAR, New Delhi visited the Institute on 10 September, 2011. Dr N. P. Singh, Director apprised the DDG (NRM) about the activities being undertaken by the Institute. He visited different field experiments and laboratories of the institute and interacted with the Scientists and other staff of the Institute. He also visited the Krishi Vigyan Kendra and various technology demonstrations in the farmers field.

Visit of Dr. A.K.Singh , DDG (NRM)

हिंदी पखवाड़ा

गोवा के लिए भा.कृ.अनु.प. का अनुसंधान परिसर, एला, ओल्ड गोवा में सितम्बर १४-२८, २०११ के दरम्यान हिंदी पखवाड़ा आयोजित किया गया। बड़े धूम-धाम से १४ सितंबर को हिन्दी दिवस मनाकर संस्थान के निदेशक डॉ. नरेन्द्र प्रताप सिंह ने पखवाड़े का शुभारम्भ किया। इस पखवाड़े के दौरान कई प्रतियोगितायें आयोजित कि गई। हिंदी निबंध, सुलेख, पत्र लेखन, हिन्दी व्याख्यान (चार वर्गों - सहायक कर्मचारी, प्रशासनिक एवं तकनीकी कर्मचारी तथा वैज्ञानिकों के लिए), कविता, शायरी, अंताक्षरी, ग़ीत गायन, चुटकुला, सामान्य ज्ञान आदि आयोजित किए गये। संस्थान के कर्मचारियों के बच्चों के प्रतिभा दर्शन के लिए कई प्रतियोगिताएँ आयोजित कि गई। २८ सितंबर २०११ को हिंदी पखवाड़े के समापन एवं पुरस्कार वितरण समारोह में गोवा बागायतदार सहकारी खरिदी विक्री संस्थान मर्यादित के चेअरमन, श्री. नरेंद्र सवाईकर को मुख्य अतिथी के रूप में आमंत्रित किया गया। समारोह का शुभारंभ ईश्वर वंदना से किया गया। संस्थान के निदेशक डॉ. नरेंद्र प्रताप सिंह ने स्वागतपर भाषण देते हुए आशा व्यक्त कि की इस पखवाड़े के खत्म होने के बाद संस्थान के कार्रवाई में राजभाषा का प्रचलन और बढेगा। डॉ. श्रीमती मथला जूलयिट गुप्ता, सचिव (रा.भा.) ने संक्षेप में पखवाड़े के दौरान आयोजित कार्यक्रमों ओर प्रतियोगिताओं की रूप-रेखा प्रस्तुत कि। मुख्य अतिथीने सभा को संबोधित किया तथा संस्थान को हिंदी पखवाड़े के आयोजन पर बधाई दी। इसके पश्चातमुख्य अतिथी श्री. नरेंद्र सवाईकर और डॉ. नरेंद्र प्रताप सिंह ने अपने करकमलो से विभिन्न प्रतियोगिताओं के विजेता प्रतिभागियों को पुरस्कार प्रदान किए। अंत में सचिव (रा.भा.) ने माननीय सुख्य अतिथी का आभार व्यक्त किया।

Inagural function of Hindi Samaroha

Field Day on Water Soluble Fertilizers in Rice

The Institute in association with Zuari Agro Industries, Goa organized a field day on 7th October, 2011 for farmers of Azzossim village to demonstrate the efficacy of using water soluble fertilizers in rice. Dr. N. P. Singh, Director, and Zuari

officials - Mr. U. M. Ramudu, DGM (Marketing), Mr. Avinash Deshpande DGM (Marketing). Mr. B. H. Nagraj, Chief Manager (Marketing) and Mr. M. P. Madhav, Sr. Manager (Marketing) participated in the programme. On the occasion, handouts of the "Technology package for higher rice production" were distributed to the participating farmers. Dr. N.P. Singh. Director, highlighted the importance of change of seed at least once in three years and the performance of the recently introduced "Naveen" variety in different parts of Goa. About 40 farmers from the villages of Azossim, Neura and Pilar-Tiswadi, Goa practically saw the impact of the liquid fertilizer spray in rice crop.

Technical guidance at field day

Rice Field Day

Rice field day was organized at Loutulim Village, South Goa on 9th October, 2011. Director, Dr. N. P. Singh, speaking on the occasion briefed the farmers regarding the high yielding rice variety, Naveen and also about the importance of seed replacement in improving the rice production and productivity. Later the farmers were taken to the demonstration plot and were appraised about the new variety by Dr. Manohara, K. K., who co-coordinated the programme.

Inaguaration of rice field day

Field Day on "Naveen" Rice Celebrated at Amona

Field day on "Naveen" rice variety was celebrated at Amona village in collaboration with the Amona Farmer's Club, Village Panchayat Amona and M/s Sesa Goa on 11October, 2011.

The event was organized to highlight the performance of a new rice variety "Naveen" which is a derivative of popular variety "Jaya" and suitable for parboiled (Ukdo) rice. It matures in 120-125 days and has the potential to yield 6 to 6.5 t/ha. The function was graced by Shri Pratap P.Gawas Hon'ble MLA of Pali Constituency, Dr. N. P. Singh, direct or of the Institute, Mrs.Anushka Gawas Sarpanch, Amona village Panchayat, Shri Mahesh Mahajan, AGM (Safety) Sesa Goa, Shri Pradeep Malik, Zonal Agricultural Officer, Bicholim and the President of Amona Farmers Club Shri Ulhas Parab and officials, Scientists of ICAR, Programme Coordinator, KVK, NGOs and more than 150 farmers from Amona and nearby villages.

Inauguration of field day on Naveen rice

In his keynote address to the gathering, Dr. N.P.Singh, Director mentioned the concept of the village adoption by KVK and said that instead of paddy as a sole crop, the farming community should have integrated farming system approach with rice based cropping systems, comprising of

cowpea (Alsando) Black gram and vegetables wherever irrigation facilities exists. Further he laid stress in organic farming practices which could only be possible with animal waste and appealed to the villagers to initiate homestead and animal based enterprises to make their farming activities sustainable. He assured all the help as far as research and extension in the village so as to make Amona a model village.

Shri Pratap Gawas, expressed his satisfaction on the active role played by Krishi Vigyan Kendra in enlightening the farming community on latest technologies and mentioned that the Government has initiated many developmental schemes which the club should be utilized for all round development of the farming activity of village which he said is the back bone of Rural as well as Urban economy.

ICAR Commemorated World Food Day

World Food Day was celebrated at the Institute under the theme "Food prices from crisis to stability" on 17 October, 2011. Shri Madhav Sahakari, Chairman Goa Milk producers Co-operative Society was the Chief Guest. Othe dignotories present on the dias were Dr. N.P.Singh, Director, of the Institute, Shri D. Dhaimodkar, Zonal Agril. Officer, Tiswadi and Dr. Raj naryan, Programme Co-ordinator, KVK, North Goa.

Shri Madhav Sahakari recalled the liberation era on the agricultural front and highlighted the contribution of Scientists and technology transfer officials who enabled the country usher in "Green Revolution". Dr. N.P.Singh, briefly highlighted the significance of the World Food day which focuses on the issue of agriculture commodity prices which he said has direct bearing on demand supply chain. He further said that the FAO theme this year focuses on our sustained efforts to ensure that the food prices are affordable to those living in poor conditions but also meet the food demand of affluent population within the country as well as abroad

Inaguration function of world food day

Scientists, Extension Officers, KVK staff and over 100 farmers and farm women from nearby villages were present for the function. Latter the farmers were taken on a visit to experimental plots of rice and other units to see the performance of various technologies at Research farm/Labs visually and then they were interacted with Scientists extension official and learnt the technologies.

Vigilance Awareness Week

The Vigilance Awareness Week was observed at the Institute from 31October to 5 November, 2011. The observance of the Vigilance Awareness Week commenced with a pledge administered by Dr. S. Subramanian, Principal Scientist (Fish & Fishery Science) of the Institute to all officials and staff of the institute on 31st October, 2011 at 11.00 am. This year the main focus of observing Vigilance Awareness Period is "Participative Vigilance".

Oath ceremony during vigilance week

Training Programme on Cottage Level Food Processing Entrepreneurship Development

An awareness cum training programme on "Cottage Level Food Processing Entrepreneurship

Development for Farmers" of Goa was held at the Institute in collaboration with Indian Institute for Crop Processing Technology, Ministry of Food Processing Industries, Thanjavur, Tamil Nadu on 4 November, 2011..In the Welcome address, Dr. N. P. Singh, Director pf the Institute highlighted the importance of farm level value addition and cottage level food processing in Goa to mitigate the post harvest losses in food, vegetable and fruit crops and to bridge the gap between the price paid by the consumers for processed foods and the farmers' earnings. Shri. A. Amudhasurabhi, the coordinator from IICPT, Thanjavur gave a brief introduction about the role of IICPT in creating awareness about value addition and food processing and the objectives of the training. Dr. Mathala Juliet Gupta, training coordinator, ICAR Research Complex for Goa, invited all the participants with a brief description about the training programme.

Over sixty seven farmers from across the state and officers from the state Directorate of Agriculture, Fisheries and Animal Husbandry & Veterinary Services and various banks of Goa participated in the programme.

Valedictory function of training programme

Sh. Gurudas Bhakta, Secretary of the Goa Olympic Association, presided as chief guest of the valedictory and distributed the certificates to the participant trainees. In his address he congratulated ICAR Research Complex for Goa for the organizing such a training programme to create awareness among the farmers about processing and value addition but added that the procedures for loan and various schemes to farmers should be simplified for the benefits to be realized by the farmers.

Dr. Mathala Juliet Gupta, Scientist (Agricultural Structures and Process Engineering) and the coordinator of the training programme propsed vote of thanks. About 67 farmers mostly women participated in the training programme.

Training cum Awareness Programme on Tuber Crops

Training cum awareness programme on tuber crops held at the Institute during 8- 9 November, 2011 for farmers of Goa state. Shri. Pratapsingh Rane, Hon'ble Speaker, Goa legislative Assembly was the chief guest and he spoke about the importance of tuber crops in local food habits and its cultivation on large scale. Dr. N.P.Singh, Director, of the Institute welcomed the participants and gave brief introduction about the programme. Dr. R.S. Mishra, Head, CTCRI Regional Centre, Bhubaneswar gave brief introductory remarks about the importance of tuber crops in food and nutrition. Dr.S.K.Naskar, Director, CTCRI, Thiruvananthapuram was the guest of honour in the inaugural function.

Inauguration of training programme on tuber crops

He spoke about the different technologies developed at CTCRI including technologies for post harvest handling and value addition in different tuber crops. It was followed by address by special invitee, Shri.S.S.Negi, DGM, NABARD, Goa where in he emphasized the role of NABARD in providing financial help to form SHG's and other farmers groups for taking up agricultural activities. Dr.M.Thangam, Organizing secretary and Senior Scientist (Horticulture), ICAR, Goa proposed the vote of thanks. A total of 100 farmers attended the programme.

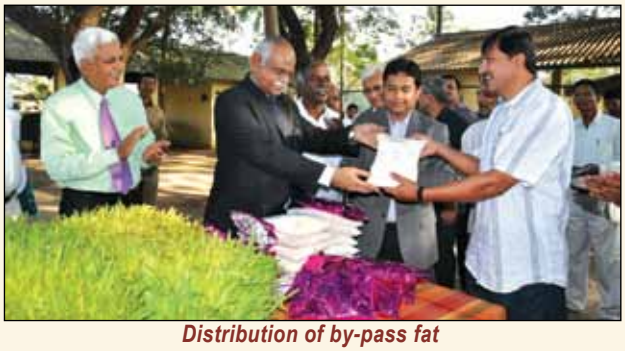
Hydroponics Green Fodder Production Unit Inaugurated

Dr. A. K. Singh, DDG (NRM), ICAR, New Delhi inaugurated the 'Hydroponics Green Fodder Production Unit' at ICAR Research Complex for Goa, Old Goa in presence of Dr. N. P. Singh, Director, ICAR Goa; Shri S. S. P. Tendulkar, Director, Department of Agriculture, Govt. of Goa; Shri S. Kulkarni, Managing Director, Goa Dairy; other officials of Govt. of Goa, Goa Dairy, progressive dairy farmers, scientist and staff members of the Institute on 19 December, 2011. The 'Hydroponics Green Fodder Production Unit' was established at the Institute under RKVY Scheme in collaboration with Goa State Co-operative Milk Producers' Union Limited, Curti, Ponda, Goa, which has capacity to produce 600 kg green fodder daily, cultivated without soil and under fully controlled environment within seven days.

languration of Hydroponic unit

Indigenous Technology for Preparation of By-pass Fat Released

An indigenous technology developed by the Institute for the preparation of 'Bypass Fat' was released by Dr. A. K. Singh, DDG (NRM), ICAR, New Delhi on 19-12-2011. The bypass fat prepared by the indigenous technology was distributed to the progressive dairy farmers of the state. The bypass fat is a specially formulated fat prepared from palm oil fatty acids and technical grade calcium oxide that can be supplemented in the ration of high producing dairy animals to increase the milk production.



Distribution of by-pass fat

Seed Distribution through Tribal Sub Plan Programme

Under the Tribal Sub plan programme for enhancing the rice production and productivity in the tribal areas of Goa, a programme was organized on 9th December, 2011 to distribute the seeds of improved rice variety, Naveen, suited for cultivation under irrigated ecosystem. A total of 200 kg of seeds was distributed to 20 tribal farmers from Carambolim village. Director, Dr. N. P. Singh, addressing the farmers briefed about the importance of the programme and distributed the seed kit to the farmers.

Seed distribution to farmers

National Extension Education Congress

ICAR Research Complex for Goa organized the 6th National Extension Education Congress 2011 (NEEC 2011) under the aegis of Society of Extension Education, Agra during 17-19 December, 2011. The theme of the congress was "Emerging Models of Technology Application for Agri-rural Development". The NEEC was inaugurated by Shri. Shripad Naik, Hon. Member of Parliament and presided over by Dr. M. Mahadevappa, Former Chairman, Agricultural Scientist Recruitment

Board (ASRB) and Dr. K. D. Kokate, Deputy Director General (Agricultural Extension), Indian Council of Agricultural Research was the Guest of Honour.

Ianguration of Extension Education Congress

The technical programme was divided into five sub themes and a lead paper session. The lead papers were presented by eminent scientists like Dr. K. D. Kokate, DDG (AE); Dr. C. Prasad, Former DDG (AE); Dr. V. Veerbhadraiah, Former Director Extension, UAS, Bangalore; Dr. A. K. Singh, Zonal Project Director, ICAR, Kanpur; Dr. N.P. Singh, Director ICAR Research Complex, Goa and Dr. R. P. S. Ratan, Director Extension, BAU, Ranchi. The valedictory session of the congress was graced by Dr. S. N. Puri, Vice Chancellor, Central Agricultural University, Imphal as the Chief Guest and Dr. V. V. Sadamate, Senior Advisor (Agriculture), Planning Commission was the Guest of Honour.

Scientists Meet of AICRP on Poultry Breeding

The scientists working on AICRP on Poultry Breeding and Poultry Seed Project met at ICAR Research Complex for Goa, Old Goa to deliberate on major issues related to improvement in poultry production duing 6-7th January, 2012. The meet was inaugurated by Dr. R. Prabhakaran, Vice-Chancellor, TANUVAS, Chennai, in presence of Dr. S.C. Gupta, ADG (AP & B), ICAR, Dr. R.N. Chatterjee, Director, PDP, Hyderabad and Dr. N. P. Singh, Director, ICAR Goa. Dr. Prabhakaran emphasized on the development of different local specific breeds for rural poultry production. Dr. Gupta stated that diversified poultry production like ducks, quails and turkeys etc needs to be strengthened in addition to the rural poultry. Dr. Chatarjee told that although India stands 3rd position in egg production and 5th position in poultry meat production, the contribution from rural poultry is not significant. Dr. N.P. Singh said that although the per capita egg and poultry meat consumption in Goa is better than the national level, still there is demand for the poultry produce as the same is being imported from the neighboring states. Dr. B. K. Swain, Senior Scientist, ICAR proposed the vote of thanks.

Inauguration function of Scientist meet

Stake Holders Meet held

For formulating XII Plan, Stake holders meet was convened on 10th February, 2012 at the Institute. The meet was chaired by Dr. Vijay Mehta, Former Vice-Chancellor BSKKV, Dapoli and Chairman, QRT. Dr. N.P. Singh, Director of the Institute welcomed the participants and briefed about the purpose of meet and called for suggestions for inclusion in the XII plan proposal of the Institute. Dr. Mehta mentioned about the importance of such meetings for proper planning of activities in a perspective manner. Officials from different development departments of State Government, NGOs, progressive farmers and Scientists of the Institute participated in the discussion. Dr. B.K. Swain Co-ordinator, PME Cell proposed vote of thanks.

Stakeholders meet

Thematic campaigns on management of cashew stem and root borers

In order to create understanding among cashew farmers about the CSRB pest damage symptoms, seasonality and its biology and the methods of pest management to be adopted to check the spread of this dreaded pest, thematic campaigns on management of this pest were organized through the Directorate of Cashew Research Puttur, Karnataka and the Directorate of Cashewnut and Cocoa Development, Kochi, Kerala. Thematic campaigns were organized in different cashew tracts of Goa during 10 – 12th January 2012. The Director, Dr. N.P. Singh presided over the thematic campaigns. Dr. T N Raviprasad, Sr. Scientist (Agricultural Entomology), DCR, Puttur explained the farmers through photographic panels, about the pest damage.

Thematic campaign at Batim, Tiswadi

This was followed by a method demonstration for removing the grubs (young larvae of beetles) from the infested trees and insecticide treatment with chlorpyriphos (0.2%) which has been proved to be effective in checking the pest reinfestation. Dr. A.R.Desai, Senior Scientist (Hort.) and Dr. R. Maruthadurai, Scientist (Agricultural Entomology) and Shri. H.R.C. Prabhu, Subject Matter Specialist (Plant Protection), KVK (North Goa) facilitated the open house interaction and practical demonstrations.

National Seminar on Composting of Coir Pith and use of Geo textiles

A National Seminar on Composting of Coir Pith and use of Geo textiles was organized by the Institute in colaboration with Association of Coastal Agricultural Research and Coir-Board Regional Office, Bangalore on the 17th March, 2012. The Seminar was inaugurated by Shri. Pratapsingh Raoji Rane, Speaker of Goa Legislative Assembly. Shri. S. Shridhar, Executive Director, Goa Mineral Ore Exporters Association, Shri. R. Nagarajan, Regional Officer, Coir Board, Bangalore, Dr. K. Pradhan. Former Vice-Chancellor, Orissa University of Agriculture and Technology and Shri. Mahesh Patil, Vice-President, Sesa Goa Ltd., graced the occasion.

During the Inaugural programme, Dr. N.P. Singh, the Director of the Institute welcomed the guests and the participants and highlighted the importance of coir waste and its composting as well as use of geo-textiles for soil and water conservation especially for mine reject dumps. Shri. R. Nagarajan, Regional Officer, Coir Board, Bangalore stressed on the theme of the Seminar and its utility especially in Goa where geo-jute can make a change for stabilization of mine reject dumps. Shri. S. Shridhar, Executive Director, Goa Mineral Ore Exporters Association, in his address highlighted the role of mining companies in the use of geo-textiles to arrest the soil and water erosion especially in mine dumps.

During the technical session, Dr. Anitha Das Ravindranath, Scientific Officer, Central Coir Research Institute, Kalavoor, Alappuzha, Kerala Shri. R Nagarajan, Regional officer, Coir Board, Bangalore and Dr. V. Arunachalam, Principal Scientist (Horticulture), ICAR RC, Goa delivered the lectures. The technical sessions were followed by discussions on the field problems of the relevant topics. The Seminar was attended by about 150 delegates/ stake holders.

Inagural function of Seminar on Coir pith Composting

Committees and Meetings

Research Advisory Committee

The VI Research Advisory Committee (RAC) for ICAR Research Complex for Goa was constituted for a period of three years from 09/08/2010 to 08/08/2013. Following is the composition of RAC.

Dr. Kirti Singh — Chairman
Ex-Chairman, ASRB
Near TD College, Jaunpur (UP)

Dr. U. S. Singh — Member
STRASA Co-ordinator
IRRI, India Liason Office,
New Delhi

Dr. P. K.Chhonkar — Member
IARI Adjunct Professor &
ICAR Emeritus Scientist
Dwarka, New Delhi

Dr. P. Rethinam — Member
Former ADG (PC), ICAR
Lakshmi Nagar, S.N.Palayam,
Coimbatore (TN)

Dr. H. Rahman — Member
Director, PDADMAS
Bangalore

Dr. M. Sinha — Member
Advisor (Fisheries)
Govt. of Tripura ,
Pandit Nehru Complex,
Agratala

Prof. B. S. Hansra — Member
School of Agriculture
IGNOU, Maidan Garhi,
New Delhi

Dr. P. S. Minhas — Member
ADG (S&WM)
ICAR, New Delhi

Mr. Madhav Sahakari — Member
Chairman, Goa State Co-operative
Milk Producers'Union Limited,
Curti, Ponda, Goa

Fr. Almeida — Member
Pillar Education Society,
Bhironda, Goa

Dr. N. P. Singh — Member
Director
ICAR RC Goa, Old Goa

Dr. B.K.Swain — Member Secretary
Sr. Scientist (Poultry Science)
ICAR RC Goa, Old Goa

The first meeting of the VI RAC was held during 12 - 13 May, 2011. The meeting was chaired by Dr. Kirti Singh, Chairman, RAC and attended by following members :

1) Dr. P. K. Chhonkar,
2) Dr. P. Rethinam,
3) Dr. H.. Rahman,
4) Dr. M. Sinha,
5) Dr. B. S. Hansra,
6) Dr. P. S. Minhas,
7) Mr. Madhav Sahakari,
8) Fr. Almeida,
9) Dr. N. P. Singh and
10) Dr. B. K. Swain, Member - Secretary.

After detailed discussions, visits and meetings, the following recommendations were made

General recommendations

- The institute should be upgraded and renamed as **ICAR Research Complex for Western Region** to address the research need of larger geographical area of coastal region in particular. The institute should prepare a Detailed Project Report (DPR) in this regard for the consideration of the ICAR.
- RAC strongly felt a need to have Social Science Section with Scientists in the discipline of Agricultural Extension, Agricultural

Economics and Rural Sociology.

- There is a need to have Scientist in the discipline of Agricultural Engineering with specialization in farm machinery and post harvest technology.
- With a Scientists strength of 20 at present, 30 technical staff are required to maintain a ratio of 1.5 : 1. At present, there are 18 technical staff. Hence, additional 12 nos of technical staff need to be appointed in the cadre strength.
- The present laboratory facility is inadequate. Hence, provision for additional laboratory space may be made to meet the increased demand in future.
- RAC strongly feels that a master plan of the entire campus should be prepared by a competent architect to avoid the haphazard growth of the institute.
- The following vacant posts should be filled up on priority since the research work is suffering badly :
  a) Senior Scientist, (Soil Science), (Soil Chemistry/ Microbiology/ Fertility)
  b) Senior Scientist (Horticulture)
  c) Scientist (Entomology)
  d) Scientist (Fish and Fishery Science)
  e) Scientist (Agricultural Statistics)

Crop Improvement & Protection

- Technology for maximization of rice yield should be developed.
- Network of multiplication of seed/ planting material of the released varieties should be worked out and implemented in collaboration with State departments.
- Salt tolerant rice varieties from other institutions like TNAU (Peravurani, tanjavur (Dist), APAU (Machalipattam) and International Rice Research Institute may be tested under condition of the Goa.
- Effect of bioinoculants on existing cashew plantations should be observed for one more year in order to draw definite conclusions.

Resource Management and Integrated Production

- In organic farming experiment nutrient application from different sources should be based on nitrogen equivalent.
- Trichoderma spp and Pseudomonas spp. colonized FYM and vermicompost should be evaluated for the use in the organic farming.
- Technology development for the management of acid saline soils should be initiated.
- Research work should be initiated on rehabilitation of mine reject soils with inclusion of cashew, simaruba and glyricidia along with fish culture in the ponds. Wider bunds to be formed making use of the dug out areas and crops can be grown on the bunds. The slopes may be covered with lemon grass, citrinell, vetiver, etc.

Horticulture

- An evaluation trial need to be taken up with grafts of promising dwarf types of cashew available at the Complex. If any available at Directorate of Cashew can be obtained and included.
- Complete documentation of age old Bhironda accession of cashew need to be attempted.
- Work may be initiated on effect of micro-irrigation/ fertigation/ drip irrigation systems during dry spell of the year in cashew plantation for increasing production.
- In cropping system experiment crops like Aonla (NA-7 and NA-10) may be included.
- Systematic collection, conservation, characterization, evaluation and utilization of specific crops in specific locations with time bound activities should be taken up.
- Identified promising varieties of mango like Cardozo mankurad progeny orchard should be maintained for production of planting material since demand is more.
- Project on collection, conservation and evaluation of Noni (Morinda citrifolia) in the western region may be submitted to World Noni Research Foundation, Chennai for financial support.
- Geographical registration (GI) of important germplasm / local land races of all crops like cashew, mango, kokum, chilli, bhendi etc. may be taken up.
- The exploration studies on cashew local type in the eastern region of Goa should be taken up on priority. The local germplasm

collection from Goa should be programmed on time targeted manner.

Animal Sciences

- Alternate housing and management options should be worked out to overcome the climate change impact on livestock in Konkan region.
- Formulation of economic ration using locally available unconventional feed ingredients for livestock and poultry for popularization should be taken up.
- Strategies should be worked out for year round production of green fodder / leguminous tree / fodder tree making use of coconut plantation and other areas.
- Work on major economically important diseases of livestock and poultry should be initiated.

Fisheries

- Locally acceptable technology of seed production for brackish water fisheries need to be developed in collaboration with CIBA.
- Breeding and rearing techniques for locally available ornamental fish seed be developed.
- Ecohatchery for Indian Major Carps (IMC) seed production should be established both for production and demonstration.

Transfer of Technology

- The revolving funds of the KVK should be made operational.
- All the sales done in KVK may be deposited in the fund.
- Demonstration units of KVK should be a part of the institute to avoid duplication.
- The seed production should be done with participation of the selected farmers.
- The baseline survey of the adopted villages should be done to ascertain the progress made by KVK.
- An impact evaluation study may be initiated to assess the impact of varieties and techniologies of this complex over a period of time to improve the agri /hort. /fish / poultry/ animals of the state.

Institute Management Committee

The Institute Management Committee is constituted for financial and administrative guidance of Institute by the council for a period of three years from 14/09/2010 to 13/09/2013. Following is the composition of IMC.

Dr. N. P. Singh Director ICAR RC Goa, Old Goa	Chairman
Shri P. Tufani Deputy Director (Plant Protection) Directorate of Agriculture, Tonca, Caranzalem-Goa.	Member
Dr. Parag Haldankar Prof. & Head Department of Horticulture, Dr.BSKKV, Dapoli, Ratnagiri – 415 712 (Maharashtra)	Member
Dr. B. B. Jadhav Director of Research Dr. BSKKV, Dapoli Dapoli – 415 712, Dist. Ratnagiri (Maharashtra)	Member
Shri Madhav Sahakari Chairman, Goa State Co-operative Milk Producers'Union Limited, Curti, Ponda, Goa	Member
Father Almeida Pillar Education Society Bhironda, Valpoi, Goa.	Member
Dr. Anand Kumar Singh Head Division of Fruit Sciences & Horticulture, IARI, New Delhi	Member
Dr. A. R. Desai Senior Scientist (Hort.) ICAR RC Goa, Old Goa.	Member
Dr. Satish Kulkarni Head, SRS of NDRI Adugodi, Bangalore	Member

Dr. (Ms.) V. Kripa Principal Scientist CMFRI, Kochi.	Member
Dr. P. S. Minhas ADG (SW&M) ICAR, KAB-II New Delhi -12	Member
Finance & Accounts Officer CIRCOT, Adenwala Road, Matunga, Mumbai - 400 019	Member
Mr. K. R. Naik Asst. Admn. Officer (Estt) ICAR RC Goa, Old Goa	Member Secretary

The meeting of the IMC was held on 29 February, 2012 under the chairmanship of Dr. N.P. Singh, Director of the Institute. Proposals for purchase of different types of equipments and undertaking different types works were approved.

Institute Research Council

The 22nd Annual Institute Research Council meeting of the Institute was held during 29th June - 1st July 2011 in the conference hall of the Institute. The IRC reviewed the progress made under various research projects for the year 2010-11 and finalized the technical programmes of the ongoing research projects for the year 2011-12. The Committee of the IRC is as follows.

Dr. N. P. Singh Director, ICAR RC Goa, Old Goa	Chairman
All Project Leaders	Members
Dr. B. L. Manjunath Senior Scientist, ICAR RC Goa, Old Goa	Member Secretary

Review of Animal Sciences Research by Dr. K. Pradhan

Dr. K. Pradhan, Ex Vice Chancellor reviewed the research activities of the Animal Science component of the Institute and suggested research programs to be undertaken during XII five year plan in the area of animal nutrition relevant to the state during March 14-15, 2012. After visiting the livestock research farm (dairy, piggery and rabbit, poultry), fodder research units, research laboratories and other infrastructural facilities, the presentations of animal science research activities were made by scientists, which were followed by discussions.

Considering the need of the state and necessity of strengthening and upgrading the status of the institute during XII Plan, the following recommendations were made for the future research and training.

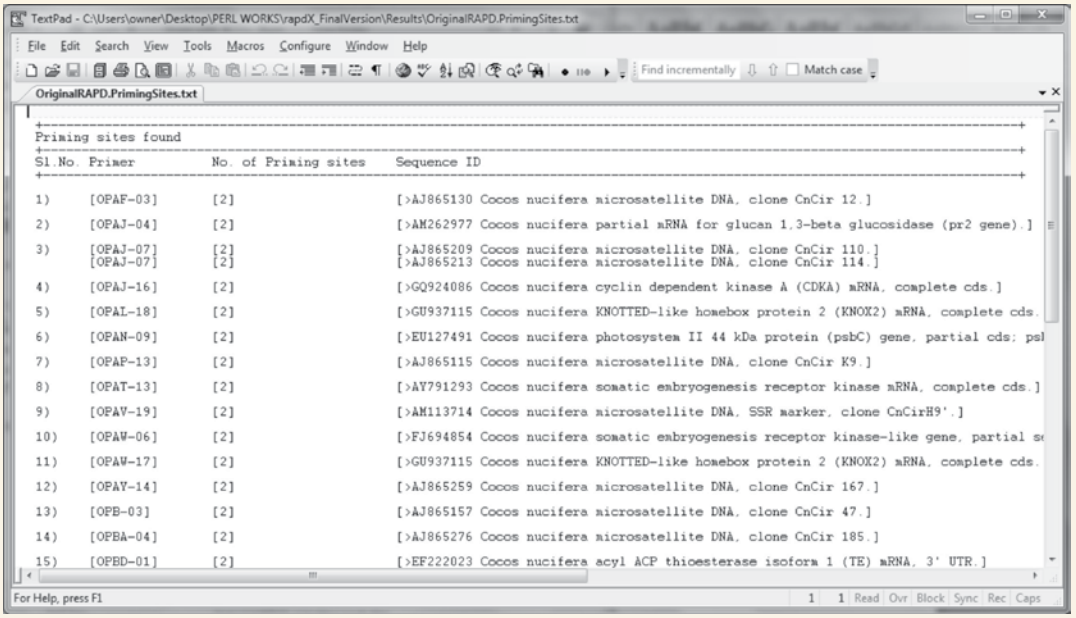
- Studies on industrial pollutants affecting animal health with a greater emphasis on Cashew Industry may be carried out.
- Environmental impact study on animals is to be carried out elaborately to develop integrated management practices for reducing adverse effects on animal health and production.
- Study on the feeding of indigenous dairy animals should be made for maintenance, growth and milk production primarily using available dry roughages like paddy straw with intervention of feed supplements where, required.
- Simple and economical methods should be developed to improve the nutritional value of poor quality roughages, develop methods to prepare feed blocks using poor quality roughages and transfer these technologies to livestock farmers through demonstration and training.
- Collaborative research on nutrition and reproduction in cattle and buffaloes should be a priority research area in the state.
- A collaborative research project on soil-plant-animal relationship should be initiated involving animal nutritionists and soil scientists/ agronomists at the Institute level.
- Studies on feed supplements, feed additives and herbal products in poultry diet in project mode within time frame for finding suitable levels of recommendations for end users.
- Studies on nutrition-immunity relationship should be made for improved poultry production.

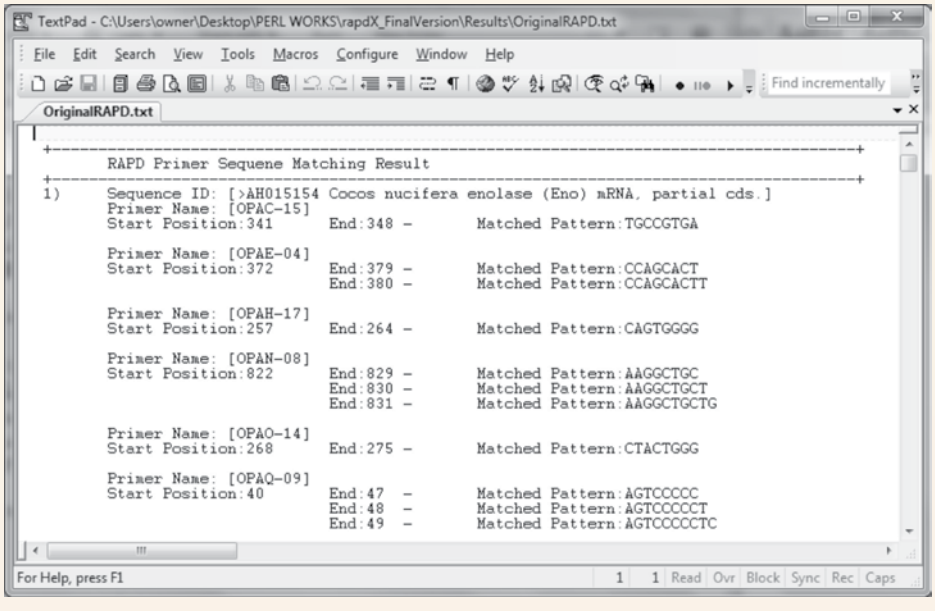
Infrastructure Development and Capacity Building

ARIS Cell (*PI: V Arunachalam*)

A video conference facility was established at the Institute.

Bioinformatics software (Marker express 1.0) was developed to aid molecular biologists in choosing right RAPD primers for genomics applications and to design iSCAR primers. The software requires two input files -nucleotide sequence of the target organism and the set of dominant primer (RAPD/ISSR) sequences. It gives the many output files such the regions where the priming sites occur, anticipated amplicon size, designed iSCAR primers etc. The tool was validated using the expressed sequences of oil palm and predicted >90 % of the published polymorphic primers.





Distinguished Visitors

Date	Name of Visitor	Designation/ Institute/ Place
20.04.2011, 08.11.2011 and 17.03.2012	Shri. Pratapsingh Rane	Honourable Speaker, Government of Goa
20.04.2011 and 18.05.2011	Shri Sripad Naik	Honourable Member of Parliament, North Goa (Lokh Sabha)
18.05.2011	Shri. Sharad Pawar	Honourable Union Minister of Agriculture and Food Processing, Government of India
27.06.2011	The Study Group of the Parliamentary Committee on Agriculture	Honourable Members of Parliament
10.09.2011 and 19.11.2011	Dr. A. K. Singh	DDG (NRM), ICAR, New Delhi
17.10.2011	Shri. Madhav Sahakari	Chairman, Goa Milk Producers Co-op. Society, Ponda
04.11.2012	Shri. Gurudas Bakta	Secretary, Goa Olympic Association
18.12.2011	Dr. S.N. Puri	Vice Chancellor, Central Agricultural University, Imphal.
18..12.2011	Dr. U.V. Sadamate	Senior Advisor (Agriculture), Planning Commission, New Delhi.
06.01.2012	Dr. R. Pradhan	Vice Chancellor, TANUVAS, Chennai
06.01.2012	Dr. S.C. Gupta	ADG (AP & B), ICAR, New Delhi
06.01.2012	Dr. R.N. Chatterjee,	Director, Project Directorate on Poultry, Hyderabad
10.02.2012	Dr. Vijay Mehta	Former Vice-Chancellor, Konkan Krishi Vidyapeeth and Chairman, QRT
17.03.2012	Dr. K. Pradhan	Former Vice-Chancellor, Orissa University of Agriculture and Technology

Personnel

Institute

Sr. No.	Name	Designation	Additional Charge
Research Management			
1.	Dr. N. P. Singh	Director	
Scientific Staff			
1.	Dr. S. Subramanian	Principal. Scientist (Fishery Science)	Fisheries Section; F&A.O; PIO
2.	Dr. S. K. Das	Principal Scientist (Livestock Production & Management)	Animal Science Section
3.	Dr. V. Arunachalam	Principal Scientist (Horticulture)	Horticulture Section; RFD Cell
4.	Dr. E. B. Chakurkar	Senior Scientist (Animal Reproduction)	Estate; Vehicle
5.	Dr. B. L. Manjunath	Senior Scientist (Agronomy)	RMIP Section; Farm; IRC
6.	Dr. S. B. Barbuddhe	Senior Scientist (Veterinary Public Health)	ATDC; Newsletter
7.	Dr. B. K. Swain	Senior Scientist (Poultry Science)	PME Cell
8.	Dr. P. K. Naik	Senior Scientist (Animal Nutrition)	HRD Cell; Annual Report
9.	Dr. A. R. Desai	Senior Scientist (Horticulture)	IPR Cell
10.	Dr. M. Thangam	Senior Scientist (Horticulture)	
11.	Dr. R. Ramesh	Senior Scientist (Plant Pathology)	CIP Section; ARIS Cell
12.	Dr. S. Priya Devi	Scientist (Horticulture)	
13.	Dr. M. J. Gupta	Scientist (AS & PE)	Hindi Cell; RKVY
14.	Dr. R. R. Verma	Scientist (Soil Physics/SWC)	
15.	Ms. S. A. Safeena	Scientist (Horticulture)	
16.	Dr. Manohara K. K	Scientist (Plant Breeding)	Library
17.	Dr. M. Karunakaran	Scientist (Animal Reproduction)	TSP
18.	Dr. R. Maruthadurai	Scientist (Agricultural Entomology)	
Technical Staff			
1.	Shri V. D. Kulkarni	Technical Officer T-6 (Farm)	
2.	Dr. Sanath Kumar	Farm Superintendent	
3.	Shri Ulhas B. Porwar	Tech. Officer . T-5	
4.	Shri Edward Crasto	Tech. Officer . T-5 (Stockman)	
5.	Shri Sidharth K. Marathe	Tech. Officer . T-5 (PME Cell)	
6.	Ms. Madina Sollapuri	Tech. Officer . T-5 (Estate)	
7.	Shri Rahul Kulkarni	Tech. Officer . T-5 (Hort)	
8.	Shri Raghurama Kukkude	Tech. Officer . T-5 (Library)	
9.	Ms. Pranjali Wadekar	Tech. Officer . T-5 (Computers)	
10.	Shri Keshav Chodnekar	Tech. Officer, T-5	
11.	Shri Dharmapala	Tech. Officer, T-5	

Sr. No.	Name	Designation	Additional Charge
12.	Shri Yoganand Gaude	Tech Asst. T-4 (Electrical)	
13.	Shri Prakash V Jannaik	Tech. Asst, T-4	
14.	Shri Mahesh Parsekar	Tech. Asst, T-4	
15.	Shri Ankush N Kambli	Tech. Asst, T-4	
16.	Shri Yeshwant K. Gawas	Tech. Asst, T-3	
17.	Shri Suresh M Gomes	Tractor Driver, T-2	
18.	Shri Upendra Kumar	Junior Technical Assistant T-1	
Administrative & Accounts Staff			
1.	Shri. Jagtar Singh	Administrative Officer	
2.	Ms.. Maria Teresa Nilgli	Assistant Administrative Officer (Stores)	DDO
3.	Shri Krishnanath R Naik	Assistant Administrative Officer (Establishment)	AAO (KVK)
4.	Shri K. Yesodharan	Assistant Administrative Officer (Works)	
5.	Ms. Lizette Noronha	Personal Assistant	
6.	Shri Agostinho Fernandes	Assistant	
7.	Ms. Asha Manjrekar	Assistant	
8.	Ms. Montia Rita D'Silva	Assistant	
9.	Ms. Pratibha Revodkar	Assistant	
10.	Ms. Sunanda Chopdekar	Assistant	
11.	Ms. Tarika Maoulignkar	Stenographer Grade.III	
12.	Ms. Shreya Barve	Stenographer Grade.III	
13.	Mr. Vinod Pagi	LDC	
14.	Miss Chitra Madkaikar	LDC	
15.	Shri. Tushar Mangaraj	LDC	
16.	Shri. Vyas Hiren Kumar	LDC	
17.	Shri. Vikrant Gupta	LDC	
Skilled Supporting Staff			
1.	Shri Subhash Melekar		
2.	Ms. Rukma R. Naik		
3.	Shri Francisco Fernandes		
4.	Shri Dugu Khandeparkar		
5	Shri Ashok Gadekar		
6.	Ms. Farida Jabbarkhan		
7.	Shri Ravi S. Kadam		
8.	Shri Chimmnu Tivrekar		
9.	Shri Umakant Haldankar		
10.	Ms. Sunitha Salgaonkar		
11.	Shri Anil Khandeparkar		
12.	Ms.Maria S. Varella		
13	Shri Giri Madkaikar		
14	Shri Gokuldas Kasker		


Sr. No.	Name	Designation	Additional Charge
15.	Shri Umesh Marcelkar		
16.	Shri Vittal Porwar		
17.	Ms. Prafulla Gadekar		
18.	Ms. Rekha V. Naik		
19.	Ms. Lalitha Gadekar		
20.	Ms. Partibha Folkar		
21.	Shri Vilas P. Gaonkar		
22.	Shri Prabhakar Goankar		
23.	Shri Gokuldas P. Gauns		
24.	Shri Sitaram Kuncolikar		
25.	Ms. Janika S. Shirodkar		
26.	Shri Shanu G. Velip		
27.	Shri Datta G. Velip		

Krishi Vigyan Kendra

Sr. No.	Name	Designation
Scientific		
1.	Dr. Raj Narayan	Programme Co-ordinator
Technical Staff		
1.	Shri. Vishram Gaonkar	Subject Matter Specialist T-9 (Horticulture)
2.	Dr. Avinash Nirmale	Subject Matter Specialist T-9 (Veterinary)
3.	Shri H. R. Prabhudesai	Subject Matter Specialist T-9 (Agronomy)
4.	Ms. Sunetra Talaulikar	Subject Matter Specialist T-9 (Home Science)
5.	Shri H. R. C. Prabhu	Subject Matter Specialist T-9 (Plant Protection)
6.	Dr. Vilas Sakharkar	Subject Matter Specialist T-6 (Extension)
7.	Shri Shashi Vishwakarma	Programme Assistant T-4 (Lab Technician)
8.	Shri Prajapati V. S.	Programme Assistant T-4 (Computer)
9.	Shri Deep Kumar	Farm Manager T-4
10.	Shri Irappa M Chalwadi	Driver-cum-Mechanic T-3
11.	Shri. Dilkush Velip	Driver T-1
Administrative		
1.	Shri Mario Fernandes	Personnel Secretary
Skilled Supporting Staff		
1.	Shri Prakash Parwar	
2.	Shri Payak J. Padkar	

Staff Activities

Appointments / Joining

Name	Post	Date of Joining
Dr. R Maruthadurai	Scientist (Agricultural Entomology)	24-04-2011
Dr. M Karunakaran	Scientist (Animal Reproduction)	13-06-2011
Shri Jagtar Singh	Administrative Officer	16-05-2011
Dr. Sanath Kumar	Farm Superintendent T-6	16-05-2011
Shri Deep Kumar	Farm Manager T-4	06-06-2011
Mrs. Shreya Barve	Stenographer Gr. III	20-12-2011
Shri. Tushar Mangaraj	LDC	23-03-2012
Shri. Vyas Hiren Kumar	LDC	23-03-2012
Shri. Vikrant Gupta	LDC	27-03-2012
Shri. Upendra Kumar	Technical Assistant T-1	27-03-2012
Shri. Dilkush Velip	Driver T-1	26-03-2012

Promotions

Name & Designation	Post held	Promoted Post	Date of promotion
Shri Yogananad Gaude	Technical Assistant T-4	Technical Officer T-5	15-11-2011
Smt. Tarika Maulingkar	Stenographer Gr. III	Personal Assistant	14-03-2012
Shri Irappa Chalwadi	Driver T-3	Driver T-4	15-11-2011
Shri Suresh Gomes	Technical Assistant T-2	Technical Assistant T-3	24-01-2012
Smt. Chitra Madkaikar,	SSS	LDC	14-07-2011

Retirement

Name	Post held	Date of Retirement
Shri Mario Fernandes	Private Secretary	31-03-2012
Shri Mahesh Parsekar	Technical Assistant T-4	01-08-2011
Shri. Ulhas Porwar	T-5 (Technical Officer)	31-03-2012
Shri B. Dharampala	T-5 (Technical Officer)	31-03-2012

Resignation

Name	Post Held	Date of Resignation
Shri Minanath Zhalmi	Technical Assistant T-1	31-05-2011

भाकृअनुप
ICAR

गोवा के लिए भा.कृ.अनु.प. का अनुसंधान परिसर

(भारतीय कृषि अनुसंधान परिषद)

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(Indian Council of Agricultural Research)

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