

वार्षिक प्रतिवेदन
Annual Report
2012-2013



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



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ICAR RC GOA

Annual Report

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Correct Citation : **Annual Report, 2012-13**
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Old Goa, Goa - 403 402, India

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Printed at : Impressions, Belgaum

Preface



The ICAR Research Complex for Goa, Old Goa is one of the unique research Institutes under ICAR where strategic and applied research on agriculture, animal husbandry and fishery sciences is carried out. The Institute research programs are carried out by multidisciplinary team of scientists from various sections viz, Crop Improvement and Protection, Resource Management and Integrated Production, Horticulture, Animal Science and Fishery Science. The technologies developed are transferred to the farmers through various programs by Scientists, Krishi Vigyan Kendra (KVK) and also in collaboration with developmental departments of the State. The Institute has state of art laboratory facilities and serves as a centre for post graduate research of various universities from within and outside the state under the guidance of scientists.

The Institute has developed and popularized several technologies over the years. The major research activities during this year include studies on suitable soil and water conservation technologies in coconut, mango in the hill slopes, soil nutrient mapping using GPS- co-ordination, standardization of organic rice production, development of integrated farming system models suitable for upland and low land situations, homestead farming, evaluation of suitable rice varieties for Goa, development of saline tolerant rice variety, evaluation of bio-control agents for wilt management in watermelon, studies on bacterial wilt in brinjal, insect pests of cashew, germplasm collection of horticultural crops and their evaluation, evaluation of hybrid cashew, nutmeg accessions, brinjal and chilli varieties. Under animal sciences, studies on the effect of micro environment on milk production, studies on fodder production, poultry feed, management of zoonotic diseases, studies on boar semen preservation were carried out. Further Centre of Excellence and Innovations in Biotechnology has been sanctioned by DBT, GOI for translational centre for molecular epidemiology of *Listeria monocytogenes* with huge budget outlay.

During this period, the Institute has organized a number of workshops, seminars and transfer of technology programmes. Research initiations and achievements were appreciated by Shri. Bharat Vir Wanchoo, Honourable Governor of Goa, Shri. Manohar Parrikar, Honourable Chief Minister, Government of Goa, Shri Shripad Naik, Honourable Member of Parliament, North Goa (Lok Sabha) and Dr. S. Ayyappan, Honourable Secretary, DARE and DG, ICAR, Government of India. Good number of peer reviewed research articles and other technical articles have been published by the Scientists of this Institute.

I place on record my gratitude to Dr. S. Ayyappan, Honourable Secretary, DARE and DG, ICAR for the encouragement and guidance extended all the while. I am thankful to Dr. A. K. Singh, Honourable Ex DDG (NRM) and Dr. A. K. Sikka, Honourable. DDG (NRM) and Dr. B. Mohan Kumar, ADG (Soils & Agro Forestry) for their constant inspiration and sustained interest in the activities and progress of this Institute. I appreciate all the scientists and other staff members who contributed to the development of the Institute. I sincerely acknowledge the efforts made by the editors of the Annual Report for compilation and proper editing.

As the Director of the Institute it gives me immense pleasure to present the Annual Report 2012-13 and I hope the report will be useful to researchers, policy makers, planners and extension personnel.



(Narendra Pratap Singh)
Director

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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. The highlights of the research achievements of this Institute for the year 2012-2013 are presented below.

Resource Management and Integrated Production

Soil and water conservation studies in mango revealed better efficiency of continuous contour trenches with vegetative barrier of *Vetiveria zizaniodes* over staggered contour trenches with vegetative barrier of *Vetiveria zizaniodes* or vegetative barrier alone. The impact of the treatment was reflected with significantly higher branching in mango as compared to staggered contour trenches or vegetative barrier alone. Further, the conservation measures also favoured higher retention of soil potassium as compared to other treatments. In a similar study under coconut system, circular trenches found to support higher growth of coconut in terms of height, girth and leaf production as compared to control.

Soil fertility mapping for the State of Goa was completed during the year with soil sampling based on GPS co-ordinates under a DAC funded project. A total of 680 samples covering both North and South Goa districts were collected and analyzed for different soil fertility parameters using standard procedures and the nutrient wise maps were prepared for the state of Goa with the co-ordination of Indian Institute of Soil Science, Bhopal.

A field trial on standardization of management practices for organic production of rice revealed significantly higher grain yield (6.02t/ha) with the high yielding medium duration rice variety, Karjat-3 followed by red kernelled rice, Revathy. Among the nutrient sources applied, paddy straw with water hyacinth and FYM application on equivalent N basis recorded significantly better yield as compared to rest of the nutrient sources. Application of FYM as well as paddy straw with water hyacinth found to enhance soil available N significantly (229 and 218

kg/ha, respectively) as compared to application of recommended fertilizers alone (170 kg/ha) or control (189 kg/ha).

All India Co-ordinated Research Project on Integrated farming systems (IFS) was continued during the year for the development of two models one each for undulating upland and lowland situations. The upland model is being developed with the predominance of plantation crops alongwith the feasible intercrops suitable to the region. Their integration with poultry, piggery, and vermi composting are being standardised. Cashew (variety Bhaskara) + pine apple (variety Giant Kew) system in the upper elevation yielded a productivity of 901 kg/ha cashew nuts with a mean nut yield of 3.2 kg nuts/ tree.

The lowland IFS model is being developed with selection of profitable rice based crops and integration with dairy, oyster mushroom and vermi-composting. During *khariif*, 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 51), brinjal (local cultivar Agassaim) and sweet corn (Hybrid Sugar 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 along with bund cropping of hybrid napier forage grass and border planting of local banana. The mean yield of rice-brinjal system was 16,956 kg/ha/year rice grain equivalent yield. Rice-cowpea system yield was 9,741 kg/ha/year. Rice-groundnut yielded 9,603 kg/ha while rice-sweet corn yielded highest 18,791 kg/ha/year productivity of Rice-sweet corn system followed by rice-brinjal system under protective irrigation were significantly more productive as compared to rice-cowpea and rice-groundnut under residual soil moisture conditions. The net returns were higher with rice-sweet corn (₹.95,350/ha) and rice-cowpea (₹.93,350/ha). Rice-Sweetcorn integrated with dairy system recorded highest gross returns (₹1,89,950/ha/yr) as well as net returns (₹1,19,050/ ha/yr).

A NABARD sponsored project on “Upscaling of Homestead farming in different farming systems of





Goa” was continued during the year with selection of twenty farmers representing two talukas each from North and South Goa districts. A preliminary survey was undertaken on the existing situation during pre-project period, suitable interventions were identified and the relevant technologies implemented with the supply of quality seed/planting materials. Data on productivity and economics was undertaken, a model homestead farming unit was established at the Institute and also standardised planting pattern for a model homestead unit.

Production of quality seeds was continued under Mega project on seed production in agricultural crops and fisheries. During *kharif* 2012, foundation seed production of rice (varieties Naveen and Karjat-3) at the Institute farm resulted in production of 3.0 tonnes of quality seeds. About 250 kg groundnut (variety TG 51) TL seed was produced during *kharif* 2012 which served as a seed chain and during *rabi* another 200 kg seed was produced. Four local cowpea selections were multiplied during *rabi* 2012-13. Further, a multiplication cum demonstration block of high yielding forage grasses was established at the Institute farm along with banana for the production of planting material.

Crop Improvement and Protection

Pure line selection in the local salt tolerant rice landrace *Korgut* has been initiated. Individual plant selections were made during *kharif* 2012 and the progeny performance was assessed during *rabi* 2012. Few promising lines were identified. F_2 seeds were obtained from the crosses involving local salinity tolerant landrace *Korgut* with high yielding popular varieties of the region *viz.*, Jyothi, Karjat-3, Naveen and Pusa-44.

A total of 16 landraces of rice from Goa were collected and characterized for various agro-morphological and yield attributing characters. Babri, a landrace from Goa and few landraces from Karnataka were added to the Institute germplasm collections. Landraces showed wide variation with respect to different agro-morphological characters.

In hybridization and generation advancement, a total of 31 salinity tolerant rice genotypes including landraces, improved cultivars and advanced breeding

lines were evaluated for yield and its contributing characters during *Kharif* 2012 under coastal salinity situations in farmers’ field at Chorao Island. Variety Sumati recorded highest grain yield of 4.31 t/ha followed by CSR-23 (4.13 t/ha) and Patnai (3.93 t/ha). The local check variety *Korgut* recorded grain yield of 2.27 t/ha.

Under rainfed shallow lowland situation, a total of 32 rice genotypes/varieties including landraces and improved cultivars were evaluated during *Kharif* 2012. Karjat-3 recorded highest grain yield of 6.83 t/ha followed by Uma (6.62 t/ha) and TRC-2005-1 (6.49 t/ha). Check variety *Jaya* recorded grain yield of 6.04 t/ha.

A total of thirty one 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. Top five entries with respect to grain yield are CSR - 2K- 262 (3.62 t/ha) followed by NDRK 11-1 (3.47 t/ha), CSR - 2K- 219 (3.42 t/ha) and NDRK 11-2 (3.25 t/ha) and PNL 4-35-20-4-1-4 (3.20 t/ha).

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. Among the test entries, the top 5 ranking entries are CN 1744-15-3-7-8-MLD 25 (4.42 t/ha), CR-2814-19-4-2-1-1 (4.07 t/ha), CR 2837-1-1-B-1-B-S-B (3.90 t/ha), Gosaba-2(IR 68652-3B-30-2) (3.70 t/ha) and CN 1785-20-21-9-MLD 26 (3.52 t/ha).

In genetic enhancement of cowpea, pure line selection in local germplasm collection was attempted. A total of 10 individual plants from each of the germplasm were selected and recorded for yield and its contributing characters.

Infestation of ambrosia beetle *Euplatypus parallelus* was recorded on cashew ecosystem. Occurrence of small, rounded bore holes on the main





trunk and branches and extrusion of saw dust frass material on the tree trunk, branches and in loose piles at the base of the tree were the major symptoms of attack. Morphometric studies of *E. parallelus* revealed that the grubs, 3.0 to 3.5 mm in length, are creamy white in colour and fully grown adult beetles are brown in colour with long and slender bodies with yellow hairs.

Three field trials were conducted to evaluate the efficiency of bio-control formulation in the management of wilt in water melon. Biocontrol treatments reduced the incidence of wilt in watermelon and increased the number of fruits. All the biocontrol treatments were better than chemical treatment. Per cent reduction of wilt was 76-84% and per cent increase in number of fruits was 26-30% based on consolidated data of three field trials. A total of 237 *R. solanacearum* isolates are being maintained in the culture collection. Twenty diverse *R. solanacearum* strains were selected based on the *egl* sequence tree, geographical location and host for MLST analysis. The MLST results indicated that some of the isolates are assigned same allelic profile. Based on the diversity analysis, pathogenicity on three hosts and geographical origin, two *R. solanacearum* isolates were selected for sequencing to understand the role of various virulence factors in infection and colonization. Twenty eight xylem residing bacteria were found to be antagonistic against *R. solanacearum*. Six xylem residing bacteria increased the growth in brinjal under green house condition. Results of mapping population of brinjal indicated that all the plants of *Agassaim* wilted but none of the plants of resistant donar. In F_2 population some plants did not wilt. Seeds were collected from the F_2 plants which were not wilted to test their resistance in the next generation and for further analysis.

Horticulture

In cashew, five new accessions were added during the year and presently a total of 81 local cashew accessions are being maintained in the institute's farm. Evaluation trial of bold nut genotypes revealed that nut yield, though not significant, varied from 0.21 kg/tree (BKL-2 and Tudal-3) to 0.56 kg/tree (Bardez-8/98) as against 0.45kg /tree recorded in check (Goa-1). On the other hand, the genotypes namely Valpoi-2, Bardez-9 and Tiswadi-3 recorded the nut weight of more than

10g. Under the evaluation trial of new hybrids / varieties introduced from other cashew research stations, 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 during the current year. Nut and apple size were observed to be stable over two seasons.

Under the evaluation of hybrids, the hybrid H-21/05 with mean nut weight of 8.6 g and shelling per cent of 29.15 continued to record promising trend with higher nut yield per tree. Other promising hybrids included H-11/05, H-12/05. Genomic DNA of 25 genotypes including cashew hybrids, their parents and accessions having contrasting or specialty traits was isolated for further studies. Eight thousand grafts of cashew varieties promising accessions and hybrids were produced for sales and also for supplying to farmers under Front line demonstration programmes.

In nutmeg, studies revealed that genotypes such as NMD1, NMD2, NMF3, NMF5 showed higher yield performance. Fruiting was observed to be staggered over 5 months in NMD1 and 2, while it was spread over four months in NMF3 and NMF5 genotypes with two peaks. NMF6 genotype, though high yielder, fruiting was spread over 3 months, starting from June first week. Higher shelling per cent of 66.03 was recorded in NME2 followed by 65.58g (NMD2), 65.18g (NMF3), 63.59g (NMD3) and 62.64 g (NMF5) respectively.

In mango, a total of 123 Germplasm accessions/ varieties are maintained in the institutue's farm besides two wild relatives of mango (*Mangifera camptosperm* and *M. spithi*). Four thousand five hundred mango grafts of Mankurad, Amrapali, Kesar and Alphonso were produced for supplying quality planting material during the current year.

Under DCCD (Directorate of Cashewnut and Cocoa Development, Kochi, Kerala, Govt. of India) sponsored programme, during the current year four new FLDs were taken up, besides the earlier five FLDs, making the total to nine FLDs, covering 12 hectares of area.

In kokum, propagation of elite types (Parashte-3, Kasarpal-5, Savoikamini-1, Hedode and Maina Pilerne-1) identified was continued. Among the





accessions studied, Kasarpal 5 has been consistently observed to be a promising accession in terms of fruit yield for the past six years. Fruit development study indicated sigmoid growth pattern for all the fruit traits studied in kokum. In wax apple, fruit diameter followed double sigmoid and other traits were in sigmoid pattern of growth. Evaluation of commercial cultivars of fruit crops continued in Aonla, cherry types, grape fruit, acid lime and pomegranate.

Among the amaranthus accessions of Goa, At-G-37 performed best with a high leaf stem ratio (4.2) and high yield of leaves. Coriander (F1 hybrid Sugandha) gave good leaf yield (5 t/ha) when grown as intercrop in coconut in acid laterite soil. Six accessions of noni collected from Goa were submitted to NBPGR New Delhi for long term conservation. Seedlings of papaya, chillies and marigold were produced and distributed to farmers.

In vegetable crops, bacterial wilt resistant brinjal varieties were evaluated along with local check. Out of seven varieties evaluated, Surya and Swetha recorded consistently high yield (25.43 t/ha and 23.36 t/ha respectively) for two years with almost zero per cent incidence of bacterial wilt under field condition. The next better varieties were Singhnath and Bholanath in respect of bacterial wilt resistance.

In AICRP trial on brinjal, the highest yield was recorded in 10/BRLVAR-6 (398.00 q/ha) followed by 10/BRLVAR-3 (380 q/ha.). The standard check Punjab Sadabahar recorded the third best yield among the varieties. In chilli IET and AVT-I trials, the highest yield of red ripe chilli was recorded in 2011/CHIVAR-3 (77.00q/ha) and KA-2 (83.33 q/ha) respectively during the evaluation.

In gerbera, out of four varieties evaluated under polyhouse, varieties blessings and Forza recorded high yield in terms of number of flowers per plant per year. In heliconia, out of twenty five types evaluated under coconut plantation, eight to ten varieties has potential as cut flower crops with long flower, colourful bracts with extended shelf life.

Primary and secondary data on paddy post harvest losses for *Kharif* paddy sown in 2011 was collected from harvest to storage. Based on secondary data collected from 50 farmers spread in 10 villages of Goa

showed that the average harvest to storage losses in paddy was around 20.4 per cent of the total produce.

Microclimates of five protected cultivation structures under conditions of Goa were studied and results indicated that among structures though shade net structures showed a more uniform microclimate as compared to naturally ventilated polyhouse where there was a build up of temperature with height, there was no significant difference of diurnal variation of microclimate between the two structures. Transmittivity, orientation of structure, prevailing wind direction and location of vents had a significant effect on airflow pattern in the structure.

Animal Science

Study on the effect of housing on the milk production and microenvironment of cattle shed revealed that orientation of cattle shed had highly significant effect on average daily milk yield. It was significantly higher in cattle shed having east – west orientation (9.466 ± 0.110 kg) than that in cattle shed with north - south orientation (9.360 ± 0.056 kg). Both average daily air temperature and average daily temperature humidity index were significantly lower in shed with east – west orientation. It was observed that significantly higher milk yield, lower air temperature, lower relative humidity and lower temperature humidity index were observed in cattle shed with good ventilation. Cooling arrangement in cattle house had highly significant effect on average daily milk yield and all the micro-environmental parameters.

It was revealed that splashing of water on the animals followed by air circulation by electric fans thrice daily and roof modification by white painting on outer surface of roof and black painting on inner surface of the roof of dairy shed benefited to overcome adverse effect of micro climatological changes on daily milk yield of cows by 70% and on monthly milk yield of cows by 76%. Study on physiological responses of cattle revealed higher heat tolerance of Sahiwal over Cross bred cattle. Cooling arrangement by way of false ceiling in rabbit shed caused lesser heat stress and reduced the decline in growth around 79%. Benefit was maximum in case of New Zealand White and Soviet Chinchilla rabbit indicating better adaptability than that of Gray Giant and Black Brown rabbit.





In the project assessment of early sexually maturity in Goa local pigs, castrations were undertaken at different age in Goa Local, Large White Yorkshire and Crossbred male pigs. Testicular bimetry was recorded *viz.* length, thickness, width and weight. Appearance of sperm cell was recorded as indication of maturity as well as serum samples were collected for the analysis of testosterone hormone.

A project under Centre of Excellence and Innovation in Biotechnology has been sanctioned by Department of Biotechnology, Government of India for Translational Centre for Molecular Epidemiology of *Listeria monocytogenes*. Isolation of *Listeria* spp. from clinical, food and environmental sources revealed high prevalence. The environmental sources (seafood handling areas, mangrove origin biota such as oyster, prawns, crabs and fishes) revealed high incidence of *L. ivanovii*. The pig products and piggery environment also harbour *Listeria* spp. significantly. The repository of *Listeria* spp. has 680 cultures of *Listeria* isolated/collected/submitted from all over India.

Mass awareness campaigns and demonstrations at farms were organized on clean milk production, zoonoses and foodborne infections. Different foodborne pathogens namely, *Escherichia coli*, *Salmonella* and *Vibrio* were isolated from food and environmental samples. High prevalence (13.62%) of brucellosis was recorded from dairy animals.

Method was standardized for extraction of dsRNA of rotavirus from fecal samples followed by detection of dsRNA NA-PAGE. A total of 42 piglet diarrhoeal fecal samples and 17 stool samples from children were also collected for screening. A total of 106 *E.coli* isolates were maintained at Laboratory of Animal Science Section, of which 68 isolates were subjected to antimicrobial sensitivity tests and results indicated that maximum isolates were resistant to almost all tested antimicrobials.

Semen samples were collected from Large White Yorkshire, Duroc and crossbred boars by gloved hand technique. Suitable semen ejaculates were preserved using short term extender BTS and long term extender Safecel plus at 17° C and evaluated for sperm motility, plasma membrane integrity, functional membrane, mitochondrial membrane potential and lipid peroxidation level. BTS buffer

was able to maintain semen quality for 4 days while, Safecel plus was able to maintain for 7 days. Artificial insemination with semen preserved in BTS given conception rate of 75%.

A fodder museum with 24 types of non-leguminous pereneal and grasses fodder and 8 types of tree fodders intercrop with horticultural crops have been developed in the Institute for training, demonstration and providing planting materials to the farmers. Silage prepared in bunker silo from napier bajra hybrid green fodder without any additives is well accepted by dairy animals. A simple indigenous technology for the production of bypass fat (rumen protected fat) has been developed and it was observed that supplementation of the indigenously prepared bypass fat increased the milk yield, fat corrected milk (FCM) yield, fat% and SNF% in crossbred cows. The cost of per kg hydroponics maize fodder is about ₹. 4-4.50/- on fresh basis in which the seed cost contributes 90% of the total cost of production. Basic infra structures for preparation of feed block was established at farmer's field and feed blocks are prepared from the available roughages.

Supplementation of multienzyme mixture (Natuzyne) @ 1.0 g/Kg diet was effective in improving the performance and net profit in broiler chickens. Brewers' dried grain can be used as an alternative feed ingredient for Japanese quail layers and Vanaraja layers with an inclusion level of 10% by replacing costly feed ingredients like maize and soybean meal to reduce the cost of production of eggs.

Under Tribal sub Plan, six farmer groups, in Gaodongrim, Bhars, Kindal katta and Cotigaon villages of Canacona zone and one farmer group in Morpirla village of Quepem zone were provided with farm machineries, inputs and were imparted training through field demonstration on nutrient management and pest management in cashew. Eight sets of farm machinery comprising of power tiller with accessories, weed cutter, mini rotary tiller, power reaper etc. suitable for small and marginal farmers were distributed among eight farmer groups. Impact studies based on questionnaires showed that there was considerable saving in time, labour and money as compared to the previous year when the farmers used bullocks for ploughing and field preparation.





Introduction

Goa is situated in Western India along the *Konkan* tract and is bounded by Arabian Sea and the states of Karnataka and Maharashtra. It has a warm humid and equanimous coastal climate which is ideally suited for all kinds of agricultural activities *viz.* annual crops, horticultural crops, livestock enterprises and fish farming. Due to increasing labour costs, cultivation of field crops especially rice is becoming unprofitable. The farmers of the state are therefore increasingly taking up to horticultural crops with emphasis on mixed farming where in farming system research including watershed management is gaining importance. ICAR Research Complex for Goa is the only organization in Goa to look after agricultural research needs of the State.

The Indian Council of Agricultural Research, New Delhi therefore established the ICAR Research Complex for Goa, in April, 1976. To begin with, the complex was 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 basic, 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, 18 Technical, 21 Administrative and 28 Skilled Support staff, making the total staff strength of the Complex to 88.

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 material
- To provide consultancy services
- To act as a repository of information on Western Ghat Agriculture System.

Staff Position as on March 31, 2013

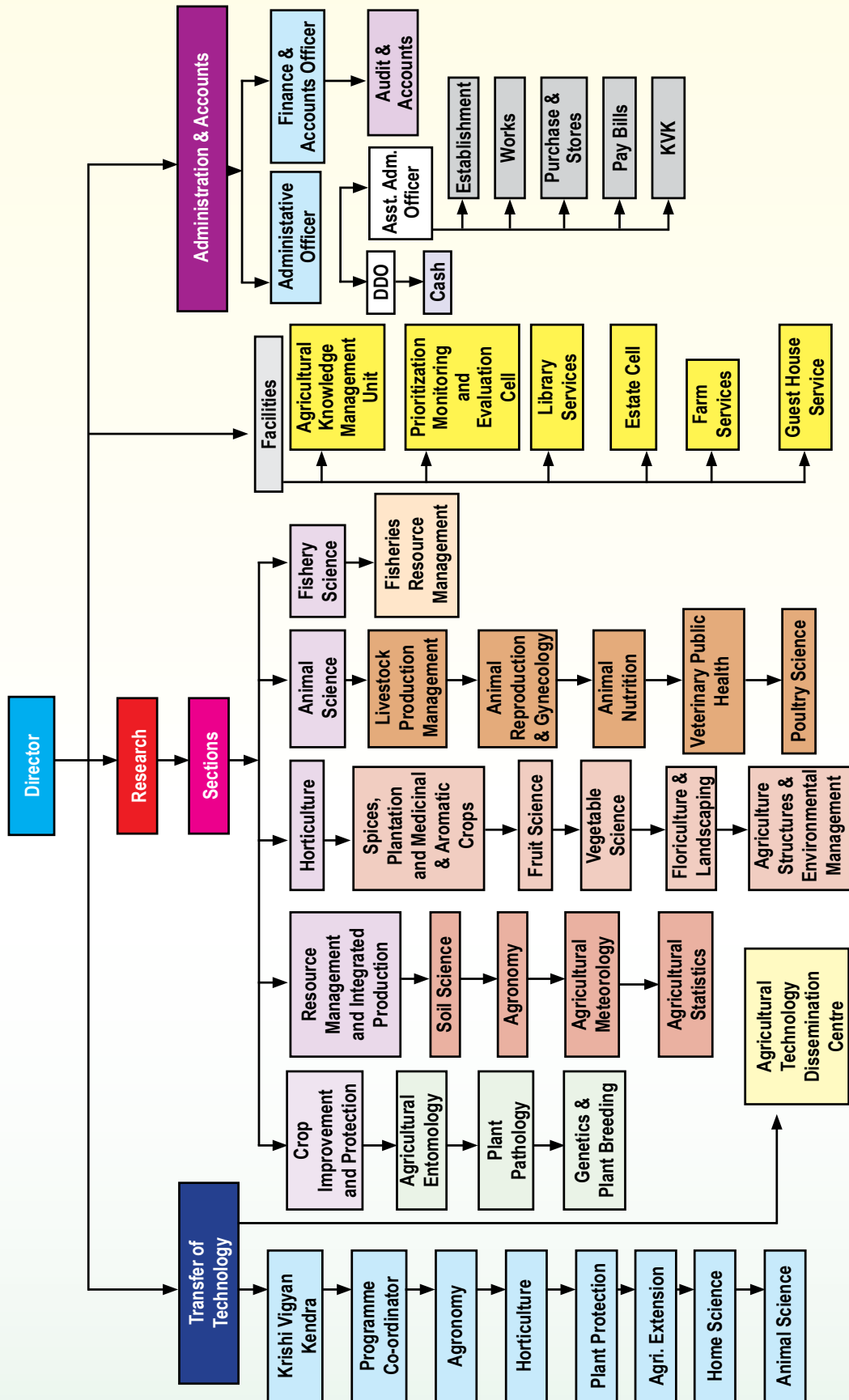
Category	Sanctioned post	Posts filled	posts vacant
RMP	01	01	-
Scientific	20	18	2
Technical	18	17	1
Administrative	21	16	5
Skilled Support Staff	32-4* = 28	25	3
Total	92-4* = 88	77	11

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





The Organogram





Financial Statement (2012-13)

(₹ in Lakhs)

Plan	Non Plan	Plan Scheme	External Aided Projects
807.63	300.00	14.86	209.84

Resource Generation (2012 - 13)

Particulars	Amount (₹ in lakhs)
Sale of Farm Produce	31.52
Sale of DOR publications and tender forms	0.47
Standard License Fees	2.73
Interest earned on loans & advances	1.10
Interest earned on STDR	24.38
Training	0.40
Miscellaneous receipts	8.53
Total	69.13



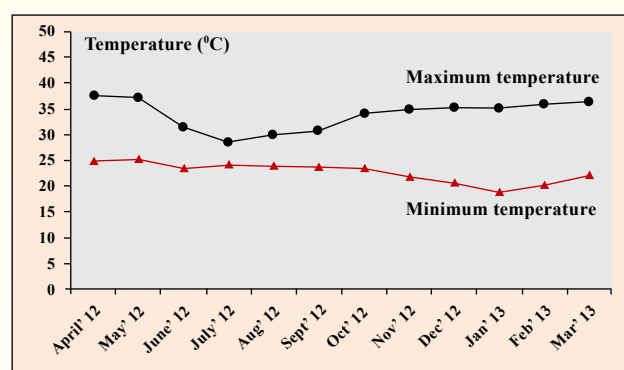


Weather Report

Agro-meteorological Observatory of ICAR Research Complex for Goa is located at 15°29'22" N, 73° 55' 10" E and 67 m above mean sea level.

Air temperature

The mean maximum temperature varied from 28.6°C (July, 2012) to 37.5°C (April, 2012), whereas mean minimum temperature varied from 18.2°C (January, 2012) to 25.3°C (May, 2012)



Mean maximum and minimum air temperature during April, 2012 to March, 2013

Rainfall and rainy days

The total rainfall received during April, 2012 to March, 2013 was 2907.9 mm, distributed over 118 days. Total of 2767.5 mm was received during *kharif* (June, 2012 to September, 2012). The annual rainfall (January, 2012 - December, 2012) was 2905.3 mm, which was 529.7 mm lesser than that of 2011 (3435.0 mm). Total number of rainy days observed were 124.

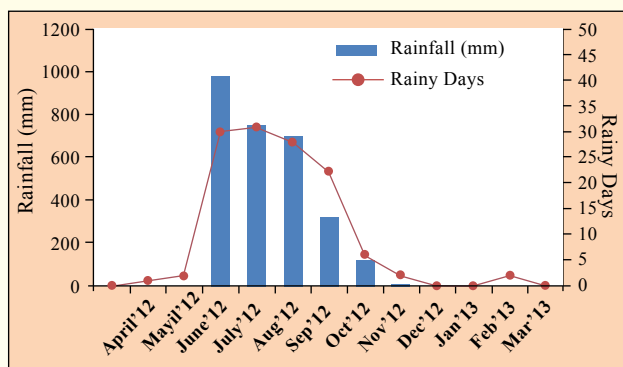
Evaporation and relative humidity

Daily evaporation was measured using USDA-Class A pan evaporimeter. Evaporation was higher than rainfall during April, May and December of 2012 and January to March of 2013. Trend of mean relative humidity revealed that highest morning as well as afternoon relative humidity was observed during June to September, 2012, whereas the corresponding lowest was recorded during December 2012.

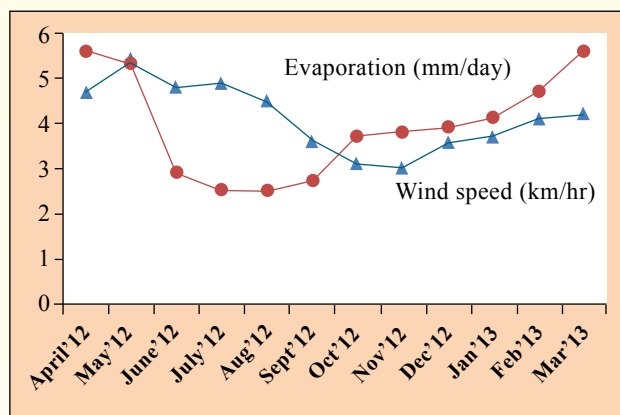
Mean monthly weather parameters recorded at ICAR Research Complex for Goa from April, 2012 to March, 2013

Parameter	Months											
	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Mean max temp (°C)	37.5	37.3	31.4	28.6	29.9	30.6	34.3	34.8	35.1	35.2	35.8	36.3
Mean min temp (°C)	24.9	25.3	23.5	24.4	24.0	23.8	23.5	22.0	20.7	18.9	20.4	22.3
Mean morning R.H. (%)	84.3	84.6	93.4	93.8	94.9	94.1	86.6	84.6	79.3	87.8	87.8	84.3
Mean afternoon R.H. (%)	58.4	57.1	77.7	84.7	83.9	74.5	57.8	48.4	40.1	46.4	40.9	45.9
Mean wind speed (km/hr)	4.7	5.4	4.8	4.9	4.5	3.6	3.1	3.0	3.6	3.7	4.1	4.2
Sunshine (hr/day)	6.5	7.5	3.4	1.5	2.4	4.0	6.2	7.4	8.9	9.3	9.1	8.2
Total rain (mm)	3.6	1.4	983.4	752.3	705.9	325.9	123.2	9.6	0	0	2.6	0
Total rainy days	1	2	30	31	28	22	6	2	0	0	2	0
Evaporation (mm/day)	5.6	5.3	2.9	2.5	2.5	2.7	3.7	3.8	3.9	4.1	4.7	5.6
Cloudiness morning (hrs)	3.3	3.0	4.7	4.8	4.4	4.9	2.7	3.0	2.9	2.4	3.3	3.2
Cloudiness afternoon (hrs)	2.3	2.1	4.5	4.6	4.3	4.0	3.0	2.6	1.3	0.9	1.1	1.7

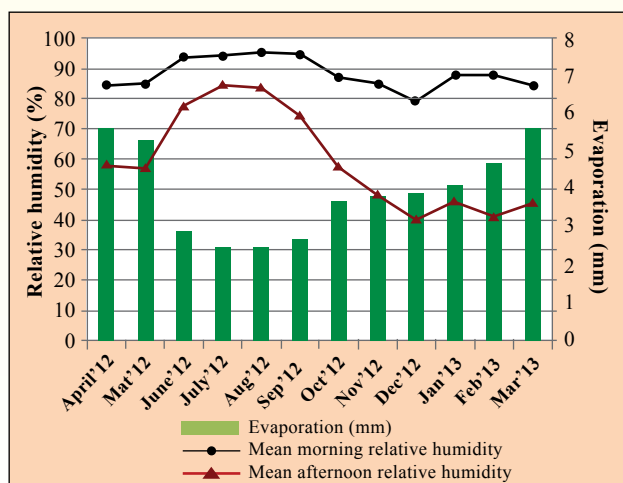




Trend of mean monthly rainfall and number of rainy days



Mean monthly wind speed and evaporation



Mean monthly evaporation and morning and afternoon relative humidity

Wind speed

Mean monthly wind speed ranged from 3 km/hr (October, 2012) to 5.4 km/hr (May, 2012). Mean monthly wind speed started decreasing from May,

2012 to December, 2012 and it increased thereon till March, 2013.

The mean monthly sunshine hour recorded ranged from 1.5 hours (July 2012) to 9.3 (January 2013). As expected, mean monthly sunshine hours were lower during rainy season compared to rest of the months of the year.

Soil temperature

The ranges of mean monthly soil temperature recorded in morning hours at 5, 10 and 15 cm depths were 22.0-32.8 °C, 25.3-35.1 °C and 26.2-35.8 °C, respectively, where as the corresponding ranges for afternoon observation were 27.4-48.3 °C, 27.2-42.2 °C and 26.9-38.8 °C.

Important dates of observations during April, 2012 to March, 2013 with highest and lowest values of weather parameter

Particular of weather parameter	Value	Date
Highest maximum temperature	40.5 °C	06/03/2013
Lowest minimum temperature	16.3 °C	18/11/2012
Highest rainfall	198.4 mm	18/06/2012
Highest evaporation	6.6 mm	02/04/2012
Highest wind speed	9.7 km/hr	05/07/2012
Maximum sunshine hours	10.7 hr	19/02/2013



ICAR RC Goa

Annual Report

2012-13

Research Achievements

- ❖ Resource Management and Integrated Production
- ❖ Crop Improvement and Protection
- ❖ Horticulture
- ❖ Animal Science
- ❖ Externally Funded Projects
- ❖ AICRP Voluntary Centres





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: B. L. Manjunath)

The cultivation of orchard crops in the steep sloping regions of the Goa State without adopting proper soil and water conservation measures has resulted in siltation of drainage channels and small reservoirs. With the result of erosion, a large amount of the fertile soil is transported from the fields. Most of the hilly areas in Goa is under perennial horticultural crops. Among the horticultural crops, cashew, mango, coconut and arecanut are the predominant ones. Although the region is receiving high rainfall during the four months period (June to September), it experiences severe drought and stress during summer resulting in low productivity. Studies on various aspects of soil and water conservation, hydrology, soil erosion, etc. have been limited in Goa State. Keeping these points in view, soil and water conservation studies were taken up in mango and coconut.

Mango system

Field Experiments were continued during the year, to evaluate the efficiency of different soil and water conservation measures in mango under West coast situations. The treatments were as follows:

- T₁ - Continuous Contour Trenching (CCT) + Vegetative Barrier
- T₂ - Staggered Contour Trenching (SCT) + Vegetative Barrier
- T₃ - Vegetative Barrier alone
- T₄ - Control

Vegetative barrier of *Vetivaria zizanioides* (Khus grass) was utilized in the mango basins for soil and moisture conservation. Soil moisture was analyzed during the post rainy season in every alternate month from November to May. Runoff

studies were conducted under different soil and water conservation treatments. Growth and yield parameters of mango were recorded in all the treatments.

The results revealed better efficiency of continuous contour trenches with vegetative barrier of *Vetiveria zizanioides* over staggered contour trenches with vegetative barrier of *Vetiveria zizanioides* or vegetative barrier alone. The impact of the treatment was reflected with significantly higher branching in mango (20.4 primary branches/plant) as compared to staggered



Treatment 1: CCT + Live barrier in mango system



Treatment 2: SCT + Live barrier in mango system





Treatment 3: Vegetative Barrier alone

contour trenches (11 primary branches/plant) or vegetative barrier alone (13 primary branches/plant). Further, the conservation measure also favoured higher retention of soil potassium (162 kg/ha) as compared to other treatments.

Coconut system

Field Experiments were continued during the year to evaluate the efficiency of different soil and water conservation measures in coconut under West coast situations. The treatments were as follows:

- T₁ - Circular trenching
- T₂ - Circular terraces
- T₃ - Control



Installation of gauging stations for measurement of run-off and soil loss in coconut

During the year, run off gauging devices were installed for the experimental plots and assessment of run-off and soil loss were initiated. The soil health under experimental plots are being assessed. Soil of the coconut experimental plot is acidic in nature with electrical conductivity in normal range. The organic carbon content in the soil was very high while the available nitrogen was in medium range. The available phosphorus in the experimental plots was very low while the available potassium was very high.



Circular trenching for coconut - the key to hold more moisture in soil

The impact of different treatments on plant growth parameters were recorded. The circular trenches found to support higher growth of coconut in terms of height (2.29m), girth (0.87m) and leaf production (9/plant) as compared to control (1.95m, 0.71m and 7.5 leaves/plant).

The soil moisture was monitored after the cessation of rainfall at periodical intervals. Among the treatments, circular trenching recorded slightly higher moisture in soil at different depths as compared to control during different months after withdrawal of monsoon.





Project :Standardisation of management practices for organic rice production (PI: B. L. Manjunath)

The practices of organic cultivation vary 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. Further, the impact on soil assumes major significance for sustenance of rice production in the region. Three promising varieties were evaluated for their suitability for organic production in the study. The trial was conducted to identify locally available manurial resources including weeds for soil nutrition in rice under west coast situations.

Field experiment was continued for the fourth 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 (Mo-17), 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 applied 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. The soil was analysed after rice crop for its fertility status in terms of nutrient status as well as microbial count.

Significantly higher rice grain yield (6.02 t/

ha) was recorded in high yielding variety Karjat-3 followed by red kernelled variety (Mo-17). Among the nutrient sources, paddy straw with water hyacinth (6.13t/ha) as well as FYM application (5.83 t/ha) recorded significantly better yield compared to rest of the nutrient sources. The higher grain yield with the application of paddy straw + water hyacinth application may be attributed to the larger volume of organic matter added to the soil.

Significantly higher straw yield was recorded in the variety Pusa Sugandh-5 (13.05 t/ha), as compared to Karjat-3 (8.79 t/ha) and Mo-17 (7.25 t/ha). Among the nutrient sources, recommended fertilizer application found to yield significantly higher straw yield (11.99 t/ha) and was followed by FYM (11.12 t/ha) and paddy straw with water hyacinth application (10.81 t/ha).

Changes in soil fertility

Application of FYM as well as paddy straw with water hyacinth on equivalent N basis found to enhance the soil available N significantly (229 and 218 kg/ha, respectively) as compared to application of recommended fertilizers alone (170 kg/ha) or control (189 kg/ha). No significant differences were observed in the soil microbial population in terms of bacteria, actinomycetes and fungi, under different manurial treatments.



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



Increased harvest through combined application of paddy straw and water hyacinth (the noxious weed of water bodies)





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.

Pureline selection in local landrace korgut

Pureline selection has been initiated in the local salt tolerant landrace, Korgut. Individual plants were selected during *kharif*, 2012. Plants to progeny rows were grown during the *rabi*, 2012 to identify promising lines. Farmers were involved at the time of selection and few promising korgut lines were identified. One selection K-S-17, found to be promising and will be tested in stress situation during the *kharif* 2013.



Promising selection K-S-17

Hybridization and generation advancement

F₂ seeds of the crosses involving local salinity tolerant landrace Korgut with high yielding popular varieties of the region *viz.*, Jyothi, Karjat-3, Naveen and Pusa-44 were collected for raising next generation.

Evaluation of rice genotypes under coastal salinity situations

A total of 31 salinity tolerant rice genotypes including landraces, improved cultivars and advanced breeding lines were evaluated for yield and its contributing characters during *kharif*, 2012 under coastal salinity situations in farmers' field at Chorao Island. Soil EC ranged from 2.08 to 7.14 dS/m and soil pH from 6.01 – 6.36 during the crop growth period.

The experiment was laid out in randomized block design with three replications. Days to fifty per cent flowering (DFF) ranging from 83 days (Kochri White) to 134.50 days (Bhaluki), plant height (PHT) ranging from 115.30 cm (FL-496) to 192.70 cm (Shidde), panicles per hill (NPT) ranging from 5.60 (Korgut) to 10.20 (Kolyo) and grain yield ranging from 752.38 kg/ha (Kolyo) to 4310.71 kg/ha (Sumati).

Among the 31 entries evaluated, top three entries are Sumati, which recorded grain yield of 4.31 t/ha followed by CSR-23 (4.13 t/ha) and Patnai (3.93 t/ha). The local check variety Korgut recorded grain yield of 2.27 t/ha.



Coastal salinity trials





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 landraces along with the introduced rice varieties under different rice ecosystems prevailing in and around Goa State.

A total of 16 landraces of rice from Goa were collected and characterized for various agromorphological and yield attributing characters. Babri, a landrace from Goa and few landraces from Karnataka were added to the Institute germplasm collections. Landraces showed wide variation with respect to different agromorphological characters. Mass selection is being applied to purify these landraces.

Evaluation of rice varieties for Rainfed shallow lowland situations in Goa, Kharif, 2012

Rainfed shallow lowland ecosystem is the predominant rice-ecosystem in Goa which accounts for more than 50% (27,000 ha) of the total rice

area. A set of 32 rice genotypes/varieties including landraces and improved cultivars were evaluated during *kharif*, 2012 to identify an alternative variety to Jaya.

The experiment was laid out at experimental field of the Institute in Randomized Block Design (RBD) with three replications. Days to fifty per cent flowering (DFF) ranging from 79.33 days (Kochri Red) to 129.67 days (Budda), Plant height (PHT) ranging from 94.20 cm (Karjat-7) to 200.73 cm (Budda), panicles/m² ranging from 200.73 (Budda) to 363 (Naveen) and grain yield ranging from 1309.03 kg/ha (Kochri Red) to 6838.19 kg/ha (Karjat-3).

Among the 32 test entries, top three entries with respect to grain yield are Karjat-3 (6.83 t/ha) followed by Uma (6.62 t/ha) and TRC-2005-1 (6.49 t/ha). Check variety Jaya recorded grain yield of 6.04 t/ha.



Field view of rice germplasm evaluation under rainfed shallow lowland situation at the Institute farm



Karjat-3: Promising variety under rainfed shallow lowland situation





Project :Genetic enhancement of Cowpea for yield and seed quality parameters (PI: Manohara K. K.)

Cowpea is the traditional pulse crop of Goa and constitutes an important diet in the people of Goa State. It is grown in rabi - summer seasons in rice fallows. Goan Cowpea is known for its bolder grain size and preferred taste. Due to its attractive appearance and bold grain size, it fetches a premium price in the market.

This project aims at collection, conservation, characterization and genetic enhancement of local cowpea accessions. A survey was undertaken to collect local Cowpea germplasm in the State. Collections were made from different places *viz.*, Sangolda, Britona, Aldona, Nuvem and Madel. Passport data on geographical co-ordinates and information on traditional knowledge associated with each of the accession was gathered from the contributing farmers.



View of the local cowpea collections block

Pure line selection

As there is demand for local cowpeas with bold grain type among the farmers, pure line selection was initiated in the existing germplasm collections of the Institute during *rabi*, 2012. A total of 10 individual plants from each of the collections were selected and tagged based on the phenotypic observation. Important yield and its contributing characters *viz.*, plant height, number of pods, pod length and seeds per pod were recorded in each of the selected plants and harvested separately to see plant to progeny performance in the next season.



Promising local cowpea selection





Project: Studies on major insect pests of cashew and their management
(PI: Maruthadurai R.)

A survey was conducted in different cashew growing areas of Goa to record the incidence of different insect pests and bio control agents. During the survey infestation of ambrosia beetles or pin-hole borers *Euplatypus parallelus* (Fabricius) (Coleoptera: Platypodidae) was recorded. Most of the infested trees were either previously attacked by cashew stem and root borer or pruned trees. Incidence was recorded at two locations, one at Ponda on currently pruned cashew plantations and at Institute research farm on cashew stem and root borer affected trees.



Small strings of compacted sawdust



Powdery frass



Portion of infested galleries



Larvae, pupae and adults on the infested galleries

Infested cashew trees showed small, rounded bore holes (1.5 mm to 1.8 mm in diameter) on the main trunk and branches from 0.5 m up to 4.0 m from the ground and extrusion of saw dust frass material on the tree trunk, branches and in loose piles at the base of the tree. Two types of

frass material were observed a) powdery frass b) small strings of compacted sawdust. Gallery length varied from 1.0 cm to 5.6 cm and the gallery walls were dark-stained with fungal mycelia.

Morphometric studies of *Euplatypus parallelus*

A large number of grubs, pupae and adults were observed on the galleries of the affected trees. The grubs, 3.0 to 3.5 mm in length, are creamy white in colour, curved and legless. Pupa is white in colour with 3.7 to 4 mm in length. Fully grown adult beetles measure 4.0 - 4.3 mm in length, are brown in colour with long and slender bodies with yellow hairs. They have a strong apical spine on protibiae but absence of pores on pronotum. Elytra are deeply impressed, subequal in width to interstriae at base of declivity which is the characteristic feature of this male beetle. It is a polyphagous insect which can breed in live trees, though it is normally associated with trees stressed by drought, disease or by recently cut wounds.

Trap for ambrosia beetle

In order to collect the ambrosia beetle for taxonomic and biological studies two types of trap were designed.

Ethanol trap: Ethanol trap was prepared with transparent white colour bucket. The entire set up was kept under the shade of cashew trees. The attracted beetles were counted on daily basis.



Ethanol trap



Light trap





Light trap: Light trap was prepared using locally available materials. The attracted beetles were counted on daily basis.

More number of ambrosia beetles was attracted to light trap compared to ethanol trap. In the light trap, apart from ambrosia beetle other insects and natural enemies were also attracted. Identification of fungal symbionts and other studies are under progress.

Apart from the ambrosia beetle other pests like black twig borer *Xylosandrus compactus*, Thrips, aphids and cotton mealy bug *Phenacoccus solenopsis* and its parasitoid *Aenasius bambawalei* was recorded in the cashew ecosystem. The rearing of cashew stem and root borer on cashew bark and artificial diet is under progress.



Bore hole



Eggs



Xylosandrus compactus

Occurrence of cotton Mealy bug *Phenacoccus solenopsis* and its parasitoid *Aenasius bambawalei*

Infestation of cotton mealy bug *Phenacoccus solenopsis* was recorded on cashew. The mealy bugs complete their life cycle around 30 days under laboratory conditions. The emergence of entomoparasitoid *Aenasius bambawalei* also observed from the mealy bug colonies.

Isolation, bioassay and characterization of entomopathogenic fungi

Rice crop in Sanguem taluk was affected by the incidence of hairy caterpillar. Natural infection of pupa and larva with some fungi was observed. Entomopathogenic fungi from larval and pupal samples were isolated and characterized. One of the fungi is morphologically identified as species of *Sesquicillium*. Artificial inoculation of this fungus caused death of hairy caterpillar larvae. Further characterization of the fungi is in progress.



Larva



Pupa



Infected with fungi. Fungus from pupa on plate



Sporulation





Project :Plant disease management by bacterial, fungal agents and other non-conventional methods under coastal ecosystem (PI: R. Ramesh)

Field evaluation of talc formulation of biocontrol agents (*Trichoderma*) on the management of watermelon wilt

Based on the *in vitro* evaluation, four strains of *Trichoderma* were selected for field evaluation for the management of wilt in watermelon. Talc based formulation of the *Trichoderma* was prepared according to the standard method.

One week old plants were treated by drenching the suspension of biocontrol formulation. Three field experiments were conducted and the incidence of wilt was recorded periodically. Results indicated that biocontrol treatments reduced the incidence of wilt and increased the number of fruits. All the biocontrol treatments were better than chemical treatment. Incidence of wilt in the treatments was 4- 10 per cent compared to control plot (21-34%). Per cent reduction of wilt was 76-84% and per cent increase in number of fruits was 26-30% based on consolidated data of all the three trials.

Filed evaluation of talc formulation of biocontrol agents (*Trichoderma*) on the management of pepper wilt

Based on the *in vitro* evaluation against soil borne pathogens, four strains of *Trichoderma* were selected for field evaluation for the management of foot rot/ wilt in black pepper. Field survey was carried out and one field (app one ha) in Netrawali

area was identified. Talc based formulation of the *Trichoderma* was prepared according to the standard method. Experiments were laid out and the treatment of the plants will be carried out after rainy season.



Field selection and preparation for experimental layout



Demonstration of application of bio-control formulation



Experimental field view of watermelon wilt management trials





Horticulture

Project : Horticultural plant germplasm of Goa (PI: V. Arunachalam)

Amaranthus

Red colored leaf amaranthus (Tamdi bhaji) is a delicious favourite type of vegetable to the people living in coastal areas. Hence a study was conducted to analyse the red and green leaf types of Goan germplasm of amaranthus. Ig-At-G-37 Green performed best with a high leaf stem ratio (4.2) and high yield of leaves (16) per plant i.e. 15.6 Kg/m². The collected amaranthus germplasm was evaluated mono-crop and in coconut basins as intercrop. Segregation for leaf color was studied in 28,314 plants of 16 populations along with a released variety (Co-2). The study concluded the inheritance of leaf color in amaranthus by a single incomplete dominant gene. Three genotypes Red (RR), intermediate (Rr) and green (rr) were identified. Leaf color was quantified using hunterlab digital colorimeter in amaranthus accessions grown in shade and in open field. Shading was found to reduce the color intensity of leaf. L* (brightness) value was highest (49.92) in green leafed progenies of intermediate plants of the population Ig-AtG57 and lowest (18.85) in Ig-AtR49 Red population. a* (red/green) value was lowest (-16.27) in green leafed progenies of intermediate plants of the population Ig-AtG57-Green and highest (15.94) in Ig-AtR18 Red. b* (yellow/blue) value varied from 34.98 in green leafed progenies of intermediate plants of the population Ig-AtG57-Green to -1.54 in Ig-AtR18 Red.

Observations on root-knot nematode, insects and diseases indicate the susceptibility of Ig-AtR56, Ig-AtR60 and Ig-AtR159 to insects. Seed multiplication in the selected accessions is in progress.

Crossandra

Red, yellow and blue crossandra types of Goa were evaluated for yield and color.

Chilli

Selected single plant progenies CA-06 accession, Canacona local chilli of Goa are grown along with Arka Meghana (F1) hybrid and evaluated for yield.

Marigold

A Marigold selection from Goa (Te03) was found to be early and high yielder. A trial is planted with Pusa Narangi and Te03 for comparative evaluation.

Orchids

A survey was conducted in collaboration with NRC for Orchids and about 125 populations of tropical orchids from different parts of Goa were collected and maintained in the Institute and an additional set of these were planted at NRC for Orchids, Pakyong, Sikkim for establishment. The predominant orchid species found in Goa were *Aerides maculosa*, *Aerides crispum*, *Rhyncostylis retusa*, *Acampe praemorsa*, *Vanda tessellata*, *Cymbidium aloifolium*, *Bulbophyllum fimbriatum*, *Vanda testacea* and *Pholidota imbricata*.





Project :Coconut/arecanut based cropping systems for Goa (PI: V. Arunachalam)

An experiment was laid out in Coconut-glyricidia system where kokum, Jackfruit, Lemon, black pepper, ornamental sweet potato were established successfully. Jack fruit plant grown in coconut systems reached a height of 0.9 to 2.3 m with 10-58 branches. Aonla plants reached a height of 0.7 to 1.1 m height and had 3-11 branches. Kokum plants grown to 0.65 to 0.9 m height and 8-33 branches. Seedless lemon plants grew 0.6 to 1.55 m tall and yielded 0-13 fruits/plant. Karonda plants did not perform well in coconut system. Pine apple (625) suckers and banana (50) were planted in the system. Seeds of marigold and amaranth were sown in the basins which gave good yield. Coriander (F1 Sugandha) was evaluated in coconut

interspaces in acid laterite soil. Seeds of 100 g sown in an area of 100 m² gave a leaf yield of 50 Kg, which works out to 5 t/ha. Fenugreek (Pusa Early Bunching) gave only 1.75 Kg leaf yield with a seeding of 100 g in 100 m² area.

High density plantation of dwarf areca

A block of arecanut cultivar Hirehalli Dwarf was established at a high density of 0.5 m x 0.5 m and the performance was monitored. Due to close planting of arecanut, the plant become a hot spot for root – knot nematode with a population of 16 juveniles and 4 adult / 100 g soil. ICAR Goa Amar 07 showed nematode free roots.

Project :Integrated strategies through classical and modern techniques for crop improvement in cashew and spices. (PI: A. R. Desai)

Cashew

Evaluation of local bold nut cashew genotypes

Results of the evaluation trial of 12 bold nut genotypes, initiated from 2008-09, revealed that Valpoi-1, 2, 3 and Tiswadi-3 genotypes started yielding from the current year while the remaining ones already started yielding from previous season. Raw nut yield of 0.56 kg/tree was recorded in Bardez 8/98, followed by 0.5 kg/tree in Bardez-9, with mean nut weight of 7.6g and apple weight of 78.5g. Other genotypes namely, Valpoi-2, Bardez-9, Tiswadi-3 recorded jumbo nut size (>10g) while Valpoi-1, Tiswadi-7, Tudal-1, Tudal-3, Mayem-1, BKL-1 & 2 and FMGDI-1 recorded more than 8 g nut weight. Size of apples significantly varied from 78.5 g (Bardez 8/98 and

Mayem-1) to 110.5 g (Valpoi-3 and Bardez-9). Valpoi-2 showed vigorous growth with higher tree height and tree girth. By and large, there was negligible incidence of Tea mosquito bug. So far All the trees are free from infestation by Cashew Stem Root and Borer (CSRB).

Genomic DNA of 25 genotypes including cashew hybrids, their parents and accessions having contrasting or specialty traits was isolated for further studies. Contrasting traits such as Jumbo nut size v/s Small nut size, Bold nut size v/s small nut size, Bunch bearing v/s solitary bearing, Vigorous v/s dwarf. canopy stature formed the basis on which the local genotypes were used for DNA extraction for using for further marker data analyses.





Production of cashew grafts

Eight thousand grafts of cashew varieties comprising of Goa-1 (2500 grafts), 1000 grafts each of Tiswadi-3, GNJ-2, KN 2/98, Vengurla-4 and 1500 grafts of other promising accessions and hybrids were produced for sales and also for supplying to farmers under Front line demonstration programmes.

Spices

Characterization of local nutmeg genotypes

Twenty four seedling genotypes of nutmeg from local sources are being maintained in Germplasm collection under intercropping situation in coconut garden. The collection includes two male genotypes and other female/bisexual genotypes from Langao, Mulgao (Bicholim), Khandola (Marcella) and Arla Keri (Ponda) villages. New nutmeg genotypes from Sirsi (Sri Poornanada Bhat) were collected.

Studies revealed the variation among nutmeg genotypes for growth habit (Conical/ Globular canopy), flowering pattern, bearing period and habit, yield per tree, physico-morphological traits of fruits, seed to mace ratio and per cent shelling. Such genotypes as NMD1, NMD2, NMF3, NMF5 and showed higher yield performance in the range of 96 to 321 fruits per tree. Fruiting was observed to be staggered over 5 months in NMD1 and 2,

while it was spread over four months in NMF3 and NMF5 genotypes with two peaks. NMF6 genotype, though high yielder, showed fruiting spread over 3 months, starting from June first week.

Kernel weight of the nutmeg accessions varied 1.34 to 3.24 g on dry weight basis. Higher shelling per cent of 66.03 was recorded in NME2 followed by 65.58g (NMD2), 65.18g (NMF3), 63.59g(NMD3) and 62.64 g (NMF5) respectively. Dry mace weight varied from 0.22g to 1.36g in NME5 and NMC3, respectively.

Coconut based multi-species cropping system

In the existing coconut garden intercropped with nutmeg trees, various multi-species namely, banana (local varieties: Saldattim, Savorbonim, Velchi, Myndolim, Sakri, and Nendran and Red banana, Rasa Bale, Paccha Bale), black pepper (Paniyur-1, Karimunda, Sreekara, Subhkara) and Nutmeg varieties like Konkan Swad and Vishvashree were planted in the inter space. Bee hive colonies were also introduced. Drum stick var. Bhagyashree was introduced along the border of the system. Data on yield of coconut, banana and nutmeg and biomass production of the unit is also being recorded.

Fruit maturity period in nutmeg genotypes during 2012

	Accen.	April	May	June	July	Aug	Sept	Fruiting duration (months)	Yield (fruits/tree)		
1	NMA1			14	22	12	4	3.5	52		
2	NMC3		8	11	10	18	7	3.0	74		
3	NMD1						6	5.0	228		
4	NMD2	6					18	4.5	321		
5	NMD3			8		2		2.0	40		
6	NME2			8		5		2.5	82		
7	NME4		3				4	3.0	39		
8	NME5		12	18	3	2	0	23	17	3.5	75
9	NMF3				9	6	16	18		4.0	122
10	NMF5	32					8			4.0	96
11	NMF6									3.0	127
12	NMG2			12			3			2.5	58
13	NMH2			24			6			2.5	82





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 maintained
123 accessions / varieties**

- 87 : Local varieties (4 Mankurad, 2 Hilario, fernandin, Salcete mussarrat)
- 15 : Introduced hybrids
- 12 : Introduced varieties
- 9 : New collections of Mankurad types

Two wild relatives of mango

- *Mangifera camptosperma*, (Courtesy : Dr. D. R. Singh, CARI, Port Blair)
- *M. griffithii* (courtesy: Dr. D J Bhat, retd prof. GU)

Following newly identified mango genotypes were clonally collected for further evaluation at the institute.

Registration

DUS data for Cardozo Mankurad variety was developed . Application is submitted along with DUS data to PPV & FRA, New Delhi to register Cardozo Mankurad variety.

Production of mango grafts

Four thousand five hundred mango grafts of Mankurad, Amrapali, Kesar and Alphonso were produced for supplying quality planting material.

Newly identified mango genotypes

Sl. No.	Collection type	Source	Tree Age (yrs)	Remark
1	MKD. Achut	Priol	>50	Mid season, medium sized fruits
2	MKD. Kudjo-1	Madkai	>50	Good quality fruits with less fibre
3	MKD. Kudjo-2	Madkai	>60	Regular, excellent fruit quality
4	MKD Kamat-1	Madkai	30	Regular, smaller fruits
5	MKD Kamat-2:	Madkai	30	Regular , Big fruits, good quality
6	MKD Kamat-3	Madkai	>50	Prize winning
7	MKD Kamat-4	Madkai	>50	Prize winning
8	MKD.Aksan	Aksan	40	Fruits less fibre and good quality
9	MKD Sakhli	Sakhli	>80	Early type, excellent fruit quality
10	MKD. Dilip	Marcell	25	Regualr, mid season, fruits medium
11	MKD. Raia	Raia	>50	Big fruits, More fibre, good sugar acid taste
12	Hialrio- Duler	Mapusa	40	Heavy yielder, Excellent fruit quality
13	Hilario- Sacorda	Sacorda	30	Excellent fruit quality Alt. bearer
14	Karel- Madkai	Madkai	>50	Pickling type
15	Karel. Sacorda	Sacorda	30	Pickling type





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. Propagation of elite types identified was continued during this year also. Parashte-3, Kasarpal-5, Savoikamini-1, Hedode-1 and Maina Pilerne-1 were propagated. Grafts of Kharekhasan-1, Savoikamini-3, Hedode-1 and Thane-1 and seedlings of *G hombroniana*, *G tinctoria*, *G mangostana* and *G india* and Tissue cultured plants of kokum were planted in germplasm block during July, 2012. The initial morphological characters observed during December, 2012 indicated that Thane-1 recorded maximum plant height of 46.1 cm. Field surveys were conducted during the season. Kasarpal-5 has been consistently observed to be a promising

accession in terms of fruit weight (47.56 g /fruit) for the past six years. Grafts of Kasarpal 5 will be planted in institute and farmers' fields during the coming year to evaluate its performance.

The variability in naturally existing kokum trees is being recorded regularly. In this regard, the descriptor data of few accessions were collected and are reported in the table.

Studies on fruit development in kokum var. Konkan Amruta

Fruit development studies were attempted during 2009 and 2010 flowering seasons (Oct-Nov). With this background, a full fledged study was taken up during this year from flowering to

Variation in vegetative and flower characters of Kokum accessions

S. No	Trait	Variation
1	Branching of trunk	Unbranched/ Branched from below/Branched from middle / Branched from top
2	Lateral branching habit	Angular /Pendulous/ Horizontal
3	Colour of exudate from plant	Light yellow /Dark Yellow
4	Tender leaf colour	Pink. Dark Pink /Green
5	Leaf Length (cm)	8.76 – 10.95
6	Leaf width (cm)	3.13 – 4.68
7	Petiole length (cm)	0.76 -1.64
8	Leaf shape	Obovate / Lanceolate/ Elliptic oblong/ Oblong lanceolate
9	No. of prominent lateral veins	8.70 – 14.60
10	Nature of midrib	Pigmented /Non-Pigmented
11	Position of inflorescence	Axillary / Both terminal and axillary
12	No. of flowers per inflorescence	2 - 6
13	Calyx colour	Green /Pinkish Green
14	Corolla colour	Yellowish orange / Creamy pink / Pinkish yellow
15	No. of stamens	6-12
16	Nature of stamens	Both free and fascicled
17	No. of staminodes	8-14
18	Nature of staminodes	Free
19	Type of stigmatic rays	Tuberculate





fruiting. The study was initiated with the onset of flowering in October 2012. The flowers were tagged on the day of anthesis. Samples were periodically drawn once in 15 days during the fruit development. Observations like fruit weight, fruit volume, fruit length and diameter, rind thickness and formation of seeds and weight were recorded. Quality or biochemical parameters like total acids and solids were also estimated.

The fruit weight and volume follow a sigmoid pattern of growth. There was a gradual increase from anthesis to 45 days after anthesis. Later on, there was a sharp increase by two fold, followed by a second phase of gradual increase. Similarly,

fruit length, fruit diameter and rind weight showed a sigmoid pattern of growth, whereas, increase in seed weight showed a double sigmoid growth pattern. The rind thickness remained constant after reaching 0.5 cm 30 days after anthesis. Unlike in other fruits, both total solids and total acids kept increasing during the development of fruit

Besides kokum, the performance of *G. gummighatta* and *G. tinctoria* trees in institute was also studied. Average fruit weight of *G. gummighatta* was 42.86 g whereas that of *G. tinctoria* was 98.72 g.



Fruits of *G. indica*



Fruits of *G. tinctoria*



Fruits of *G. gummighatta*





Project :Evaluation of commercial cultivars of fruit crops under the agro-climatic conditions of Goa (PI: S. Priya Devi)

Commercially important fruit crops like aonla, citrus, papaya *etc* have got potential to be grown under climatic conditions of Goa. In this context, evaluation trials were initiated in 2008 in several fruit crops.

Aonla

Evaluation of Aonla varieties *viz.* Krishna, Kanchan, NA-7, NA-10 and Chakaiya is being continued. The fruits were harvested during November 2012, four years after planting. The fruit and quality characters of varieties Krishna and Kanchan were recorded.

Krishna recorded 38.58 g of average fruit weight whereas var Kanchan recorded 32.32g. Fruit length was 3.79 and 3.62 cm; fruit diameter was 4.34 and 4.06 cm; fruit volume was 38.80 and 39.40 cc; seed weight was 1.80 and 1.36 g; seed length was 1.63 and 1.44 cm; seed volume was 10.85 and 6.95 cc; pulp percentage was 95.27 and 80.26; TSS was 13.13 and 11.77 per cent; total acids was 2.19 and 2.85 per cent; vit C was 290.18 and 363.25 mg /100g; total sugars was 7.11 and 7.63 per cent; reducing sugars was 1.59 and 1.38 per cent; phenols was 124.10 and 156.40 mg; tannins was 4.44 and 4.50 per cent; Pectin (Ca) was 1.50 and 2.05 per cent and moisture content was 86.76 and 87.81 percent respectively in varieties Krishna and Kanchan.

Grape fruit

Evaluation of grape fruit varieties *viz.* Marsh seedless, Red blush and Star Ruby is also being continued. Profuse flowering, marble and pea sized fruits are found on plants.

Other fruits

Other than these, observations were also recorded in West Indian Cherry and Ribbed cherry types in Cherry block and karonda with respect to fruit characters. The average fruit weight of Ribbed cherry, West Indian Cherry and Karonda were 4.66g, 1.74 g and 12.59g respectively.

Acid Lime

An evaluation trial has been laid out in field with six varieties of acid lime *viz.*, Vikram, Pramalini, Kasi Pentla, Sai Sharbati, Tenali and PKM-1 in RBD with four replications. Planting was done in July 2012. Plant height after six months of planting ranged from 44.7 cm in PKM 1 to 69.07 cm in Pramalini.

Pomegranate

An evaluation trial was laid out in main field in RBD with eight varieties of Pomegranate *viz.*, Bhagwa, Mridhula, Ganesh , Jalore Seedless, G-137, Arahta, P-23, and P-26 in March 2013.

Passion Fruit

Three varieties of passion fruit *viz.*, Yellow, Purple and Kaveri were planted in main field in August 2012. The vines of all varieties have started flowering.

Fruit development studies in *Syzygium spp*

Flowering was observed since second week of November and continued upto end of March, 2013. The flowers were tagged on the day of anthesis. The samples were drawn periodically in weekly intervals till the stage of harvest. Observations like fruit dimensions and quality characters like sugars and acids were recorded.

Syzygium malaccense (Rose apple)

The increase in fruit weight followed a double sigmoid curve, whereas, those like diameter (top side (D2), middle (D3) and lower portion (D1) and length followed a sigmoid pattern of growth. The percentage of total acids showed a decrease from 1.9 to 0.1 whereas the total and reducing sugars increased during fruit development.





Fruits of Syzygium malaccense

Syzygium samarangense
(Wax jumbo Pink)

The increase in fruit weight and fruit volume followed a sigmoid curve, and, those like diameter (top side (D2), middle (D3) and lower portion (D1)) and length also followed a sigmoid pattern of growth. The percentage of total acids showed a decrease from 0.42 to 0.1 and the sugar content increased during the growth and development of fruit.



Fruits of Syzygium samarangense (Pink)

Syzygium samarangense
(Wax jumbo white)

The increase in fruit weight and fruit volume followed a sigmoid curve, and, those external characters like diameter (middle (D2), top (D3) and lower portion (D1)) and length also followed a sigmoid pattern of growth. The percentage of total acids showed a decrease from 1.43 to 1.9 and the sugar content increased during the growth and development of fruit.



Fruits of Syzygium samarangense (White)





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

Objective of this project is to evaluate bacterial wilt resistant varieties for yield and yield contributing traits. Out of seven varieties evaluated viz., Surya, Swetha, Utkal Madhuri, Arka Nidhi, Singhnath, Bholanath and SM-6-6 under the RBD design. Surya and Swetha recorded consistently

high yield (25.43 t/ha and 23.36 t/ha respectively) for two years with almost zero per cent incidence of bacterial wilt under field condition. The next better varieties were Singhnath and Bholanath in respect of bacterial wilt resistance.



Glimpse of bacterial wilt resistance brinjal varieties evaluated at Goa





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

Objectives of the project are to evaluate different varieties and hybrids of flower and vegetable crops under naturally ventilated polyhouses for commercial cultivation Goa condition and to standardize package of practices for optimum yield and quality of flowers and vegetables in poly houses.

Gerbera

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

(Yellow) under RBT with five replications during 2012-13. Consistently the varieties *viz.*, Forza and Malibou recorded the highest flower yield per plant (45 and 42 flowers /plant /year) over the other varieties during the period.

Heliconia

In addition to earlier 25 varieties of Heliconia, 20 new Heliconia varieties were introduced from Kerala and evaluation is in progress for flower and other yield traits under coconut plantation.



View of new gerbera trial at the Institute



Blessings



Forza



Malibou



Scope





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

The data on Post-harvest losses in paddy for Goa was continued this year and will be concluded in June 2013. The data was collected both by (i) enquiry and (ii) by actual observation in field from farmers. A total of ten villages, five each from the two districts of Goa i.e., North and South were taken for the study. From each village five farmers were chosen randomly totalling 50. A total of 16 rice mills and 3 godowns were also surveyed. Data collection on storage losses was done periodically every three months on the farmers' field and will be completed by June 2013.

Basic data of the farmers chosen

Out of the ten villages studied three viz., Chodan, Carambolim, Dongrim have paddy farming under *Khazan* topography, three i.e., Amona, Dulapi, Sukhaldem have farming under midland i.e. *Kher* topography, three villages viz., Morpirila, Dabem and kavrem are under upland or *morod* type of cultivation, while one village i.e. Lotolim had farming under both *Khazan* and *kher* topography. The land holding pattern of the farmers indicated that 72 per cent of the farmers had landholdings from 1 to < 5 acres, while 22 per cent of the farmers had less than 1 acre of land. None of the farmers surveyed had 10 or more acres of land. Just 6 per cent had land holdings of 5 or more acres.

Harvest to storage of paddy

The paddy crop was transplanted from end of May to July in the field, across the state. There was a wide variation in the time of harvest and month of storage and methods of harvest and post-harvest operations. The variations in harvest are due to lack of labour and vagaries of the monsoon. Still manual labour is the main method of harvesting in the state due to lack of mechanization. The fragmented size of land holdings, inaccessibility of land for machinery, submerging of the fields due to ingress of sea water during monsoons etc. are the reason for this. Government of Goa has given many power tillers to the farmers through its subsidy

program. Also it has purchased many combine harvesters and is supplying them to the farmers at subsidized hiring rates. But the subsistence method of cultivation of the Paddy crop means the crop is sown by broadcast method in many fields and in many the spacing is very close -15 cm or less. This makes the fields suitable for use of machinery. The farmers have used the combine harvesters in these fields leading to more than 20 per cent harvesting losses. There is a need to sensitize the farmers to appropriate methods of crop management viz., sowing, spacing etc. to make them suitable for use of harvesters.

Parboiling

Paddy is mostly consumed as parboiled rice and hence parboiling is an important unit operation. In Goa parboiling of paddy is done using brass pots on wood, rice husk and coconut coir and shell fired chulhas. This method of parboiling leads to over cooking of paddy at the bottom and hence lot of breakage during milling. Introduction of the modern parboiling units with training is a must as all the farmers use parboiled rice for self and also there is a niche for parboiled organic red rice. Chodan-Madel Farmers Association have branded their parboiled organic red rice and sell it for ₹. 75 per kg and are unable to meet the demand in the market with their production.

Storage

The storage of paddy begins as early as October and extends up to the month of April. The paddy is dried and stored without milling or parboiled and milled and stored as rice.

The quantity of paddy stored is mostly in the range of 5 quintals to less than 1 tonne range. Mostly Paddy is stored in jute or plastic woven sacks and stacked in the verandah or inside the house or if it is in large quantity, it is piled in a room without any bagging. Farmers add *Vitex negundo* (Lingur) leaves, neem leaves in the sacks to protect from pest infestation. In milled paddy usually Boric





Traditional parboiling method

acid powder @ 50g per sack of 50 kg is added to prevent pest infestation. Some traditional methods of paddy storage is in Kanagis or in earthen pots (for seeds). There is a large amount of pest-infestation in paddy stored in the Kanagis as they are open at the top. A few metal bins are also in use. But the awareness about metal bins and their advantages is very less. Hence, training the farmers on safe storage methods is very important to reduce storage losses in Goa. Out of the 3 major godowns surveyed, there was no storage losses as the Paddy procured was immediately sold to the farmers and vendors within a month of procurement.

Milling of paddy

Paddy is milled in Goa in traditional rice mills which are not having rubber rollers and also system for bran removal. This is because primarily Goa was only growing the bold size varieties of paddy which they consume and these varieties are parboiled and milled. But now though slender varieties are being introduced which are high yielding, the mills have not been modernized and hence the farmers need to either mill their paddy in Goa which causes very high breakage or take the paddy out of the state for milling which reduces their profit margins. Most of the mills in the state were either closed down or running at a loss as they operated for 1 – 10 hours only during the peak season which ranged from March-May, April to May, May and October. During off-season the mills operated on need basis for farmers who brought their stored grain for personal consumption on monthly or weekly basis. Some mills operated once or twice a week and the farmers

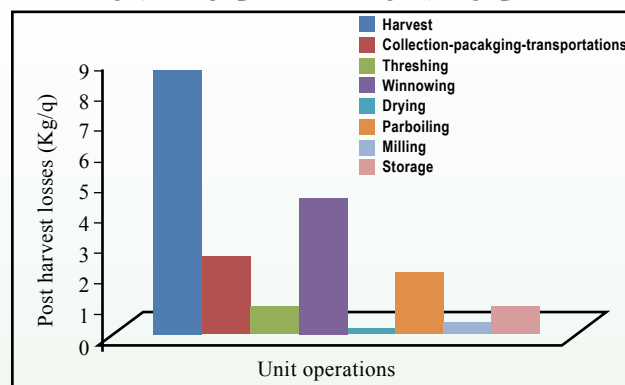
brought their paddy for milling only on those days. The data as reported by the mill owners in the rice mills indicated that that head rice recovery was 60-65% for parboiled rice and 25-33.33% for raw rice. Thus the need for modernization of the rice mills in Goa is paramount to promoting and popularizing paddy cultivation in Goa.



Traditional parboiling method of paddy

Post-harvest losses in paddy

The secondary data i.e. as reported by farmers showed that maximum losses in paddy have been recorded in harvesting (8.7 kg/q) followed by winnowing (4.6 kg/q), collection-packaging-transportation (2.5kg/q), parboiling (2 kg/q), threshing (1.6 kg/q), and storage (1 kg/q).



Post harvest losses estimated on data as reported by farmers (50)





Project :Design of protected cultivation structures for Year round utilization in western region (PI: M. J. Gupta)

Five structures viz, shade net tunnel, shadenet house, naturally ventilated Gerbera polyhouse, naturally ventilated polyhouse and FRP air-conditioned structure were compared for their micro climate. No significant difference on micro climate except for FRP air-condition structures was observed.



Structures studied

Comparison of diurnal variation of shade net tunnel and naturally ventilated gerbera polyhouse

The temperature, humidity, solar radiation and plant temperature in a shade net tunnel and naturally ventilated poly house were recorded in the morning and afternoon on a daily basis at three locations in the structures and outside too. The average data were then analysed using single factor anova.

The results showed that there was no significant effect of structure on the various microclimatic parameters as calculated F value was lower than the critical F value.

Effect of vents on naturally ventilated polyhouse

The variation in temperature and humidity at various distances from the ground level was recorded in a naturally ventilated polyhouse which was newly constructed in three replications. The data were then analyzed using single factor Anova. The results indicated that there was significant effect of vents on the vertical average temperature build up with height. The effect of vertical heat build up towards ridge was more pronounced with higher ambient air temperature and solar radiation. There was significant effect of ventilation on difference of structure's air temperature over ambient (ventilation area 0.5m x 21m (ridge) and 1.8m along 21 m length and 1.5 m along width).

Effect of prevailing winds and location of vents on greenhouse air flow patterns

The effect of vents orientation and prevailing winds was studied on the airflow pattern, temperature and humidity inside a naturally ventilated polyhouse. The vents of the polyhouse were opened on all four sides, in the prevailing winds direction only and on the leeward side only and the airflow rates and direction in the polyhouse near the inlet vents and outlet vent as a function of the ambient air flow and direction using ultrasonic anemometers (operating range of 0-65 m/s wind velocity and 0-359° direction, threshold of 0.01 m/s and accuracy of ±2%). The data was analysed using evaluation version of windRose Pro (3.01.44.0 ©2012) and Origin Pro 9.0 (Origin Lab, MA 01060 USA).

Windroses clearly show that airflow patterns are not same as outside, this could be because of pressure drop, drag coefficients, ridge and leaks due to door and other openings. But they are strongly influenced by windward vents inflow. Average wind velocity in structure is significantly different from that outside, but average air flow within the structure different only when windward vents





are closed. Though there is a significant relation between outside wind velocity and air flow inside the orientation of the vents clearly affect the extent of this effect.

Effect of greenhouse air flow patterns Temperature and humidity profile

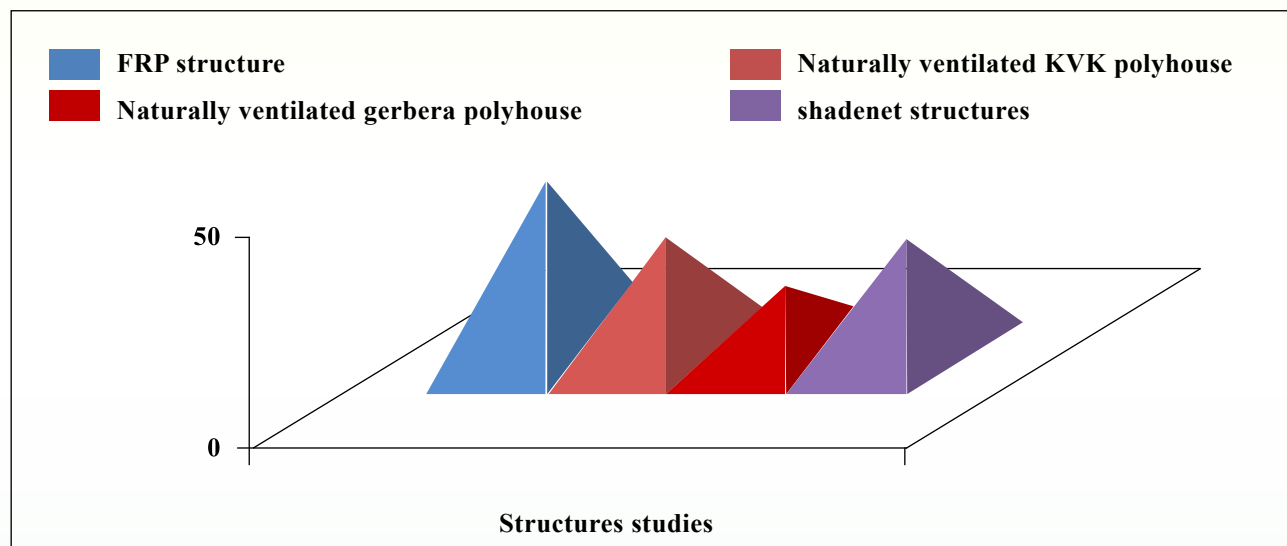
The temperature and humidity profiles in the structures are significantly different from the outside air temperature and relative humidity. But within the structure the air humidity and temperature profiles are not significantly different for most conditions except when the windward vents are closed.

To summarise, significant effect of vent screens' drag-coefficient and pressure drop through them on airflow direction and speed inside structure. Air leaks from structure and thermal effect and ridge vents too influence the airflow pattern in the

structure. Orientation of structure, prevailing wind direction and location of vents had a significant effect on airflow pattern in the structure. More vents does not necessarily mean better ventilation inside structure (windward vents closed- more effect). Studies on the pressure drop through vents, drag coefficient and air flow through ridge vents and leaks important to quantify air flow and its contribution to greenhouse cooling.

Combined effect of transmittivity of cover and ventilation

The trasmittivity of FRP structure is highest followed by that of shadenet, KVK (silpaulin cover) and gerbera polyhouse (PE >5 years old) respectively. The effect of transmittivity on the average air temperature of the structures cannot be isolated. However, the average temperatures are influenced by transmittivity and ventilation area in combination.



Combined effect of transmittivity of cover and ventilation





Animal Sciences

Project :Effect of dairy housing on microenvironment and productive performances of cow (PI: S. K. Das)

Four farmers each from Pernem, Bicholim and Ponda talukas of North Goa district and Salcet, Canacona and Sanguem talukas of South Goa district; in total twenty four farmers spread over six talukas were considered for this study. Thermometers and hygrometers were fitted in the cattle sheds of all those farmers. Milk yield of individual cow and different microenvironmental parameters were recorded daily. It was observed that highest daily milk yield was recorded in Salcet taluka (11.064 ± 0.157 kg) followed by Bicholim, Pernem, Ponda, Sanguem and Canacona. Highest air temperature was recorded in Canacona (28.34 ± 0.10 °C), whereas highest relative humidity was recorded in Ponda ($86.74 \pm 0.31\%$) and highest temperature humidity index was reported in Salcet taluka (81.41 ± 0.17).

Data analysis revealed that orientation of cattle shed had highly significant ($P < 0.01$) effect on average daily milk yield and average daily relative humidity, while significant effect ($P < 0.05$) on av daily air temperature and av daily temperature humidity index. Average daily milk yield was significantly higher in cattle shed having east – west orientation (9.466 ± 0.110 kg) than that in cattle shed with north south orientation (9.360 ± 0.056 kg). Both average daily air temperature

and average daily temperature humidity index were significantly lower in shed with east – west orientation. So, it indicated that lesser heat stress and more milk yield were observed in cattle house having east – west orientation.

Data analysis revealed that ventilation of cattle shed had highly significant ($P < 0.01$) effect on av daily milk yield, while significant effect ($P < 0.05$) on av daily air temperature, av daily relative humidity and av daily temperature humidity index. It was observed that significantly higher milk yield (9.608 ± 0.051 kg), lower air temperature (26.88 ± 0.10 °C), lower relative humidity ($80.06 \pm 0.34\%$) and lower temperature humidity index (77.63 ± 0.17) were observed in cattle shed with good ventilation. The corresponding figures in cattle shed with poor ventilation were 8.252 ± 0.042 kg, 27.25 ± 0.11 °C, 80.83 ± 0.32 % and 78.08 ± 0.15 respectively. Good ventilation is characterized by proper height of roof and wall of shed.

Effect of floor space provision inside cattle shed revealed that it had highly significant ($P < 0.01$) effect on average daily milk yield, average daily air temperature and average daily relative humidity while significant effect ($P < 0.05$) on average daily temperature humidity index. It was



Standard cattle shed in field maintaining standard floors space and East-West orientation



Arrangement of false ceiling in cattle shed in the field





observed that average daily milk yield (9.253 ± 0.065 kg) was significantly higher while av daily air temperature (27.45 ± 0.10 °C) and av daily temperature humidity index (77.19 ± 0.19) were significantly lower in cattle shed where standard floor space of minimum 5 m^2 per cattle was maintained. The corresponding figures in shed with low floor space were found to be 8.092 ± 0.058 kg, 27.91 ± 0.11 °C and 79.76 ± 0.18 respectively.

Cooling arrangement in cattle house had highly significant ($P < 0.01$) effect on av daily milk yield

and all the microenvironmental parameters. It was observed that av daily milk yield (11.210 ± 0.073 kg) was highest while av daily air temperature (25.34 ± 0.17 °C) and av daily temperature humidity index (76.52 ± 0.30) were lowest in cattle shed where mechanical cooling by electric fans was done in addition to manual cooling by splashing water and false ceiling by arecanut stem. So, it was inferred that besides manual and mechanical cooling if false ceiling is made inside cattle house cow would feel more comfort with higher milk yield.

Project :Impact of microclimatological changes on livestock production and ameliorative measures through managerial intervention (PI: S. K. Das)

Interventions were cooling arrangement by splashing of water on the animals followed by air circulation by electric fans thrice daily and roof modification by white painting on outer surface of roof and black painting on inner surface of the roof of dairy shed. It was revealed that implementation of interventions has benefited to overcome adverse effect of micro climatological changes on daily milk yield of cows by 70 % and on monthly milk yield of cows by 76 %. Air temperature out of different microclimatological components had maximum adverse effect on monthly milk yield. Crossbred cattle were more affected than Sahiwal cattle due to change of different microclimatological components. Cattle producing more milk were more affected by air temperature than that of low producer.

Overall mean value of air temperature, relative humidity, temperature humidity index, maximum temperature and minimum temperature in cattle shed in the year 2012 were recorded to be 27.20 ± 0.17 °C, 85.89 ± 0.52 %, 81.43 ± 0.23 30.27 ± 0.10 °C, 24.13 ± 0.11 °C respectively. Microclimate in dairy shed while compared with that of earlier year, it revealed that overall mean air temperature,

relative humidity, temperature humidity index in 2012 were lower than that of earlier year. It might be due to arrangement of electric fans. So, 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 microclimate.

Different physiological responses were measured for adult cattle. It was observed that average rectal temperature in Sahiwal and Cross bred cattle were 38.17 ± 0.07 and 37.86 ± 0.04 °C respectively; average skin temperature in Sahiwal and Cross bred cattle were 33.61 ± 0.18 and 33.97 ± 0.11 °C respectively; average heat storage in Sahiwal and Cross bred cattle were 1937.35 ± 4.53 and 2152.94 ± 9.07 kJ/h respectively. Data analysis revealed significantly ($P < 0.05$) higher heat storage and higher surface temperature of Cross bred cattle. It indicated higher heat tolerance of Sahiwal over Cross bred cattle.

Regression analysis was done between different physiological responses in cattle with microenvironmental parameters. It was revealed that rectal temperature was increased by 0.547





Roof paniting was done to reduce climatic stress on cattle



False ceiling made in rabbit shed to reduce heat stress

$^{\circ}\text{C}$ per unit increase of air temperature; skin temperature was increased by 1.306°C per unit increase of air temperature; heat storage of cattle was increased by 110.56 and 3.55 kJ / h per unit increase of air temperature and relative humidity respectively.

It was revealed that after intervention i.e. arrangement false ceiling inside the rabbit shed, the reduction in live weight and growth in New Zealand White, Soviet Chinchilla, Gray Giant and Black Brown rabbit per unit increase of all micro environmental components was much lower. So, cooling arrangement by way of false ceiling in rabbit shed caused lesser heat stress and reduced the decline in growth around 79 %. Benefit was maximum in case of New Zealand White and Soviet Chinchilla rabbit indicating better adaptability

than Gray Giant and Black Brown rabbit. So, cooling management has helped to reduce the adverse impact of maximum and minimum temperature on live weight and growth of rabbit. Study on physiological response of rabbit revealed that respiration rate of rabbit was non significant ($P > 0.05$) higher in New Zealand White breed than Soviet Chinchilla, Gray Giant and Black Brown. However, there was non significant difference between the later three breeds. It indicated highest adaptability of New Zealand White rabbit. In rabbit shed overall mean value of air temperature, relative humidity, temperature humidity index, maximum temperature and minimum temperature in the year 2012 were recorded to be $28.19 \pm 0.11^{\circ}\text{C}$, $94.66 \pm 0.68\%$, 81.59 ± 0.24 , $31.81 \pm 0.15^{\circ}\text{C}$ and $24.25 \pm 0.17^{\circ}\text{C}$ respectively.

Project :Assessment of early sexual maturity in Goa local male pigs through spermogram and *in vivo* pregnancy (PI: E. B. Chakurkar)

It was decided to castrate six male piglets of each Goa Local, Large white Yorkshire and Crossbred (Goa Local x Large white Yorkshire 50 %) male pigs at 30 days interval till 180 days of age i.e. total 118 pigs in the span of study. It was also decided to collect blood serum/plasma from all these experimental animals to study level of testosterone, a male sex hormone.

Till date 26 Goa Local, 13 Large white Yorkshire

and 20 crossbred pigs were castrated. Testicular biometry i.e. weight, length, thickness, width and circumference was recorded. Epididymis weight and appearance of sperm cell in epididymal content was studied. Motility and maturation stage of sperm cells appearing in the epididymal content was recorded.

Testicular biometry of Goa Local, Large White Yorkshire and 50 % crossbred indicated





Surgical experiments for castration of pig



Measurement of testicle in pig

that average length, thickness and circumference of testis at 30 days was 2.60, 2.26, 3.40 and 1.12, 1.15, 1.62 and 4.15, 4.45 a 5.22 cm, respectively. Whereas, these observations at 90 days age were 4.03, 3.99, 4.06 cm length, 1.82, 1.51 and 2.21 cm thickness and 7.46, 6.51, 8.03 cm circumference.

Weight of testicles in Goa Local, Large White Yorkshire and 50 % crossbred at 30 days was 2.33, 5.5 and 3.15 gms where as the weight at 90 days was 11.31, 15.68 and 20.83 gms.

There was sperm cell appearance in all Goa Local epididymal samples at 90 days and were mature cells whereas in Large White Yorkshire few sperm cells were present at this stage. *In vivo* pregnancy test of the Goa Local pigs showed that sexual maturity age of Goa Local male ranged from 47 to 139 days.

Project :Evaluation and preservation of boar semen (PI: M. Karunakaran)

Neat semen characters

A total of 45 semen ejaculates were collected from sexually matured boars (Large White Yorkshire, Duroc and Crossbred) by gloved hand method. Out of the 45 ejaculates, 27 ejaculates were of sub-optimal quality and discarded. Semen ejaculates were collected in two fractions namely, fraction I and fraction II. The volume of the semen ejaculates (mean \pm SEM in ml) in fraction I, fraction II and total ejaculate in Large White Yorkshire breed were 151.00 ± 10.207 , 139.60 ± 17.42 and 258.39 ± 22.73 , respectively. The values corresponding in Duroc breed were 105.89

± 11.74 , 87.50 ± 19.31 and 144.78 ± 19.00 . The corresponding values in crossbred boars were 129.16 ± 28.62 ml, 117.50 ± 27.50 ml and 168.33 ± 48.90 ml respectively.

Neat semen samples were evaluated for the motility pattern using microscope. The progressive forward motility (mean \pm SEM in %) in Large White Yorkshire, Duroc and Crossbred boars were 77.69 ± 3.56 , 76.37 ± 4.73 and 88.00 ± 3.75 , respectively. Sperm cell concentration in the semen ejaculates were estimated using haemocytometer and the values (mean \pm SEM in





millions/ ml) in Large White Yorkshire, Duroc and Crossbred boars were 797.15 ± 91.80 , 774.54 ± 177.37 and 552.50 ± 121.47 , respectively.

Semen preservation

Neat semen samples that had more than 80% progressive forward motility along with sperm cell concentration more than 200 millions/ml were selected for preservation. A total of 24 ejaculates were selected for preservation, one part of each ejaculates were extended and preserved using short term buffer Beltsville thawing solution (BTS) and another part of the semen ejaculates were extended and preserved using long term buffer – Safcel plus. The extended semen samples were stored at 17°C in a BOD incubator. The stored semen samples were evaluated for in vitro sperm characters at every 24 hours interval during storage until the motility reduced to below 30%.

Estimation lipid peroxidation

Lipid peroxidation level of spermatozoa was estimated in semen samples by measuring the malondialdehyde (MDA) production, using thiobarbituric acid (TBA) assay. MDA level increased significantly ($P < 0.01$) during different periods of incubation in BTS as well as Safcel plus group. During the start (day 0) of preservation at 17°C , the MDA level was low in BTS as well as in Safcel plus groups. The MDA level (Mean \pm SEM) in BTS group on day 0 was 0.558 ± 0.068 which increased significantly ($P < 0.01$) during storage on day 1 (0.760 ± 0.053), day 2 (0.946 ± 0.081), day 3 (1.228 ± 0.100), day 4 (1.509 ± 0.132), day 5 (2.012 ± 0.149).

Similarly, in Safcel plus group, the MDA level (Mean \pm SEM) on day 0 was (0.613 ± 0.052) which increased significantly ($p < 0.01$) during storage on day 1 (0.848 ± 0.071), day 2 (0.976 ± 0.068), day 3 (1.127 ± 0.074), day 4 (1.297 ± 0.087), day 5 (1.613 ± 0.108), day 6 (1.613 ± 0.141), day 7 (2.210 ± 0.158), day 8 (2.526 ± 0.167), day 9 (2.781 ± 0.173). There was no significant difference ($P > 0.01$) in the MDA levels between BTS and Safcel plus groups on days 0, 1 and 2. However, the MDA level in BTS group were significantly higher ($P < 0.01$) than the Safcel plus

group, on day 3 (1.228 ± 0.100 vs 1.127 ± 0.074), day 4 (1.509 ± 0.132 vs 1.297 ± 0.087) and day 5 (2.012 ± 0.149 vs 1.613 ± 0.108).

Motility pattern

The mean progressive forward motility in boar semen samples preserved in BTS on day 0 was 72.08% with range of 40 to 90%, on day 1 was 54.58% with range of 20 to 70%, on day 2 was 45.42% with range of 10 to 70%, on day 3 was 40.84% with range of 10 to 70%, on day 4 was 33.34% with range of 20 to 70%, on day 5 was 27.51% with range of 10 to 40%. In the BTS group, there was higher significant difference ($P < 0.01$) in sperm cell motility when day 0 was compared with other storage days. Motility value on day 1 (54.583 ± 2.829) was significantly ($P < 0.05$) higher on day 2 (45.42 ± 4.216), day 3 (40.83 ± 3.508) and highly significant ($P < 0.01$) on day 4 (33.33 ± 3.160) and day 5 (27.50 ± 2.019) of storage. Motility value on day 2 (45.42 ± 4.216) highly significant ($P < 0.05$) then the value on day 5 (27.50 ± 2.019). Motility value on day 3 (40.83 ± 3.508) was significantly higher ($P < 0.01$) than the value on day 4 (33.33 ± 3.160) and day 5 (27.50 ± 2.019). Motility value on day 4 (33.33 ± 3.160) has no significant difference ($P > 0.01$) with the value on day 5 (27.50 ± 2.019).

The mean progressive forward motility in boar semen samples preserved in Safcel plus on day 0 was 78.54 %, on day 1 the mean value was 67.91 %, on day 2 it was of 57.08 % , on day 3, 52.92 %, on day 4, 52.51 % , on day 5, 51.26 % , on day 6, 48.34 % , on day 7, 43.76 % , on day 8, 40.63% and on day 9 mean value was 30.83%.

Sperm cell motility on day 0 (78.55 ± 1.686) was significantly ($P < 0.01$) higher than the motility during other days of storage from day 1 to day 9. Sperm cell motility on day 1 (67.92 ± 2.401) was significantly ($P < 0.05$) higher than the motility on day 2 (57.08 ± 3.960), and highly significant ($P < 0.01$) against the other days of storage, (i.e) day 3 to day 9. Sperm cell motility on day 2 (57.08 ± 3.960), through it was not significant statistically, had higher values than the day 3, day 4, day 5 and day 6. But motility on day 2 was significantly ($P < 0.01$) higher than days 7,





day 8 and day 9. Sperm cell motility on day 3 (52.92 ± 3.434) do not differed significantly with motility values of storage days 4 to 7, but it was significantly ($P < 0.05$) against day 8, and highly significant ($P < 0.01$) against day 9 motility. Sperm cell motility on day 4 (52.50 ± 3.026) do not differ statistically with motility value of storage day 5 and 6. But it was significantly ($P < 0.05$) higher than motility values on day 7, and highly significant ($P < 0.01$) against the values of day 8 and 9. There was no significant difference ($P > 0.01$) on motility values on day 5 with day 6, day 7 and day 8. Motility value of day 6 did not differ with day 7 and 8. Motility values on day 5, 6, 7 and day 8 differed significantly ($P < 0.01$) with motility values of day 9.

On day 0, sperm cell motility in semen samples stored in BTS (72.08 ± 2.945) and Safcel plus (78.54 ± 1.686) did not differ ($P > 0.01$) statistically. But during storage, the Safcel plus maintained significantly higher ($P < 0.01$) motility than the BTS buffer. The values obtained on day 1 (67.92 ± 1.686 vs 54.58 ± 2.829 , $P < 0.01$), on day 2 (57.08 ± 3.960 vs 45.42 ± 4.216 , $P < 0.01$), on day 3 (52.92 ± 3.434 vs 40.83 ± 3.505 , $P < 0.05$), day 4 was (52.50 ± 3.026 vs 33.33 ± 3.160 , $P < 0.01$), and day 5 (51.25 ± 4.355 vs 27.50 ± 2.019 , $P < 0.01$) differed significantly. MDA level had highly significant ($P < 0.01$) negative correlation with sperm motility during storage in BTS (-0.926) and in Safcel plus buffer (-0.924) during the storage period.

Plasma membrane integrity

Integrity of sperm cell plasma membrane during storage of preserved boar semen was assessed using fluorescent stain propidium iodide and carboxy fluoresce diacetate. The percent



Plasma membrane integrity and mitochondrial membrane potential assessment

of sperm cells (mean \pm SEM) with intact plasma membrane in the semen samples preserved in Safcel plus on day 1, 2, ...and Day 6 were 32.45 ± 0.45 , 29.90 ± 5.90 , 19.00 ± 2.33 , 18.00 ± 0.45 , 14.28 ± 3.04 and 14.10 ± 1.70 , respectively.

Functional membrane integrity

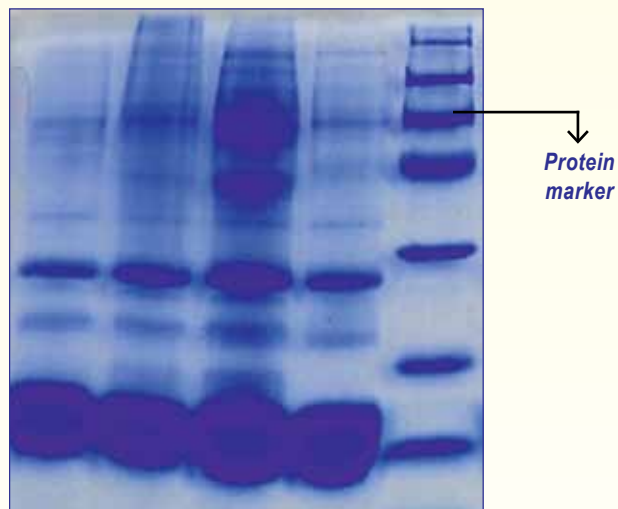
Functional integrity of sperm cell membrane during storage period was assessed by incubating sperm cells with hypo osmotic solution for a period of 2 hours. The percent of sperm cells (mean \pm SEM) with functional membrane integrity in the semen samples preserved in BTS buffer on day 0, 1, 2 ...and Day 9 were 26.47 ± 2.87 , 26.05 ± 5.65 , 24.70 ± 3.95 , 23.97 ± 3.34 , 22.16 ± 4.56 , 20.81 ± 2.86 , 20.62 ± 3.95 , 19.03 ± 2.12 , 18.30 ± 3.66 and 14.55 ± 2.88 , respectively. The values for the samples preserved in Safcel plus buffer were 31.30 ± 3.73 , 30.33 ± 3.75 , 30.23 ± 3.64 , 27.04 ± 3.26 , 25.88 ± 4.32 , 22.57 ± 3.22 , 22.10 ± 2.36 , 21.97 ± 1.74 , 21.70 ± 1.74 , and 21.24 ± 3.97 , respectively for the days 0, 1, 2 ...and Day 9.





Project :Screening for fertility markers in boar semen (PI: M. Karunakaran)

Seminal plasma proteins were extracted from 10 boar semen ejaculates by ice cold ethanol precipitation procedure. Estimation of concentration of the seminal proteins was carried out by UV spectrophotometer. The values are as follows, 3.318 mg/ml, 2.291 mg/ml, 2.833 mg/ml, 2.917 mg/ml, 2.499 mg/ml, 2.991 mg/ml, 3.426 mg/ml, mg/ml, 2.120 mg/ml and 1.454 mg/ml. Characterization of seminal plasma proteins by discontinuous sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) is ongoing.



Electrophoretic pattern
of seminal plasma proteins

Project :Studies on prevalence of clostridia in bovines, farm environment and foods (PI: S. B. Barbuddhe)

The genus *Clostridium* includes 168 different species divided into 10 different clusters, which are Gram-positive, spore-forming, anaerobic bacteria and are widely distributed in nature in oxygen-free habitats. The objective of the study was to study clostridial diseases as one of the cause of the paralysis and muscular degeneration. Cattle, sheep, goats and other herbivore species are susceptible to blackleg and malignant edema, which cause fever, depression, lameness and a high level of mortality.

There were no outbreaks of the disease during the year. Seroconversion of vaccinated animals was monitored.

A total of 170 samples were collected from different locations in Pernem, Canacona, Salcete 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 39 isolates of *Clostridium sp.* were isolated. The isolated were characterized for phenotypic characteristics. The enterotoxin gene was detected in 12 strains.





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

Establishment of fodder museum intercrop with horticultural crops

A fodder museum with 24 types of non-leguminous fodder and grass and eight types of tree fodders intercrop with horticultural crops have been developed in the Institute for research, training and demonstration.

The non-leguminous fodders are Anjan grass (*Cenchrus setigerus*); APBN (*P. glaucum x P. purpureum*); Broom grass (*Thysanolaena maxima*); Blue Panicum (*Panicum colaratum*); Bundal Guinea-1 (*Panicum maximum*); Bundal Guinea-2 (*Panicum maximum*); CO-3 (*P. glaucum x P. purpureum*); CO-4 (*P. glaucum x P. purpureum*); DHN-6 (*P. glaucum x P. purpureum*); Guinea grass (grazing type) (*Panicum maximum*); Hamil grass (*Panicum maximum*); IGFRI-3 (*P. glaucum x P. purpureum*); IGFRI-7 (*P. glaucum x P. purpureum*); Karad grass (*Themeda quadrivalis*); NB-21 (*P. glaucum x P. purpureum*); Palisade grass (*Brachiaria brizantha*); Para grass (*Brachiaria mutica*); PBN-16 (*P. glaucum x P. purpureum*); PTH (*P. glaucum x P. purpureum*) *x P. squamulatum*; Rhodes grass (*Chloris gayana*); Riversdale (*Panicum maximum*); Sain grass (*Sehima nervosa*); Signal grass (*Brachiaria decumbens*) and Signal (Congo) grass (*Brachiaria ruziziensis*).



Establishment of fodder museum

The different tree fodders are Albizia (*Albizia lebbek*); Drumstik (*Moringa oleifera*); Glyricidia

(*Gliricidia sepium*); Hedge Lucerne (*Desmanthes virgatus*); Karijali (*Acacia nilotica*); Mulberry (*Morus alba*); Sesbania (*Sesbania grandiflora*) and *Subabul (Leucaena leucocephala)*. The horticultural crops intercropped with the fodder crop are coconut, mango, papaya, banana and pine apples. Besides, research, training and demonstrations, planting materials for different fodder crops are being provided to the farmers for fodder production in their own farm.



Establishment of fodder tree museum

Quality of napier bajra hybrid silage prepared in bunker silo without additives

Silage was prepared from napier bajra hybrid fodder in bunker silo without additives in 45 days. For the test of palatability of silage, six dry Deoni cows were divided into two groups (control group and treatment group) and offered rations with or without napier bajra hybrid silage along with concentrate mixture and jowar straw for a period of 45 days to fulfill their nutrient requirements. The colour of the napier bajra hybrid silage was greenish yellow to brownish with vinegar smell and pleasing taste. The silage was firm in texture, without mould growth and acidic (pH 4.0) in nature. The dry matter content of the fodder did not change ($P > 0.05$) during ensiling. The CP% and NFE% decreased ($P < 0.05$) and CF% increased ($P < 0.05$) during ensiling. The intake of the silage per cow per day was 13.61 kg on fresh basis. The total DM intake (kg/day) in the treatment group





(7.96) was lower ($P < 0.05$) than the control group (8.59). However, the DM intake (kg/day) as percent body weight was similar ($P > 0.05$) in both groups and ranged between 2.52 to 2.72. There was no change ($P > 0.05$) in the body weight of the animals and all the animals were in healthy conditions. It was concluded that silage prepared in bunker silo from napier bajra hybrid green fodder without any additives is well accepted by dairy animals.

Development of technology for production of bypass fat indigenously

A simple pro-small farmers technology for the production of bypass fat (rumen protected fat) has been developed indigenously, in which all types of dairy farmers, particularly in rural areas can prepare it in their farm as per their daily requirement. The bypass fat made up of in this technology is calcium salts of long chain fatty acids, prepared from vegetable fatty acids (palm fatty acids) and technical/ commercial grade calcium oxide/ calcium hydroxide under specific conditions without any sophisticated equipments. The vegetable fatty acids (palm fatty acids) are the byproducts of the oil refinery industry and are available in the market in low price.

Field trial was conducted at Mandrem, Pernem to evaluate the indigenously prepared bypass fat on the performance of lactating crossbred cows. Six



Indigenously Prepared Bypass Fat

lactating crossbred cows were divided into two groups based on their body weight, lactation days and daily milk yield. Animals of both the groups were kept under similar feeding and management condition of the farmers. Randomly, the animals of both the groups were supplemented without (control group) and with (bypass fat group) indigenously prepared bypass fat @ 20g/ kg milk production for 60 days. It was observed that supplementation of the indigenously prepared bypass fat increased the milk yield, fat corrected milk (FCM) yield, fat% and SNF% in crossbred cows by 7.71%, 23.33%, 23.30% and 2.12%, respectively.

Project :Survey on the feeds and feeding practices of the livestock in Goa (PI: P. K. Naik)

Study of the quality of the compounded cattle feed

Samples (15) of compounded cattle feed were analyzed for proximate principles and compared with Bureau of Indian Standard (BIS) specifications for quality. Only 7 feed samples (46.67%) had moisture percentage below 11%. The crude protein content of the feed samples met the Type-I and Type-II specification of BIS were 26.67 and 46.67, respectively. Only 33.34 and 46.67%

of the feed samples qualified the Type-I and Type-II specifications of BIS standard for ether extract. The crude fibre content of the feed samples met the Type-I and Type-II specification of BIS were 6.67 and 53.34, respectively. Only 53.34% of the feed samples qualified the BIS specification for both the Type-I and Type-II compounded cattle feed. Out of the 15 feed samples tested, only one feed sample passed the Type-I and three samples passed the Type-II specifications in all aspects of compounded cattle feed.





Project :Molecular detection and characterization of rotaviruses from animals and humans (PI: Z. B. Dubal)

Standardization of method for extraction and detection of dsRNA of rotavirus

Extraction of dsRNA of rotavirus from fecal samples was carried out by conventional phenol:chloroform:isoamyl alcohol (25:24:1) method. The extracted dsRNA was then subjected to Ribose nucleic acid-polyacrylamide gel electrophoresis (RNA-PAGE) followed by silver staining to determine the presence of rotavirus. The dsRNA of rotavirus was also loaded on agarose gel (1.0%) stained with ethidium bromide and it has been found that all the segments of rotavirus could be clearly visualized at 100 ng and above concentration of RNA.

Collection of fecal samples and screening for rotavirus

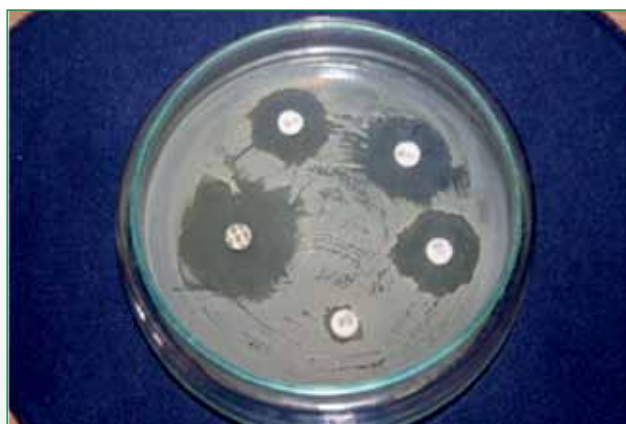
A total of 42 piglet diarrhoeal fecal samples were collected from ICAR Pig farm and surrounding areas. Additionally 17 stool samples from children were also collected from Government and private hospitals from Goa. The dsRNA of rotavirus from fecal samples were extracted by phenol:chloroform:isoamyl alcohol method. The screening of these samples by RNA-PAGE is under process.

Isolation and identification of *E. coli* and their antimicrobial sensitivity test

A total of 106 *E.coli* isolates were maintained at laboratory ICAR Complex for Goa which were isolated from diarrhoeal fecal samples of cattle, pig and poultry using standardized protocol. Out of 106 isolates, 68 isolates were subjected to antimicrobial sensitivity tests following standard procedure (i.e. disc diffusion method). Maximum isolates were resistant to almost all antimicrobials. Sensitive antimicrobials to *E.coli* isolates were from cattle and piglets are ceftriaxone, ofloxacin, sparfloxacin, gentamycin and imipenem. However, poultry *E.coli* isolates were more sensitive to ceftriaxone and imipenem.

Disease diagnostic services and health care practices

- Nasal swab (7) and serum samples (7) were collected from Don Bosco pig farm from the cases which showed the symptoms of high fever, rashes on the abdomen, anorexia and sudden death. Additionally piece of heart, kidney, liver and intestine samples were also collected during post mortem of dead pig which showed the same symptoms before death. All these samples were processed for isolation of bacteria and parts of these samples were sent to Nagpur Veterinary College for



Antibiotic sensitivity pattern of the isolate



Isolation of pathogen from mastitis milk





- detection of Classical Swine Fever (CSF) virus. The samples were positive for swine fever virus.
- Milk samples from clinical and subclinical mastitis cases of buffaloes were collected from Krishi Vigyan Kendra buffalo farm and process for isolation of pathogen and their antimicrobial sensitivity test.
 - Serum samples from 39 cows located at Ambaulim and nearby area of Quepem taluka, Goa were collected and process for detection of brucellosis. Out of 39 samples, 18 samples were found to be positive of brucellosis.
 - Dairy cows (10 no) of ICAR Dairy farm were tested for mastitis by testing milk samples by California mastitis test. A total of 37 no of samples were collected and processed for isolation of bacterial pathogen and also for antimicrobial sensitivity pattern. Of the 37 samples, 19 samples were positive for *Staphylococcus aureus*, 6 for *Streptococcus* spp. and 5 for *E. coli*.
 - Milk samples received from Purti Bhandar Sena Seva Corps, Margao were tested for different adulterants and the report has been given to the concerned person.

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 Natuzyme on the performance and economics of production in broilers

A study was carried out to assess the effect of supplementation of Natuzyme on the performance and economics of production in broiler chickens. Day old broiler chicks (N=120) were randomly distributed into four equal groups. Control diet was prepared in both starter and finisher phases with maize, soybean meal and deoiled rice bran which met the nutrient requirement as per BIS (1992). The experimental diets were prepared with supplementation of Natuzyme to control diet @ 0 g (T₀), 0.5 g (T_{0.5}), 1.0 g (T_{1.0}) and 1.5 g (T_{1.5}) per kg and offered randomly to the broiler chicks for a period of 6 weeks. Data were recorded on body weight gain, feed intake and feed conversion ratio was calculated. At the end of 6 week 1 bird from each replicate was slaughtered for the determination of dressing % and other carcass traits and organ weights. The results indicated that body weight gain was higher (P<0.05) in broilers

fed diet supplemented with Natuzyme @1.0g/ kg at 6 weeks of age. Significant (P<0.05) improvement in feed conversion ratio (FCR) was observed in broilers fed Natuzyme @1.0 or 1.5 g/kg at 3 or 6 weeks of age. There was no significant difference among the various treatments for the eviscerated yield and the relative weight of breast. The values of eviscerated yield were 67.77, 67.82, 66.96 and 68.04 for T₀, T_{0.5}, T_{1.0} and T_{1.5}, respectively. The values for relative weights of breast were 32.87, 31.99, 32.83 and 31.92 for T₀, T_{0.5}, T_{1.0} and T_{1.5}, respectively. The relative weight of thigh was significantly higher (P<0.05) in broilers fed highest level of Natuzyme. The relative weight of back significantly reduced (P<0.05) in broilers fed diet supplemented with Natuzyme @ 1.0 or 1.5 g/kg. The relative weight of liver increased (P<0.05) due to supplementation of enzyme @ 0.5g/kg. Relative weight of gizzard was increased (P<0.05) due to supplementation of Natuzyme @ 1.0 or 1.5 g/kg diet. Relative weight of bursa of Fabricius decreased (P<0.05) in broilers fed diet





supplemented with Natuzyme @ 1.0/kg diet. The relative weight of abdominal fat increased ($P < 0.05$) in broilers fed diet supplemented with Natuzyme at the highest level i.e. 1.5 g/kg diet. Enzyme supplementation @ 1.0g/kg diet was profitable in terms of higher percentage of net profit. It was concluded that supplementation of multienzyme mixture (Natuzyme) @ 1.0 g/Kg diet was effective in improving the performance and net profit in broiler chickens.



Broilers fed enzyme supplemented diet

Effect of feeding Brewers' dried grain with or without Natuzyme supplementation on performance and economics of production in Japanese quail (*Coturnix coturnix japonica*) layers

A study was carried out to assess the effect of incorporation of brewers dried grain (BDG) with or without supplementation of Natuzyme on the egg production performance and economics of production in Japanese quail laying hens for a period of 21 weeks. Natuzyme contained cellulase, 6000 units, xylulase, 10000 units, β -glucanase, 700 units, phytase, 400 units, α -amylase, 700 units, pectinase, 400 units, protease, 70 units and lipase, 5 units per gram. Eight week old Japanese quail layers ($N=135$) were randomly distributed into five equal groups with a male : female ratio of 1:2. The control diet was formulated with maize, soybean meal and de-oiled rice bran. Four test diets were formulated with incorporation of BDG at 5 and 10% level by replacing part of maize, soybean meal and de-oiled rice bran without or with supplementation of Natuzyme @ 1.5 g/kg diet (D1-control diet, D2- 5% BDG, D3-10%

BDG, D4-5 % BDG+1.5g/kg Natuzyme, D5-10 % BDG+ 1.5g/kg Natuzyme). The diets were offered randomly to the quail layers hens for a period of 21 weeks. Data on egg production, egg weight, feed intake, egg quality were recorded. The feed conversion ratio (FCR) was calculated as the ratio of feed intake and dozen egg produced. The egg production and FCR were similar for the control and treatment groups fed only BDG at both levels without supplementation of Natuzyme. Natuzyme supplementation of 5% BDG group depressed the egg production and FCR. However, the laying hens fed 10% BDG with Natuzyme had similar egg production and FCR compared to the control group. The feed intake increased significantly ($P < 0.05$) due to incorporation of BDG at 10 % level. The other treatment groups had similar feed intake compared to the control group. The egg quality parameters like percentages of whole egg content, albumen, egg shell, shape index, specific gravity and egg weight remained similar across all the groups. The shell thickness was depressed due to feeding of BDG at 10 % level. The egg yolk per cent was significantly higher for the laying quails fed BDG at 5% level. The feed cost to produce dozen egg was lowest for laying quails fed diet D3 with 10% BDG without Natuzyme. The net profit in quails fed 10% BDG was similar to control. It was concluded that BDG could be incorporated as an alternative feed ingredient in the diet of Japanese quail layers at 10% level without any adverse effect on egg production performance and economics of production.



Japanese quails fed enzyme supplemented diet





Project :Utilisation of palm oil and other unconventional feed resources for efficient poultry production. (PI: B. K. Swain)

Effect of feeding Brewers' dried grain with or without Natuzyme supplementation on performance and economics of production in Vanaraja laying hens

A study was carried out to assess the effect of incorporation of brewers dried grain (BDG) with or without supplementation of Natuzyme on the egg production performance and economics of production in Vanaraja laying hens for a period of 11 weeks. Natuzyme contained cellulase, 6000 units, xylulase, 10000 units, β -glucanase, 700 units, phytase, 400 units, α -amylase, 700 units, pectinase, 400 units, protease, 70 units and lipase, 5 units per gram. Twenty one week old Vanaraja layers (N=45) were randomly distributed into five equal. The control diet was formulated with maize, soybean meal and de-oiled rice bran. Four test diets were formulated with incorporation of BDG at 5 and 10 % level by replacing part of maize, soybean meal and de-oiled rice bran without or with supplementation of Natuzyme @ 1.5 g/kg diet (D1- control diet, D2- 5 % BDG, D3-10 % BDG, D4 -5 % BDG+1.5g/kg Natuzyme, D5-10 % BDG+ 1.5g/kg Natuzyme). The diets were offered randomly to the laying hens for a period of 11 weeks. Data on egg production, egg weight, feed intake, egg quality were recorded. The feed conversion ratio (FCR) was calculated as the ratio of feed intake and dozen egg produced. The egg production and FCR were significantly depressed ($P<0.05$) due to incorporation of BDG and



Feeding of BDG in Vanaraja laying hens

Natuzyme. The feed intake increased significantly ($P<0.05$) due to incorporation of BDG at 10 % level. The other treatment groups had similar feed intake compared to the control group. The egg quality parameters like percentages of whole egg content, albumen, yolk, egg shell, shape index, specific gravity and egg weight remained similar across all the groups. The shell thickness was increased due to feeding of BDG at 10 % level with Natuzyme supplementation @ 1.5 g/kg diet. The feed cost to produce one dozen egg was similar for laying hens fed diet D1, D3 and D5. It was concluded that BDG could be incorporated as an alternative feed ingredient in the diet of Vanaraja laying hens at 10 % level for better economics of production.





Externally Funded Projects

Project :Preparation of GPS and GIS based soil fertility maps for selected districts of the country. (DAC) (PI: B. L. Manjunath)

This project was taken up with the co-ordination of Indian Institute of Soil Science, Bhopal for the State of Goa with the following objectives:

- Collection of GPS based soil samples from selected villages of the two districts, viz., North Goa and South Goa.
- Analysis of the collected soil samples for various parameters viz., pH, EC, Nitrogen, Phosphorus and Potassium.
- Analysis of the collected soil samples for various micronutrients viz., Zinc, Iron, Copper and Manganese.
- Documentation of the analyzed data in order to prepare the soil fertility maps for North Goa and South Goa.

As per the list of villages circulated by Indian Institute of Soil Science, Bhopal both for North and South Goa, the representative soil samples were collected and the geographical coordinates were recorded using Geographical Positioning System (GPS). A total of 680 soil samples were collected from different villages of North and South Goa



The location of the selected villages in the different talukas of Goa

districts, as identified by the Indian Institute of Soil Science, Bhopal. A total of 42 villages from North Goa and 26 villages from South Goa were covered in the study.

A total of ten samples were collected based on its GPS coordinates from each village following the standard procedures for soil sampling for a depth of 15cm depth with the help of auger. The collected samples were prepared for analysis by air drying and sieving by 0.2mm sieve.

The soil samples were analyzed for various parameters including pH, electrical conductivity, available NPK, organic carbon and micronutrients (Copper, Iron, Manganese and Zinc) using the standard procedures for analysis of soil with few modifications as required.

pH and electrical conductivity

The pH of the surface soil of North Goa ranged from 3.73-6.52 with an overall mean of 4.93 and about 96.33, 3.67 and 0.0 per cent of the samples analysed were found to be acidic, neutral and alkaline, respectively. In Bardez, Bicholim and Sattari talukas, 97 per cent of the samples were acidic whereas in Pernem, Tiswadi and Ponda talukas, 98, 97 and 93 per cent samples, respectively were acidic. The pH of the surface soil of South Goa ranged from 3.93-6.33 with an overall mean of 5.09 and about 97 and 3 per cent of the samples analysed were found to be acidic and neutral, respectively. In Canacona, Quepem and Sanguem talukas, 100 per cent of the samples were acidic whereas in Salcete and Marmugao 99 and 60 per cent samples, respectively were acidic. In all the talukas of Goa predominantly acidic pH was observed.

The electrical conductivity of the soil ranged from 0.0067 to 4.98 dS m⁻¹ with a mean of 0.19 dS m⁻¹ in the soils of North Goa. In all the talukas, the major area was under non-saline condition, except for Bardez and Tiswadi wherein 8% and





2% samples were found to be in injurious range, respectively. In case of South Goa, the electrical conductivity of the soil ranged from 0.0094 to 1.79 dS m⁻¹ with a mean of 0.09 dS m⁻¹. In all the talukas, the major area was under non-saline condition, except for Marmugao and Salcete wherein 5% and 1% samples were found to be in injurious range, respectively.

Organic carbon

The overall organic carbon status of the soils of North Goa ranged from 0.38 to 4.78 with a mean value of 1.94 %. Bicholim taluka recorded the highest mean organic carbon content of 2.18 per cent followed by Ponda taluka (2.16 %). The organic carbon content was found to be distributed as 93, 4 and 3 per cent in high, low and medium categories, respectively. The overall organic carbon status of the soils of South Goa ranged from 0.49 to 4.59 with a mean value of 1.78 %. Marmugao taluka recorded the highest mean organic carbon content of 2.08 per cent followed by Canacona taluka (1.93 %). The organic carbon content was found to be distributed as 72, 10 and 18 per cent in high, low and medium categories, respectively. The nutrient index values ranged from 2.7 to 3.0 with a mean value of 2.9 in North Goa and 2 to 2.9 with a mean value of 2.6 in South Goa. The overall fertility rating for organic carbon was high in the state of Goa.

Available NPK

The overall available nitrogen status in the surface soils of North Goa ranged from 69.06 to 430.26 kg ha⁻¹ with a overall mean value of 198.12 kg ha⁻¹. Among the different talukas, Sattari recorded highest percentage of 'low' available N status (91%) followed by Bicholim (85%), Pernem (80%), Tiswadi (70%), Bardez (67%) and the lowest was observed in Ponda taluka (55%). The overall available nitrogen status in the surface soils of South Goa ranged from 106.4 to 439.18 kg ha⁻¹ with overall mean value of 214.16 kg ha⁻¹. Among the different talukas, Marmugao recorded highest percentage of 'low' available N status (85%) followed by Salcete (84%), Sanguem (70%), Quepem (63%) and the lowest was observed in Canacona taluka (60%). The nutrient index values

ranged from 1.1 to 1.5 with a mean value of 1.2 in North Goa and 1.2 to 1.4 with a mean value of 1.3 in South Goa. The overall fertility rating for available Nitrogen was low.

The overall available P in North Goa ranged from 2 to 77 kg ha⁻¹ with a overall mean value of 20. The overall per cent sample category under low, medium and high was 30, 42 and 28, respectively. Among the six talukas, in Tiswadi, the highest per cent sample category of "high" was noticed and the highest percent category of "low" was observed in Ponda taluka. The overall available P in South Goa ranged from 2 to 73 kg ha⁻¹ with an overall mean value of 21. The overall per cent sample category under low, medium and high was 42, 32 and 26, respectively. Among the five talukas, in Marmugao, the highest per cent sample category of "high" was noticed and the highest percent category of "low" was observed in Quepem taluka. The nutrient index values ranged from 1.9 to 2.2 with a mean value of 2 in North Goa and 1.8 to 2.3 with a mean value of 1.8 in South Goa. The overall fertility rating for available phosphorus was medium.

The overall range values recorded for available potassium status in surface soils of North Goa ranged from 61 to 995 kg ha⁻¹. Considering the mean values, the highest value of 480.37 kg ha⁻¹ was recorded in Ponda taluka and the lowest mean value of 222.17 kg ha⁻¹ in Sattari taluka. The percentage sample category under low, medium and high ranged from nil to 25, 25 to 51 and 24 to 75, respectively. The highest percent deficiency of potassium was noticed in Pernem taluka. The highest status of available K, was observed in Ponda taluka. The overall range values recorded for available potassium status in surface soils of South Goa ranged from 73.2 to 814 kg ha⁻¹. Considering the mean values, the highest value of 452 kg ha⁻¹ was recorded in Canacona taluka and the lowest mean value of 196 kg ha⁻¹ in Quepem taluka. The percentage sample category under low, medium and high ranged from nil to 31, 30 to 55 and 24 to 70, respectively. The highest percent deficiency of potassium was noticed in Quepem taluka (31). The highest status of available K, (70%) was observed in Canacona taluka. The nutrient index values ranged from 1.5 to 2.3 with a mean value of 2 in





North Goa and 1.6 to 2.3 with a mean value of 2.19 in South Goa. The overall fertility rating for available potassium varied from low to medium in North Goa and was predominantly medium in South Goa.

Available micronutrients

The overall DTPA-Zn content in North Goa ranged from 0.01-1.54 mg kg⁻¹ with a mean value of 0.29 mg kg⁻¹. Among the six talukas almost all had deficient Zn content except in the soils of Ponda where moderate Zn status was noticed (0.547mg kg⁻¹). The overall DTPA-Zn content in South Goa ranged from 0.065-1.61mg kg⁻¹ with a mean value of 0.24mg kg⁻¹. Among the five talukas, almost all the talukas had deficient Zn content.

The DTPA Fe content in North Goa varied from 0.71 to 27.8 mg kg⁻¹ with a mean value of 10.13 mg kg⁻¹. On contrary to Zn, Fe was found to be sufficient in all the talukas. The DTPA Fe content in South Goa varied from 0.61 to 22.49 mg kg⁻¹ with a mean value of 7.34 mg kg⁻¹. Fe was found to be sufficient in all the five talukas.

The availability of Cu in North Goa ranged from 0.04 to 3.09 mg kg⁻¹ with a mean of 0.46 mg kg⁻¹. The mean Cu status in different talukas showed that, all the talukas had sufficient amount of Cu content. The availability of Cu in South Goa ranged from 0.06 to 2.18 mg kg⁻¹ with a mean of 0.44 mg kg⁻¹. The mean Cu status in different talukas showed that, all the talukas had sufficient amount of Cu content.

The Mn availability in the soils of North Goa varied from 0.18 to 21.00 mg kg⁻¹ with a mean of 7.91 mg kg⁻¹. The lowest mean value of 5.67 mg

kg⁻¹ was observed in Bardez and Pernem taluka and the highest mean value in Sattari taluka (11.41 mg kg⁻¹).

Similar to Fe, Mn was also found to be sufficient in all the talukas. The Mn availability in the soils of South Goa varied from 0.76 to 19.59 mg kg⁻¹ with a mean of 7.68 mg kg⁻¹. The lowest mean value of 4.58 mg kg⁻¹ was observed in Salcete taluka and the highest mean value in Sanguem taluka (10.6 mg kg⁻¹). Mn was found to be sufficient in all the talukas of South Goa.

The per cent sample deficiency was worked out for all the talukas. On an average, Zn was predominantly deficient in all the talukas of North Goa (85%) and South Goa (93%) followed by Cu, 34% and 35%, Fe 22% and 13%, and Mn 10% and 12%, respectively. Among the talukas, more than 88 per cent of the samples collected from Bicholim, Pernem and Sattari talukas of North Goa and more than 95 percent of the samples collected from Canacona, Quepem, Salcete and Sanguem talukas of South Goa showed Zn deficiency. Almost all the talukas had sufficient Mn availability except for Pernem and Tiswadi in North Goa and Salcete in South Goa which showed deficiency in the range of 24-30%. In case of Fe, deficiency was predominantly observed in Sattari taluka (50%) of North Goa and Canacona (20%), Marmugao(20%) and Sanguem (20%) talukas of South Goa. With reference to Cu, Bicholim (37%), Sattari (46%) and Tiswadi (38%) talukas from North Goa and Marmugao (50%), Salcete (44%) and Sanguem (43%) talukas from South Goa had higher per cent Cu deficiency as compared to other talukas.





Project :Upscaling of Homestead farming in the different farming systems of Goa (NABARD) (PI: B. L. Manjunath)

During the year, NABARD funded Project on “Homestead farming systems” was continued 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.
- Gaps in the existing production technology were identified for each of the farmers based on the prevailing situation and need of farm family.
- Suitable interventions were identified to meet the identified production gaps.
- A total of 4 training programmes were organised on different aspects of homestead farming to create awareness among the beneficiaries including farmer to farmer exposure visits.
- High yielding varieties of seeds/planting material in different crops were procured from the reliable sources and the technology implemented in the farmers field.
- The relevant growth and yield observations were recorded periodically and the technologies intervened were assessed in farmers field.



A typical homestead unit at Chodan –Goa



Training on Homestead farming in progress



Cultivation of Red Amaranthus and radish in the field of Virendra Parab-Porvorim,Goa.



High yielding cucurbits on demonstration at Velling (Durga Zalmi)





Long beans (Waal) in the homestead of deepavati (Sangolda-Goa)



Vanaraja– A backyard breed of poultry in the homestead of Chandrakant Gaonkar (Chodan)

- 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 system was taken up.
- Recycling of farm waste through vermicomposting is done.
- Standardised the planting pattern for a model housefeed unit under Goa conditions.

Project :Stress Tolerant Rice for Africa and South Asia: Salinity Tolerant Breeding Network trial, Kharif 2012 (BMGF) (PI. N. P. Singh)

The experiment consisted of 31 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 2.08 to 7.14 dS/m and soil pH from 6.01 to 6.36.

Days to fifty per cent flowering ranging from 91.66 (CR 2815-4-26-1-S-3-1-1) days to 131.66 (CARI Dhan 4) with a mean days of 109.20, plant height ranging from 95.00 cm (PNL 9-1-2-7-4-6-1) to 178.86 cm (korgut, local check) with a mean height of 115.12 cm, productive tillers ranging from 5.66 (CR 2815-4-3-1-1-1-1) to 8.26 (NDRK 11-2) with a mean of 6.93, while, grain yield ranging from CR 2218-41-2-1-1-S-B-1 (1207.5 kgs/ha) to CSR - 2K- 262 (3620.83 kgs/ha) with a mean of 2571.90 kgs/ha.

Top five entries with respect to grain yield are CSR - 2K- 262 (3.62 t/ha) followed by NDRK 11-1 (3.47 t/ha), CSR - 2K- 219 (3.42 t/ha) and NDRK

11-2 (3.25 t/ha)) and PNL 4-35-20-4-1-4 (3.20 t/ha). CSR-36 recorded highest grain yield of 2780 kgs among the four check varieties followed by CSR-27 (2728.33 kgs), CST-7-1 (2255.33 kgs) and korgut with 2087.50 kgs. Entry CSR-2K-262 and NDRK 11-1 recorded significantly higher yield compared to that of the better check variety CSR-36.



Field view of STBN trial at Chorao Island in farmers' field





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

Collection of *Ralstonia solanacearum* isolates and their diversity

Ralstonia solanacearum isolates (237) collected from different crops i.e. Brinjal, chilli and tomato from Goa (79 different places, 154 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) are preserved in 30 % glycerol stored at -70 °C.

Virulence of the isolates (196) collected from different regions was tested on brinjal seedlings. The disease incidence was recorded as percent disease index from 7 days after inoculation. Results indicated that the isolates vary in virulence on brinjal.

Twenty diverse strains were selected based on the *egl* sequence analysis, geographical location and host for MLST analysis. All the gene products were sequenced, the sequences were submitted to NCBI and accession numbers were obtained.

The MLST scheme suggested by Castillo and Greenberg (2007) was adopted and the sequences of the isolates were compared in the MLST database and the allele numbers were assigned. Results indicated that some of the isolates are assigned same allelic profile (Rs-08-55, Rs-10-204, Rs-10-

292, Rs-09-193; Rs-10-253, Rs-10-257; Rs-10-336, Rs-09-131), while the others are genetically different from each others.

Study on the genomics of *R. solanacearum* infecting solanaceous vegetables

Based on the diversity analysis, pathogenicity on three hosts and geographical origin, two *R. solanacearum* isolates were selected for genome sequencing and to understand the role of various virulence factors in infection and colonization.

Evaluation of antagonists against *R. solanacearum*

Antagonists from Xylem bacteria were screened for the production of antagonistic compounds against *R. solanacearum* by standard bioassay. Isolates were tested against mildly virulent, moderately virulent and highly virulent strains of *R. solanacearum*. Twenty eight isolates were found to be antagonistic against all the strains of *R. solanacearum* and they were evaluated for growth promotion in brinjal under greenhouse conditions. Based on the observations six bacteria increased the growth in brinjal as compared to the uninoculated control. Disease suppression ability of these bacteria is being evaluated in the greenhouse condition.



Wilting of susceptible line of brinjal in the mapping population





Development of suitable mapping population

Seedlings from F_2 cross seeds were raised along with the resistant and susceptible parent lines for collection of F_3 seeds and for further evaluation. Results indicated that all the plants of Agassaim wilted but none of the plants of resistant donar. In F_2 population some plants did not wilt. Seeds were collected from the F_2 plants which are not wilted to test their resistance in the next generation.

Evaluation of plant products for the inhibition of *R. solanacearum*

Local and wild plant species were selected and extracted with different organic solvents. The crude extract was used in the bioassay against the pathogen. Results indicated that some of the plant products exhibit inhibition of *R. solanacearum* when tested *in vitro*.

Project :Genetic diversity of noni in Konkan coast of India (Noni Foundation) (PI: V. Arunachalam)

About 20 locations in Goa and 12 locations in Maharashtra were surveyed. Out of 20 sites surveyed in Goa, noni plants were not found in 10 sites. In Maharashtra, noni was present in Dapoli, Malvan, Jejamata Udyan (Mumbai), Velneshwar and Varchahapaat. Six noni accessions of Goa received accession numbers (IC 0595272 to IC 0595277) from NBPGR, New Delhi. About 3000 seeds of each of accession are stored in long term conservation at NBPGR New Delhi. About 57 rooted cuttings of ten accessions of Goa are planted

in the experimental fields at ICAR RC farm. Seed germination technique in noni was standardized by treatments with panchagavya, scarification and both. About 2815 seeds from 16 Lakshadweep accessions of previous collections were sown in polybags and kept in the mist chamber for germination. Vegetative traits were recorded in the field planted Goan noni germplasm. Bogmalo2 plant had wide (14 cm) and Vagator3 had long (29.7 cm) leaves and Shirdona 3 plant had narrow (1.8 cm) and short (6.1 cm) leaves in main field.





Project : Translation Centre for Molecular Epidemiology of *Listeria monocytogenes* (TranceLis) (DBT) (PI: S. B. Barbuddhe)

ICAR Research Complex for Goa, Old Goa has been recognized as Centre of Excellence and Innovation in Biotechnology by Department of Biotechnology, Government of India for Translational Centre for Molecular Epidemiology of *Listeria monocytogenes*. The project has been sanctioned under multi-institutional network mode with ICAR, Goa as the lead centre. Other collaborators institutions are Indian Veterinary Research Institute, Izatnagar, ICAR Research Complex for NEH region, Barapani, Meghalaya and Nagpur Veterinary College, Nagpur, Maharashtra.

Maintenance of repository of *Listeria* cultures

The repository of the *Listeria* cultures is being maintained at the Institute by regular subculture and freeze drying. The repository has 680 cultures of *Listeria* isolated /collected /submitted from all over India.

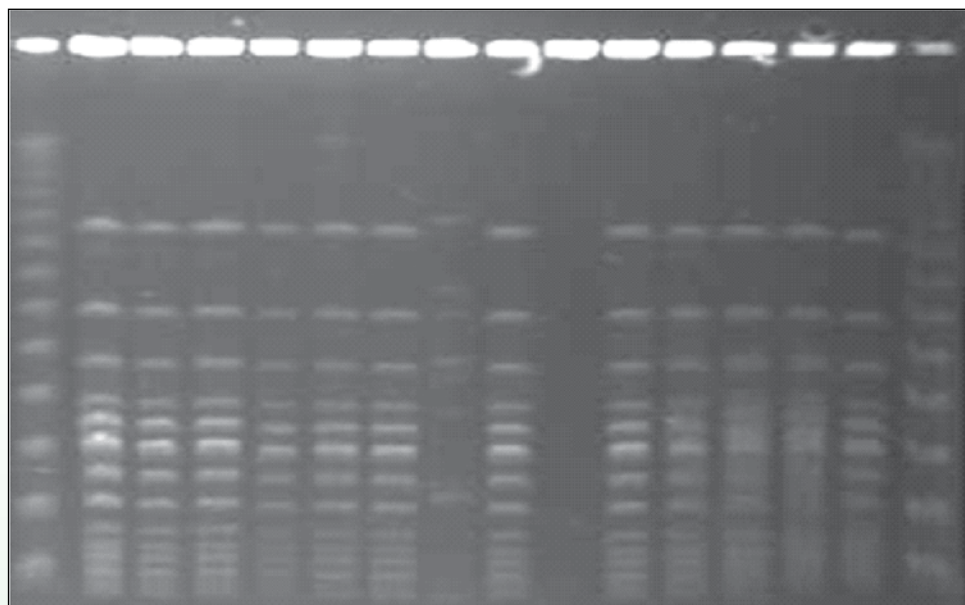
Isolation of *Listeria* from clinical and environmental sources

Listeria monocytogenes is an emerging Gram positive, facultative intracellular foodborne pathogen and etiological agent of listeriosis with high hospitalization and case fatality rates. A total of 180 samples were collected from environmental sources (seafood handling areas, mangrove origin biota such as oyster, prawns, crabs and fishes) and attempted for isolation of *Listeria*. Isolation of *L. monocytogenes* was carried out following ISO method. Out of twenty six presumptive isolates, one isolate was confirmed as *L. monocytogenes* serogroup 4b, 4d, 4e, nine isolates were confirmed as *L. ivanovii*, 16 as *L. innocua*.

A total of 290 samples were screened to detect the prevalence of *L. monocytogenes* from piggery environment and pork products. Out of samples screened, 36 isolates were selected as presumptive *Listeria* species. Of these, 18 (6.20%) isolates

Serotypes

M 4b 4b 4b 4b 4b 1/2a 1/2a 4b 4b 1/2a 4b 4b 4b M



PFGE profiles of Listeria monocytogenes isolates using ApaI enzymes. The profiles are highly clonal.





were characterized as *Listeria*. Nine (3.10%) isolates were confirmed as *L. monocytogenes* and remaining were *Listeria* species. *L. monocytogenes* was isolated from live pigs (feces, tongue, and vagina). This may result in shedding the organisms during cutting and contaminating the carcass as well as abattoir and consequently in food. Two isolates were isolated from the raw sausage (RTE food) which is a major concern to public health. From this study, it was observed that the probable source of in piggery environment could be the contaminated or perished feed, which is used to feed the pigs daily. None of the clinical samples from humans were positive for *Listeria*.

Characterization of *Listeria monocytogenes* using serotyping and Pulsed Field Gel Electrophoresis (PFGE)

A total of 25 suspected isolates of *Listeria* spp. (16 from humans, 5 from foods and 4 from environment) were referred for characterization from different parts of India. Of these 16 isolates from humans and 4 isolates from food were confirmed as *L. monocytogenes*. The serotypes were 1/2a, 1/2b and 4b. A study on characterization of *L. monocytogenes* strains (65 Nos.) dating from 1995 to 2012 revealed the presence of strains with highly similar phenotypic and fermentation characteristics, virulence factors and identical PFGE profiles. The strains are a member of the serotype 4b and are widely present in the Indian subcontinent in terms of geographical location, source and dates of isolation. Indeed the strain appears to be highly clonal and occasional variants.

Determination of resistance of *L. monocytogenes* to benzalkonium chloride (BC) in planktonic and biofilm phase.

Specific differences, if any, as per biofilm formation capabilities of *Listeria monocytogenes* were determined. Six strains each of the strong, moderate and weak biofilm forming groups were taken for study. Initially, resistance towards benzalkonium chloride (BC) was determined by minimum inhibitory concentration (MIC) of each isolate. No significant difference was observed among the planktonic listerial cells from strong, moderate and weak biofilm forming group. The MIC of the listerial cells ranged between 1 to 32 µg/ml for BC. This variation in biofilm formation has been suggested due to the intrinsic bacterial property or bacterial adaptability to the disinfectants by prolonged exposure to sublethal concentration. The MIC in the biofilm form was significantly higher ranging between 256-1024 µg/ml for strong biofilm formers, 128-256 µg/ml for moderate biofilm formers and 4-64 µg/ml for weak biofilm formers. Strong biofilm forming isolates could resist 50 fold, moderate could resist 10 fold and lower biofilm former could resist 3 fold concentrations of BC than the planktonic cells.

None of the cell could grow more than 32 µg/ml of BC in planktonic phase. While same cells when formed the biofilm, their resistance capability increased according to their biofilm formation capability. Resistance by biofilm clearly showed the correlation of degree of biofilm formation with the resistance towards BC. Therefore, the study strongly indicates that it is not the inherent property of the cell but it is the biofilm forming capability that plays an important role in exhibiting resistance towards microbicidal agents.





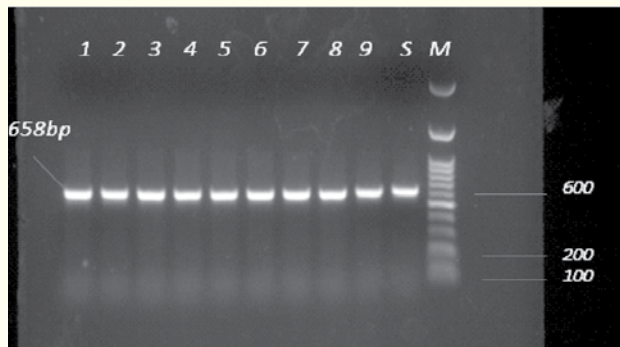
Project :Approaches towards combating zoonotic and food borne infections through community participation (Zoonoses) (DBT)
(PI: S. B. Barbuddhe)

**Pre-campaign Assessment of samples
Isolation of foodborne pathogens**

A total of 180 samples from environment, food sources were analysed for *E. coli*, *Salmonella* spp. and *Vibrio* spp. following ISO method. Presumptive isolates of *E. coli* (60), *Salmonella* (10) spp., *Vibrio* spp. (100) were obtained.

A total of 60 *E. coli* presumptive isolates were sent for serotyping to National Reference Centre for *Salmonella* and *Escherichia*, Kasauli. Out of 60 isolates, 55 isolates were confirmed as *E. coli* by serotyping. The common serogroups isolated were O148 (n=3), O17(n=5), O13 (n=2), O41 (n=3), O116 (n=2), O10 (n=2), O8 (n=3), O141 (n=1), O1 (n=1), O159 (n=3), O105 (n=1), O36 (n=1), O68 (n=1), O162 (n=1), 10 rough and 16 strains were untypable. In the present study, a total of 14 different serogroups of *E. coli* were isolated, of which O17 was the predominant.

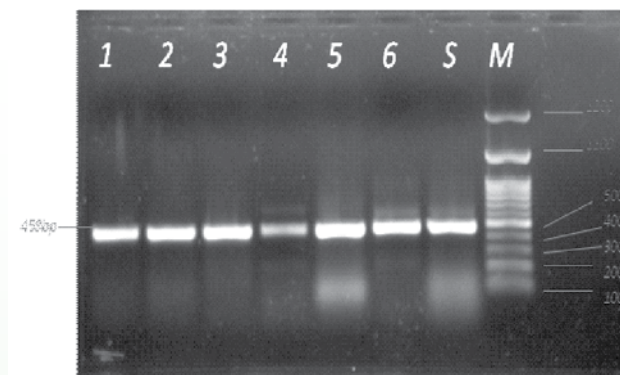
Virulence associated genes among the biochemically confirmed *Vibrio* spp. were determined in-vitro by PCR. Genes for toxinR (*toxR*), Cholera toxin (*ctx*) and thermolabile haemolysin (*tlh*) were screened to differentiate the virulent strains. Out of 100 isolates 10 (10%) isolates were found to contain *toxR* gene, 7 (7%) isolates were found to possess *tlh* gene. None of the isolates could show presence of *ctx*.



Vibrio spp. isolates showing amplification of the *toxR* gene
Lanes 1-9 showing amplification *toxR* gene, lane 10: *Vibrio* paraahaemolyticus MTCC 3906, Lane 11: Marker

Detection of zoonotic infections

A total 301 serum samples from animals (157) and humans (144) were tested for brucellosis. Of these 41 samples from animals were found to be positive for brucellosis. None of the human sample was positive. Out of 144 human serum samples tested for rickettsial infections, three were positive by Weil-Felix test. Apart from these, a total 110 samples of milk, placenta, uterine discharge and vaginal swabs were collected during the campaigns and analysed for brucellosis. Sixteen presumptive isolates of *Brucella* were obtained.



Vibrio spp. isolates showing amplification the *tlh* gene
Lanes 1-6 showing amplification of *tlh* gene, lane S: *Vibrio* paraahaemolyticus MTCC 451, Lane 8: DNA marker





**Project :Augmentation of rural pig production for socio-economic upliftment of the rural poor in Goa through artificial insemination (DBT)
(PI : M. Karunakaran)**

Artificial insemination

Total of 23 Artificial inseminations were carried out using the preserved semen samples to assess the conception rate. Pregnancy verification

was carried out using ultra sonography for 16 sows and found that 12 were pregnant (75 % conception rate). 4 pregnant sows delivered with average litter size of 9.5 piglets.



Piglets born through AI



Artificial insemination in pigs

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 (INCOIS) (PI : S. Subramanian)

During 2012, a total of 136 PFZ advisories were received for Goa coast, of which 102 could be validated and the rest could not be validated as the PFZ markings were either not off Goa coast or far away (100 to 200 m depth and beyond). A total of 304 fishing feedback were received from the purse seine boat operators. The major fish species caught from purse seine boats were Indian mackerel, Oil sardine, Tuna, Seer fish, Horse mackerel and lesser sardines with CPUE ranging from 0.1 to 6.1 tons. The validation percentage of PFZ advisories received for the coast of Goa was 100 % during this year. The PFZ advisories were more useful to purse seine operations than others. In all the three important landing centers, latest 1.9 version of Electronic Display Boards (EDB) were installed.

Biological data on length, weight, gut content, gonad condition and chemical composition for Oil Sardine and Mackerel were collected and analyzed.

Forty - six experiments comparing fish catches by identical purse-seine boats operated on the same day, in PFZ and non PFZ notified areas were conducted. All the experiment results indicated higher catch and higher net profit in the PFZ areas compared to the non PFZ areas.

Individually, for a mackerel catch of 5.0 tons in the PFZ area, the non PFZ yield was 0.3 tons which was sixteen times more and the difference in the net profit was ₹ 5.35 lakh. Similarly, for 4.5 tons catch of Oil sardine in PFZ area, the non PFZ yield





was 0.42 tons which was ten times lower than PFZ area. The net difference in the profit for oil sardine was ₹.2.43 lakh. For seer fish, it was observed that 4.5 tons in PFZ area corresponded to 0.65 tons in non PFZ area. The net difference in the profit for seer fish was ₹. 10.61 lakh. Thus the comparative experiments clearly indicate that the fish catch and net profit was 2 to 16 times more in the PFZ area than that of non PFZ area.

The effective use of PFZ advisories, how to read the data shown on the map and table and apply it in day to day fishing activities were explained to the fishermen during the field visits to the jetties. The use of wind feature which was newly added this year with the PFZ advisory was also explained to the boat owners. A total of 102 field visits have been made during the year.

The PFZ advisories received were disseminated to the identified boat owners at Malim (Panaji), Marmugao (Vasco) and Cutbona (Betul). Feedback data were collected from the mechanized fishing boats (with Purse seine operators) during that period and the exact location of the fish catch were marked on the map indicating distance from the shore, depth reference of the catch etc., including angle, direction, latitude and longitude. The boats from which the feedback data were collected were equipped with GPS and depth finder. The person identified for the purpose is also trained in locating the position of the fish catch so that the data is accurate. Altogether, 304 feedbacks were collected during this period. A total of 46 experiments were conducted during the year to compare the fish availability data and to validate the difference in fish catch in PFZ and Non PFZ area. The experiments were conducted on the same day by the fishing boats at two different points, one being within the PFZ area whereas other outside the PFZ area (non notified area). Feedback on fish catch details, major fish landings and other biological details were collected by fortnightly visits to all the three identified fish landing centers.

Fish samples of two major fishes, Indian mackerel (*Rastrelliger kanagurta*) and Oil sardine (*Sardinella longiceps*) were collected fortnightly from the jetty to study its Morphometric

characteristics (Length-weight). Biochemical estimation for proteins, carbohydrates, crude fats, ash, etc., were also studied. Gut content and gonadal condition of the fishes were also studied on monthly basis and analyzed.

The three EDBs at the three jetties, viz Malim (Panjim), Marmogoa (Vasco), and Cutbona (Betul) in Goa were monitored regularly to receive the latest accurate data from the satellite.

Boat owners with the purse seine gear were seen to develop a keen interest in using the PFZ advisories at all the landing centers at Goa. The interest was mainly due to several reasons.

Reduction in search time: the exact location of the fish shoal was tracked using the GPS on the boat by referring to the PFZ map and date and hence search time was reduced which also reduced the fuel consumption.

Good profit for the boat owners

- The amount of money spent on the fuel was reduced as the search time was reduced.
- The crew did not have to take extra tons of ice. For long journey the ice melts, so the crew takes extra ice to keep the fish fresh that added to the expenditure.
- The crew did not also spend time (in terms of days) in the sea that reduced the food consumption.
- Some amount of profit money was given to the crew in addition to their wages. This attitude developed a good relation between the boat owners and his crew making communication easier.
- PFZ advisories were given to trawlers operating in Goa coast but were found to be ineffective and hence no feedback was collected from them.
- The boat size ranged from 45 to 65 feet in length with 6 cylinder capacity. The purse seine net size varied between 1000 x 60 m and 1000 x 40 m, in some cases with 80 m depth.





A total of 136 PFZ forecasts were received during the year April, 2012 to December, 2012. Out of which 102 were validated. Forty - six experiments were conducted within PFZ and non PFZ area to compare the fish catch in those areas. Altogether 304 feedbacks were received from the three landing centers from Goa state. Out of these, 185 feedbacks were from within the PFZ advisories and 119 were from outside the PFZ area.

The major fish species caught during the period of report were Indian mackerel, (*Rastrelliger kanagurta*), oil sardine (*Sardinella longiceps*), tuna (*Katsuwonus pelamis*), Seer fish (*Scomberomorus guttatus*), Horse mackerel (*Megalapsis cordella*), lesser sardines (*Sardinella fimbriata*) and solar shrimps. The other species were Black pomfret (*Parastromatus niger*), Silver pomfret (*Pampus chineses*), Pearl spot (*Etroplus suratensis*), Silver whiting, Mulletts.

Out of the 304 feedback received this year, 142 were of Indian mackerel, 51 of oil sardine, 82 of seer fish, 10 of tuna, 4 of horse mackerel, 7 of solar prawns and 8 of lesser sardine. Indian mackerel formed the major part of the total fish landing at the three jetties contributing to around 46.7 % of the total catch. Seer fish ranked second by contributing 27.0 % followed by Oil sardine (16.8 %). Tuna was found to be less this year contributing to around 3.3 % and Horse mackerel around 1.3 %. Solar prawns that appeared soon after the ban period in early August were also less during the year contributing to around 2.3 % to the total fish catch. Lesser sardines contributed to around 2.6 %.

Out of 136 PFZ forecasts validated during the period under report, as per the feedback received from 304 purse seine operators utilizing the advisory, 100 percent boats reported availability of

fish. Out of the 119 non PFZ feedback responses recorded during year, the purse-seine fish catches ranged from 200 kg to 1.1 tons in the non PFZ area which was less than the catches from boats using PFZ advisory.

The highest catch obtained using PFZ advisories were 6.1 tons for Indian mackerel, 4.5 tons for oil sardine, 2.5 tons for Horse mackerel, 4.6 tons for tuna, 5.7 tons for seer fish and 2.7 ton for lesser sardine..

Out of the 185 feedbacks received from boats using PFZ advisories, 152 boats fished on the first day of receipt of the advisory, 33 on the second day. The CPUE ranged from 1.5 ton to 6.2 ton on the first day fishing average of 3.85 ton. The range of fish caught on the second day of fishing was from 0.3 to 1.0 ton with an average of 0.75.

It was observed from the data 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 83.7 % which reduced to 16.7 % on the second 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 day one is highly profitable. In comparison, PFZ advisories users were less on first day and catch was more and users were more on second day but the catch was less. However, during the current year, as the PFZ forecast were available daily, the users are more on the first day as they get a better catch and the users on the second day were only those who could not get the PFZ forecast in their location and therefore had to depend on the previous days forecast.



Process of loading and unloading of Oil sardine at Vasco jetty





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

The project involved seed / planting material production in major field crops, horticultural crops and ornamental fishes.

As per the seed production programme envisaged in major field crops of the region, seed production in different crops were undertaken. Keeping in view, the local demand for seeds of various crops and the target fixed, seed production was undertaken during *kharif* both in Institute farm and in farmers' 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 Bagayatdar Society.

A total of 3000 kg foundation seed of rice (variety Karjat-3 and Naveen) was produced by procuring the Breeder seed from Regional Research Station (K.K.V., Dapoli), Karjat and CRRI, Cuttack, respectively. The seed material produced was sold to State Directorate of Agriculture, Goa Bagayatdar Society and to the farmers.



*Foundation seed of high yielding rice variety Naveen under multiplication
Inset: (Seed set in Naveen)*



*Popular high yielding rice variety Karjat-3 under seed production
Inset: (Seed set in Karjat-3)*



The demand driven rice (variety Karjat-3) under harvest



High yielding rice Naveen being harvested with mini combine





Participatory seed production

During the *kharif* season, seed production of high yielding rice variety Naveen was taken up in farmers' field at Pilerne, Bardez-Goa. 50 Quintals of seed was produced from 1.0 ha of land.

Groundnut seed production

Considering the high potential for groundnut, efforts were made to evaluate 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 *rabi* season in paddy fallows as storage of seeds during *kharif* is difficult in the region owing to humid conditions prevailing in the State.

During the *kharif* season of 2012, seed production of proven high yielding variety of groundnut TG-51 was taken up in an area of about 0.5 ha under sloping upland situations. During *rabi*, high yielding groundnut variety TG-51 was taken up in rice fallows.



High yielding groundnut (Variety TG 51) under multiplication during *rabi* season

Cowpea seed production

Improved local cowpea selections which are known for their bold size, preferred taste and remunerative market price were multiplied during the year, in an area of about 4500 sq.m. The seeds were sown separately with different spacings depending on the selections and the observations were recorded on the number of

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

1. Alsando-1 (Determinate type)
2. Nadora Bardez-4 (Indeterminate type)
3. Dulape Utorda-3 (Indeterminate type)
4. Mahakhajan Pernem-2 (Indeterminate type)
5. DC-15 (a cross of local cowpea developed by UAS, Dharwad)

The selections are being purified and being harvested.



Local cowpea selection Alsando-1 under seed multiplication

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

- IGFRI-7, ● IGFRI-3 ● DHN-6
- *Pennisetum* trispecific hybrid ● Co-3 ● Co-4



High yielding Hybrid napier being multiplied for supply of planting material





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

Goa, a small State in the West coast of India, has a geographical area of 3,70,100 ha, with 34,112 land holdings, more than 80 per cent of which are being below one ha. The average holding size of farmers is below 0.5 ha. These small land holdings are further characterized by undulating terrain with diverse soil conditions. The marginal uplands with shallow soils are predominated by cashew crop while the low lying areas with rice. However, the local food habits of rice-fish curry, use of coconut in most of the culinary preparations and cashew for beverage and food needs to be met continuously by the agricultural sector. Further, the local milk production is only one third of the present demand to meet the daily minimum basic requirement of milk (0.25 litres / head).

Keeping these points in view, a research project on Integrated Farming Systems was initiated.

Development of Integrated Farming System Models

Based on the survey results and the agro-climatic conditions of the region, the land topography, crops and cropping systems and the socio-economic feasibility, two versions of 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 I: Upland (Plantation) based IFS model

Holding size of the model: 0.79ha

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 the lower terrain. The feasible intercrops under each of the plantation crops and their integration with poultry, piggery and vermi-composting are being evaluated.

Land allocation

- Cashew + Pineapple = 0.25 ha
- Coconut+ Elephant foot Yam+ Papaya = 0.23 ha
- Arecanut + Banana = 0.22 ha
- Piggery = 48.00 m² (Low cost pig shed)
- Poultry = 56.96 m²
- Vermi-compost unit = 35.75 m²
(Low cost shed)
- Compost unit = 42.7 m²
- Direct catch pits = 6 nos.(10.89 m² each)

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 901 kg/ha cashew nuts with a mean nut yield of 3.2 kg nuts/ tree. The apple yield of the cashew crop was 6.5 t/ha with a mean apple weight of 23.5 kg/tree. The intercropped pine apple has started yielding giving 70 kg fruits during the season. The middle terrain of the plot measuring about 0.22 ha is planted with local coconut cultivar Benaulim selections and intercropped with elephant foot yam (variety Gajendra, a selection from CTCRI, Trivandrum). Further the feasibility of growing papaya (variety Surya) in the line of coconut were evaluated. The high yielding arecanut variety Mangala interspersed with inter crop of tissue cultured banana (Grand Naine) has yielded 4.8 t/ha of banana fruits in a year with a mean bunch weight of 12 kg/tree. Integrated vermicomposting has yielded output of 465kg manure in 8 months in different batches period with an input of 1148 kg showing an output-input relationship of 0.41:1.





Model II. Lowland (Rice) based IFS model

Holding size of the model: 0.40 ha Selection of improved rice based crops for diversification

The study included the following aspects

- Integrated Farming System model for lowlands: including cropping systems Rice – Vegetables (Brinjal)+ Oilseed (Groundnut)+ Sweet corn + Pulse (Cowpea)
- Study on effect of rice based crops on soil fertility.
- Bund planting of forage grasses and integration with dairy.
- Planting banana along the borders of the bund.
- Initiation of integrated mushroom cultivation.
- Initiation of vermicompost unit.



The predominant rice based cropping systems of the region are being evaluated under lowland IFS model

Allocation of land area for different components as follows

- Rice = 0.40 ha during *kharif*
- Oilseed (groundnut) = 0.1 ha
- Pulse (cowpea) = 0.1 ha
- Vegetable (brinjal) = 0.1 ha
- Maize = 0.1 ha
- Forage crops (IGFRI- 3) = 0.0183 ha
- Rice cum fish pond= 0.07 ha
- Dairy = 24 m² for low cost shed near fish pond

Experimental results

System productivity

The lowland IFS model is being developed with selection of profitable rice based crops and integration with dairy. 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 51), brinjal (Local cultivar Agassaim) and sweet corn (Hybrid Sugar 75) were taken up.



Mulching in cowpea with paddy straw mulch for the dual purpose of moisture conservation and addition of organic matter

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. High yielding forage grass, hybrid napier, IGFRI-3 was grown on the field bunds to supply green fodder for the integrated dairy unit. The bund area available for planting of forage grass was 162 m² from an experimental field of 4000 m². 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 in a year which will provide green grass supply to the integrated dairy unit throughout the year.

The mean yield of rice-brinjal system was 16,956 kg/ha/year rice grain equivalent yield. Rice-cowpea system yield was 9,741 kg/ha/year. Rice-groundnut yielded 9,603 kg/ha while rice-sweet corn yield was 18,791 kg/ha/year. Thus,





Border planting of Local banana will add to the returns of the grower

rice-sweet corn system gave the highest system productivity followed by rice-brinjal system under protective irrigation which were significantly more productive as compared to rice-cowpea and rice-groundnut under residual soil moisture conditions.

Economics

Among the cropping systems evaluated under protective irrigation with dairy enterprise, Rice-sweet corn system involved higher cost of cultivation (₹. 28360/acre/year) owing to higher seed cost coupled with requirement of fertilizers and irrigations followed by rice-brinjal (₹. 21470/acre/year). Within the two cropping systems evaluated under residual soil moisture viz. rice-groundnut and rice-cowpea system with dairy enterprise, owing to lesser seed cost and relatively fewer cultural operations, rice-cowpea system recorded lower cost of production (₹. 19420/acre/year) as compared to rice-groundnut system (₹. 19870/acre/year).



The gross returns were relatively higher for rice-sweet corn system (₹. 75980/acre/year) and was followed by rice-brinjal system (₹. 66020/acre/year). Higher assured market price both for sweet corn and brinjal coupled with easy marketing has favored higher gross returns in this system.

The net returns which is the decisive factor in the selection of profitable cropping system was found higher with rice-sweet corn (₹. 47620/acre/year) and rice-cowpea (₹. 45980/acre/year). Higher productivity of the rice based crops and the variety in these systems coupled with relatively assured market with stable prices have resulted in better net returns from these systems. The net returns were relatively lower with rice-groundnut system as the crop was raised only under residual soil moisture resulting in medium returns.



Local brinjal with bigger sized fleshy fruits for enhanced returns

The returns per rupee invested which is being reflected through benefit cost ratio was found highest with rice-cowpea system (3.37) and was followed by rice-brinjal system (3.07). Rice-cowpea system having higher productivity with relatively lesser cost of production being cultivated under residual soil moisture could able to depict a better benefit cost ratio as compared to others. Rice-sweet corn system although recorded higher gross and net returns, the B:C ratio was relatively lower (2.68) as the cultivation of sweet corn involved more costlier inputs like labour, fertilizer, irrigation, etc.





Bund planting of hybrid napier forage grass for economic rationing of integrated dairy

Thus under protective irrigation, by adopting integrated approach the farmer is expected to get

a return of ₹. 6330/month in one acre holding by following rice – sweetcorn (Naveen - Sugar 75 Hybrid) + dairy (1 milch cow) with heifer as bonus. Under residual soil moisture, by adopting integrated approach the farmer is expected to get a return of ₹. 5450/month in one acre holding by following rice- cowpea (Naveen- local selection) + dairy (1 milch cow) with heifer as bonus. Alternatively, with 50% area under protective irrigation + 50% area under residual moisture, by adopting integrated approach the farmer is expect to get a return of ₹.5890/month by following ½ acre rice – sweetcorn (Naveen - Sugar 75 Hybrid) and ½ acre rice- cowpea (Naveen- local selection) + dairy (1 milch cow) with heifer as bonus.

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

Germplasm collection, conservation, evaluation, characterization and cataloguing

Clonal germplasm bank

With addition of 3 bold nut types and 2 cluster bearing types to the existing Germplasm of 76 local accessions, a total of 81 germplasm accessions of cashew representing the following groups is being maintained in the institute.

- Jumbo Bold nut types : 14 accessions
- Bold nut types : 29 accessions
- Medium nut and high yielders : 12 accessions
- Remaining 23: high yielders/ cluster bearers irrespective of nut size
- Dwarf canopy types : 3 accessions
- Total germplasm collection : 81 accessions

Study on the characteristics of mother trees of five new accessions identified during 2012 revealed that, nut yield per tree varied from 8.4 kg (Keri-1) to 26.4 kg (Curti-1) with average nut weight of 9.1g and 8.1g, and apple weight of 98.6 g and 80.5 g respectively. During year, four accessions from Gaodogrim and two from Sanquelim-Keri have been identified for desired traits of nuts, apple and

bearing. The survey is under progress during the current season of 2013.

Characterization of selected local bold nut cashew genotypes

Studies on performance and characterization of local bold nut genotypes, initiated from 2008-09, are under progress. The RBD experiment with three replications comprises 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 4.8m with collar girth of 65cm and canopy spread of 6.5m (NxS) and 6.3m (ExW), started flowering and fruit set from current season (2012) along with other accessions namely, Valpoi-1, Valpoi-3 and Tiswadi-3 with medium vigorous growth habit.

Nut yield, though not significant, varied from 0.21 kg/tree (BKL-2 and Tudal-3) to 0.56 kg/tree (Bardez-8/98) as against 0.45kg /tree recorded in check (Goa-1). On the other hand, the genotypes namely Valpoi-2, Bardez-9 and Tiswadi-3 recorded





the nut weight of more than 10g with average apple weight of 105.0, 110.5 and 98.4 g respectively. Other genotypes like Valpoi-1, Tiswadi-7, Tudal-1, Mayem-1 and BKL-1 yielded more than 0.30 kg per tree of nuts having the average nut weight of more than 8g. In general, the trees of all the genotypes were free from Tea mosquito infestation while the infestation of mealy bugs and thrips was recorded in Tiswadi-3, Tudal-1 and BKL-1.

Varietal evaluation trial (MLT-VI)

Evaluation of new hybrids / varieties introduced from other cashew research stations

The growth of all varieties was observed to 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 against 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.

Hybridization and selection

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 continued 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 4.60 m was recorded in H-31/05 followed by H-22/05 (3.90m) and H-2 1/05 (3.8m). 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. Trees of H-31/05 and H-11/05, H23/05, H-27/05 and 29/05 had higher incidence of TMB and leaf webber.

The hybrids namely, H-13/05, H-27/05 and

H-30/05 started yielding from current 2012). The recording of the nut yield of the hybrids in the current season is under progress, although till date the higher nut yield of 3.55kg/tree was recorded in H31-/05 followed by 2.15 kg/tree in H-21/05 with mean nut weight of 7.2 g and 8.6 g and shelling per cent of 29.02 and 29.15 respectively.

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. Second set of 34 hybrids of seedlings of the following parental combinations is also planted in the field for evaluation which is under juvenile stage.

Second set of hybrids

S. No.	Parental combination
1	KN 2/98 X Goa-1
2	Goa-1 X Tiswadi-3
3	Tiswadi-3 X Red local-1
4	Red local-1 X Tiswadi-3
5	Tiswadi-3 X Ganje-2
6	Ganje-2 X Tiswadi-3
7	V-4 X Tiswadi-3
8	Ganje 2 X Valpoi-3
9	Valpoi-3 X Red local

Land preparation is made for taking up planting of third set of 53 Hybrid seedlings of the following parental combinations in the main field for further evaluation.

Third set of hybrids

S. No	Parental combination
A	Bold nut size Vs High yielding
1	Tiswadi-3 X Red local
2	Bardez-9 X Ganje-2
3	Tiswadi-3 X Vengurla-4
B	High yielding Vs Bold nut size
1	Red local X Tiswadi-3
2	Ganje-2 X Bardez-9
3	Vengurla-4 X Tiswadi-3





Hybridization work

Crossing was carried out among the following four identified parents and 42 hybrid seedlings were raised as a fourth set of hybrids.

1. RL-1 (small nut & high yielder) x Bardez-9 (jumbo nut) : 14 seeds
2. RL-1 (small nut & high yielder) x Tiswadi-3 (Bold nut) : 18 seeds
3. RL -1 (small nut & high yielder) x Valpoi-2 (Jumbonut) : 10 seeds

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

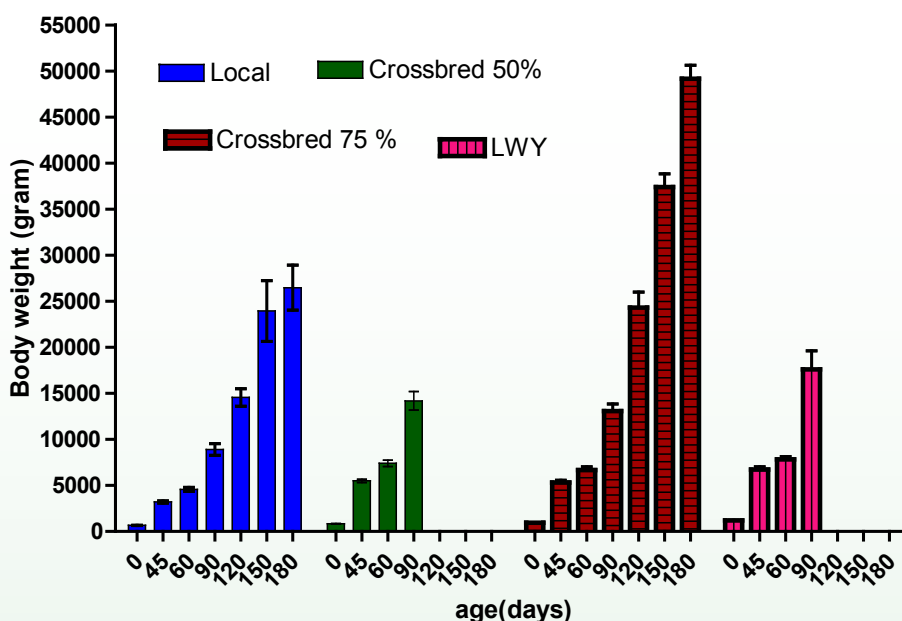
There were 42 farrowings of which 22 were from Goa Local, six from Large white Yorkshire and seven each from 50% and 75% crossbred. Gestation period of Goa Local, Large White Yorkshire, 50% crossbred and 75 % crossbred was 112.54, 112.00, 109.57 and 112.28 days respectively.

Litter size at birth and weaning of Goa Local, Large White Yorkshire, 50% crossbred and 75% crossbred were 6.81, 7.00, 7.16, 8.33 and 5.33,

5.60, 6.50, 5.40 respectively.

Average birth weight of Goa Local, Large White Yorkshire, 50% crossbred and 75 % crossbred were 669.16, 1191.97, 820.34 and 965.00 gms. Average weaning weights of Goa Local, Large White Yorkshire, 50% crossbred and 75% crossbred were 3207.14, 6711.76, 5420.51 and 5044.44, respectively.

Body weight gain



Growth performance of different pig breeds





**Project :Generation of elite planting material in horticultural crops for Goa
(RKVY) (PI: V. Arunachalam)**

Planting material of selected horticultural crops were produced as seedlings of papaya, chillies, marigold, crossandra and passion fruit and rooted

cuttings of barbodos cherry, crossandra, ornamental sweet potato (Akshaya), seedless lemon, passion fruit and suckers of curry leaf.

Details of the production and sale

Crop	Variety	Plants produced	Plants sold
Marigold	Pusa Narangi Gainda	1900	1900
Barbados cherry	Red	90	88
Crossandra (cuttings)	Blue	93	34
Sweet potato	Akshaya	5000	5000
Seedles lemon	Konkan	95	92
Papaya	Pusa Nanha	519	507
Passion fruit (cuttings)	Cauvery	78	0
Passion fruit (cuttings)	Yellow	108	10
Passion fruit	Yellow	260	0
Curry leaf	Dharwad	541	61
Chilly	Canacona	4000	1627
Chilly	Arkha Meghana	2000	692

**Project :Crossbred pig production (RKVY)
(PI: E. B. Chakurkar)**

Farrowing unit and piglet unit constructed under RKVY were inaugurated by Shri Manohar Parrikar, Honourable Chief Minister, Government of Goa. Under this program piglets were sold to farmers as base stock and details are as follows-



Inauguration of piglet unit

Sr. No	No. of piglets sold	Month	Constituency
1	21	March	Salcette, Panjim, Bardez
2	15	April	Tiswadi, Cortalim, Salcette
3	19	May	Bardez, Aldona, Colva, Ponda
4	42	June	Pernem, Bardez, Tiswadi
5	5	July	Panjim, Mapusa, Bardez,
6	10	August	Mapusa, Panjim, Verna, Bicholim
7	16	September	Sanguem, Bardez, Salcette,
8	40	October	Salcette , Bardez, Tiswadi, Vasco, Pernem
9	24	November	Cortalim, Salcete
10	6	December	Salcette , Tiswadi
11	8	January	Verna , Salcette, Bardez
12	8	February	Salcette, Bardez, Panjim, Sanguem
Total no of piglets sold			214





Project :Production of hydroponics green fodder for eco-friendly and sustainable milk production in Goa (RKVY) (PI: P. K Naik)

Cost of Production of Hydroponics maize Fodder

The cost of seed, electricity, water, detergent, petty items and manpower contribute the cost of production of the hydroponics fodder. In the hydroponics maize fodder production unit with daily accommodation capacity of 72 trays, 108 kg seed is required daily (1.50 kg seed per tray) costing about ₹. 2376. It is observed that in the hydroponics fodder production unit with daily production potential of 600 kg hydroponics maize fodder, approximately 16 units of electricity and 1560 liters of water (if water is not recycled) is consumed costing about ₹.24/- and ₹. 16/-, respectively. Only one man power is sufficient for the daily maintenance and production of hydroponics fodder. Very small amount (₹.3/- per day) is required for detergent charges to clean the hydroponics green house trays. Thus, the total input per day is approximately ₹. 2419/-. The total fresh hydroponics maize fodder production is about 540-594 kg per day. Thus, the cost of per kg hydroponics maize fodder is about ₹.4.07-4.47/- on fresh basis. It is observed that seed cost is the major factor influencing the cost of production of the hydroponics maize fodder, which is about 90% of the total cost. If the seeds will be produced by the farmers, then the cost of the hydroponics fodder will be decreased significantly.

Long term feeding of hydroponics maize fodder to dairy animals

Maize fodder produced by hydroponics system was fed to the dairy animals (heifers, pregnant and lactating cows) of the Institute @ 7-10 Kg/ animal/ day along with concentrate mixture and jowar straw for a period of one and half year. It was observed that during the feeding period the incidence of digestive disorders such as anorexia, diarrhoea, tympanitis were reduced and appreciable increase in the appetite and milk production of the lactating animals. There was improvement in the reproductive performance such as early onset of post partum estrus, reduction in calving to conception interval,

reduction in number of services required for conception. There were reductions in the occurrence of post partum complications such as retention of placenta and post partum metritis. The incidence of metabolic disorders such as ketosis and milk fever were not observed during the feeding period. There was improvement in the general health of the cows including skin coat conditions.

Feeding of hydroponics maize fodder in field condition – A success story

Mr. Suryakant B. Gawde, a farmer of Mandrem village in Pernem Taluka of Goa is producing green fodder maize under hydroponics technology and feeding to his dairy animals since last six months. On daily feeding of 10 kg hydroponics fodder maize per cow, he saved 1.0 kg concentrate mixture per cow daily and experienced enhancement of approximately 1.0 litre (from 8 litres to 9 litres) milk per cow per day. His four cows, which were repeat breeder conceived after incorporation of hydroponics green fodder maize in their ration. The young calves fed with 1-2 kg hydroponics fodder gained higher body weight (350g Vs 200g) with better skin coat. On economics point of view, he is earning additional net profit of ₹. 10/- per cow per day and the animals are remaining healthy and without reproductive problems. The case study indicates that it may have positive impact on the production and reproduction of the dairy animals; however, further study in detail is needed.



Mr. Suryakant B. Gawde, dairy farmer feeding hydroponics green fodder to his cows





AICRP Voluntary Centres

Project :All India Co-ordinated Rice Improvement Project (Coastal Saline Tolerant Variety Trial, CSTVT), Kharif 2012 (PI: Manohara K. K.)

The coastal saline tolerant variety trial consisted of 33 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,



Field view of CSTVT trial at Chorao Island in farmers' field

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 88 days (CR 2815-2-4-2-1-1-1) to 129 days (CR 2461-1-30-1-1), plant height ranged from 91 cm (CR 2815-5-1-3-3-S-1-2-1) to 147.3 cm (Korgut (LC), panicles / m² ranged from 148.5 (Jaya, Yield Check) to 260.7 (CR 2839-*R-1-1-S-1-B-1), while grain yield ranged from 1179.19 kgs/ha (CHR-16) to 4426.39 kgs/ha (CN 1744-15-3-7-8-MLD 25).

Among the test entries, the top 5 ranking entries are CN 1744-15-3-7-8-MLD 25 (4.42 t/ha), CR-2814-19-4-2-1-1 (4.07 t/ha), CR 2837-1-1-B-1-B-S-B (3.90 t/ha), Gosaba-2(IR 68652-3B-30-2) (3.70 t/ha) and CN 1785-20-21-9-MLD 26 (3.52 t/ha).

Project :National Network Project on Arid Legumes I. Evaluation of Cowpea IVT (Northern Locations) and AVT-I (North) lines, Rabi, 2012-13 (PI: Manohara K. K.)

Two trials IVT and AVT-I comprising 18 and 10 Cowpea lines, respectively, were evaluated under residual moisture conditions after rice fallows at the Institute farm. The trials were laid out in Randomized Block Design with three replications. In IVT, entry PCP-306-1, PNT recorded highest seed yield of 3008.77 kgs/ha followed by CPD-115, DGP with 2836.84 kgs/ha and GC-901, SKN with 2813.45 kgs/ha. In AVT trial, entry CPD-119, DGP recorded highest seed yield of 3297.66 kgs/ha followed by DC-15, DHW with 3074.8 kgs/ha and KBC-4, BGL with 2845.61 kgs/ha.



Field view of Cowpea IVT and AVT-I trials





II. Yield optimization in *rabi* cowpea through organic management (PI: B. L. Manjunath)

AICRP on Arid legumes

A network project on AICRP on Arid legumes entitled “Yield optimization in *rabi* cowpea through organic management” was initiated during the year with 11 treatments in three replications. The main objective of the trial is to optimize the productivity

of *rabi* cowpea through organic production technique.

Relevant growth and yield observations were recorded and the progress of the project work was reported in the Annual workshop.



A view of the experimental plot of AICRP on Arid legumes



Foliar spray of PGPR I & II at 50% flowering stage

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

Varietal trial in Brinjal (long) AVT-I

Six varieties and three checks in brinjal AVT-I were evaluated for yield and yield contributing traits during 2012-13. The highest yield of 398q/ha was recorded in 10/BRLVAR-6 followed by 10/BRLVAR-3 (380q/ha.). Among the checks evaluated, Punjab Sadabahar recorded the highest fruit yield (363 q/ha.). With respect to ancillary observations, the earliest flowering was noticed in Kashi Tarou (36 days) followed by 36.33 days in 10/BRLVAR-6. The yield per plant was highest in 10/BRLVAR-6 (1.33 kg) followed by 10/BRLVAR-3 (1.23 kg).



Experimental trial on AICRP on Vegetable Crops





Performance of brinjal (long) AVT-I during 2012-13

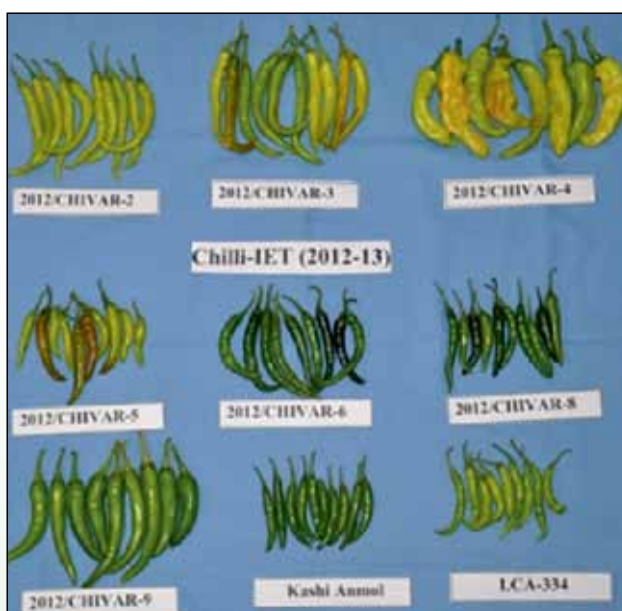
Varietal trial in Chilli IET

Seven varieties of chilli with one check were evaluated for red ripe chilli and other yield contributing traits during the year. Among the varieties evaluated, the highest red ripe chilli was recorded in 2011/CHIVAR-3 (77q/ha) which was closed followed by the check variety LCA-334 (76.33 q/ha.). In case of ancillary observations, the

earliest flowering was noticed in 2011/CHIVAR-5 (28.33 days) followed by 2011/CHIVAR-1 and 6 (29.67 days) for days to first flowering. The yield per plant was highest in the check variety LCA-334 (0.36 kg/plant) followed by 2011/CHIVAR-3 (0.33 kg/plant)

Varietal trial in Chilli AVT-I

Six varieties of chilli and two checks viz., LCA-334 and Kashi Anmol were evaluated during 2012-13 for red ripe chilli yield and yield



Performance of Chilli-IET during 2012-13



Performance of Chilli-AVT-I during 2012-13

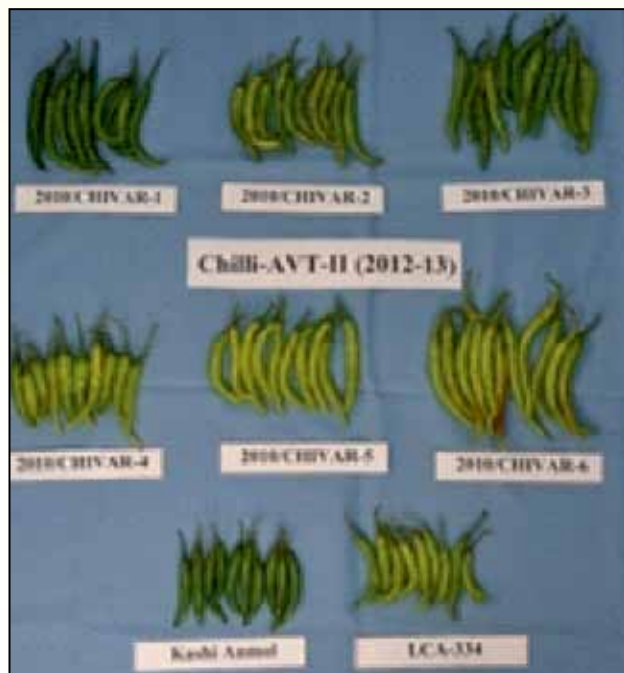




contributing traits. The highest yield of red ripe chilli was recorded in check variety KA-2 (83.33 q/ha) followed by again the check variety LCA-334 (77 q/ha.). The earliest flowering was recorded in 10/CHIVAR-2 (28.33 days) and the highest per plant yield was recorded in check variety KA-2 (0.36kg/plant)

Varietal trial in Chilli AVT-II

Nine varieties including two check varieties were evaluated for yield and other traits in AVT-II trial. Among the varieties evaluated, the check variety KA-2 recorded the highest red ripe chilli (83.33q/ha) followed by LCA-334 (77q/ha). The earliest flowering was recorded in KA-2 (33 days) followed by 09/CHIVAR-2 (34.67 days).



Performance of Chilli-AVT-II during 2012-13

AICRP bacterial wilt resistance trial in brinjal-AVT-I and AVT-II

In AVT-I trial, six bacterial wilt resistant varieties were evaluated along with two resistant checks viz., Arka Nidhi and SM-6-6 for yield and wilt incidence. The yield range was from 127.58 to 180.67 q/ha with wilt incidence of 8.96 to 37.03 per cent.

In AVT-II trial, four bacterial wilt resistant varieties were evaluated along with two resistant checks viz., Arka Nidhi and SM-6-6 for yield and wilt incidence. The highest fruit yield of 180.67q/ha was recorded in the resistant check SM-6-6 which was closed followed by Arka Nidhi (157.76 q/ha.). The wilt incidence was recorded at one month after transplanting and it ranged from 8.96 to 37.03 per cent.



Arka Nidhi - bacterial wilt resistant variety



SM-6-6 - bacterial wilt resistant variety





ICAR RC Goa

Annual Report

2012-13

Institutional Activities

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





Transfer of Technology

Demonstration of newly introduced rice varieties

The objective is to showcase the newly introduced rice varieties in the different groups to the farmers. Demonstration plots were laid out comprising 15 rice varieties representing medium duration, short duration, hybrid rice and scented rice varieties. Varieties showcased in the demonstration plots are Jaya, Jyothi, PA-6444, Naveen, Karjat-3, Akshayadhan, Pusa-44, Chandan, TRC-2005-1, Pusa Basmati-1, PB-1121, Pusa Sugandh-5, MTU-1010, MTU-1001 and MTU-7029. Farmers were briefed with the potentiality of each of these varieties during their visit to the field.



Demonstration of popular rice varieties at the Institute farm

Front Line Demonstrations in rice

Front Line Demonstrations were conducted in high yielding variety of rice-Naveen and Karajat-3



FLD on high yielding rice at Cortalim-Goa

against ruling variety Jaya/ Jyoti in farmer's fields during *kharif* and *rabi* seasons of 2012-13 in different parts of Goa. A total of 10 farmers with different holding size were selected for demonstration of the rice variety. Periodical field visits were made and on the spot assessment was made by discussion with farmers. The yield of both the high yielding varieties and the local checks were assessed through crop cuttings and the results showed a superiority of 30-50% increased yield with rice variety Kajat-3 / Naveen against the check varieties.

Front Line Demonstration on Rice (Popularization of "Naveen" & "Akshayadhan" and salt tolerant CSR- 36

Among white kernel rice demonstrated Akshayadhan yielded 5.46 t/ha followed by Naveen 5.20 t/ha as against the traditional variety Jaya 4.4 t/ha and Jyoti 4.26 t/ha. The % increase in yield in demonstrated technology was 24%, 18% over Jaya and 18.16%, 22% over Jyoti in case of white kernel rice Akshayadhan and Naveen, respectively.



Akshayadhan variety demonstrated at Gaodongrim village, Canacona





Popularization of SRI system of planting

The SRI system resulted in yield level of 9.67 t/ha at Bhironda as case of Makam. The overall FLD mean in 4 villages was 8.47 t/ha. Yield increase-86%, Net return - ₹106619/-, Net return increase- ₹33609/-, B:C ratio - 1:4.7.



SRI cultivation of rice

Front Line Demonstration on groundnut (Kharif)

The FLD was carried out in 3 villages covering 1.6 ha with groundnut variety TG 37 demonstrated. Area covered 1.8ha. The FLD recorded mean yield of 1.89 t/ha as against control (fallow). Additional income of ₹44,600/ha was realized by stakeholders as against control. B:C ratio of 1:2:73 was realized under FLD. Fodder yield of 6.5 t/ha could be supplied for animal feed.



Groundnut cultivation in rice fallows

Assessment of management of Koleroga in arecanut

Trial was taken for 2 farmers in Priol village with following treatment

- i) T₁- Spraying of 1% Bordeaux mixture thrice

- ii) T₂ - Phytosanitation
 - a) Avoid water stagnation
 - b) Proper fertilizer application
 - c) Use of plastic to cover the areca bunches for 4 months since before the commencement of monsoon so as to prevent the spread of the diseases on the bunches.
- iii) Disease incidence (%) 2.96, 2.82 respectively to T₁ and T₂
- iv) Yield (kgs / acre) 1520, 1680 respectively to T₁ and T₂
- v) B:C Ratio 2.43, 2.66 respectively to T₁ and T₂

Frontline Demonstration on Popularization of turmeric cv. Pratibha under coconut garden

Area under intercropping of turmeric in coconut garden has increased to 20 ha with B:C Ratio of 1:1.66. Area covering 0.40 ha with 10 farmers.



Field of view of turmeric cultivation

Testing of vegetable Red Gram c.v. BGR-2

Eight stakeholders were exposed to transplanted Tur technology with one On Farm Training at KVK Campus covering 0.8 ha. Additional employment and income generation with this technology resulting in 57% yield increase (54.69/ha) in green pods against dibbling method (34.59/ha) with B:C Ratio of 1:4.7.





OFT in vegetable red gram

Frontline Demonstration on Popularization of vermiculture technology for waste management

Five units have been established at Bhironda, Neura, Amona, Aldona and Dhulapi villages and their performance was monitored. The stakeholders have reported success of their units with regular harvest of Vermicompost. Compost produced and sold: 8,500 kgs (₹ 85,000/-), Live earthworm sold: 4.15 kg (₹ 1,660/-).



Demonstration of vermicompost technology

Frontline Demonstration on Popularisation of Homestead farming

Demonstration unit at KVK- 600sq.mt and Revenue generated ₹ 4,530/-. Produce sales viz; Vermicompost, banana, bottle gourd, tomato, tidge gourd, green chillies, karela, drumstick, bread fruit, turmeric, onion, etc.

Farmers field- 400sq.mt, No. of farmers- 2., Income generated ₹ 5825/-. Produce sales viz; eggs, ridge gourd, cluster bean, okra, vermicompost, tomato and red amaranthus.



View of homestead farming in Goa

Tribal Sub Plan Programmes

Technology interventions for higher productivity and production in plantation, spice and fruit crops for improving livelihood security of tribe in Goa

Eight Self Help Groups (SHGs), 7 in Gaodongrim and Cotigaon villages of Canacona Taluka and one group in Morpirla village of Quepem Taluka of South Goa were identified by personal interaction and meetings with the farmers. Farmers of ST community in these villages were engaged entirely on farming for livelihood. Cashew, coconut, arecanut, mango, banana, rice, seasonal local vegetables including Canacona chillies, etc., were the main crops, cashew having the major area on hills. Each of the above eight groups was provided with one professional brush cutter (Oleo-Mac) and two power sprayers (Knapsack Power sprayers) for taking up weed management and foliar spray of nutrients and plant protection chemicals respectively. In order to improve the productivity levels of the existing plantations, each tribal farmer of the SHGs was provided with N P K fertilisers and Micro nutrients for applying for 50 cashew trees and a few fruit trees and coconut palms. Ring method of soil application of recommended dose of fertilizers with green leaf manure was demonstrated, besides briefing them about the timely application and its ultimate benefits.

Water soluble fertilizers like, 3 kg of Poorna (19:19:19 NPK), 3.0 kg Boon-45 (13:0:45) 3.0 kg Boost-52 (0:52:34) were also provided to each farmer in Canacona zone and Morpirla village





of Qupem Zone, to take up nutrient application through foliar spray during critical stages of growth, flowering and fruit-set & development stage. Method of preparation of foliar spray solution of required concentration followed by foliar spray on cashew canopy was practically demonstrated to all the beneficiary farmers who were also further briefed about the timely foliar application of nutrients at critical stages for obtaining the increased yield. During the appraisal meet of all beneficiary tribal farmers of the selected SHGs in cancona zone, a technical bulletin about the integrated pest management practices in cashew, specially published in local language (Marathi) having pictorial depiction, was released and copies were distributed among the farmers for ready reference. At the same time, prescribed agrochemical inputs required for pest management of cashew were provided to farmers. Each Farmer was supplied with Agrochemicals namely Cyhalothrin and Monocrotophos to take up the foliar prophylactic plant protection spray (combined with foliar nutrients) against the tea mosquito bug. Chlorpyriphos was also provided for effective management of cashew stem and root borer. Farmers were specially trained to identify the CSRB infested trees in the early stages, extract the grubs from the infested tree trunks and roots and drench the trees with chlorpyriphos solution.

Distribution cum Demonstrations of agrochemicals and sprayers for cashew stem and root borer management was organised on 9 August, 2012 at Bhars Panchayat, Canacona. Technical bulletin in Marathi and English with highly illustrative pictures of cashew insect pests and their



Distribution of agrochemicals and sprayers

management has been prepared and distributed to cashew growers. Demonstrations was organised for the management of tea mosquito bug on 21st December at Bhars, Canacona. Distribution cum Demonstrations of agrochemicals and sprayers for the management of tea mosquito bug was conducted on 22nd December at Morpillo.

Agricultural Mechanization Program for Small and Marginal Tribal farmers of Goa

Farming patterns and mechanization requirements of the tribal farmers of various parts of Goa were assessed. Based on the needs as expressed by the farmers' and their farming patterns, and in consultation with experts in the field, it was decided to distribute Power tillers with all accessories and 1.5 ton trailer, Mini Rotary tillers, Brush cutters. Eight such sets were distributed to farmers of Gaodongrim and Quepem, Based on a survey of post harvest management of rice, threshers and winnowing fans were included in the set.



Distribution of farm machineries

Eco-friendly plates and cups from areca leaf sheath wastes of Goa

Three machines each with two dies of areca leaf plate/cup making were purchased during 2012. Five self help groups were identified for distribution in areca growing locations.

Ten round dies were purchased during 2013 for replacement wherever cups are to be produced.





Economic upliftment of tribal community by introduction of improved livestock and poultry germplasm in the tribal area of Goa

Two numbers of milking machines were procured and distributed to the self help groups namely, Uddngi Self Help Group, Tudav, Netraivalim, Sanguem and MataShakti Self Help Group, Maddiwada, Vichndrem, Netraivalim, Sanguem.

Conducted an Infertility Camp in association with Goa State Veterinary and Animal Husbandry Services at Netravali on 30.10.2012. 50 numbers of crossbred cows were examined for infertility problems. 15 numbers cows were repeat breeders, 3 cows had endometritis, 3 cows suffered with cystic ovarian degeneration problem. Blood samples and vaginal swabs were also collected for bacteriological examination. Guidelines to handle infertile cases were given. Cystic ovarian cases were advised to use luteinizing hormone. Anoestrus cows were given with nutritional supplements including mineral mixtures.

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

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



Gramapriya birds in the backyard of farmer

Improving the Livelihood Security of the Tribal People of Goa through Dissemination of Animal Nutrition

Planting material for fodder crops (CO-4) was provided to the representative (Shri Rajesh Gaude) of the farmers' group for cultivation high yielding fodder for feeding of dairy cows. He has cultivated fodder in his 3 Ac (approx.) of land and producing sufficient fodder for about 40 dairy animals. Now he is able to provide fodder planting material to the other tribal farmers of Goa.



Cultivation of high yielding quality green fodder by TSP farmer

Infrastructure for preparation of feed block was established in Sangod Village, Taluka- Dharbhandora, Goa with the supervision of the farmers' group and feed block preparation was commenced. Feed blocks are being prepared and all the tribal farmers of Goa can avail the facility of feed block preparation.



Establishment of infrastructure for making feed block at farmer's field





Enhancing rice production and productivity in the tribal areas of Goa

Front Line Demonstrations (FLDs) on high yielding upland variety Sabhagi dhan was taken up in farmers' field at Gaodongrim village, South Goa during Kharif 2012. Farmers' were briefed about the various information viz., importance of the use of quality seeds, seed replacement, plant protection measures etc.

A total of 24 farmers with different land holding size were selected for demonstration. Periodical field visits were made during various stages of the crop and given regular technical advice as and when required. The performance of Sabhagi dhan was compared with Jyothi, a popular variety among the farmer's in the village. The yield of Sabhagi dhan and local check Jyothi were assessed through crop cutting method. Sabhagi dhan recorded grain yield ranging from 4.5 t/ha to 5.0 t/ha while Jyothi recorded grain yield of 3.0 – 3.5 t/ha. A yield advantage of 40–50% was observed due to the introduction of this new variety. As the farmers in the area prefer parboiled rice over the raw rice, the variety responded very well to local mills with head rice recovery of more than 70%.



Sabhagi dhan at Gaodongrim Village, Canacona

Further, Sabhagi dhan could meet the preference of the farmers with respect to taste and all the farmers have shown interest in taking up the crop for next year as well. Incidence of hairy caterpillar and caseworm was noticed during the peak tillering stage which caused severe defoliation. The caseworm showed symptoms like skeletonised leaf tissue and papery leaf structure. We have distributed and demonstrated the insecticide like Monocrotophos and Chlorphyriphos for the management of these pests.

Empowering tribal farmers, farm women & tribal youth through bioinput production and enhancing organic food security by sustainable cropping models

The project has enabled the Tribal farmers and farm women from Dhulapi as well as Quitla Aldona to acquire various machinery, farm tools and implements as well as other agricultural inputs and updating of skills through on as well as off campus trainings and demonstrations. The field demonstration of the working of various farm machinery and equipments like Power tiller and accessories, rotovator, Mechanical Grass cutter and water pump was held in Dhulapi on 7th July 2012. Practical demo was held in the village with the active participation of all the 42 stakeholders including women.

During the Kharif season, Frontline demonstrations with four rice varieties namely Naveen, Akshaydhan, Revati and Makam was held with training in "SRI" system which was done by 13 out of 42 stakeholders on a small area individually in area which was not inundated with water. Skill demo on SRI nursery raising and transplanting was given with weekly/fortnightly advice on weeding, water management etc. Regular visits were made to guide them about weeding and fertilizer management. The tillers per hill were counted in presence of 50% of the stakeholders and they were surprised to see profuse tillering in all the four demonstrate varieties. On an average each plant had 38-42 tillers.

An on campus training in transplanted tur nursery raising was organised for the farmers and OFT on red gram was conducted by 6 farmers at Dhulapi village. A vermiculture unit was also established with both on campus as well as off campus training to the stakeholders led by Shri Motiram Dhulapkar The President of the Sateri Farmers Club.



Implement distribution at Quitla, Aldona village





Intellectual Property Rights Cell (IPR)

Activities

- In response to the application submitted to PPV & FRA with regard to the registration of Cardozo Mankurad, DUS data, generated for the mango accession “Cardozo Mankurad” during the season (April - June 2012) was compiled and sent to PPV & FR Authority, New Delhi for further processing of application.
- IPR cell facilitated the signing of Memorandum of Understanding (MoU) for collaborative research project, between ICAR RC, Goa and Codon Biosciences Pvt. Ltd, Panjim, Goa.
- “Inventillect Consultancy Services Private Limited”, Pune has been appointed as patent attorney, for providing services related to IPR issues of this Institute with effect from 29-09-2011 to 31-12-2012. .
- One hundred seven *Listeria* cultures, isolated at this Institute are deposited with National Facility for Veterinary Type Cultures (NRC on Equines, Hisar, Haryana) and accession numbers have been obtained for each culture type under the technical expertise of Dr. S.B. Barbuddhe, Sr. scientist (VPH).
- Filing of patent application on technology entitled “Novel Process for fermentation of Cashew Apple juice using native microbes” is initiated and with services of “Inventillect Consultancy Services Private Limited”, Pune.
- Application for registration of four promising Cashew Germplasm accessions viz. “Tiswadi-3”, “KN-2/98, Ganje-2,” and “GB-2”, a genotype with dwarf canopy stature, with NBPGR New Delhi, is under process.

Meetings held

- A meeting of Institute’s Germplasm Identification Committee (IGIC) was convened on 2nd April, 2012 to discuss the matter on registration of Cardozo Mankurad, mango accession with PPV & FR Authority, New Delhi.
- A meeting of Institute Technology Management Unit (ITMU) was convened on 13th September, 2012 to discuss patenting of the Institute’s technologies and matters pertaining to IPR issues.
- Institute Technology Management Unit (ITMU) / Institute Technology Management Committee meeting (ITMC) was convened on 1st October, 2012 to discuss matters pertaining to filing of patent application and other IPR issues. External members of ITMC, Dr. R.P. Nachane, Principal scientist & Head, Div. of QEI and Member secretary, Zonal Technology Management Centre, West Zone, CIRCOT, Mumbai, and Dr. Sanjeev Saxena, Principal Scientist, Intellectual Property and Technology Management Unit, ICAR New Delhi, attended the meeting.





Programme conducted

Sensitization Programme on “Intellectual Property Rights (IPR): Issues & Perspectives” was held on 1st October, 2012 at ICAR Research Complex for Goa, Old Goa to refresh the current knowledge on latest IPR issues and policies in ICAR system. Dr. R.P. Nachane, Principal scientist & Head, Div. of QEI and Member Secretary, Zonal Technology Management Centre, West Zone, CIRCOT, Mumbai, enlightened the scientists and other staff involved in research leading to technology development, on “IPR Issues in ICAR System: Development of Commercializable technologies in

Agriculture and allied sectors. Dr. Sanjeev Saxena, Principal Scientist, Intellectual Property and Technology Management Unit, ICAR New Delhi delivered an informative talk on “Intellectual Technology Management and IPRs in ICAR System” with classical examples and case studies. Mr. Rohit Deshpande, Director Inventillect Consultancy Services Private Limited, Pune, was invited as a special invitee to enlighten all aspects and technical details about filing procedure, fees etc. for different forms of IPs with the special reference to patents.



Inaugural session of sensitization programme





EDUCATION AND TRAINING

Education

- Evaluated thesis of Ph.D. student of Department of Agronomy, Post Graduate Institute, Akola on the topic "Optimization of nutrient requirement and plant geometry for Bt and Non-Bt Cotton." **(NP Singh)**
- Evaluated thesis of Ph.D. student of Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University on the topic "Effect of Herbicides and Cultivars on Weed growth and yield of Boro Rice (*Orya sativa* L.)" **(NP Singh)**
- Acted as external examiner for conducting the oral comprehensive examination of Ph.D. Research Scholar of the Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University Varanasi. **(NP Singh)**
- Acted as major guide to B.Tech. (Hons.)-Bioinformatics students from TNAU Coimbatore on the topic "In silico mapping of genes and markers in public domain genome sequences –tool development, validation on Chr 1 and F locus of cucumber and mobile app development". **(V Arunachalam)**
- Evaluated thesis of Ph.D student of University of Agricultural Sciences, Dharwad on the topic "Soil and water conservation measures and cropping system in a watershed Dharwad." **(BL Manjunath)**
- Evaluated thesis of M. Sc student of University of Agricultural Sciences, Dharwad on the topic "Effect of sulphur application and foliar sprays to green gram under rainfed condition." **(BL Manjunath)**
- Evaluated thesis of Ph.D. student of Department of Fruit Science, University of Horticultural Sciences, Bagalkot on the topic "Studies on the effect of bio-fertilizers, growth regulators and media on seed germination and seedling growth of Aonla (*Emblica officinalis* Gaert.)". **(AR Desai)**
- Evaluated thesis of Ph.D. student of Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, University of Horticultural Sciences, Bagalkot on the topic "Genetic variability for herbage and seed yield in coriander (*Coriandrum sativum* L.) under hill zone of Karnataka." **(AR Desai)**
- Acted as major guide for the dissertation work entitled "Evaluation of boar semen quality in relation to lipid peroxidation status and In vitro sperm characters" to a student of Master of Technology in Biotechnology and Genetic engineering submitted to School of Life Sciences, Bharathidasan University, Tiruchirapalli. **(M Karunakaran)**

Lectures delivered by the Scientist

Date	Lecture Topic/Programme	Participants	Venue
BL Manjunath			
20.12.2012	Nutrient recycling through integrated farming systems	Trainees	U.A.S., Raichur
31.01.2013	Irrigation methods and water management for crop production	Farmers	KVK, ICAR RC, Goa
04.02.2013	Scope and the need for homestead farming	Farmers	KVK, ICAR RC, Goa





BK Swain			
02-02-2013	Poultry rearing under homestead farming system	Trainees	KVK, ICAR RC, Goa
05-02-2013	Backyard poultry farming	Trainees	Velge Panchayat, Pali
AR Desai			
03.10.2012	Horticulture for health and wealth of mankind	Trainees	KVK, ICAR RC, Goa
23 10.2012	Academics of horticulture and rainbow facet of professional opportunities	Trainees	ICAR RC, Goa
04.02.2013	Plantation crops and spices in homestead gardens of Goa	Trainees	KVK, ICAR RC, Goa
28.02.2013	Genetically modified crops and food security	Participants	GSCST, Tonca, Miramar, Goa.
21.03 2013	Quality planting material production in important fruit and plantation crops	Trainees	KVK, ICAR RC, Goa
PK Naik			
26-09-2012	Entrepreneurship opportunities in fodder production	Trainees	KVK, ICAR Goa
30-07-2012	Hydroponics green fodder production	Trainees	Goa Dairy, Curti, Ponda, Goa
03-09-2012	Hydroponics technology for green fodder production	Trainees	Goa Dairy, Curti, Ponda, Goa
M Thangam			
15.09.2012	Landscape gardening	Students	Chowgule College, Margao
18.09.2012	Vegetative propagation in horticultural crops and Garden principles and Components on at ICAR (RC), Goa	Students	Chowgule College, Margao
01/02/2013	Flower cultivation in Green House	Trainees	KVK, ICAR, Goa
21/03/2013	Quality seed production in ornamental crops	Trainees	KVK, ICAR, Goa
Z. B. Dubal			
06.07.2012	Foodborne viruses	Participants	ICAR RC, Goa

Training programmes organized by the Institute

Name of the Training	Venue	Period
Training on artificial insemination	ICAR RC, Goa	May 21-23, 2012
Training on boar semen collection, evaluation and preservation procedures	ICAR RC, Goa	February 19-21, 2013
Training on principles and practices of seed and planting material production	KVK, ICAR, Goa	March 21-23, 2013

Awareness programmes organized by the Institute

Sl No	Name of the Programme	Venue	Period
1.	Clean milk production	ICAR RC, Goa	26 October, 2012
2.	Clean milk production	Sanquelim, Goa	13 January, 2013
3.	Animal Health and hygienic production of milk	Ambulim, Quepem, Goa	18 February, 2013





Awards and Recognition

Dr. Narendra Pratap Singh

- Participated as an Invited Speaker in the International Conference on Global Food and Nutritional Security: Role of Science and Technology held at Wilton Park, Sussex, United Kingdom during 17-20 October, 2012.
- Deputed by the ICAR to participate in the NAIP sponsored training programme on Leadership decision Making, Optimizing Organizational Performance conducted by the Harvard Kennedy School Executive Education at Cambridge, Boston, MA United States of America during 29 October - 2 November, 2012.
- Conferred with Fellow of Indian Society of Agronomy for the year 2009 at 3rd International Congress held at IARI, New Delhi during 26-30 November, 2012.



Dr. S. B. Barbuddhe

- Deputed to Germany during 3-16 February, 2013 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.



Dr. A. R. Desai

- Participated in the meeting of the Fund Council Reference Group on Harmonization Annual Report held at Paris France during 14 – 15 February, 2013.



Dr. R. Ramesh

- Successfully completed DBT- CREST award training for one year from October, 2011 to September, 2012 at University of Georgia, Athens, USA.



Dr. Manohara K. K.

- Attended 'Molecular breeding' course at International Rice Research Institute, Philippines (IRRI) during 12 - 23 November, 2012.





Ongoing Research Projects

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





14.	Breeding of brinjal for high yield and resistance to bacterial wilt through conventional and molecular approaches	M Thangam	
15.	Standardization of production technologies for flowers and vegetables under protected structures (Polyhouses) and under coconut plantations.	M Thangam	
16.	Estimating post harvest losses in different crops of Goa	MJ Gupta	R Maruthadurai
17.	Design of protected cultivation structures for year round utilization in western region	MJ Gupta	M Thangam

Animal Sciences

18.	Impact of microclimatological changes on livestock production and ameliorative measures through managerial intervention	SK Das	
19.	Effect of dairy housing on microenvironment and productive performance of cows	SK Das	M Karunakaran SB Barbuddhe
20.	Assessment of early sexual maturity in Goa local male pigs through spermogram and in vivo pregnancy	EB Chakurkar	M Karunakaran
21.	Evaluation and preservation of boar semen	M Karunakaran	EB Chakurkar ZB Dubal
22.	Screening for fertility markers in boar semen	M Karunakaran	EB Chakurkar ZB Dubal
23.	Survey on the feeds and feeding practices of the livestock in Goa	PK Naik	BK Swain EB Chakurkar
24.	Nutritional interventions for optimization of economical milk production in Goa	PK Naik	BK Swain M Karunakaran
25.	Studies on prevalence of Clostridia in bovines, farm environment and foods	SB Barbuddhe	ZB Dubal
26.	Molecular detection and characterization of Rota virus from animals and humans	ZB Dubal	SB Barbuddhe M Karunakaran
27.	Effect of supplementation of feed additives on the performance and economics of production of broilers, layers and backyard poultry	BK Swain	PK Naik
28.	Utilization of palm oil and other unconventional feed resources for efficient poultry production	BK Swain	PK Naik





EXTERNALLY FUNDED PROJECTS

Sr. No	Project Title	PI
Foreign Aided		
1.	BMGF funded project 'Stress Tolerant Rice for Africa and South Asia' (STRASA)-Phase II	NP Singh
DBT		
2.	Translation centre for molecular epidemiology of <i>Listeria monocytogenes</i> (Trancelis)	SB Barbuddhe
3.	Approaches towards combating zoonotic and food borne infections through community participation (Zoonoses)	SB Barbuddhe
4.	Augumentation of rural pig production for socio economic upliftment of rural poor in Goa through artificial insemination	M Karunakaran
INCOIS		
5.	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	S Subramanian
ICAR		
6.	Seed production in agricultural crops and fisheries	BL Manjunath
7.	Outreach project on <i>Phytophthora</i> , <i>Fusarium</i> and <i>Ralstonia</i> diseases of horticultural and field crops	R Ramesh
8.	Preparation of GPS and GIS based model soil fertility maps for selected districts of the Country	BL Manjunath
9.	All India Co-ordinated Research Project on Cashew	AR Desai
10.	All India Co-ordinated Research Project on Integrated farming System	NP Singh
11.	All India Co-ordinated Research Project on Pigs	EB Chakurkar
NABARD		
12.	Upscaling of Homestead farming in the different farming systems of Goa	BL Manjunath
Noni Foundation		
13.	Genetic diversity of noni in konkan coast of India	V Arunachalam
RKVY		
14.	Generation of elite planting material in horticultural crops for Goa	V Arunachalam
15.	Production of hydroponics green fodder for eco friendly and sustainable milk production in Goa	PK Naik
16.	Cross breed pig production	EB Chakurkar
17.	Rural Poultry Production for livelihood security in Goa	BK Swain

AICRP VOLUNTARY CENTRES

Sr. No	Project Title	PI
1.	All India Co-ordinated Rice Improvement Project (Coastal Saline Tolerant Variety Trial, CSTVT), Kharif 2012	KK Manohara
2.	All India Co-ordinated Research Project on Arid Legumes 1) Evaluation of cowpea IVT and AVT – 1 lines, Rabi, 2012-13 ii). Yield optimization in Rabi cowpea through organic management	KK Manohara BL Manjunath
3.	All India Co-ordinated Research Project on Vegetable crops	M Thangam





Human Resource Development

Participation in Conference / Seminar/ Symposia/ Workshops

Date	Name	Programme	Venue
April 6-9, 2012	Dr. NP Singh Dr. KK Manohara	47 th Annual Rice Workers Group Meeting	Directorate of Rice Research, Hyderabad
April 11-13, 2012	Dr. KK Manohara	Annual planning and review workshop of 'Stress tolerant rice for Africa and South Asia (STRASA)-Phase-II	CSSRI, Karnal
April 19-20, 2012	Dr. NP Singh	Biennial Conference on "Weed threat to Agriculture, biodiversity and Environment	Kerala Agriculture University, Thrissur
April 20, 2012	Dr. M Thangam	Seminar on analytical instruments-GC, GCMS, HPLC, UHPLC,	International Centre, Donapaula Goa
May 7, 2012	Dr. M Thangam	7 th Konkan Fruit Festival	Panaji Goa
May 26-27, 2012	Dr. NP Singh Dr. BL Manjunath Dr. KK Manohara	28 th Annual Group Meeting of AICRP on Arid legumes-2012	Pattambi
May 28-31, 2012	Dr. BK Swain Dr. AR Desai Dr. PK Naik Dr. M Thangam Dr. MJ Gupta	Global Conference on Horticulture for Food, Nutrition and Livelihood Options	OUAT, Bhubaneswar, Odisha
June 18-20, 2012	Dr. NP Singh	National workshop on "Integrated land use planning for sustainable Agriculture and Rural development"	National Institute of Rural Development, Hyderabad
June 20, 2013	Dr. V Arunachalam	Nodal officers meeting of the project on strengthening of statistical computing of NARS	UAS, Benagaluru
July 10-13, 2012	Dr. V Arunachalam	Annual group meeting of AICRP (palms)	Agricultural College & Research Institute, Madurai
July 25-26, 2012	Dr. BL Manjunath	Review meeting of Mega Seed Project in Agricultural crops and Fisheries	ICAR, New Delhi
August 20, 2012	Dr. NP Singh	Knowledge Meet	ICAR, New Delhi
October 6-8, 2012	Dr. V Arunachalam	National symposium "Noni a tool for wellness	Chennai Trade Center Chennai





October 11- 12, 2012	Dr. NP Singh Dr. BL Manjunath Dr. EB Chakurkar Dr. BK Swain Dr. AR Desai Dr. PK Naik Dr. R Ramesh Dr. S Priya Devi Dr. M Thangam Dr. M Karunakaran Dr. MJ Gupta Dr. R Maruthadurai Dr. ZB Dubal Dr. GR Mahajan	International conference on cashew – Sustainable cashew production- challenges and opportunities	Panaji, Goa
November 6-9, 2012	Dr. M Thangam	5 th Indian Horticulture Congress	PAU, Ludhiana
November 16-19, 2012	Dr. SK Das Dr. BL Manjunath Dr. BK Swain Dr. PK Naik Dr. S Priyadevi	Biennial workshop on Integrated Farming System Research	ICAR RC, Goa
November 19, 2012	Dr. M Thangam	RFD meeting of SMD (NRM)	IASRI, New Delhi
November 20-22, 2012	Dr. AR Desai	National Group Meeting of Scientists of AICRP (Cashew)	Navasari Agril. University, Navsari
November 26–30, 2012	Dr. NP Singh Dr. BL Manjunath	Third International Agronomy Congress	New Delhi
November 28-30, 2012	Dr. BK Swain Dr. PK Naik	8 th Biennial Animal Nutrition Association Conference on ‘Animal Nutrition Research Strategies for Food Security’	RAJUVAS, Bikaner, Rajasthan
December 4-6, 2012	Dr. R Ramesh	National symposium on blending conventional and modern plant pathology for sustainable agriculture	IIHR, Bangalore
December 5-7, 2012	Dr. BK Swain	XXIX annual Conference and National Symposium of Indian Poultry Science Association (IPSACON 2012) on Commercial and rural poultry production: Novel concepts and strategies to meet growing demand and changing consumer needs	Sri Venkateswara Veterinary University, Rajendranagar, Hyderabad





December 8, 2012	Dr. BK Swain	Sensitization meeting of Scientist in-charges for all PME cells of ICAR	NDRI, Karnal, Haryana
December 12-15, 2012	Dr. R Maruthadurai Dr. MJ Gupta	PLACROSYM XX	Coimbatore
December 17-21, 2012	Dr. NP Singh	Executive Development Programme on Leadership Development	NAARM Hyderabad
January 2-3, 2013	Dr. NP Singh	QRT meeting of the Directorate of Cashew Research Puttur	Regional Fruit Research Station, Vengurle.
January 3- 7, 2013	Dr. SK Das	100 th Indian Science Congress	Kolkotta
January 11, 2013	Dr. V Arunachalam	RFD meeting of Institutes under Engg. and NRM	IASRI, New Delhi
January 18, 2013	Dr. S Priya Devi	National papaya Consultation Meet	IIHR, Bengluru
January 27-29, 2013	Dr. R Ramesh Dr. M Thangam Dr. R Maruthadurai	10 th National symposium on biotechnological approaches for plant protection: constraints and opportunities	ICAR RC, Goa
January 28-30, 2013	Dr. MJ Gupta	International Symposium on Bio-Energy: Challenges and Opportunities,	Hyderabad
February 2-3, 2013	Dr. NP Singh Dr. AR Desai	National Seminar on production, productivity and quality of spices	Ajmer
February 21, 2013	Dr. M Thangam	Value chain meeting on oil palm	DOR, Hyderabad
February 26 – March 1, 2013	Dr. R Ramesh	International workshop on data analytics and applications, 2013	BITS Pilani, Goa
February 27, 2013	Dr. EB Chakurkar	Seminar on post mortem techniques and interpretation;	Panaji Goa
March 1- 2, 2013	Dr. GR Mahajan	National workshop on future and foresight pathway of agricultural research through youth in India	NASC Complex, New Delhi.





March 2-5, 2013	Dr. NP Singh Dr. KK Manohara	International Symposium on Sustainable Rice Production and Livelihood Security: Challenges and Opportunities	CRRI, Cuttack
March 8-9, 2013	Dr. NP Singh	National Seminar on Enhancing Water Productivity in Agriculture	Institute of Agricultural Sciences, BHU, Varanasi
March 11-12, 2013	Dr. R Ramesh Raghurama Kukkudy	Capacity building workshop on agropedia and open access Institutional repository	ICRISAT, Hyderabad
March 19, 2013	Dr. SB Barbuddhe Dr. ZB Dubal	Workshop on diseases of livestock in Konkan region with reference to Botulism, Leptospirosis & plant toxicities	RFRS, Vengurla
March 21, 2013	Dr. MJ Gupta	National Seminar on Advances in Protected Cultivation	New Delhi

Trainings /Summer/Winter school attended

Date	Name	Programme	Venue
December 3 – 23, 2012	Dr. ZB Dubal	Winter school on Advance molecular techniques in Gene regulation and functional genomics	NDRI, Karnal
December 14, 2012 – February 14, 2013	Dr. GR Mahajan	Biosynthesis of nanoparticles	CAZRI, Jodhpur





List of Publications

Research Articles

- Ashok Kumar J, Rao PR and Desai AR (2013). Cashew kernel Classification using machine learning approaches. *Journal of the Indian Society of Agricultural Statistics*. 67(1) :1-10
- Azeez S, Rajagopal V, Jayarama Pai T, and Arunachalam V (2012). A comparison between the effects of coconut oil and other vegetable oils on human health with emphasis on heart disease. *Journal Plantation Crops*. 40(1):16-22.
- Chakurkar EB, Naik PK, Swain BK and Singh NP (2012). Performance of different breeds of piglets on starter diet in Goa. *Indian Veterinary Journal*, 89: 85-86.
- Chakurkar EB, Naik PK, Swain BK and Singh NP (2013). Effect of feeding standard grower diet on the performance of Large White Yorkshire and Goa Local (50% Cross) pigs. *Indian Veterinary Journal*, 90: 131-132.
- Das SK and Baisya SK (2012). Adoption Behavior of Improved Pig Production Technology in Meghalaya of India. *International Journal for Livestock Research*, 2 (2) : 111- 121.
- Das SK (2012). Adoption Behavior of Rabbit Production Technology in Meghalaya of India. *Indian Research Journal of Extension Education*, Special Issue, V-1, P. 75-79
- Das SK and Singh NP (2012). Effect of microenvironmental changes on rabbit production. *Indian Research Journal of Extension Education*, Special Issue, V- II, P.36-37.
- Dubal ZB, Bhilegaonkar KN, Barbuddhe SB, Kolhe RP, Kaur S, Rawat S, Nambiar P, Karunakaran M (2013). Prevalence and genotypic (G and P) determination of porcine group A rotaviruses from different regions of India. *Tropical animal health and production* 45(2): 609-615.
- Firake DM, Behere GT, Firake PD, Azad Thakur NS and Dubal ZB (2012). An outbreak of pine lopper moth, *Kunugia latipennis* in mid-altitude hills of Maghalaya state, India. *J. Phytoparasitica*, DOI 10.1007/s12600-012-0228-2
- Kuenne CT, Billion A, Mraheil MA, Strittmatter A, Daniel R, Goesmann A, Barbuddhe SB, Hain T and Chakraborty T (2013). Reassessment of the *Listeria monocytogenes* pan-genome reveals dynamic integration hotspots and mobile genetic elements as major components of the accessory genome. *BMC Genomics* 22:14:47.
- Kurkure NV, Chopade NA, Narkhede HP, Barbuddhe SB, Bhandarkar AG and Kalorey DR (2013) PCR analysis of *Escherichia coli* virulent strains Isolated from apparently healthy pigs. *Indian Veterinary Journal*. 90:9-11.
- Manjunath BL, Verma RR, Ramesh R. and Singh NP (2012). Evaluation of varieties and local manurial sources for organic rice (*Oryza sativa*) production. *Indian Journal of Agronomy* 57 (3): 241-244.
- Mahesh P, Gautam RD, Sudhida Gautam and Maruthadurai R (2012). Kairomones of *Earias vitella* (f.) and their influence on the parasitic potential of *Trichogramma Spp* (Trichogrammatidae: Hymenoptera). *Indian Journal of Entomology*, 74(1): 47-53.





- Naik PK, Swain BK, Chakurkar EB and Singh NP (2012). Performance of dairy cows on green fodder maize based ration in coastal hot and humid climate. *Animal Nutrition and Feed Technology*, 12: 265-270.
- Naik PK, Dhuri RB, Swain BK and Singh NP (2012). Nutrient changes with the growth of hydroponics fodder maize. *Indian Journal of Animal Nutrition*, 29: 161-163.
- Naik PK, Dhuri RB, Swain BK, Karunakaran M, Chakurkar EB and Singh NP (2013). Analysis of existing dairy farming in Goa. *Indian Journal of Animal Sciences*, 83 (3): 299-303.
- Prejit, Agarwal RK, Kannan Porteen, Dubal ZB, Karthikeyan A, Singh S and Biswas R (2013). Evaluation of recombinant outer membrane protein based vaccine against *Salmonella Typhimurium* in birds. *Biologicals xxx*: 1-7.
- Priya Devi S, Balamohan TM, Thangam M, Ashok Kumar J, Ramachandrudu K and Korikanthimath VS (2012). A study on diversity and distribution of kokum (*Garcinia indica* (Choisy) using DIVA_GIS in Goa with respect to fruit characters. *Indian J. Hort.*: 69 (2): 156-162
- Puro K, Ahuja A, Doley S, Sanjukta R, Dubal ZB, Ghatak S, Shakuntala I, Laha R and Sen A. (2012) "Molecular characterisation of *turkeypoxvirus* from recurring infection in Meghalaya". *Vety. Pract.* 13(1): 49-51.
- Ramesh R and Phadke GS (2012). Rhizosphere and endophytic bacteria for the suppression of eggplant wilt caused by *Ralstonia solanacearum*. *Crop Protection*. 37: 35-41. DOI:10.1016/j.cropro.2012.02.008
- Shakuntala I, Das RK, Sanjukta RK, Singh P, Dubal ZB and Kumar Suresh. (2012). PCR-based detection of *Streptococcus agalactiae* from milk of subclinical mastitis in Meghalaya. *Indian Journal of Animal Science* 82(9)
- Shome BR, Bhuvana M, Mitra S D, Krithiga N, Shome R, Velu D, Banerjee A, Barbuddhe SB, Prabhudas K and Rahman H (2012) Molecular characterization of *Streptococcus agalactiae* and *Streptococcus uberis* isolates from bovine milk. *Tropical Animal Health Production* 44:1981-1992.

Paper Presented/ Conference Abstracts

- Achari G A, Ramesh R and Gaitonde S (2012). Diversity, antagonistic and growth promotion ability of xylem residing bacteria isolated from eggplant and chilli held during 16-19 June, 2012 at San Francisco, California USA.
- Achari G A and Ramesh R (2013). Xylem bacteria for the plant growth promotion and pathogen inhibition in brinjal. 10th National symposium on biotechnological approaches for plant protection: constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa
- Arunachalam V, Jerard BA, Shaji D, Apshara SE, Jayabose C, Subaharan K, Ravikumar N and Palaniswami C. (2012) Plant traits associated with resistance to eriophyid mite (*Aceria guerreronis* Keifer) infestation in coconut (*Cocos nucifera* L.): Morphological, digital phenotyping and molecular markers. Poster presented at XX Plantation crops symposium (Placrosym) held during 12 – 15 December, 2012 at Coimbatore, Tamil Nadu.





- Arunachalam V, Swapnaja D, Vaingankar JD, Sapna H, Maruthadurai R and Singh NP (2013). Evaluation of Goan germplasm accessions of *Amaranthus (Amaranthus tricolor L.)* for insect, nematode and disease incidence and yield & color traits. Lead lecture delivered at 10th National Symposium on Biotechnological approaches for plant protection: Constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa
- Arunachalam V, Anusha Kumari GY, Namitha C, Sinla S, Amrutha Sindhu, Manju KP and Reji JT (2013). Genetic markers associated with root (wilt) resistance in coconut. Lead lecture delivered at 10th National Symposium on Biotechnological approaches for plant protection: Constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa.
- Arunachalam V, Prem Krishnan BV, Paul K and Singh NP (2012). Discovery of molecular markers in *Mangifera* sequences. Poster presented at Global conference on Horticulture for Food Nutrition and Livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.
- Das SK and Singh NP (2013). Adaptation of rabbit towards microenvironmental changes by managerial intervention . In the proceeding of 100th Indian Science Congress -2013 held during 3-7 January, 2013 at Kolkata, West Bengal.
- Desai AR (2012). Strategic crop improvement in cashew : An overview on global status and future needs. Presented in International Conference on Sustainable Cashew Production - Challenges and Opportunities held during 11-12 October, 2012 at Goa
- Desai AR, Kelkar VS and Singh NP, (2012). Molecular diversity analysis in local genetic resources of nutmeg (*Myristica fragrans* Houtt). Presented in the Global conference on horticulture for food, nutrition and livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.
- Desai AR, Bhawe RA and Singh NP. (2012). Diversity analysis of cashew hybrids using RAPD marker. Presented in the Global conference on horticulture for food, nutrition and livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.
- Desai AR and Singh NP (2013). Genetic resources of nutmeg of Goa and their characterization for morphometric variation. Presented in National Seminar on Production, productivity and Quality of Spices held during 2-3 February, 2013 at Ajmer
- Dubal ZB, Mawlong M, Susngi B, Sanjukta R, Puro K, Ghatak S, Sen A, Shakuntala I, Barbuddhe SB, Ahuja A and Bhattacharjee U (2012). Comparison of agarose gel electrophoresis and RNA-PAGE for rapid detection of rotavirus from fecal samples. Abstract published in International Symposium on One Health: Way forward to challenges in Food Safety and Zoonoses in 21st Century held during 13-14th December, 2012 at GADVASU, Ludhiana.
- Dubal ZB, Madakini R, Sanjukta R, Puro K, Shakuntala I, Ghatak S and Sen A (2012). Detection of drug resistant and shiga toxin producing *Escherichia coli* Abstract published in First International Conference on Bio-resource and stress management held during 6- 7 February, 2013 at Kolkata.
- Gupta MJ (2012). Comparative study of the microclimate under three protected cultivation structures under Goan climatic conditions. Presented in the Global conference on horticulture for food, nutrition and livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.





- Gupta MJ (2012). Mechanization of plantation crops of Goa: Scope and Constraints. Presented at Poster presented at XX Plantation crops symposium (Placosym) held during 12 – 15 December, 2012 at Coimbatore, Tamil Nadu.
- Gupta MJ, Bandekar P and Chavan SP (2013). Comparative study of the microclimate profiles in existing protected cultivation structures in Goa as a function of ambient conditions, ventilation area and cladding material. Presented at 47th Annual Convention of Indian Society of Agricultural Engineers (ISAE) and International Symposium on Bio-Energy: Challenges and Opportunities held during 28-30 January, 2013 at Hyderabad
- Gupta MJ, Chavan SP and Bandekar P (2013). Processing and storage practices of Paddy in Goa. Presented at 47th Annual Convention of Indian Society of Agricultural Engineers (ISAE) and International Symposium on Bio-Energy: Challenges and Opportunities held during 28-30 January, 2013 at Hyderabad
- Gupta MJ, Thangam M, Chavan SP and Bandekar P. (2013). Effect of orientation, ventilation area and location and prevailing winds on the airflow patterns and microclimate of a naturally ventilated greenhouse. Presented at First National Seminar on Advances in Protected Cultivation held on 21 March, 2013 at New Delhi.
- Manjunath BL and Singh NP (2012). Farming system options for different topographical situations of West coast region, In: Extended summaries of 3rd International Agronomy Congress on Agriculture Diversification. Climate change and Livelihoods held during 26-30 November, 2012 at New Delhi.
- Manohara KK. and Singh NP (2013). Genetic diversity studies among the landraces of Goa and improved cultivars of rice (*Oryza sativa L.*). In: Proceedings of ARRW Golden Jubilee International Symposium on Sustainable Rice Production and Livelihood Security: Challenges and Opportunities held during 2-5 March, 2013 at Cuttack.
- Maruthadurai R, Desai AR and Singh NP (2012). New report of pin-hole borer *Platypus parallelus* (F) infestation on cashew from Goa, India. Poster presented at XX Plantation crops symposium (Placosym) held during 12 – 15 December, 2012 at Coimbatore, Tamil Nadu.
- Maruthadurai R and Singh NP (2013). Integrated Pest Management Strategies for Goa region Presented at 10th National symposium on biotechnological approaches for plant protection: constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa.
- Maruthadurai R and Gautam RD (2013). Influence of larval rearing and adult food supplements on some biological attributes of green lacewing predator *Mallada astur* (Banks). Presented at 10th National symposium on biotechnological approaches for plant protection: constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa.
- Naik PK, Swain BK, Arunachalam V and Singh NP (2012). Horticultural crops as potential livestock and poultry feeds in Goa. In: Abstracts of Global conference on horticulture for food, nutrition and livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.
- Naik PK (2012). Nutrient changes with the growth of hydroponics fodder maize. In: Abstracts of International Conference on Agricultural and Horticultural Sciences on Scientific Principles and Contemporary Issues in Agriculture and Horticulture held during 14-15 September, 2012 at Hyderabad.





- Naik PK, Dhuri RB, Swain BK and Singh NP (2012). Cost of production of hydroponics fodder maize. In: Proceedings of 8th Biennial Animal Nutrition Association Conference on Animal Nutrition Research Strategies for Food Security held during 28-30 November, 2012 at RAJUVAS, Bikaner.
- Priya Devi S, Thangam M, Ramachandrudu K and Singh NP (2012). A review on *Garcinia indica* (Kokum) : An under utilized horticultural crop for nutrition. In: Abstracts of Global conference on horticulture for food, nutrition and livelihood options held during 28-31 May, 2012 at OUAT, Bhubaneswar.
- Priya Devi S, Thangam M, Singh NP (2013). Evaluation of papaya varieties in Goa. In abstracts of National papaya consultation meet held on 18th January, 2013 IIHR, Bengaluru .
- Priya Devi S, Thangam M and Singh NP (2012). Grading of kokum fruits based on fruit weight over the year and harvests. In abstract of 5th Indian Horticulture Congress held during 6 - 9 November, 2012 at PAU, Ludhiana.
- Priya Devi, S, Thangam M and Singh NP (2012). Proportion of variable fruit size harvested in different years in Kokum Cv. Amrutha. In abstract of 5th Indian Horticulture Congress held during 6 - 9 November, 2012 at PAU, Ludhiana.
- Ramesh R and Singh NP (2012). Bacterial wilt of vegetables caused by *Ralstonia solanacearum*: pathogen diversity, detection and disease management. Invited talk at winter school held on 22 November, 2012 at IIVR, Varanasi.
- Ramesh R, Achari G and Gaitonde S. (2012). Improved detection of *Ralstonia solanacearum* by multiplex and BIO-PCR. In abstracts of National symposium on Blending conventional and modern plant pathology for sustainable agriculture held during 4-6 December, 2012 at IIHR, Bengaluru
- Ramesh R, Manjunath BL, Prabudesai HR and Singh NP (2013). Plant disease management technologies developed for Goa region: An overview. Presented at 10th National symposium on biotechnological approaches for plant protection: constraints and opportunities held during 27-29 January, 2013 at ICAR Research Complex for Goa, Old Goa, Goa.
- Sanjukta R, Mandakini RK, Ahuja A, Sen A, Shakuntala I, Ghatak S, Dubal ZB, Puro AK and Ngachan SV (2012). Molecular characterization of emerging multi-drug resistant *Escherichia coli* isolates of swine from Northeast India. Poster presented in 15th International Congress on Infectious Diseases held on 16 June, 2012 at Bangkok, Thailand.
- Sanjukta RK, Mandakini RK, Ahuja A, Puro K, Dubal ZB, Ghatak S, Shakuntala I, Sen A (2012). Extended-spectrum β -lactamases and antibiotic resistance integrons recovered from *Escherichia coli* isolates of swine in Northeast India. Paper presented in 22nd International Pig Veterinary Society Congress, held during 10 – 13 June, 2012 at Jeju, South Korea.
- Singh NP and Manjunath BL (2012). Predominant Farming systems of West coast region of India, In: Extended summaries of 3rd International Agronomy Congress on Agriculture Diversification. Climate change and Livelihoods held during 26-30 November, 2012 at New Delhi.
- Singh NP, Desai AR and Priya Devi S (2013). Spice gardens in Goa: An account of prospects and challenges. In Souvenir of National Seminar on Production, Productivity and Quality of Spices held during 2-3 February, 2013 NRC on Seed Spices, Ajmer, Rajasthan





Swain BK, Naik PK and Singh NP (2012). Effect of feeding cashew apple waste replacing maize in the Vanaraja chicks. International Conference on Sustainable cashew production-challenges and opportunities held during 11-12 October, 2012 at Panjim, Goa.

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Technology inventory on agricultural mechanization for Goa. Pp 1-31	Gupta MJ, Thangam M, Priya Devi S and Singh NP
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Insect pests of cashew and their management Technical Bulletin No 28 pp 1-16	Maruthadurai R, Desai AR, Prabhu HRC and Singh NP
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Gramapriya : Andautpadanakarta Kharamagil Anganath Kukkutpalan. Extension Folder No.47	Swain BK, Chakurkar EB, Naik PK and Singh NP
Endometritis in dairy cows – causes and management. Extension Folder No. 48	Karunakaran M, Chakurkar EB, Naik PK, Swain BK and Singh NP
Anoestrus and repeat breeding in dairy cows – causes and management. Extension Folder No 49	Karunakaran M, Chakurkar EB, Das SK and Singh NP
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Listeriosis: an important foodborne infection. Extension Folder No 51	Barbuddhe SB and Singh NP
Brucellosis : an important occupational hazard. Extension Folder No 52	Barbuddhe SB and Singh NP
Hygiene in animal housing. Extension Folder No. 53	Barbuddhe SB, Das SK, Karunakaran M and Singh NP
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Workshops, Seminars and Other Events

Institute Foundation Day

Institute Foundation Day was celebrated at ICAR Research Complex for Goa, Old Goa on 3 April, 2012. Shri Shripad Yeso Naik, Honourable Member of Parliament, North Goa was the Chief Guest. Other dignitaries present on the dais were Shri. S.S.P. Tendulkar, Director of Agriculture, Dr. H. Faleiro, Director of AH&VS, Shri. N. C. Verlekar, Director of Fisheries and Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa. On the Occasion the awards were presented to the staff for their best performance and also the children of the staff who excelled in academics were awarded. All the staff members along with their family attended the programme.



Foundation day celebration

Launching programme cum workshop under Center of Excellence on *Listeria*

ICAR Research Complex for Goa, Old Goa has been granted a Centre of Excellence and Innovation in Biotechnology (CEIB) on “Translational Centre for Molecular Epidemiology of *Listeria monocytogenes*” under multi-institutional network programme by Department of Biotechnology, Government of India. A launching programme cum workshop under the project was organized on 23rd May 2012. The function was chaired by Dr Narendra Pratap Singh, Director, ICAR Research Complex for Goa. Dr. V.K. Naik, Director, Tulip Groups of Companies, Verna, Goa was the Chief Guest. Dr. S. B. Barbuddhe, Project Coordinator,

Dr. D. R. Kalorey, Co-Project Coordinator, Nagpur Veterinary College, Nagpur, Co-Principal Investigators from other centers, were present on the occasion. Officials from Departments of Health Services, Animal Husbandry and Veterinary Services, Forest department, Goa Dairy and faculty from Goa University also graced the occasion.

At the outset, Director, ICAR Research Complex for Goa delivered a welcome address. He also briefed the activities of the Institute and expressed that under this program a good quantum of research work would be undertaken considering national interest and would be utilized for the well being of humans and livestock. Dr D.R. Kalorey, Project Co- coordinator CEIB briefly explained the genesis of the project and highlighted objectives of the project.

Dr S.B. Barbuddhe, Project coordinator, CEIB explained how the scientific data would be generated and translated. He assured that better diagnostics and preventives biological tools would be developed for listeriosis. Dr Barbuddhe informed that under CEIB, trained human resource would be developed to cater the need of medical and veterinary sciences. Since, food items would be required to be screened for *L. monocytogenes*, a fodborne pathogen, as per Food Safety and Standards Regulations 2011, training in specified area would be organized for the personnel from food industries. He also explained the adaptation of approaches toward combating zoonotic and food borne infections through community participation.



Launching programme of Centre of Excellence on *Listeria*





Dr. V.K. Naik, Chief Guest of the function spoke about commercialization of technologies developed by research institutes for benefit of the public. He also expressed satisfaction over the continued interactions between industries and the academic institutions. On the occasion training manual on Listeria and two extension folders were released.

Later during technical session, the details of the project were explained by the Project Coordinator and discussed with stakeholders.

Quinquennial Review Team meeting of AICRP on Integrated Farming Systems

A review meeting of Quinquennial Review Team of AICRP on Integrated farming systems for the West coast zone of India was held at ICAR Research Complex for Goa, old Goa during 9 -10 June, 2012.

The Review team constituted of Experts under the Chairmanship of Dr. Punjab Singh, the former Director General, ICAR and President, FAARD Foundation, Dr. C. L. Acharya, Former Director of Extension Education (HPU, Palampur) and Former Director, Indian Institute of Soil Science (ICAR), Bhopal, Dr. D.M. Hegde, Ex. Project Director, Directorate of Oilseeds Research, Hyderabad, Dr. W. S. Dhillon, Director, Institute of Post-harvest Processing, Ludhiana, Dr. Anjani Kumar, Principal Scientist (Agri. Economics), National Centre for Agricultural Policy and

Planning, New Delhi, Dr. B. Gangwar, Project Director, PDFSR, Modipuram and Dr. Kamta Prasad, Programme Facilitator, PDFSR, Modipuram. The meeting was attended by all the Principle Investigators of Integrated Farming Systems and Organic farming centres of Goa, Karnataka and Maharashtra.

Presentations and discussions were made on the five yearly progress of research of all the centres on Integrated Farming systems and the organic farming with suitable suggestions for improvement.

Agricultural Mechanization Program for small and marginal tribal farmers of Goa

Agricultural Mechanization Program for small and marginal tribal farmers of Goa” under Tribal sub plan scheme, Government of India was held on 12 June, 2012 at ICAR Research Complex for Goa, Old Goa Farm machineries and agricultural implements were distributed to eight groups of tribal farmers under the Tribal Sub plan programme. Shri. Ramesh Tawadkar, Minister for Sports, Youth affairs and Tribal welfare, Government of Goa emphasized that the farmers should adapt improved agricultural practices for their economic upliftment. Shri. Datta Prasad Kholker, Deputy Chairman, Planning Commission, Government of Goa encouraged the tribal farmers to incorporate animal husbandry activities to enhance their income level. Mr. Arvind Bugde, Director, Directorate of Tribal Welfare, Government of Goa asked the farmers to utilize the technical



Meeting of QRT of AICRP on IFS



Distribution of farm machineries and agricultural implements





help from the agencies for better profitability in the agricultural activities. Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa informed beneficiaries to concentrate on secondary agricultural activities and post harvest processing of the agricultural produce to enhance the profit from farm activities. He also expressed that establishment of modern mini rice mill may benefit the rice producers to get value added products.

World Zoonoses Day

ICAR Research Complex for Goa celebrated the World Zoonoses Day on 6th July, 2012 as a part of awareness campaign about zoonotic and foodborne infections funded by Department of Biotechnology, Government of India. The theme of the celebrations was 'Towards a healthier life', in order to educate and create public awareness about the importance of zoonoses. The World Zoonoses day is celebrated on July 6 every year to bring the problem into people's consciousness, and remind them to take action. This day is the anniversary of the invention of rabies vaccine by the great scientist Louis Pasteur. Shri. Laxmikant Parsekar, Honourable Minister of Health, Panchayat, and Rural Development, Government of Goa graced the celebrations as Chief Guest for the Valedictory function. Dr. N.P. Singh, Director of the Institute welcomed the delegates and briefed about the World Zoonoses Day. Hon. Minister spoke about the importance of zoonotic infections in our day to day life and called for collaboration from Departments of Health, Animal Husbandry and Veterinary Services, Department of Agriculture, Science Colleges. He assured his support of any of

such programmes for the betterment of the people of Goa. During the day four resource persons, deliberated on different aspects of zoonotic infections. Over 100 delegates from all over Goa participated in the programme.

Workshop cum exhibition on Agricultural Mechanization for small and marginal farmers of Goa

A two day workshop cum exhibition on "Agricultural Mechanization for small and marginal farmers of Goa" was organized on 11-12 September, 2012 at the ICAR Research Complex for Goa in collaboration with Central Institute for Agricultural Engineering, Bhopal. Agricultural machinery and technologies suitable for Goa were brought from CIAE Bhopal and CIAE Regional Centre, Industrial Extension Programme, Coimbatore. Various Agricultural equipment manufacturers and dealers displayed their products in the exhibition. The programme was inaugurated by the Shri. V.P. Rao, Secretary Agriculture, Government of Goa, Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa and Shri. Satish Tendulkar, Director, Directorate of Agriculture, Government of Goa. Large numbers of farmers from various parts of Goa visited the exhibition and interacted with the scientists and the exhibitors in the exhibition. A workshop for farmers with power point presentations, demonstration and video films was conducted. The farmers too interacted and presented their problems in the use of the machinery and the areas in which they sought intervention of machines during the workshop.



Release of folder on World Zoonoses day



Inauguration of workshop





हिन्दी सप्ताह कार्यक्रम

गोवा के लिए भा. कृ. अनु. प. का अनुसंधान परिसर में हिन्दी सप्ताह मनाया गया। हिन्दी सप्ताह का प्रारंभ गीत गायन प्रतियोगिता के साथ हुआ। सुलेख प्रतियोगिता में बड़ी उत्साह के साथ कई प्रतिभागियों ने भाग लिया। हिन्दी निबंध प्रतियोगिता में स्वास्थ्य में आहार और व्यायाम का योगदान, अपने बच्चों को यौन शोषण के खिलाफ सशक्त कैसे करें, हमारे संस्थान की टाइम मशीन, जलवायु परिवर्तन, हिन्दी का बचाव कैसे? कृषि की उन्नति या किसान का अभिशाप, मेरे मन में भारत की छवि आदि रोमांचक शीर्षक दिए गए और प्रतिभागियों ने बड़े ही मनमोहक निबंध लिखे। संस्थान के तकनीकी अधिकारी ने “भारतीय लोक परम्परा में वृक्ष” के शीर्षक पर बड़े ही रोमांचक और लोक गीतों से भरा व्याख्यान दिया और सब का मन हर लिया। संस्थान के वैज्ञानिकों ने भी “प्रयोगशाला से प्रयोग कृषक के खेत” तक के विषय पर दिल और दिमाग से व्याख्यान प्रदान करके दर्शकों का दिल जीत लिया। हिन्दी में सामान्य ज्ञान प्रतियोगिता का भी आयोजन किया गया और अल्प हिन्दी भाषी लोगों से भरे इस संस्थान में बड़े ही उत्साह से कई प्रतिभागियों ने भाग लिया। बच्चों के लिए चार श्रेणियों में पाँच से कम साल, एक से लेकर चौथी कक्षा तक, पाँचवीं से आठवीं कक्षा तक और नौवीं से बारहवीं कक्षा तक (चित्रकला, सुलेख, निबंध, प्रतिभा दर्शन और वाद विवाद प्रतियोगिताएं आयोजित किये गए। इस कार्यक्रम में श्रीमति निर्मला सिंहजी विशेष निर्णायक के रूप में आमंत्रित की गई, उन्होंने बड़े रुचि से प्रतिभागी बच्चों का उत्साह बढ़ाया। बच्चों ने भी बड़े उत्साह से



प्रतियोगिताओं में भाग लेकर हिन्दी सप्ताह समारोह का रौनक बढ़ा दिया। 9 अक्टूबर 2012 को हिन्दी सप्ताह का समापन एवं पुरस्कार वितरण समारोह डॉ. नरेन्द्र प्रताप सिंहजी के अध्यक्षता में संपन्न हुई। हिन्दी सप्ताह के कार्यक्रमों में 90 वैज्ञानिक, 9 तकनीकी अफसरों, 9 प्रशासनिक अधिकारियों, 9 अनुसन्धान अध्ययों और 22 बच्चों ने भाग लिया और सब कर्मचारियों में कुल 39 पुरस्कार एवं संस्थान के कर्मचारियों के बच्चों को 30 पुरस्कार प्रदान किये गए। सब प्रतिभागियों को प्रतिभागी पुरस्कार के रूप में उध्दरण छपा सुन्दर मग प्रदान किया गया। स्वागत भाषण में डॉ. श्रीमति मतला जूलियट गुप्ताजी ने हिन्दी सप्ताह के सफल आयोजन में संस्थान के सभी कर्मचारियों को उनके उत्साहपूर्ण सहयोग के लिए धन्यवाद दिया और कहा कि सब प्रतियोगिताओं को एक साथ आयोजित करने से संस्थान के कई अन्य जतिविधियों के कारण कई बाधाएँ आती हैं और उन्हें सालभर एक महीने के कालान्तर में आयोजित करने का सुझाव रखा। निदेशकजी ने अपनी भाषण में सभी पुरस्कारार्थियों को बधाई देते हुए आशा व्यक्त किया कि इस हिन्दी सप्ताह के खत्म होने के बाद भी संस्थान के कारवाई में राजभाषा का प्रचलन और बढ़ेगा।

Seminar on Opportunities in Agriculture

ICAR Research Complex for Goa, Old Goa organized an Interactive session on “Human Resource Development “ and opportunities in Agriculture and allied sectors on 23rd October, 2012 to enlighten the youth about entrepreneurship development in agriculture and allied sectors. Dr. S.B. Barbuddhe, Sr. Scientist and HRD cell Coordinator welcomed the dignitaries and the delegates and gave an overview of the programme.

Shri. V.P. Rao, Secretary, Agriculture, Govt. of Goa inaugurated the session. He highlighted the role of agriculture in providing livelihood security to the masses and narrated various activities of agriculture sector. He stressed the need for wider agriculture extension network for the benefit of the farmer. He suggested that the small holder farmers can go for integrated farming systems





involving agriculture, horticulture, apiary and dairy. Dr. Narendra Pratap Singh, Director of the Institute delivered key note address. He narrated about the history of agriculture research in India and role of ICAR. He gave an account of different opportunities in the field of agriculture and allied sectors. He appealed the youth to come forward and make their career in agriculture.



Inaugural session of seminar

Later in technical session talks on different aspects of entrepreneurship by various scientists were presented. Over 60 participants from different colleges from Goa participated in the program.

Awareness programme on Clean milk and foodborne Infections

An awareness programme on “Clean milk production and foodborne Infections” was organized under the aegis of a project sponsored by Department of Biotechnology, Government of India under societal development programme on “Approaches towards combating zoonotic and foodborne infections through community participation” at ICAR Research Complex for Goa, Old Goa in collaboration with Goa State Cooperative Milk Producers’ Union Ltd., Curti on 26 October, 2012. The awareness programme focussed on quality assurance of animal-based products to meet



Awareness programme on clean milk

consumer expectations; knowledge of the causes, of food borne zoonotic and emerging diseases; adverse effects of agricultural and other human activities on food quality, animal welfare, human health and the environment. Over 180 farmers from all over the state of Goa participated in the programme. Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa, Dr. N.C. Sawant, Managing Director, Goa Dairy, Dr. E.B. Chakurkar, Principal Scientist, Dr. S.B. Barbuddhe, Principal Scientist and PI of the project, Dr. R.B. Dhuri, Manager, Animal health, Goa Dairy and Dr. Z.B. Dubal, Scientist participated in the deliberations. Presentations on clean milk production, foodborne infections, infertility in dairy animals were delivered.

Biennial workshop of AICRP on Integrated farming system

A biennial Workshop of AICRP on Integrated Framing Systems was held at ICAR Research Complex for Goa, Old Goa during 16 - 19 November, 2012. The workshop was inaugurated by Hon’ble Member of Parliament, North Goa, Shri. Shripad Yesso Naik, Thirty One Co-ordinated Centres including State Agricultural Universities and ICAR Institutes participated in the workshop.

Dr. Narendra. Pratap Singh, Director of ICAR Research Complex for Goa welcoming the delegates for the biennial workshop highlighted the importance of integrated farming systems in the predominant small and marginal holdings of the region.

Dr B. Gangwar, Project Director, Project Directorate for Farming Systems Research,



Inauguration of workshop of AICRP on IFS





Modipuram, Meerut in his introductory remarks highlighted the major concern for livelihood security and sustainability of millions of small and marginal farm households, who are struggling with ever declining operational holding size coupled with rampant escalation of production costs.

Honourable Member of Parliament, North Goa. Shri. Shripad Yesso Naik called for the fruitful transfer of technology from Scientists to the farmers. He also emphasized the need for integrated farming systems in the present agricultural scenario.

The Biennial workshop was conducted in seven technical sessions starting with pre-workshop review of on-going programmes followed by formulation of new technical programmes for both on-farm and on-station in farming system perspective. In all about 100 delegates representing different State Agricultural Universities and ICAR Institutes participated in the workshop.

Visit of DG, ICAR and Secretary, DARE

Dr S. Ayyappan, Honourable Secretary (DARE) & DG (ICAR) visited Institute on 8 November, 2012. Director and Scientists of the Institute explained him about the research activities carried out in the Institute. He visited all the experimental units including livestock units and laboratories. While complementing the research activities, he emphasized the need for having basic research in core areas and farmers outreach programmes.

Further, he addressed the staff of the Institute and listened the grievances.



Secretary (DARE) & DG, ICAR interacting with staff

XXII Meeting of ICAR Regional Committee No VII

Twenty second meeting of Regional Committee VII hosted by ICAR Research Complex for Goa, Old Goa was inaugurated at International Centre Goa on 9th November, 2012. Honourable Governor of Goa, Shri Bharat Vir Wanchoo, inaugurated the meeting. The function was graced by Dr. Ramkrishna Kusmaria, Honourable Minister of Farmer Welfare and Agriculture Development, Government of Madhya Pradesh, Dr. S. Ayyappan, Secretary, DARE and DG, ICAR, Dr. Bhargava, Member, GB, ICAR, Secretaries to Government of India and State Governments, Deputy Director Generals of ICAR, Vice Chancellors of Agricultural Universities, Officials from State Governments, Directors of ICAR Institutes and Scientists from ICAR. Dr. N. P. Singh, Director, ICAR Research Complex for Goa welcomed the dignitaries and the participants

Honourable Shri. B. V. Wanchoo urged the scientists to come forward to promote agricultural production and productivity. He called for identifying the problems faced by farming communities and solutions for them. He further stated agriculture is a way of life and major source of livelihood. He narrated the role of agriculture and allied sectors in bringing out the stability in life and livelihood security. He stressed the need for strengthening the agriculture research and extension services, and evolving strategies to empowering farmers.



Inauguration of XXII meeting of ICAR Regional Committee No. VII





Dr. Ramkrishna Kusmaria, Minister of Farmer Welfare and Agriculture Development, Government of Madhya Pradesh stressed the need for maintaining the soil health for sustained production. He advocated organic farming, conservation of indigenous livestock breeds. He expressed the concern about weak extension linkages and called for its intensification.

Dr. S. Ayyappan, Secretary, DARE and DG, ICAR gave an overall account of agriculture scenario in India vis-à-vis the state under Region VII. He stressed the need for Conservation of Agricultural Resources, their processing, value addition and food safety. He urged the scientists to bring prestige and profitability in agriculture profession so that young generations get attracted to it. He cautioned about the effect of climate change on different crops. He called for registration of more GIs for the crops and commodities in the region. He highlighted the initiatives taken by ICAR for farmers. Dr. M. M. Pandey, DDG (Engg. And NRM), ICAR, New Delhi gave overview of the region and role of the regional committee. Dr. K. R. Kranthi, Director, CICR, Nagpur and Member Secretary proposed the Vote of Thanks.

Awareness programme on “Clean milk production”

An awareness programme on “Clean milk production” was organized under the aegis of a project sponsored by Department of Biotechnology, Government of India under societal development programme on “Approaches towards combating zoonotic and foodborne infections through community participation” by ICAR Research Complex for Goa, Old Goa in collaboration with Goa State Cooperative Milk Producers’ Union Ltd., Curti on 13th January, 2013 at Sawant Hall, Sanquelim. Shri . Anant Shet, Hon. Deputy Speaker, Goa Legislative Assembly was the “Chief Guest” for the function. Dr. Pramod Sawant, Hon. MLA, Sanquelim Constituency, Shri Shrikant Naik, Chairman, Goa Dairy, Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa, Dr. V.L. Bhaje, Deputy Director, Animal Husbandry and Veterinary Services, Govt. of Goa, Dr. N.C. Sawant, Managing Director, Goa Dairy were also present on the occasion. Director



Inaugural session of awareness programme

welcomed the dignitaries and the farmers. He spoke about various programmes of ICAR for benefit of the farming community Shri. Anant Shet spoke about the importance of hygiene and cleanliness in milk production. Dr. Pramod Sawant urged the dairy farmers to come forward and take advantage schemes of Dept. of Animal Husbandry and Veterinary Services.. The awareness programme focused on quality assurance of animal-based products to meet consumer expectations; knowledge of the causes, of food borne zoonotic and emerging diseases; adverse effects of agricultural and other human activities on food quality, and mastitis. Over 350 farmers from Bicholim and Stattari talukas participated in the programme. Kits for detection of mastitis were demonstrated and supplied free of cost to the farmers by ICAR.

10th National Symposium on Biotechnological approaches for Plant Protection: Constraints and Opportunities.

The 10th National Symposium on Biotechnological approaches for Plant Protection: Constraints and Opportunities was held at the institute on 27-29th January 2013 in collaboration with Society of Plant Protection Sciences, New Delhi. Honourable Governor of Goa, Shri. Bharat Vir Wanchoo inaugurated the Symposium. He emphasised that the challenges in agriculture are major and scientific method are important to solve these issues so that higher growth rate in agriculture can be achieved in future. Further, he said that the pest problems complicate the production scenario and the stakeholders should join hands





Inaugural session of National Symposium

to achieve the target that was committed. He emphasised use of good agricultural practices to mitigate the pest and disease issues. Dr. Narendra Pratap Singh, Director of the institute welcomed the chief guest, dignitaries and other delegates. Dr. Singh described the problems faced by the farmers of the region especially pest and diseases in high value crops. He emphasised the demand of the farmers for new, innovative and eco-friendly technologies including biotechnology to solve these issues. National organising secretary of the symposium, Dr. D. Prasad, introduced the theme of the symposium. He elaborated about the society of plant protection sciences, its objectives and the scientific publication. Shri. V.P. Rao, Principal Secretary (Agriculture), Govt. of Goa in his guest of honour address invited the scientists to work hard to help the farming community by developing sustainable technologies. More than 120 scientists from all over India were actively participated in the symposium.

Awareness programme on animal health and hygienic production of milk

An awareness programme on “Animal Health and hygienic production of milk” was organized by ICAR Research Complex for Goa under Tribal Sub Plan or programme in collaboration with Goa State Cooperative Milk Producers’ Union Ltd., Curti on 18th February, 2013 at Ambulim village, Quepen. Shri Rajan Naik, MLA was the “Chief Guest” for the function. Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa, Dr. Bale from Goa Dairy and a team of a scientist from were also present on the occasion. Shri. Rajan Naik spoke about the importance of hygiene and cleanliness in

milk production. He called upon the farmers to take advantage of government schemes. Dr. Narendra Pratap Singh spoke about different programmes and agricultural techniques were available with the ICAR. The awareness programme focused on quality assurance of animal-based products to meet consumer expectations; knowledge of the causes of food borne zoonotic and emerging diseases, hygienic production of milk and mastitis. Over 40-



Inauguration of awareness programme

50 farmers from Ambulim and nearby villages of Quepen taluka were participated in the programme. On this occasion, ICAR has distributed medicine and mastitis detection kit for all the participated farmers free of cost. There was interactive session for the farmers to discuss about the health related problems of animals with the Veterinary Scientist Team of ICAR.

Visit of Chief Minister of Goa

Shri. Manohar Parrikar, the Chief Minister of Goa visited the ICAR Research Complex for Goa on 06.03.2013 evening. He inaugurated the pig farrowing unit and poultry hatchery unit, established through Rashtriya Krishi Vikas Yojana (RKVY), Government of India. Other dignitaries present were Dr. Pramod Sawant, Vice-Chairman, Goa Infrastructural Development Corporation, Shri Pandurang Madkaikar, MLA, Cumbharjua Constituency, Shri. S. S. P. Tendulkar, Director, Department of Agriculture, Govt. of Goa and Nodal Officer, RKVY and Dr. Narendra Pratap Singh, Director, ICAR Goa. He visited to piggery unit, fodder unit, rabbit unit, poultry and quail unit, hydroponic fodder production unit and dairy





Chief Minister of Goa addressing the staff

unit of the Institute. He also visited to rice and other experimental crop fields and appreciated the scientists of ICAR for conducting very good research work and giving valuable output to the farmers of Goa. While interacting with the concerned scientists, he encouraged the use of latest technology to increase the productivity. He expressed his happiness that the farmers of the state are being benefited through the ICAR technologies.

After inauguration, formal meeting with the staff of ICAR was organized at Conference Hall of ICAR. Dr. N.P. Singh, Director of the institute welcomed the Chief Minister. He briefed about the institute and the research activities of the centre. He highlighted the importance of horticulture and eco-tourism in the State. Dr. Singh described the problems faced by the farmers of the region especially pest and diseases in high value crops. He emphasized the demand of the farmers for new, innovative and eco-friendly technologies including biotechnology to solve these issues. Shri. Manohar Parrikar addressed the ICAR staff stating that he has very keen interest for developing agricultural sector in Goa. For this he said he expected joint efforts between ICAR and State Govt. Officials in improving production in crop plants and milk production.

Awareness programme on Bee Keeping

An awareness programme on beekeeping was organized at Krishi Vigyan Kendra, ICAR Research Complex for Goa, Old Goa, on 25 March, 2013. The programme was inaugurated by Mr. S. P. Rao, Secretary, Public grievances and Official language, Govt. of Goa. In his remarks, mentioned about the importance honey bees in agriculture and as a additional income generating activity to the farmers.

Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa, while welcoming the delegates spoke on role of bees in pollination, its advantages in agriculture and the importance of honey for good health. He also expressed necessity of having long duration course wherein participants can learn the handling of bees more confidence.

During the technical session, Dr. Desy Thomas, Asst. Director, Central Bee Research and Training Institute, Pune, spoke on the types of bees their management aspects, harvesting and packing of honey. Mr. Donald Paius, Asst. Director, CBRTI, Pune, covered the quality and marketing aspects of honey.

In the practical session, handling of the bees was demonstrated. In the interactive session experts answered all the queries from the participants. The programme was attended by 102 participants from different parts of the state.



Inauguration session of awareness programme





Committees and Meetings

Quinquennial Review Team

Director General, ICAR, New Delhi constituted a Quinquennial Review Team in respect of ICAR Research Complex for Goa for the period 1/1 2007 to 31/03/2013 with the following members

Dr. Vijay Mehta - Chairman

Ex-Vice Chancellor,
201, Om Residency,
Opposite Manas Lane, Kalepath,
Bhandarkar Road, Pune – 411004

Dr. P. K. Joshi - Member

Ex- Director
D-7, Pusa Apartment,
Sector – 15, Rohini,
New Delhi - 110085

Prof. S. R. Singh - Member

Ex- Director
15- Bhagirathi Nagar Colony,
Sunderpur, Varanasi – 5, U.P

Dr. V. A. Parthasarthy - Member

Ex – Director & Emeritus Scientist,
Narmada Nilayam, 32/482-C,
Bharathan Bazar, Chelvoor,
Calicut – 673571, Kerela

Dr. R. P. Sharma - Member

Ex – Director & Emeritus Scientist,
204, UC Apartments,
Rukmanpura,
Patna – 800014, Bihar

Dr. M. B. Chetti - Member

Dean, Crop Science,
University of Agricultural Sciences,
Dharwad – 580005, Karnataka

Dr. Ananad Kumar Singh - Member

Head,
Division of Fruits & Horticulture,
IARI, Pusa,
New Delhi - 110012

Dr. S. B. Barbuddhe - Member Secretary

Senior Scientist (VPH),
ICAR Research Complex for Goa,
Old Goa -403402-Goa

The first meeting of QRT of ICAR Research Complex for Goa was held on 27th August, 2012 at Krishi Anusandhan Bhawan II, ICAR, New Delhi for planning the process. The meeting was chaired by Dr. A.K. Singh, DDG (NRM). The meeting was attended by Dr. Vijay Mehta, Chairman, Prof. S.R. Singh, Dr. P. K. Joshi, Dr. R.P. Sharma, Dr. M.B. Chetti, Dr. A.K. Singh as Members, Dr. Narendra Pratap Singh, Director, ICAR Research Complex for Goa, Dr. A. Arunachalam, Principal Scientist, Dr. P.P. Biswas, Principal Scientist, Dr Rajbir Singh, Principal Scientist, NRM Division as special invitees and Dr. S.B. Barbuddhe, Principal Scientist as Member Secretary.

The second meeting of QRT of ICAR Research Complex for Goa was held during 28-29th September, 2012. The meeting was chaired by Dr. Vijay Mehta, Chairman, QRT and Former Vice Chancellor, DR BSKKV, Dapoli. The members of the QRT present were Prof. S.R. Singh, Dr. R.P. Sharma, Dr. M.B. Chetti, Dr. A.K. Singh and Dr. S.B. Barbuddhe, Member Secretary. Representatives of development departments, progressive farmers and scientists of the Institute also participated in the meeting.



Quinquennial Review Team meeting.





Dr. N. P. Singh, Director, ICAR Research Complex for Goa, Old Goa welcomed the Chairman and members of the QRT and briefed about previous QRTs. He also mentioned about the background of the Institute.

Dr. Vijay Mehta, Chairman, QRT invited the suggestions from development departments and progressive farmers for planning the future research programmes of the Institute. He expressed the need to address soil and water conservation for sustainable production.

The progressive farmers and officials from development department narrated their views about overall development of agriculture in the State of Goa.

The members of the QRT also gave valuable remarks for the benefit of farming community.

Later in the day the QRT visited various experimental units of the Institute including Agricultural Technology Dissemination Unit, rice plots, horticultural units, integrated farming systems, animal units and Krishi Vigyan Kendra. On 29th September, 2102, the QRT visited farmers fields at Dhulapi, Amona and Tisk Usgaon.

The third meeting of the QRT was held on 14th January, 2013 at the Institute. The meeting was attended by Dr. Vijay Mehta, Chairman, Dr. V.A. Parthasarathy, Member, Dr. N.P. Singh, Director and Dr. S.B. Barbuddhe, Member Secretary, scientists of the Institute and staff of KVK. Dr. N. P. Singh welcomed the Chairman and QRT Member and briefed the purpose of the meeting.

During this meeting, the Committee Members held discussions with Director regarding widening the mandate of the Institute. Later the QRT members visited the different facilities at the Institute and the farmers' fields. It was decided to call a meeting for finalization of recommendations.

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. The composition of RAC is given below.

Name	Designation
Dr. Kirti Singh, Ex-Chairman, ASRB, Near TD College, Jaunpur (UP)	Chairman
Dr. U. S. Singh STRASA Co-ordinator, IRRI, Indian Liason Office, New Delhi	Member
Dr. P. K. Chhonkar IARI Adjunct Professor & ICAR Emeritus Scientist Dwarka, New Delhi	Member
Dr. P. Rethinam Former ADG (PC), ICAR, Lakshmi Nagar, S.N.Palayam, Coimbatore (TN)-	Member
Dr. H. Rahman Director, PDADMAS Bangalore	Member
Dr. M. Sinha Advisor (Fisheries), Govt. of Tripura , Pandit Nehru Complex, Agratala	Member
Prof. B. S. Hansra Ex-Director, School of Agriculture, IGNOU, Maidan Garhi. New Delhi	Member
Dr. P. S. Minhas ADG (S&WM), ICAR, New Delhi	Member
Mr. Madhav Sahakari Chairman, Goa Dairy, Curti, Ponda Goa	Member
Fr. Almeida Pillar Education Society, Bhironda, Goa	Member





Dr. N. P. Singh Director, ICAR RC for Goa, Old Goa	Member
Dr. B. K. Swain Principal Scientist (Poultry Science) ICAR RC for Goa, Old Goa	Member Secretary

The second meeting of the VI RAC was held on 16 and 17 May, 2012 at ICAR Research Complex for Goa. The meeting was chaired by Dr. Kirti Singh, Chairman, RAC and attended by following members : Dr. P. Rethinam, Dr. U. S. Singh, Dr. B. S. Hansra, Mr. Madhav Sahakari, Fr. Inacio Almeida, Dr. N. P. Singh and Dr. B. K. Swain, Member - Secretary.

At the outset Dr. N. P. Singh, Director of the institute gave welcome address followed by addresses of Shri. Madhav Sahakari and Father Almeida highlighting the areas where farmers are getting benefit from ICAR Complex and the areas which need to be researched by the ICAR Scientists. Then Chairman of RAC, Dr. Kirti Singh addressed the gathering. He advised all Scientists and staff to work in harmony to find out the solutions of the problems faced by the farmers of the state of Goa.

Presentations were made by all the Scientists and Programme Co-ordinator, KVK on transfer of technology highlighting the research work done by them during the last year. This was followed by the presentation of action taken report on recommendations of last RAC meeting by Dr. B. K. Swain, Member – Secretary.



RAC meeting of the Institute

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

General recommendations

RAC strongly feels that a master plan of the entire campus should be prepared by an Architect on priority and completed within this financial year.

Applied research need to be given more thrust.

Crop Improvement & Protection

1. Studies on developing salt tolerant varieties to be intensified by getting more rice germplasm from other institutes like CSRI, Karnal, NDUAT, Faizabad, CRRI, Cuttack and IRRI, Philippines.
2. Scientist (Entomology) should review the work done in all the pests of cashew and coconut and he can visit NBAII, Bangalore, CPCRI, Kasargod and Directorate of Cashew Research, Puttur to get maximum information on this aspect and build up capacity to take up research.

Resource Management and Integrated Production

1. There is a need to study the variations in the soil fertility under organic rice experiment.
2. Project on mine reject soils may continue with integrated approach.
3. Water harvesting technologies developed at this institute need to be promoted through watershed programmes of soil conservations Departments of the Goa Government.
4. Nutrient management studies should be made based on the available soil fertility maps.
5. Mechanization and other labour saving technologies in rice cultivation and in plantation work should be worked out.
6. Studies on the direct sowing of rice using seed drills, mechanical weeder, herbicide usage and mechanical harvester be taken up and the cost of production should be worked out.

Horticulture

1. Promising quality planting material of improved varieties of horticultural crops should be supplied and simultaneously





- evaluated on farmer's fields and other locations for better output.
2. There is a need for the development and utilization of low cost mist chambers for kokum propagation.
 3. Supply of promising quality kokum grafts to farmers and recording of their performance should be taken up simultaneously.
 4. Catalogue of kokum genetic resources need to be completed on priority.
 5. Documentation of all promising available material of vegetables and flowers in Goa should be made on priority.
 6. Selection of best plants for the local available brinjal varieties i.e Agassaim and Taligao and development of improved varieties need to be done on priority.
 7. Production of planting material of ginger lilly and promising heliconia varieties need to be augmented.
 8. Experiments on liquid fertilizers in cashew may be taken up for one more season to draw valid conclusion.
 9. Out of 79 cashew accessions 27 were catalogued, the remaining accessions need to be catalogued and documented immediately.
 10. Multi crop thresher should be evaluated with small farmer groups.
 11. Stem cuttings should be collected along with seeds while augmenting the germplasms of Noni (*Morinda citrifolia L.*).
 12. *Glyricidia* in coconut block may be removed and utilized to establish coconut based farming system model on top priority.

Animal Sciences

1. In-charge AICRP on pig may visit AICRP on pig, Ranchi Centre of Birsa Agricultural University to get information on research and development activities related to pig production.
2. Different fodder crop seeds like grass, maize, pulses, lucerne should be tested in the hydroponic system to study the growth potential and nutrient content.

Transfer of Technology

1. A revolving fund of ₹. one lakh may be provided by the institute to KVK to generate

profits to continue their programmes more effectively.

2. The transfer of technology work in the area of animal sciences in KVK is not satisfactory and needs immediate improvement. The SMS (Animal Sciences) has to work hard to make the impact of Animal Science technologies visible among farmers of the area..

Institute Research Council

The 23rd Annual Institute Research Committee meeting of the Institute was held during 7-8 July, 2012 in the conference hall of the Institute. The IRC reviewed the progress made under various research projects for the year 2011-12 and finalized the technical programmes of the ongoing research projects for the year 2012-13. The Committee of the IRC is as follows

Dr. N. P. Singh - Chairman
Director,
ICAR Research Complex for Goa,
Ela, Old Goa

All Project Leaders - Members

Dr. B.L.Manjunath - Member Secretary
Principal Scientist
ICAR Research Complex for Goa
Ela, Old Goa

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 - Chairman
Director,
ICAR Research Complex for Goa,
Ela, Old Goa

Shri P. Tufani, - Member
Deputy Director (Plant Protection),
Directorate of Agriculture,
Tonca, Caranzalem-Goa.





Dr. Parag Haldankar, - Member
Prof. & Head
Department of Horticulture,
Dr.BSKKV, Dapoli,
Ratnagiri – 415 712 (Maharashtra)

Dr. B.B. Jadhav - Member
Director of Research,
Dr. BSKKV, Dapoli
Dapoli – 415 712,
Dist. Ratnagiri (Maharashtra)

Shri Madhav Sahakari - Member
Chairman, Goa Dairy,
Curti, Ponda Goa

Father Almeida - Member
Pillar Education Society,
Bhironda, Valpoi, Goa.

Dr. Anand Kumar Singh - Member
Head,
Division of Plant Sciences
& Horticulture,
IARI, New Delhi

Dr. A.R.Desai, - Member
Senior Scientist (Hort.),
ICAR Research Complex for Goa,
Ela, Old Goa.

Dr. Satish Kulkarni - Member
Head, SRS of NDRI,
Adugodi, Bangalore

Dr. (Ms.) V. Kripa, - Member
Principal Scientist,
CMFRI, Kochi.

ADG (Soils) / ADG (SW&M) - Member
ICAR, KAB-II,
New Delhi -12

The Finance & Accounts Officer - Member
Central Institute for Research on
Cotton Technology,
Adenwala Road, Matunga,
Mumbai - 400 019

Administrative Officer -Member Secretary
ICAR Research Complex
for Goa, Ela, Old Goa

The meeting of the IMC was held on 1st
August, 2012 and 23rd April,2013.

Interface Meeting

An interface meeting with Developmental Departments was held on 10 May, 2012 at ICAR Research Complex for Goa. Shri K.V. Singh, Director, Indian Meteorological Department, Goa was the Chief Guest and other dignitaries on the dais were Shri S.S.P Tendulkar, Director of Agriculture and Dr. N. P. Singh, Director, ICAR Research Complex for Goa. There was a through discussions between Scientists of the Institute and Officers of the Departments on the formulation of research programmes taking in to the account on need of the Goa state.



Interface meeting

Recommendations

- Good agricultural practices for rice cultivation in Goa to be published. At least two FLD's for each zone on good agricultural practices in rice to be implemented. (Action - Directorate of Agriculture/ ICAR, RC/ KVK).
- For upland cultivation rice variety, Sahbhagidhan may be recommended. (Action - Directorate of Agriculture).





- The technology for *kharif* groundnut production on hill slopes so as to serve as a seed chain for *rabi* cultivation in rice fallows to be provided.
(Action- ICAR, RC, Goa).
- A training programme on wilt management in black pepper to be organized in the month of June at Ela, Old-Goa
(Action - Directorate of Agriculture/ KVK).
- The relevant package along with the film show on management of cashew stem and root borer to be provided
(Action- ICAR, RC, Goa).
- Model solar drier suitable for drying of arecanut, Kokum, Jackfruit, etc., to be established.
(Action - ICAR RC /Directorate of Agriculture).
- The Varietal Release Committee meeting to be convened during June- July for which all the relevant details will be provided by the Scientists of ICAR.
(Action - Directorate of Agriculture/ ICAR RC, Goa).
- Infertility, nutrition and health camps management for dairy animals to be organized in villages in each month by preparation of a calendar of camps for the year
(Action- Directorate of AH & VS/ ICAR, RC, Goa).
- Goa Dairy, Zuari Industries Limited also to be invited for the next Interface meeting
(Action- ICAR, RC, Goa).
- A Farmers Fair may be organised on advanced technologies in agriculture
(Action- ICAR, RC, Goa).





Distinguished Visitors

Date	Name of Visitor	Designation/ Institute/ Place
27.01.2013	Shri. Bharat Vir Wanchoo	Honourable Governor, Goa
06.03.2013	Shri. Manohar Parrikar	Honourable Chief Minister, Govt. of Goa
03.04.2012 and 16.11.2012	Shri Shripad Naik	Honourable Member of Parliament, North Goa (Lok Sabha)
06.07.2012	Shri. Laxmikant Parsekar	Honourable Minister for Health, Panchayat and Rural Development, Govt. of Goa
12.06.2012	Shri. Ramesh Tawadkar	Honourable Minister of Sports, Youth Affairs and Tribal Welfare, Govt. of Goa
8/11/2012	Dr. S. Ayyappan	Honourable Director General, ICAR and Secretary, DARE, Govt. of India
06.03.2013	Shri. Pramod Sawant	MLA and Vice Chairman, Goa Infrastructural Development Corporation, Govt of Goa
06.03.2013	Shri. Pandurang Madkaikar	MLA, Kumbharjua Constituency
09.06.2012	Dr. Panjab Singh	Former Director General, ICAR and President FAARD, Foundation
11.09.2012 and 23.10.2012	Shri. V. P. Rao	Secretary (Agriculture), Govt. of Goa
25.03.2013	Shri. V. P. Rao	Secretary (Public Grievance and Official Language, Govt. of Goa
12.06.2012	Shri. Dattaprasad Kholkar	Deputy Chairman, Planning Commission, Govt. of Goa

Visits of farmers and students

- Farmers (about 750) from different parts of Goa and the Country visited the Institute during the year. They were explained about the research activities being carried out in the research complex. Further, they visited the experimental fields and animal units.
- Students (around 1050) from different schools, colleges and universities from within the State and outside the state visited the Institute. They visited the laboratories, experimental fields and other facilities to know the activities of the Institute





Personnel

Institute

Sr. No.	Name	Designation	Additional Charge
<i>Research Management</i>			
1.	Dr. Narendra Pratap Singh	Director	
<i>Scientific Staff</i>			
1.	Dr. S.K. Das	Principal Scientist (Livestock Production & Management)	Animal Science Section & Annual Report
2.	Dr. V. Arunachalam	Principal Scientist (Horticulture)	Horticulture Section
3.	Dr. B.L. Manjunath	Principal Scientist (Agronomy)	RMIP Section, Farm & IRC
4.	Dr. E.B. Chakurkar	Principal Scientist (Animal Reproduction)	Estate
5.	Dr. S.B. Barbuddhe	Principal Scientist (Veterinary Public Health)	ATDC, HRD Cell, Fisheries, QRT & Newsletter
6.	Dr. B.K. Swain	Principal Scientist (Poultry Science)	PME Cell, RAC, HYPM
7.	Dr. P.K. Naik	Senior Scientist (Animal Nutrition)	
8.	Dr. A. R. Desai	Senior Scientist (Horticulture)	IPR Cell
9.	Dr. R. Ramesh	Senior Scientist (Plant Pathology)	CIP, AKMU Cell, PIMS
10.	Dr. M. Thagam	Senior Scientist (Horticulture)	RFD Cell
11.	Dr. S. Priya Devi.	Senior Scientist (Horticulture)	
12.	Ms. S. A. Safeena	Scientist (Horticulture)	
13.	Dr. Manohara K.K	Scientist (Plant Breeding)	Library
14.	Dr. M.J. Gupta	Scientist (Structural and Process Engineering)	Hindi Cell, RKVY
15.	Dr. M. Karunakaran	Scientist (Animal Reproduction)	TSP
16.	Dr. R. Maruthadurai	Scientist (Agricultural Entomology)	
17.	Dr. Z. B. Dubal	Scientist (Veterinary Public Health)	
18.	Dr. Mahajan G. R	Scientist (Soil Science)	





19.	Ms Manju Lekshmi N	Scientist (Fisheries Resource Management)	
20.	Shri Sreekanth G. B.	Scientist (Fisheries Resource Management)	
Technical Staff			
1.	Shri V.D.Kulkarni	Technical Officer T-7 (Farm)	
2.	Dr. Sanat Kumar	Farm Superintendent T-6	
3.	Ms. Madina S. Sollapuri	Technical Officer T-6 (Estate)	
4.	Shri Edward Crasto	Technical Officer T-5 (Stockman)	
5.	Shri Sidharth K. Marathe	Technical Officer T-5 (PME Cell)	
6.	Shri Rahul Kulkarni	Technical Officer T-5 (Hort)	
7.	Shri Raghurama Kukkude	Technical Officer T-5 (Library)	
8.	Ms Pranjali N. Wadekar	Technical Officer T-5 (Computers)	
9.	Shri Yoganand Gaude	Technical Officer T-5 (Electrical)	
10.	Shri Prakash V Jannaik	Technical Assistant T-4	
11.	Shri Ankush N Kambli	Technical Assistant T-4	
12.	Shri Suresh M Gomes	Tractor Driver, T-3	
13.	Shri Upendra Kumar	Junior Technical Assistant T-1	
14.	Shri Sanjeev Kumar Singh	Junior Technical Assistant T-1	
15.	Shri Prakash Parwar	Junior Technical Assistant T-1	
16.	Shri Gokuldas P. Gawas	Junior Technical Assistant T-1	
17.	Shri Data G. Velip	Junior Technical Assistant T-1	
18.	Shri Laxman A. Naik	Junior Technical Assistant T-1	
Administrative & Accounts Staff			
1.	Shri. P. Rajendran	Administrative Officer	
2.	Shri Saurabh Muni	Finance & Accounts Officer	
3.	Ms Maria Teresa Nigli	Assistant Administrative Officer	Works
4.	Ms Lizette Noronha	Private Secretary to Director	
5.	Ms Montia Rita D'Silva	Assistant Administrative Officer	Estt.
6.	Shri Agostinho Fernandes	Assistant Administrative Officer	Store/ DDO/ Vehicle in Charge
7.	Ms Asha Manjrekar	Assistant	
8.	Ms Pratibha Revodkar	Assistant	
9.	Ms Sunanda Chopdekar	Assistant	
10.	Shri Vishwas Sharma	Assistant	





11.	Ms. Tarika Maulingkar	Personal Assistant	
12.	Ms. Shreya Barve	Stenographer Grade.III	
13.	Mr. Vinod D. Pagi	UDC	
14.	Ms Bushra Ansari	Stenographer Grade.III	
15.	Miss Chitra Madkaikar	LDC	
16.	Shri. Tushar Mangaraj	LDC	
17.	Shri. Vyas Hiren Kumar	LDC	
18.	Shri. Vikrant Gupta	LDC	

Skilled Supporting Staff

1.	Shri Subhash Melekar		
2.	Ms. Rukma R Naik		
3.	Shri Dhaku Kankonkar		
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		
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 Sitaram Kuncolikar		
24.	Ms. Janika S Shirodkar		
25.	Shri Shanu G Velip		





KVK (North Goa)

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-4
11.	Shri. Dilkush Velip	Driver T-1
Skilled Supporting Staff		
1.	Shri Payak J Padkar	

Staff activities

Appointments / Joining

Name	Post	Date of Joining
Dr. Z. B. Dubal	Scientist (Veterinary Public Health)	05-06-2012
Dr. Mahajan Gopal Ramdas	Scientist (Soil Science)	02-07-2012
Ms. Manju Lekshmi N	Scientist (Fisheries Resource Management)	01-01-2013
Shri. Sreekanth G.B.	Scientist (Fisheries Resource Management)	01-01-2013
Shri. Saurabh Muni	Finance & Accounts Officer	12-06-2012
Shri Gurav Kumar Rajput	Administrative Officer	12-06-2012
Shri Vishwas Sharma	Assistant	21-05-2012
Ms. Bushra Ansari	Stenographer Gr.III	27-02-2013
Shri. Sanjeev Kumar Singh	Technical Assistant T-1	04-04-2012
Shri. Laxman Naik	Technical Assistant T-1	11-02-2013





Promotions

Name & Designation	Post held	Promoted Post	Date of promotion
Dr. S.K. Das	Principal Scientist	Principal Scientist	01-01-2009
Dr. B.L. Manjunath	Senior Scientist	Principal Scientist	01-01-2009
Dr. E.B. Chakurkar	Senior Scientist	Principal Scientist	01-01-2010
Dr. S. B. Barbuddhe	Senior Scientist	Principal Scientist	05-07-2011
Dr. B.K. Swain	Senior Scientist	Principal Scientist	10-03-2012
Shri V.D. Kulkarni	Technical Officer T-6	Technical Officer T-7	01-01-2010
Smt. Madina Sollapuri	Technical Officer T-5	Technical Officer T-6	20-11-2012
Smt. Lizette Noronha	Personal Assistant	Private Secretary	02-04-2012
Smt. Montia Rita D'Silva	Assistant	Assistant Administrative Officer	18-06-2012
Shri Agostinho Fernandes	Assistant	Assistant Administrative Officer	02-07-2012
Shri Vinod D Pagi	LDC	UDC	15-12-2012
Shri Prakash Parwar	SSS	Technical Assistant T-1	12-01-2013
Shri Gokuldas Gawas	SSS	Technical Assistant T-1	12-01-2013
Shri Datta Velip	SSS	Technical Assistant T-1	14-01-2013

Superannuation

Name	Post held	Date of Retirement
Dr. S. Subramanian	Principal Scientist	31-5-2012
Shri Krishnanath R Naik	Assistant Administrative Officer	30-04-2012
Shri Yesodharan K	Assistant Administrative Officer	30-6-2012
Shri Keshav A Chodnekar	Technical Officer	01-12-2012
Shri Prakash V Jannaik	Technical Assistant	31-03-2013





Resignation

Name	Post held	Date of Resignation
Shri Gurav Kumar Rajput	Administrative Officer	28-9-2012
Shri Yeswant K Gawas	Technical Assistant T-3	15-10-2012

Transfer

Name & Designation	Post held	Transfer to	Date of transfer
Dr. Ram Ratan Verma	Scientist (Soil Science)	IISR, Lucknow	31-5-2012
Dr. Avinash V Nirmale	T-9 (SMS) KVK	NIASM, Baramati	15-12-2012
Shri Jagtar Singh	Administrative Officer	NBAGR, Karnal	11-5-2012



वार्षिक प्रतिवेदन
Annual Report
2012-2013



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

