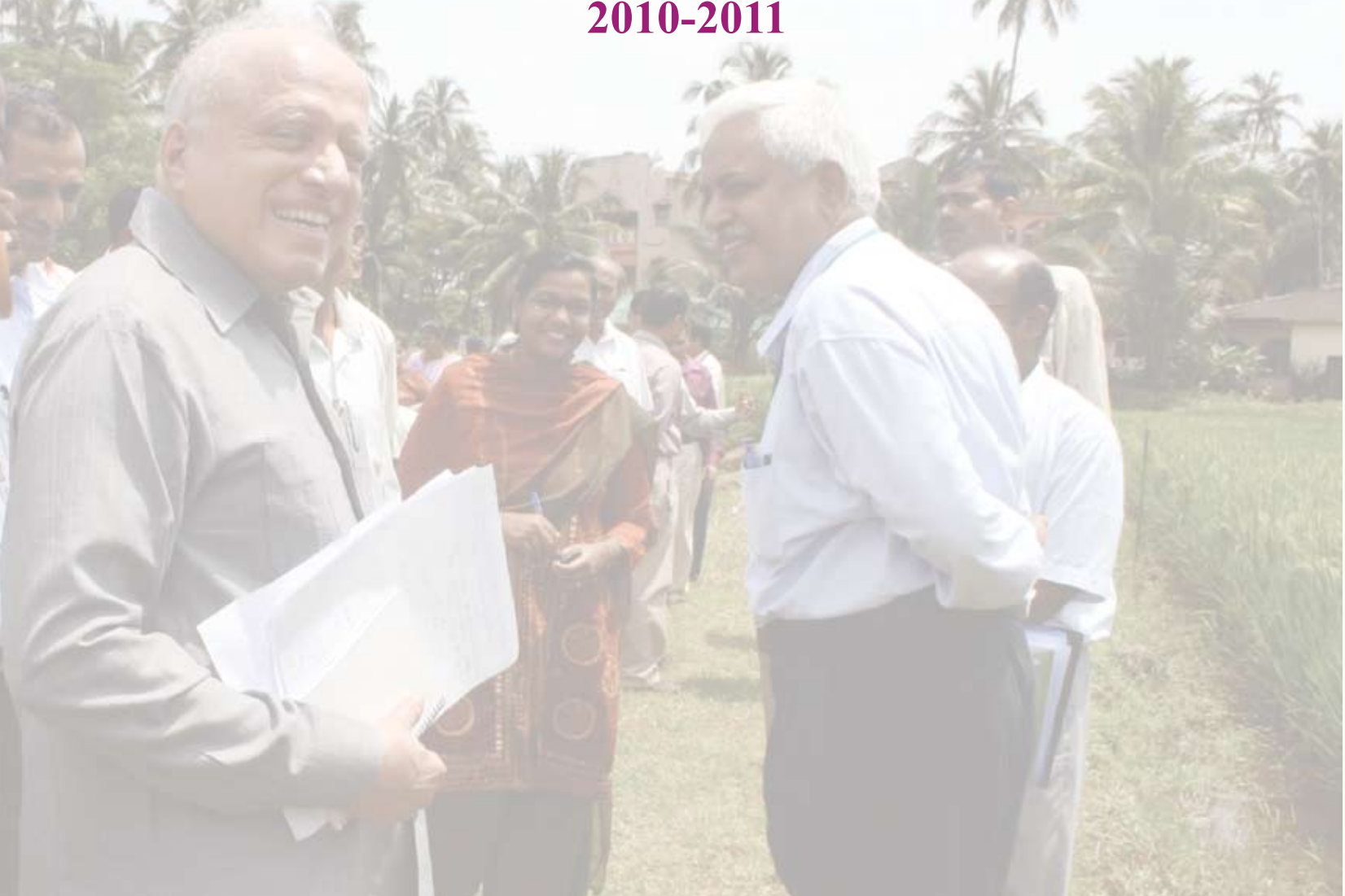


वार्षिक प्रतिवेदन  
**ANNUAL REPORT**  
2010-2011



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

ओल्ड गोवा - 403 402, गोवा, भारत

**ICAR Research Complex for Goa**

(Indian Council of Agricultural Research)

Old Goa - 403 402, Goa, India

*With Best Compliments From*

*Prof. (Dr.) Narendra Pratap Singh*  
*Director*

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





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# ICAR RC GOA

# Annual Report

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## *Preface*

It gives immense pleasure in presenting the Annual Report of ICAR Research Complex for Goa, Goa for 2010-11. The year 2010-11 has been action-packed in several ways and the Annual Report highlights the significant research achievements of the various sections (Resource Management & Integrated Production, Crop Improvement & Protection, Horticulture, Animal Sciences and Fisheries) along with the Institutional activities.



The major research activities undertaken during the year under report were soil and water conservation studies in mango and coconut, standardization of cultivation of organic rice, development of integrated farming system models for up land and low land situations for the small and marginal farmers, identification of rice varieties for rainfed low land situation, evaluation of biocontrol agents for management of bacterial wilt in brinjal, investigation of sex specific markers in kokum, standardization of enhancement of self life of flowers, evaluation of gerbera under poly house, evaluation of hybrid cashew, standardization of use of probiotics and un-conventional feeds (brewer's dried grains) in the livestock and poultry ration, development of model for cultivation of green fodder with intercrop approach in cashew field, development of crossbred (Goa Local X Large White Yorkshire) pigs. A web-based retrieval system, fisheries resources of Goa was designed using scripting language PHP. Besides, this institute has initiated work to promote Agro-Eco-Tourism in the state. This Institute has been remained as a light house for the various Departments (Agriculture, AH & VS and Fisheries) of the state.

In the year under report, the Institute has organized a number of workshops, seminars and transfer of technology programmes. The eminent personalities visited this Institute during this year include Dr. M. S. Swaminathan, Hon'ble MP (RS); Shri Ravi Naik, Hon'ble Minister, AH & VS, Govt. of Goa; Shri. Aleixo Siqueira, Hon. Minister for Power and Environment, Govt. of Goa; Dr. S. Ayyappan, Hon'ble Secretary (DARE) and DG (ICAR); Shri Rajiv Mehrishi, Adl. Secretray (DARE) and Secretary (ICAR); Dr. A. K. Singh, DDG (NRM); Prof (Dr.) M. J. Modiyal, Member, ASRB; Shri. V.V. Sadamate, Advisor (Agri.), Planning Commission etc. The Institute has conducted 10 workshops and seminar this year. Besides, 14, 69, 6 and 16 research articles, conference abstracts, popular articles and book chapters, respectively have been published by the Scientist of this Institute. As publisher, this Institute published 23 publications during this year.

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

A handwritten signature in blue ink, appearing to read 'NP Singh', written over a horizontal line.

**(Narendra Pratap Singh)**  
Director

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## कार्यकारी सारांश

गोवा के लिए भा. कृ. अनु. प. का अनुसंधान परिसर पाँच कार्यात्मक अनुभागों, जैसे फसल सुधार एवं संरक्षण, संसाधन प्रबंधन एवं एकीकृत उत्पादन, उद्यान विज्ञान, पशुपालन विज्ञान और मत्स्य विज्ञान के अन्तर्गत कुशल एवं व्यवहारिक अनुसंधान संचालित करता है। संस्थान द्वारा विकसित तकनीकियों को इसके कृषि विज्ञान केन्द्र, नार्थ गोवा के माध्यम से कृषक समुदायों तक हस्तांतरित किया जाता है। इस संस्थान की वर्ष 2010-2011 की मुख्य अनुसंधान उपलब्धियाँ नीचे दी गई हैं।

### संसाधन प्रबंधन एवं एकीकृत उत्पादन

- आम की फसल के लिए मृदा एवं जल संरक्षण के अध्ययन में पाया गया कि लगातार समोच्च खाई के साथ वेटीवेरिया जिजनिओइडस के अन्तर्गत कम से कम मृदा नुकसान 5.5 टन/हेक्टेयर और नारियल की फसल के लिए गोलाकर खाई अधिक उपयोगी है।
- तटीय लवण युक्त मृदा में ढ़ाँचा के प्रयोग के साथ संस्तुत उर्वरक के उपयोग से धान की अधिक दाना उपज दर्ज की गई।
- जैविक खेती के तहत 10 कुन्तल गोबर की खाद के प्रयोग से धान की लाल दाना किस्म एम.ओ.-17 में अधिक दाना उपज (3.97 टन/हेक्टेयर) प्राप्त हुई।
- धान की अधिक उत्पादन देने वाली किस्म करजत-3, नवीन और लवण सहिष्णु प्रजाति सी. एस. आर. -27, मूंगफली की किस्म टी. जी. 37ए, क्षेत्रीय लोबिया की प्रजाति एवं उच्च उपज देने वाले चारा फसलों की किस्मों का गुणन, अधिक मात्रा में बीज उत्पन्न करके क्षेत्रीय विकास विभागों के द्वारा बाँटवाने के लिए किया गया।
- क्षेत्रीय कृषि जलवायु एवं संसाधनों को ध्यान में रखते हुए लघु एवं मध्यम किसानों के लिए दो एकीकृत खेती प्रणाली के नमूने, एक पहाड़ी क्षेत्र हेतु और दूसरा निचले क्षेत्र हेतु विकसित किए गए।

### फसल सुधार एवं संरक्षण

- गोवा के विभिन्न क्षेत्रों से धान की दस क्षेत्रीय किस्मों (कोरगुट, डैमगो, वालियो, केन्डल, मुङ्गो, बेलो, काला बेलो, साल, कोलियो और कोचरी) को एकत्रित किया गया।
- धान की उन्नत प्रजातियों में करजत-3 और नवीन ने क्षेत्रीय चेक प्रजाति जया की तुलना में अधिक उपज क्रमशः 5.21 टन/हेक्टेयर और 6.27 टन/हेक्टेयर दर्ज की।
- देश स्तरीय लवणीय एवं क्षारीय दशाओं के लिए चुने हुए प्रजातियों में आई. ई. टी. 21734 प्रजाति ने उत्तरी गोवा के दुलापी गांव में किसानों के खेत पर जहाँ की मिट्टी का ई.सी. 2.39 से 5.69 डेसी साइमन्स/मी. और पी.एच. 5.06 से 5.86 था, सबसे अधिक उपज 5.15 टन/हेक्टेयर का प्रदर्शन किया।
- बैंगन के पौधों को 2.5 ग्रा. के टॉल्क फॉरमुलेशन से शोधित करने पर अधिकतम पौध वृद्धि पाई गई। दो जीवाणु आइसोलेट्स, ई. बी. -69 और आर.एस.-08-72 (पी. एरजीनासा) मिलावट के लिए प्रयोग किए जा सकते हैं।

- काजू की पौध पर बायो-इनोकुलेंट आधारित आई. एन. एम. प्रयोग ने नर्सरी एवं खेत में अच्छा प्रभाव दिखाया। काजू की वृद्धि को बिना प्रभावित किए करीब 25 से 50 प्रतिशत नत्रजन एवं फास्फोरस को बायो-इनोकुलेंट द्वारा दिया जा सकता है।
- जीवाणु विग्लन बीमारी प्रतिरोधी प्रजातियों के चयन कार्य के आधार पर बैंगन की प्रजाति सूर्या, श्वेता और उत्कल माधुरी डोनर पैरेंट के तौर पर प्रतिरोधी प्रजनन के लिए उपयोगी पाए गए।

### उद्यान विज्ञान

- कोकम में लिंग विशेष का जांच किया गया जिसमें प्राइमर पी-12 ने द्विलिंग का विशेष बँड दर्शाया जबकि एम-06 ने नर विशेष बँड उत्पन्न किया।
- लिली की शोल्फ लाइफ सबसे अधिक (9.47 दिन) सिल्वर नाइट्रेट में एवं उसके उपरान्त सिट्रिक अम्ल (9.00 दिन) में और कंट्रोल में (7.33 दिन) दर्ज की गई।
- पॉलीहाउस में परखे गए जेबेरा की किस्मों के बीच प्रति पौधा फूलों की संख्या सबसे ज्यादा 'ब्लेस्सिंग्स' (45.60 प्रति वर्ष) में और दूसरे स्थान पर 'फ़ोरजा' (39.40 प्रति वर्ष) में दर्ज की गई।
- नारियल की छाया में उगाए सत्रह 'हेलिकोनिआ की किस्मों के बीच, 'सेक्सी पिंक' ने सबसे लंबा स्पाइक (108.2 से.मी.) और बड़ा ब्राक्ट (23.6 से.मी.) प्रदर्शित किया।
- संकर काजू एच.-21/05 ने अन्य संकर पौधों की तुलना में अपने मोटे अखरोट और उच्च अखरोट उपज की बेहतर रुझान को जारी रखा।
- आर. ए. पी. डी. मार्कर से उपलब्ध बैंगन जर्मप्लाज़म के पच्चीस जीनोटॉइप के आनुवंशिक विषमता गुणांक 0.013 से 0.275 पाया गया। सात प्राइमरों अर्थात ओ. पी. एन. - 03, ओ. पी. एन. 14, ओ. पी. ओ.-19, ओ. पी. पी.-01, ओ. पी. आर.-15, ओ. पी. एस.-11, और ओ. पी. जे.-16 ने सौ प्रतिशत बहुरूपता दर्ज की।
- बैंगन के राष्ट्रीय चेक किस्म के. एस.-33 ने उच्चतम उपज (333.73 कुन्तल/हेक्टेयर) दर्ज की। बैंगन में जीवाणु विग्लन रोग की घटना शून्य प्रतिशत (एस.एम.-6-6) से लेकर 33.33 प्रतिशत (पूसा पर्पल लॉग) तक पाई गई।
- किस्म के. ए.-2 परिपक्व लाल मिर्च में उच्चतम उपज (103.83 कुन्तल/हेक्टेयर) और उसके उपरान्त 09/चिवर-1 (95.13 कुन्तल/हेक्टेयर) में दर्ज की गई। स्थानीय चेक किस्म ने 77.86 कुन्तल/हेक्टेयर उपज दर्ज की।





## पशु पालन विज्ञान

- फेनी बनाने के किण्वन प्रक्रिया के प्रमुख कारक खमीरों में सखारोमाइसेस सेरिविसिए 1 पिचिया प्रजाति और आईसेटचेन्किया ओरियंटालिस को पहचाना गया ।
- प्रोबायोटिक (लेक्टोबैसिलस स्पोरोजेनेस) और खमीर (सखारोमाइसेस सेरिविसिए) के मिश्रण को वनराजा मुर्गियों के आहार में (1.5-2.0 ग्रा. प्रति कि. ग्रा.) अनुपूरण करने पर अंडों के माप, आकार, मजबूत खोल एवं अंडे की सफेदी की बढ़ोतरी और कुल लाभ के संदर्भ में लाभदायक पाया गया । इसी मिश्रण को ब्रांडेयलर के आहार में सम्मिलित करने से शारीरिक वजन वृद्धि, फीड क्षमता, कर्कस लक्षण आदि बेहतर पाए गए ।
- वनराजा चूजे के आहार में मक्के की जगह बीस प्रतिशत की स्तर तक ब्रूवर्स सूखे अनाज, सोयाबीन की पुट्टी और तेल निकाले हुए चावल की भूसी को शामिल करने से उच्चतर अंतर्झी निकला मांस उत्पाद, बेहतर पोषण उपयोग और उच्च लाभ पाया जा सकता है।
- साल्मोनेला प्रजातियों और लिस्टेरिया मोनोसाइटोजेनेस की समुद्री भोजन में व्याप्तता काफी महत्वपूर्ण है क्योंकि यह प्रसंस्करण वातावरण को प्रदूषित कर सकता है ।
- औसत वायु तापमान की प्रति इकाई बढ़ोतरी से गाय का औसत मासिक दुग्ध उत्पादन साहिवाल, दियोनी और संकर गाय में क्रमशः 1.0021 मि. ली. (पी. > 0.05), 1.1361 मि. ली. (पी. > 0.05) और 1.7691 मि. ली. (पी. > 0.05) तक घटा ।
- प्रति इकाई औसत वायु तापमान के बढ़ने से पाक्षिक जैव वजन सबसे ज्यादा जाइअन्ट ग्रे खरगोश में (116.45 ग्रा.) और उसके उपरान्त ब्लैक ब्राउन (101.43 ग्रा.), सोवियत चिनचिला (93.98 ग्रा.) और न्यूजीलैंड व्हाइट में (85.90 ग्रा.) घटा ।
- साप्ताहिक वायु तापमान का लॉर्ज यॉर्कशायर, गोवा लोकल और संकर सुअरों के जैव वजन पर नकारात्मक प्रभाव रहा, अतः प्रति डिग्री वायु तापमान के बढ़ोतरी से क्रमशः जैव वजन 4.26, 3.89 और 5.26 कि. ग्रा. घटा ।
- किसानों के दुधारु पशुओं की संख्या 51.5, 27.3, 16.7 एवं 4.5 प्रतिशत के आधार पर उन्हें सीमांत (<5), लघु (5- <10), मध्यम (10 - < 20) और बड़े (>20) के वर्गों में बाँटा जा सकता है । जोत के माप से किसानों को क्रमशः सीमांत (0.01-1.00 हेक्टेयर), लघु (1.02-2.00 हेक्टेयर), मध्यम (2.01-4.00 हेक्टेयर) और बड़े (>4.00 हेक्टेयर) वर्गों में वर्गीकृत किया जा सकता है ।
- काजू के बागानों में कुल क्षेत्रफल के लगभग 57 प्रतिशत भाग पर अंतर फसल के रूप में चारे की उपज की जा सकती है ।
- यदि पशु के आहार में उचित मात्रा में मोटा चारा अर्थात ज्वार का भूसा (कड़प्पा कुट्टी) दिया जाता है तो ऐसी दशा में प्रति दिन पाँच किलो दुग्ध देने वाली गाय की दूध देने की मात्रा को प्रभावित किए बिना एक कि.ग्रा. सांद्र मिश्रण को अच्छी गुणवत्ता के दस कि.ग्रा. हरे चारे से प्रतिस्थापित किया जा सकता है।

- एक वास्तविक समय पी.सी.आर. आधारित प्रोटोकॉल भोजन और नैदानिक नमूनों में लिस्टेरिया को जल्दी पता लगाने के लिए मानकीकृत किया गया।
- गोवा परिस्थितियों में 50 प्रतिशत संकर सुअर के बच्चों में (लॉर्ज व्हाइट यॉर्कशायर X स्थानीय) वृद्धि दर एवं आहार रुपांतरण दक्षता असली लार्ज व्हाइट यॉर्कशायर और स्थानीय सुअर के बच्चों से बेहतर पाया गया । संकर सुअरों के बच्चों का दैनिक वृद्धि दर 300 ग्रा. से ज्यादा था । पोल्ट्री अवशेष तत्व एवं गूहूँ के चोकर के मिश्रण पर पले संकर सुअर के बच्चों का विकास प्रदर्शन रसोई और बेकरी अवशेष पर पले बच्चों से बेहतर पाया गया ।
- असली व्हाइट यॉर्कशायर सुअरों की तुलना में संकर सुअरों की यौन परिपक्वता आयु कम थी ।
- 7.5 मि. ग्रा. डिनोप्रॉस्ट (प्रॉस्टग्लान्डीन) का उपयोग सुअरों के समूह पर करने से उनका एस्ट्रेस का तुल्यकालन बेहतर पाया गया।
- संकर सुअरों के ड्रेसिंग प्रतिशत, मांस उत्पादन, पीठ की चर्बी की मोटाई आदि बेहतर थे।

## मत्स्य विज्ञान

- उपग्रह के समुद्र सतह के मानकों की प्रतिरूपा पर आधारित 'संभावित मछली पकड़ने के क्षेत्र' का सत्यापन परियोजना के तहत 33 पी. एफ. ज़ेड. परामर्श समुद्री मछुआरों के बीच प्रचारित किए गए और उनकी प्रतिक्रिया प्राप्त करके उनका सत्यापन किया गया ।
- गोवा मत्स्य संसाधन (FROG), एक इन्टर्नेट आधारित डाटा पुनर्प्राप्ति प्रणाली का डिजाइन PHP स्क्रिप्टिंग भाषा में किया गया। उसके संबंधकारक डेटाबेस MySQL का स्क्रिप्टिंग भाषा को PERL से PHP में बदला गया ।
- गोल्ड फिश, एन्जल फिश, ब्लैक मौली, कोई कार्प, नीली गौरामी एवं गम्पी के लगभग 80,000 अंडे तैयार किए गए । उपरोक्त प्रजातियों के वंश समूहों को आगामी प्रजनन मौसम के लिए विकसित किया गया ।

## कृषि पारिस्थितिकी पर्यटन

- औसतन कृषि पारिस्थितिकी पर्यटन प्रदाताओं ने अपने शुद्ध आय में कृषि पारिस्थितिकी पर्यटन गतिविधियों को 10-50 प्रतिशत तक हिस्सेदार बताया।







## Executive Summary

ICAR Research Complex for Goa conducts strategic and applied research under five functional sections viz. Resource Management and Integrated Production, Crop Improvement and Protection, Horticulture, Animal science and Fisheries. Technologies developed are transferred to the farming community through its Krishi Vigyan Kendra (KVK), North Goa. The highlights of the research achievements of this Institute for the year 2010-2011 are presented.

### Resource Management and Integrated Production

- Soil and water conservation studies in mango showed higher efficiency of continuous contour trenches with *Vetiveria zizanioides* with minimum soil loss of 5.5 t/ha, while in coconut circular trenchers were better.
- *Sesbania rostrata* with recommended levels of fertilizers recorded significantly higher grain yield of rice under coastal saline condition.
- Higher grain yield (3.97 t/ha) with FYM application @ 10 t/ha was recorded in red kernelled variety Mo-17 in organic rice experiment.
- Multiplication of high yielding rice variety Karjat-3 and Naveen, salt tolerant rice variety CSR -27 and groundnut variety TG 37A, local cowpea selections and high yielding forage grasses were taken up for large scale seed production for further distribution to State Developmental Departments.
- Two integrated farming system models for up land and low land situations for the small and marginal farmers of the region are being developed based on the prevailing agro-climatic conditions and resource situations.

### Crop Improvement and Protection

- A total of ten land races (Korgut, Damgo, Walio, Kendal, Mudgo, Belo, Kala Belo, Saal, Kolio and Kochri) of rice belonging to various places of Goa were collected.
- Rice varieties Karjat-3 (6.27 t/ha) and Naveen (6.193 t/ha) are found suitable for rainfed lowland systems significantly out yielding the check variety Jaya (5.21 t/ha).
- Among the National Saline Alkaline Screening Nursery entries, IET-21734 (5.15 t/ha) performed well in farmers field at Dhulapi village of North

Goa where soil EC ranged from 2.39 to 5.69 ds/m and soil pH 5.06 to 5.86.

- Brinjal plants treated with 2.5 g of talc formulation showed increased plant growth. Two bacterial isolates namely EB69 and RS-08-72 (*P. aeruginosa*) could be used for developing a consortium.
- Bio-inoculant based INM treatments performed better in improving the growth of cashew grafts in nursery as well as in field. About 25 to 50% NP could be replaced with the use of bio-inoculants without compromising the growth of cashew.
- Based on the screening of resistant varieties to bacterial wilt disease, brinjal varieties Surya, Swetha and Utkal Madhuri showed potential as donor parents in resistant breeding.

### Horticulture

- In kokum, sex specific markers were investigated where; primer P-12 produced a specific band for hermaphrodite whereas M-06 produced a male specific band in kokum.
- Longest shelf life of lilies (9.47 days) was recorded in silver nitrate treatment followed by citric acid (9.00 days) and control (7.33 days).
- Among the varieties of gerbera evaluated under poly house, highest number of flowers per plant (45.60/year) was recorded in Blessings followed by Forza (39.40/year).
- Among 17 *Heliconia* varieties grown under coconut canopy, Sexy Pink displayed long spikes (108.2 cm) and large bract (23.6 cm).
- The hybrid cashew H-21/05 performed better compared to other hybrid seedlings and continued to record bold nut and higher nut yield trends.
- The genetic dissimilarity coefficient for the 25 genotypes of brinjal germplasm obtained with RAPD markers ranged from 0.013 to 0.275. Seven primers viz., OPN-03, OPN-14, OPO-19, OPP-01, OPR-15, OPS-11 and OPZ-16 recorded 100 percent polymorphism.
- The national check KS-331 brinjal variety recorded the highest yield (333.73 q/ha). The incidence of bacterial wilt in brinjal ranged from 0.00% (SM-6-6) to 33.33% (Pusa Purple Long).
- Highest red ripe chilli was recorded in KA-2 (103.83 q/ha) variety followed by 09/CHIVAR-1 (95.13 q/ha), where as the local check recorded 77.86 q/ha of red ripe chilli.





## Animal Sciences

- The predominant yeasts identified during the fermentation process of fenni making were *Saccharomyces cerevisiae*, *Pichia* species and *Issatchenkia orientalis*.
- Supplementation of mixture of probiotic (*Lactobacillus sporogenes*) and yeast (*Saccharomyces cerevisiae*) @ 1.5-2.0 g/kg diet in Vanaraja laying hens is beneficial in terms of better egg size, shape, stronger shell, increased albumen and more net profit. Addition of mixture of probiotic (*Lactobacillus sporogenes*) and yeast (*Saccharomyces cerevisiae*) @ 1g/Kg diet in broilers improved the body weight gain, feed efficiency, carcass traits, organ weights, leanness of meat and profit margin.
- Brewers' dried grain can be incorporated up to a level of 20 % in the diet of Vanaraja chicks by replacing maize, soybean meal and deoiled rice bran partially for higher eviscerated yield, better nutrient utilization and higher profit margin.
- Prevalence of *Salmonella spp.* and *L. Monocytogenes* in fresh sea food is of significance as it may contaminate the processing environment.
- Monthly average milk yield of cow was reduced by 1.002 l ( $P > 0.05$ ), 1.136 l ( $P > 0.05$ ) and 1.769 l ( $P > 0.05$ ) in Sahiwal, Deoni and crossbred cow per unit increase of monthly average air temperature respectively.
- Maximum reduction of fortnightly live weight was observed in Gray Giant rabbit (116.45 g) followed by Black Brown (101.43 g), Soviet Chinchilla (93.98 g) and New Zealand White (85.90 g) per unit increase of maximum temperature.
- The weekly air temperature had negative influence on weekly live weight which was reduced by 4.26, 3.89 and 5.26 kg in a week per degree centigrade rise of air temperature in Large White Yorkshire, Goa Local and cross bred pigs respectively.
- Based on the number of milch animals 51.5, 27.3, 16.7 and 4.5, per cent farmers were marginal (<5), small (5-<10), medium (10-<20) and large (20 or above), respectively; while based on the land holding size 37.9, 18.2, 16.7 and 27.3, per cent farmers were marginal (0.01-1.00 ha), small (1.01-2.00 ha), medium (2.01-4.00 ha) and large (>4.0ha), respectively.
- In a cashew field, approximately 57% of the total area can be utilized for fodder cultivation with intercrop approach.
- During feeding dairy cows yielding around five kg milk daily, one kg standard concentrate mixture can be replaced by ten kg good quality fresh green fodder without affecting the daily milk yield, provided that the bulk of the animal should be fulfilled by ad lib. roughage like jowar straw (Kadaba kutti).
- A real time PCR based protocol has been standardized for quick detection of *Listeria* from food and clinical samples.
- In Goa conditions, the growth rate and feed conversion efficiency of the 50 % cross bred piglets (Large White Yorkshire X Local) were better than the pure Large White Yorkshire and pure Local piglets and achieved daily growth rate of more than 300 g. Growth performance of crossbred pigs fed poultry offal plus wheat bran was better as compared to those fed either with kitchen waste or bakery waste.
- Age of puberty (sexual maturity) was less in crossbred pigs as compared to the pure Large White Yorkshire. Synchronization of estrous in pigs was better in group where 7.5 mg Dinoprost (Prostaglandine) was used.
- Cross bred pigs were better in terms of dressing percent, meat yield and back fat thickness.

## Fishery Science

- A web- based retrieval system, Fisheries resources of Goa (FROG), was designed using scripting language PHP and the relational database, MySQL, in which the scripting language has been changed from PERL to PHP.
- Under the potential fishing zone validation project based on the satellite imaged sea surface parameters, 33 PFZ advisories were disseminated to marine fishers and validated and as per the feedback received from 79 purse seine operators utilizing the advisories, 100 percent boat reported availability of fish.
- About 80,000 spawn of gold fish, angelfish, black molly, koi carp, blue gourami and guppy were produced. The brood stocks of the above species are being developed for the ensuing breeding season.

## Agro-Eco-Tourism

- Agro-eco-tourism providers on an average attributed approximately 10-50% of their total on farm net revenue to agro-eco-tourism.







## Introduction

Goa is located in South-Western India in the region, also known as Konkan. It is cradled between Karnataka, Maharashtra and the Arabian Sea. Goa is India's smallest state by area, 4<sup>th</sup> smallest by population but is richest with a GDP per capita 2.5 times that of the nation. Also, it is a renowned international tourist destination for its beaches, places of worship and world heritage architecture. Blessed with a unique climate of 18-35°C temperature, 2500 – 4000 mm annual rainfall with humidity, it is a biodiversity hot spot and best suited for integrated farming system including Agriculture, Horticulture, Animal Husbandry and Fisheries. However, due to lucrative tourism and mining industry and increasing labour costs, agricultural and allied activities have taken the back seat in the state.

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

The Institute is headed by the Director, who is supported by 20 Scientists, 19 Technical, 19 Administrative and 32 Supporting staff, making the total staff strength of the Complex to 91. Besides, one Scientific, 11 Technical, 2 Administrative and 2 Supporting staff functions under the KVK of the Institute.

### Mission

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

### Mandate

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

### Staff Position as on March 31, 2011

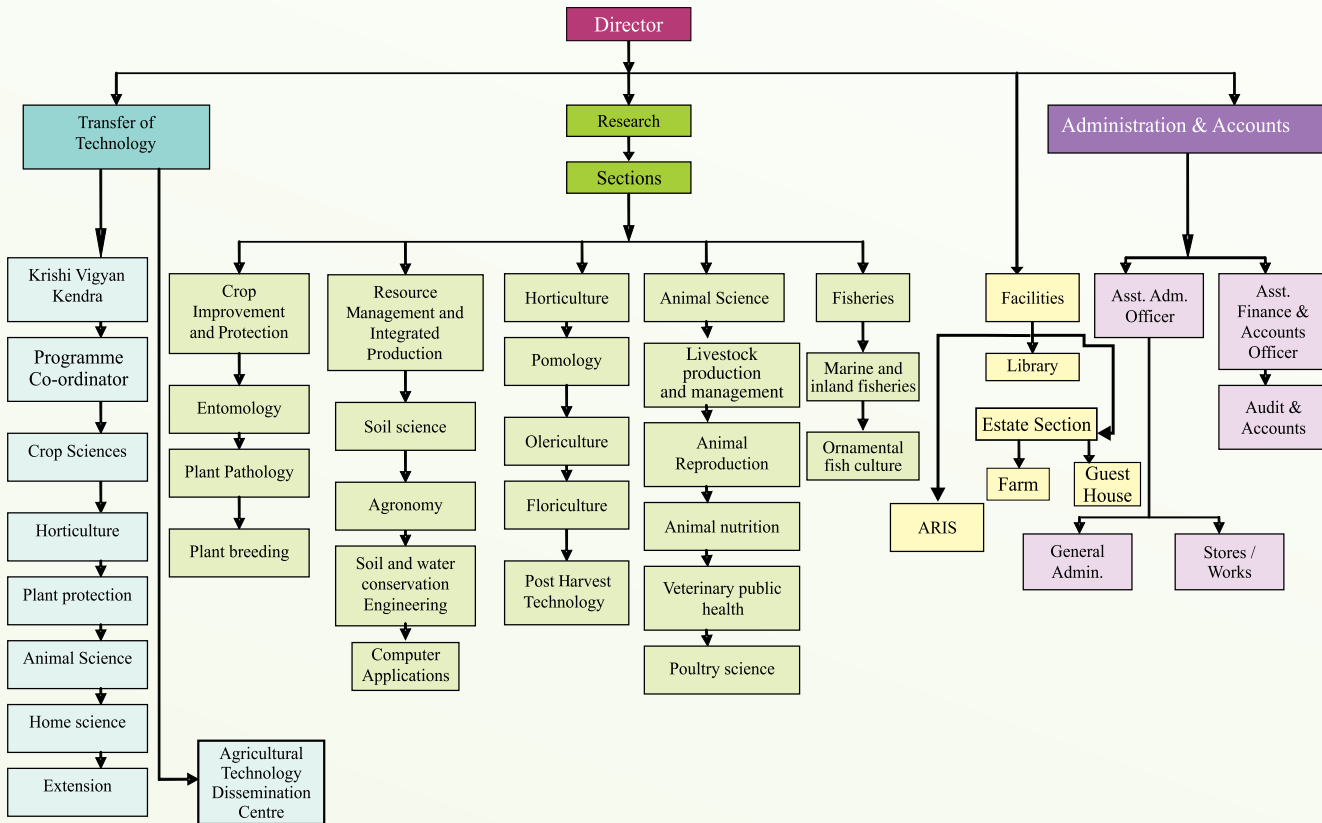
Category	Sanctioned post	Posts filled	Posts Vacant
RMP	01	01	-
Scientific	20	16	04
Technical	19	17	02
Administrative	21	12	09
Supporting	32	28	04*
Total	93	74	19

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



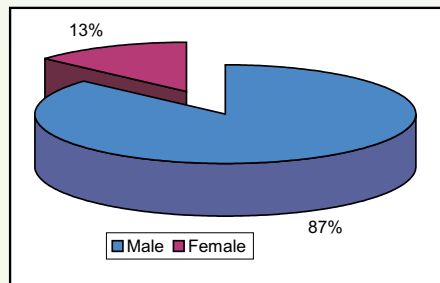


## The Organogram

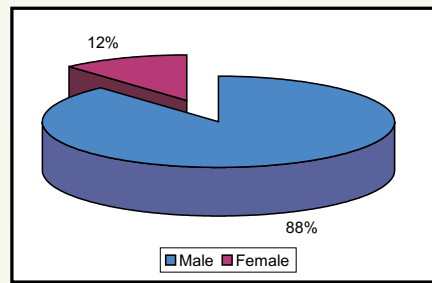


## Ratio of Male and Female Staffs

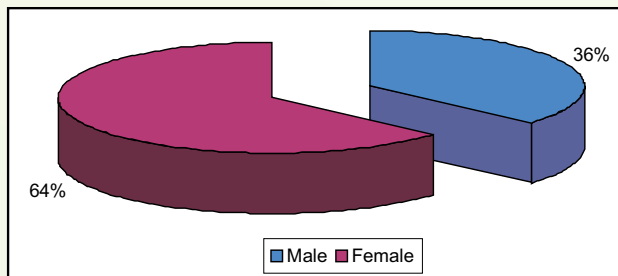
*Scientific Staff*



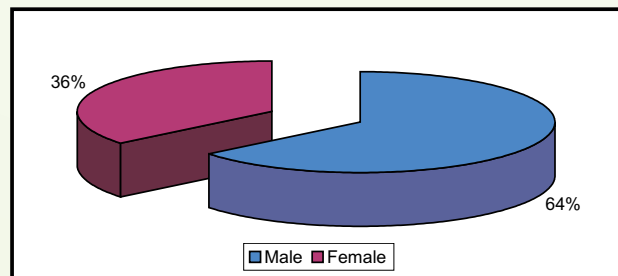
*Technical Staff*



*Administrative Staff*



*Skilled Supporting Staff*





## Financial Statement (2010-11)

(₹. in lakhs)

Head	Allocation					Expenditure				
	Plan	Plan Scheme *	Non plan	Ex-tern. Funded Projects	Total	Plan	Plan Scheme *	Non plan	Ex-tern. Funded Projects	Total
Establishment Charges	-	85.74	385.00	13.55	484.29	-	73.53	373.08	10.53	457.14
OTA	-	-	0.05		0.05	-		0.03		0.03
Wages	-	-	-			-				
HRD	2.00	0.50	-		2.50	2.00	0.19			2.19
TA	8.00	3.30	4.50	3.64	19.44	8.00	3.03	4.50	1.09	16.62
Other Charges including equipments	165.00	56.69	79.45	22.51	323.65	161.92	36.71	79.44	18.42	296.49
Works	95.00	14.80	27.00	-	136.80	95.00	10.00	27.00	-	132.00
<b>Total</b>	<b>270.00</b>	<b>161.03</b>	<b>496.00</b>	<b>39.70</b>	<b>966.73</b>	<b>266.92</b>	<b>123.46</b>	<b>484.05</b>	<b>30.04</b>	<b>904.47</b>

\* includes AICRP, IFS, IPR, Mega Seed Project

## Resource Generation

Head	Amount (₹. in lakhs)
Sale of Farm Produce	13.82
Sale of publications and tender forms	0.66
Standard licence Fees	1.09
Interest earned on loans & advances	5.55
Analytical testing charges	0.01
Interest earned on STDR	2.50
Training	2.16
Miscellaneous receipts	5.21
<b>Total</b>	<b>31.00</b>







# **ICAR RC Goa**

## **Annual Report**

### **2010-11**

# **Research Achievements**

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











# Resource Management and Integrated Production

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

## Objectives

- To develop and demonstrate soil and conservation measures suitable for major horticultural crops in Goa State.
- To assess runoff and soil loss from different land use systems / conservation measures.
- To evaluate the impact of soil and water conservation measures on soil health.
- To assess the impact of soil and water conservation measures on growth and productivity of major horticultural crops.
- To evaluate the economic feasibility of different soil and water conservation measures for different horticultural crops.

## Methodology

The rainfall, soil texture and slope are important parameters considered to design any soil conservation measures. Hence, the long-term rainfall data on weekly basis were analyzed. The experimental site was divided into number of sub plots based on the slope and topography. Each plot was treated by different bioengineering measures. Runoff and soil loss under different treatments were monitored by hydrological instruments. Actual runoff in each experimental plot was monitored by the use of multi-slot device. The effect of soil and water conservation measures on runoff and soil loss, yield and morphological characters were analyzed by using pooled data. The following soil and water conservation measures were implemented in the field.

### Mango System

- T1 - Continuous Contour Trenching + Veg. Barrier
- T2 - Staggered Contour Trenching + Veg. Barrier
- T3 - Vegetative Barrier alone

T4 – Control (Without any measures)

Main Crop: Mango

Vegetative barrier: *Vetiveria zizanioides*

### Coconut Systems

T1 - Continuous Contour Trenching + Veg. Barrier

T2 - Circular Trenching + Veg. Barrier

T3 – Circular Terraces + Veg. Barrier

## Results

### Mango system

Out of four conservation measures in mango system, continuous contour trenches with *Vetiveria zizanioides* and staggered contour trenches with *Vetiveria zizanioides* reduced the runoff by 47.0 and 36.0 per cent, respectively. Minimum soil loss of 5.5 t/ha was observed in the treatment of continuous contour trenches with *Vetiveria zizanioides* and was followed by 8.8 t/ha in staggered contour trenches with *Stylosanthes scabra* and *Vetiveria zizanioides* as compared to the maximum soil loss of 18.4 t/ha in control. Maximum mean height of mango (3.83



*Performance of mango under continuous contour trenches with *Vetiveria zizanioides* treatment*





m) was recorded in the treatment CCT + vegetative barrier followed by SCT + vegetative barrier (3.67 m) against the lowest height of 3.25 m in control plot. Similarly, the maximum mean girth of mango (45.4 cm) was recorded under CCT + vegetative barrier followed by 43.4 cm in SCT + vegetative barrier whereas lowest was recorded 40.6 cm in control treatment.

### Coconut system

Circular trenches and circular terraces were evaluated along with one control treatment for soil and water conservation in the coconut system. Plant growth parameters were recorded during the year. Maximum coconut plant height was recorded in the treatment of circular trenches (1.70 m) followed by in circular terrace (1.35 m) and lowest was recorded in the control treatment (0.95 m). Similarly, maximum coconut plant girth was recorded maximum in the treatment of circular trenches (37.5 cm) followed by circular terrace (33.16 cm) and minimum was recorded in the control treatment (30.5 cm).



*Performance of circular terrace for soil and water conservation in coconut*

### Conclusion

Preliminary studies of the of soil and water conservation treatments indicate the better results in terms of runoff reduction and plant growth under continuous contour trenches with *Vetiveria zizanioides* in mango system and Circular trenches in coconut system.

## Project : Integrated Nutrient Management in Coastal Saline Soils of Goa for Sustainable Crop Production (PI : R. R. Verma)

### Objectives

- To quantify the salinity variations of coastal saline soils during different cropping seasons of the year.
- To characterize coastal saline soils for soil physico-chemical properties.
- To study the effect of different sources of nutrient supply on crop production, productivity and physico-chemical properties of coastal saline soils.
- To study the economic feasibility of different sources of nutrients supply on crop production and suggest the suitable sources of nutrients supply.

### Methodology

Field experiments were conducted during the *kharif* season of 2010-11 in coastal saline soils at two different selected locations, one at Chodan and another at Dauji, Old Goa. Salt tolerant rice variety CSR-27 was selected for experiment. Experiment

consisted eight INM treatments i.e. *Sesbania rostrata*, *Glyricidia*, FYM, recommended dose of the fertilizer (RDF i.e. 100:50:50 NPK kg/ha), *Sesbania rostrata* +RDF, FYM + RDF, *Glyricidia* +RDF and control. Trial was conducted in randomized block design with three replications.

### Results

The effect of different integrated nutrient treatments on crop growth and yield contributing parameters were recorded during the different growth stages of the crop and statistically analyzed. The treatment *Sesbania rostrata* + RDF recorded significantly higher grain yield in the in the trial at both the sites of the experiment (4.41 t/ha at Chodan and 3.68 t/ha at Dauji). Among the organic sources of the nutrient supply, *Sesbania rostrata* treatment recorded significantly higher grain yield (2.88 t/ha at Chodan and 2.36 t/ha at Dauji). The yield in other treatments were *Glyricidia*+ RDF (3.90 t/ha and







Rice cultivation integrated with FYM and recommended fertilizers

3.29 t/ha), FYM + RDF (3.44 t/ha and 3.11 t/ha), RDF (2.93 t/ha and 2.55 t/ha), Glyricidia (2.61 t/ha and 2.34 t/ha), FYM (2.37 t/ha and 2.21 t/ha), and control (1.80 t/ha and 1.71 t/ha) at Chodan and Dauji, respectively. The performance of the integrated nutrient treatments was better on grain yield at the experimental site of Chodan in comparison to experimental site of Dauji.

### Conclusion

Application of Sesbania rostrata + RDF found most suitable technology for higher sustainable rice production of coastal saline soils of Goa.

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

### Objective

- To study the standardisation of management practices for organic rice production.

### Methodology

Field experiment was continued for the second year to standardize nutrient management practices for organic rice production in a Split-plot design with three replications involving rice varieties as main plot treatments and organic 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.

### Results and Conclusions

Among the rice varieties evaluated, Karjat-3 and Mo-17 recorded significantly higher dry matter production (39 and 37.7 g/hill, respectively) over Pusa Sugandh-5, the latter being scented with shy tillering. Although, the variety Pusa Suagndh-5 was relatively more taller (97.2 cm) with significantly longer panicles (24.5 cm), the grains in the panicle were lower (125/panicle) with incidence of more sterility (26.9 %). On the contrary, Karjat-3 with

more productive tillers (7.1/hill) was good in yielding more panicles per unit area (269/m<sup>2</sup>) with least sterility (17.7 %).

Among the nutrient sources, although the productive tillers were significantly higher with application of inorganic fertilizers (7.5/hill), application of Glyricidia and Eupatorium each 5t/ha at planting recorded higher total dry matter (36 g/hill), panicles per unit area (272/m<sup>2</sup>) and lengthy panicles (22.4 cm). Application of Sesbania rostrata @10 t/ha recorded significantly higher plant height and spikelets (144/panicle) while vermi-compost application at 5 t/ha recorded least sterility (18.6 %).



A view of organic scented rice with application of Sesbania rostrata @ 10t/ha





Grain yield differed significantly among the varieties with Karjat-3 and Mo-17 recording significantly higher grain yield (3.13 and 3.57 t/ha, respectively) over Pusa Sugnadh-5 (1.64 t/ha). Grain yield differed significantly with the application of all the nutrient sources evaluated as compared to control (1.99 t/ha) indicating the need to provide supplementary nutrition to the crop. The straw yield record was significantly higher with application of vermi-compost @ 5 t/ha (5.96 t/ha) significantly differing from the control (3.29 t/ha). The interaction effects between the varieties and the nutrient sources was also found significant for all the growth and yield parameters studied and the grain and straw yield. Higher grain yield (3.97 t/ha) was recorded with FYM application @ 10 t/ha in variety Mo-17 followed by application of vermi-compost -5t/ha and Sesbania rostrata-10 t/ha in the same variety (both 3.81 t/ha).

Application of all the organic nutrient sources increased the organic carbon content of soil over the initial level. Among the nutrient sources, higher increase was observed with FYM @ 10t/ha (1.44% O.C.) and paddy straw with water hyacinth each at 5 t/ha (1.36% O.C.)

Higher nitrogen levels in soil were observed with treatment of Sesbania rostrata @ 10t/ha compared to other treatments. While the highest phosphorus content (35.5 kg/ha) was observed with FYM @ 10t/ha, the highest potassium content being recorded in paddy straw and water hyacinth treatment each at 5 t/ha after two years of continuous application of organic nutrient sources in the fixed plots. It is pertinent to note that all the nutrient sources have reduced the available potassium content in soil over a period of two years indicating the need for supplementation of potassium for sustainable rice production.







## Crop Improvement and Protection

**Project : Breeding Salt Tolerant Rice Varieties for Coastal Saline Soils of Goa and Evaluation of Rice Varieties/Hybrids for their Suitability for Cultivation in Goa (PI: Manohara, K. K)**

### Survey, collection and evaluation of rice germplasm

#### Objective

- To collect, conserve and evaluation of genetic resources of rice viz., land races and wild species for various parameters.

#### Methodology

During *Kharif* 2010, a survey was undertaken both at North Goa and South Goa districts. Passport data on geographical co-ordinates was recorded using GPS. Information on the traditional knowledge associated with each of the accession was gathered from the contributing farmers.



Survey and collection of local land races of rice

#### Results and Conclusions

A total of ten land races viz., Korgut, Damgo, Walio, Kendal, Mudgo, Belo, Kala Belo, Saal, Kolio and Kochri of rice belonging to various places are collected and will be evaluated during *rabi* 2010.

### Evaluation of rice varieties for rainfed lowland situations in Goa

#### Objective

- To evaluate introduced rice varieties for their suitability for cultivation in rainfed low land situation in Goa.

#### Methodology

The experiment consisted of nine rice genotypes/ varieties introduced from different rice breeding Institutes across India was laid out at Experimental field of the Institute in Randomized Block Design (RBD) in three replications with Jaya as check. Data on all the yield and yield related parameters was recorded during the various growth stages of the crop.



Evaluation of rice varieties under rainfed lowland situation

#### Results

Analysis of variance revealed significant differences among the entries for all the characters studied. Days to fifty per cent flowering (DFF) ranging



Naveen - a promising rice variety





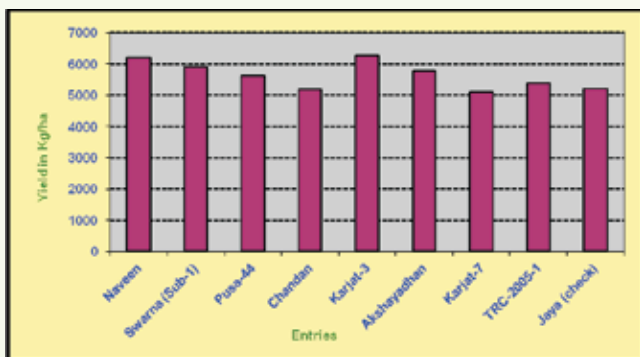
from 79 days (Karjat-7) to 116 days (Swarna Sub-1), Plant height (PHT) ranging from 95 cm (Karjat-7) to 131 cm (Akshayadhan) and grain yield ranging from 5120 kg/ha (Karjat-7) to 6277 kg/ha (Karjat-3).



*Karjat-3 - a promising rice variety*

### Conclusion

Among the nine entries evaluated, Karjat-3 (6.27 t/ha), Naveen (6.193 t/ha) and Swarna Sub-1 (5.913 t/ha) significantly outyielded the check variety Jaya (5.21 t/ha) (Fig).



**Fig. Performance of different entries under rainfed lowland situation during Kharif 2010**

Overall, variety Naveen and Karjat-3 found promising entries.

### National Saline Alkaline Screening Nursery Trial

#### Methodology

The experiment consisted of 48 rice genotypes/cultures was laid out in farmers' field at Dhulapi village of North Goa in Randomized Block Design (RBD) with two replications. The soil EC ranged

from 2.39 to 5.64 dS/m and soil pH from 5.06 to 5.86. Four entries did not flower may be due to sensitivity to altered photoperiod. Data on all the yield and yield related parameters was recorded during the various growth stages of the crop.

### Results

Analysis of variance revealed significant differences among the entries for all the characters studied. Days to fifty per cent flowering (DFF) ranging from 89 days (Jaya, yield check) to 103 days (IET-21945 & IET 21947), Plant height (PHT) ranging from 94 cm (IET-21642, 21725, 21727 & 21936) to 165 cm (IET-21737) and grain yield ranging from 100 kg/ha (IET-21947 ) to 5155 kg/ha (IET-21734).

**Table. Performance of top 5 entries in national saline alkaline screening nursery**

Entry	DFF	Plant height (cm)	Panicles/m <sup>2</sup>	Grain yield (kg/ha)
IET 21734	92	119	308	5155
IET 22017	94	121	440	4475
IET 21935	95	102	330	3870
IET 21946	94	121	411	3865
CSR 23	92	127	323	3850
CST 7-1 (Coastal saline check)	99	107	359	1755
Korgut (local check)	94	157	286	2740
Mean	86.4	103.28	302.19	2340
SE	2.79	1.59	19.64	568.36
CD (0.05)	5.62	3.18	39.48	1142.40
CV (%)	3.23	1.54	6.50	24.28

### Conclusion

Among the entries tested, IET-21734 (5.15 t/ha) out yielded all the genotypes/entries followed by IET-22017 (4.47 t/ha), IET-21935 (3.87 t/ha) and IET-21946 (3.86 t/ha). While, the local check variety Korgut yielded 2.74 t/ha and the coastal saline check variety CST 7-1 yielded 1.75 t/ha.







## Project : Development of Potential Bacterial Bio-control Agents for Plant Disease Management under Coastal Ecosystem (PI: R. Ramesh)

### Objectives

- Evaluation of soil application of antagonistic bacteria for suppression of bacterial wilt and growth improvement in eggplant under green house conditions
- Evaluation of different doses of talc formulation of antagonistic bacteria
- Development of a biocontrol consortium
- Field evaluation of talc formulation of antagonistic bacteria for the management of bacterial wilt in brinjal

### Methodology

Based on the in vitro studies on the inhibition of *R. solanacearum* and growth improvement under glass house conditions, five promising isolates were selected to test their efficacy in the green house before taking them into field. All the isolates were grown in KB medium for 48 h and 10 ml of bacterial cells ( $10^{11}$  CFU ml<sup>-1</sup>) were applied to the base of the 20 days old brinjal seedlings. Two sets of plants were treated. In one set, *R. solanacearum* was inoculated (RS-09-100 ( $7.2 \times 10^9$  CFU ml<sup>-1</sup>) @ 10ml) after 10 days of treatment while the other set of plants were not inoculated. Plant growth parameter in terms of plant height was recorded in one set of the plants where the pathogen was not inoculated. In the other set, where plants were challenge inoculated, incidence of wilt was recorded.

Based on the efficiency of the antagonistic bacteria in reducing the incidence of wilt, two isolates (EB69, RS-08-72) were selected for standardizing the dosage of talc formulation to be applied in the field. Talc formulation of the isolates was prepared according to the standardized procedure. Population of the bacteria in talc formulation was assessed and it was about  $10^8$  CFUg<sup>-1</sup> which is normally recommended for field application. Three different dosages (1.25, 2.5 and 5.0 g per plant) were evaluated. Plant height was considered as a parameter to the efficiency.

Based on the efficiency of the antagonistic bacteria three isolates were selected for compatibility

study by streaking the bacteria in a crisscross manner to know about the antagonism against each other.

Based on the in vitro studies, greenhouse evaluation three bacterial antagonists (EB69, RS-08-72 and EC13) and one consortium (EB69 + RS-08-72) is being evaluated in the field experiments for the management of bacterial wilt in brinjal. Talc formulation of the antagonistic bacteria was used in this study to treat the nursery (80g/m<sup>2</sup>) and in the main field. Germination percentage, growth parameters like, shoot length, root length, biomass, rhizosphere population and incidence of damping off were recorded in the nursery.

### Results

#### Evaluation of soil application of antagonistic bacteria for suppression of bacterial wilt and growth improvement in eggplant under green house conditions

Results from the PGPR activity indicated that except K1 isolate, others did not show any improvement over control up to a period of 57 days. Similarly in the other set, the wilt incidence also did not differ much though there was an initial delay of one week for the wilt occurrence in the treatments. Since the plants were very young when antagonistic bacteria was treated and pathogen was inoculated, in the other experiment relatively older seedlings (45 days old) were treated as described above. In the set where there was no pathogen inoculation, the growth parameter (height) was recorded up to 47 days and the results indicated that all the isolates increased plant height compared to control. Maximum increase in height was observed in EB69, EC13 and RS-08-72 treatments. In the other set, where plants were challenge inoculated with pathogen, 90 per cent plants wilted after 7 days in control, whereas treated plants delayed the incidence. Even after 21 days of pathogen inoculation, only 50 per cent plants wilted in EB69, EC13 and RS-08-72 treatments. Results from the above two experiments indicated that EB69, EC13 and RS-08-72 improved plant growth





and reduced the incidence of bacterial wilt in the presence of high pathogen inoculum (10 ml of 109 CFU ml<sup>-1</sup>), which is unlikely to be present in the normal fields except in sick plots.

#### **Evaluation of different doses of talc formulation of antagonistic bacteria**

Results revealed that plants treated with 2.5g showed increased plant throughout the period up to 28 days. The next best is 1.25g/plant. However, increased dose of 5.0g per plant did not show any growth improvement. Hence, 2.5 g of talc formulation of the antagonistic bacteria (108 CFUg<sup>-1</sup>) could be used in the field experiments for wilt management.

Development of a bio-control consortium  
Results indicated that EC13 growth was inhibited in the presence of EB69 and RS-08-72. However, the growth of EB69 and RS-08-72 were not inhibited in any of the combination. In the other experiment, EB69, EB152 and RBh42a were tested for the compatibility. EB152 growth was inhibited in the presence of the other two bacteria. EB69 and RBh42a were compatible and their growth is not inhibited. Hence, for the bacterial wilt management experiment, EB69 and RS-08-72 could be used for developing a consortium.

#### **Field evaluation of talc formulation of antagonistic bacteria for the management of bacterial wilt in brinjal**

Results indicated that germination was good in the treated nursery compared to control. Consortium treated nursery was superior to the individual treatments. Severe incidence of damping off was

observed only in control nursery. All the growth parameters are better in the antagonistic treated nursery compared to control.

Immediately after transplanting the plants were drenched around roots with talc formulation (2.5g plant<sup>-1</sup>). After 20 days of first treatment another drenching was given with the same quantity. Field experiments are in progress and the observations on the incidence of wilt, yield are being recorded.



*Biocontrol treated brinjal field*

#### **Conclusions**

Soil application of antagonistic bacteria in eggplant improved plant growth and reduced the incidence of bacterial. Brinjal plants treated with 2.5g of talc formulation showed increased plant growth. Two bacterial isolates viz. EB69 and RS-08-72 could be used for developing a consortium. Field application of talc formulation of antagonistic bacteria resulted better germination and improved growth parameters.



*Treatment of brinjal plants with talc formulation of bio-agents*







# Horticulture

## Project : Survey, Collection, Introduction and Evaluation of Kokum and Other *Garcinia spp* (PI: S. Priya Devi)

### Diversity analysis using RAPD markers

#### Objectives

- To assess the genetic diversity among the local kokum accessions found in Goa both at phenotypic and genotypic level (Molecular markers).
- To evaluate the genetic relationships among other *Garcinia species*.

#### Methodology

The molecular diversity was assessed for kokum accessions using RAPD primers. The related species like *G hombroniana*, *G cambogia*, *G tinctoria* and *G mangostana* were included in the study. In a preliminary experiment 25 primers were screened over a small number of random *Garcinia indica* accessions and 20 primers, which produced the most consistent and clear marker profiles, were selected for further analysis. The majority of RAPD markers were reproducible and so they were preferred for experiment.

#### Results and conclusions

The 20 RAPD primers produced 201 bands, among which 199 were polymorphic between the screened genotypes accounting for 98.95 % polymorphism. The size of the bands ranged from 100 bp to 1250 bp. Number of bands per primer varied from 3 (Y-19 and Z-11) to 17 (P-12). On an average each primer produced 10.05 bands.

The dendrogram developed with the RAPD marker data consisted of two major clusters, Cluster A and Cluster B at coefficient level of 0.25. The cluster A has two species namely *G. mangostana*

and *G. hombroniana*. The Cluster B consists of two branches B1 and B2. The B1 has two other species viz. *G. tinctoria* and *G.cambogia* at coefficient level of 0.4. The sub cluster B2 has got all the *G. indica* accessions in it. The B2 is sub divided into two major branches in which, one branch has got only one accession, which is a hermaphrodite. The other male and pistillate accessions have grouped altogether in a separate cluster. However, the male accession is located in the farthest end of the cluster as a lone member in a branch at 0.65 coefficient level.

From the study, it was evident that some primers were capable of producing specific markers for some accessions or species. Marker M-09 and Y-03 were able to produce separate specific markers for *G. tinctoria*, *G.mangostana* and *G.hombroniana*. Markers M-09 and N-05 could produce specific markers for *G. tinctoria*, whereas R-01, S-11 and Y-03 primers were seen to produce 3, 1, and 1 specific marker respectively for *G. tinctoria*. Many specific markers were produced for *G. hombroniana* by primers like M-05, M-06, M-09, O-14, P-12, Q-03, Q-15, S-11, Y-03, Y-13, Y-19, Z-08 and Z-11. Interestingly, the same list of primers in addition to N-05, N-14, N-17 and O-19 could produce specific markers for Mangosteen.

Primer P-12 produced a specific marker for hermaphrodite whereas M-06 produced a male specific marker. There were also specific absence of markers noticed for *G.tinctoria* (M-05) and *G. hombroniana* (O-19).







**Project : Evaluation of Commercial Cultivars of Fruit Crops under the Agro - Climatic Conditions of Goa (PI: S. Priya Devi)**

**Growth performance of commercial cultivars of fruit crops**

**Objectives**

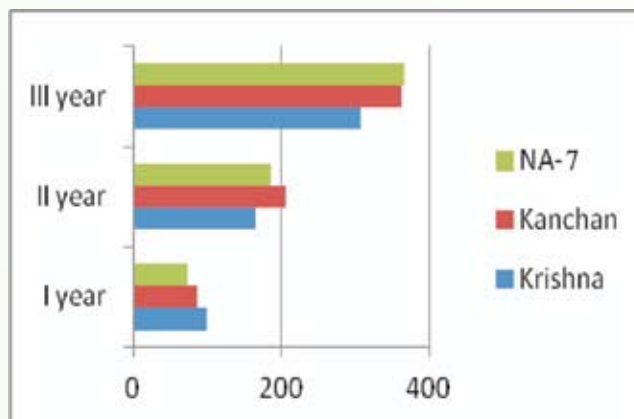
- To find out the adaptability of certain commercial fruit crops
- To study response of introduced fruits to recommended agro-techniques

**Methodology**

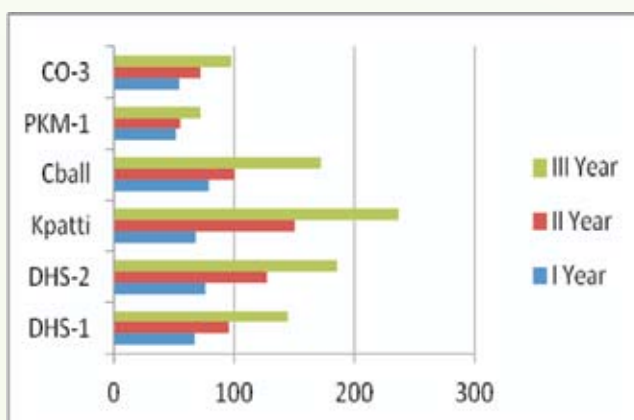
The growth parameters of crops like sapota, aonla, karonda, cherry types and grape fruit were recorded.

**Results and conclusions**

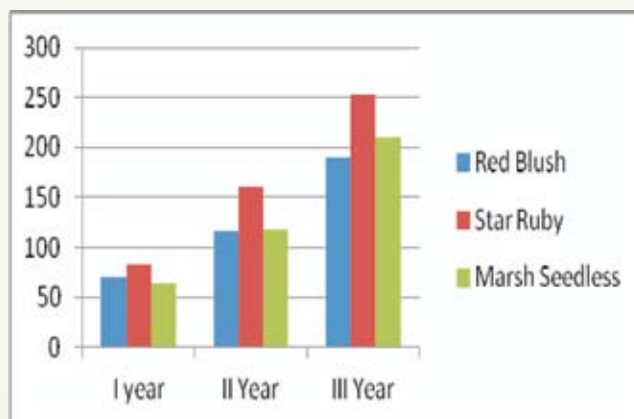
Among the three varieties evaluated in Aonla, var NA-7 recorded the maximum plant height of 308.05 cm. Var Krishna recorded maximum number of branches (6.5). Among the sapota varieties evaluated, variety Kalipatti recorded the maximum plant height (236.63 cm), canopy spread and DHS-2 recorded maximum number of primary branches (3.86). The minimum values were observed in PKM-1. Among the grape fruit varieties evaluated, Star Ruby was observed to be robust with maximum plant height (252.85). Variety Red Blush recorded highest number of primary branches per plant (4.5). Plants of karonda var Konkan Bold have recorded 296.95 cm of plant height, whereas it was 150.1 cm during last year. The plant growth parameters of West Indian cherry have shown remarkable growth. The plant height was 191.25 cm last year, whereas it is 255.10 cm during the current (third year) year.



*Fig. Increase in plant height in Aonla varieties during last three years*



*Fig. Increase in plant height in sapota varieties during last three years*



*Fig. Increase in plant height in grape fruit varieties during last three years*





## Project : Post Harvest Management of Horticulture Crops (PI: S. Priya Devi)

### Studies on enhanced vase life of Lilium cut flower cultivars

#### Objective

- Experiments were conducted to study the effect of chemical treatments on the vase life of three cultivars of lily (*Lilium longiflorum*) viz. Serrada (yellow), Courier (white) and Brindisii (pink).



Effect of different treatments on var Courier



Effect of different treatments on var Serrada



Effect of different treatments on var Brindisii

#### Methodology

Treatments and cultivars were combined in a factorial fashion and arranged in a completely randomized design. The treatments included 8-Hydroxy Quinoline Citrate (200 ppm), Floracare (1000 ppm), Silver nitrate (50 ppm), Citric acid (50 ppm), BAP (50 ppm) and distilled water (no chemical treatment) as control. All the preservative solutions were supplemented with 3% sucrose except in control. Effects of applied treatments were evaluated on different characteristics like days to opening of

flower bud, the amount of solution absorbed, days to senescence of leaf, days to dropping of petals, days to wilting of flower, vase life of the flower and analyzed statistically.



Best variety Brindisii in best treatment Ag NO<sub>3</sub>

#### Results

Data revealed differential responses of all the cultivars to chemical treatments. Results revealed that among the varieties evaluated, Brindisii had a vase life of 8.33 days followed by Serrada (8.03). Out of six treatments, Silver nitrate recorded the longest shelf life (9.47 days) which was closed followed by Citric acid (9.00 days) and control treatment recorded a shelf life of 7.33 days. The interaction effects between varieties and treatments revealed that Serrada flower pulsed in silver nitrate could keep well for 10.60 days which was closely followed by Brindisii pulsed in citric acid (10.20 days).

#### Conclusion

Among the chemicals, silver nitrate was the most effective in all the three cultivars and can be used to prolong vase life, delay leaf senescence and enhance post-harvest keeping quality of Lilium cut flowers.







**Project : Hybridization of Local Coconut Cultivars (Benaulim and Calangute) with Dwarf Varieties. (PI: A. R. Desai)**

**Fruit component analysis of local tall varieties of coconut of Goa**

**Objective**

- To analyse the fruit component characters of Benaulim and Calangute

**Methodology**

No. of Traits recorded : 6

No. of Palms Benaulim : 5; Calangute : 4

**Results and Conclusions**

Nut characters of some selected mother palms included in hybridization were recorded (Table).

**Table. Mature nut characteristics of local coconut varieties viz. Benaulim and Calangute**

Variety	Matured nut weight with husk (g)	* Nut weight without husk (g)	Kernel thickness (cm)	Fresh kernel wt/nut (g)	TSS of water °Brix
Benaulim	1032.4	521.6	1.27	242.2	5.42
Calangute	1323.75	627.75	1.26	320.5	3.71

In general, mature nut size of Benaulim variety was observed to be smaller (1.032 kg) than Calangute variety (1.32 kg) . Fresh kernel yield per nut was higher (320.5g) in Calangute than Benaulim (242.2 g). TSS varied from 4.8 to 6.4o Brix Benaulim but was only 4.45 to 4.0 in Calangute.

**Crossing programme of tall and dwarf coconut**

**Objective**

- To attempt hybridization of local tall varieties of Goa with dwarf varieties of coconut

**Methodology**

Parents used -

Tall varieties : 1. Benaulim, 2. Calangute

Dwarf varieties : 1. COD (Chowghat Orange Dwarf)  
2. MYD (Malayan Yellow Dwarf)

No. of parental palms : 54

**Results**

A total of 54 palms comprising of 16 Benaulim and 12 Calangute varieties and 14 COD and 12 MYD varieties were involved in crossing work. In all 9115 buttons were crossed in 54 mother palms for T x D and D x T combinations. Nut set till date was observed to be 1506 (ie. 16.52 %).

**Conclusion**

As on now, a total of 276 crossed nuts were harvested from 1252 crosses in 54 selected parental palms.







## Project : Standardization of Production Technologies for Flowers and Vegetables (PI: M.Thangam)

### Evaluation of flower crops under polyhouse

#### Objectives

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

#### Methodology

##### Varieties in Gerbera

1. Blessings : White
2. Scope : Yellow
3. Malibou : Pink
4. Forza : Dark Red

Design: RBD, Replications: 5

##### Varieties in Lillium

1. Courier : White
2. Serrada : Yellow
3. Brindisii : Pink
4. Brunello : Orange

Design: RBD, Replications: 5

##### Varieties/Types in Heliconia

No of types : 23  
Design : RBD  
Replications : Three

### Results and conclusions

#### Gerbera

Evaluation of gerbera varieties under polyhouse was initiated. The varieties included were viz., Blessings (White), Forza (Red), Malibou (Pink) and Scope (Yellow).



View of new gerbera trial at the Institute

Among the varieties evaluated, the highest number of flowers per plant (45.60/year) was recorded in Blessings followed by Forza (39.40/year) and the lowest number of flowers per plant was recorded in Malibou (33.20/year). In addition to flower yield, other important traits like flower stalk length, flower stalk diameter and number of petals/flower were recorded. The important traits essential for the florists are flower stalk length, diameter and flower diameter. The stalk length and diameter was highest in Blessings i.e. 66.78cm and 0.54 cm respectively.



Blessings



Forza



Malibou



Scope

Varieties of Gerbera







### Lilium

Lilium is an important cut flower produced for its brilliant colour and shape. In order to diversify the cut flower production under polyhouse and to produce short duration flower crops, different lilium varieties were evaluated during the year. In Lillium, four varieties viz., Serrada (Yellow), Brindisii (Pink), Courier (White) and Brunello (Orange) were evaluated under polyhouse. Observations on plant height, no of leaves, bud diameter and length, no of petals, no. of buds per flower stalk, pedicel length, flower size, petal width and petal length were recorded.



*Flowering in lillium variety Courier*

The highest number of buds per flower stalk (1.87) was recorded in Courier followed by Serrada and Brindisii (1.40). The flower stalk length was highest in Brindisii (103.23cm) followed by Courier (87.65cm). With respect to size of the flower, the largest flower was recorded in Serrada (17.77cm) followed by Brunello (17.68cm).

### Heliconia

In order to diversify the cropping the pattern and to effectively utilize the interspaces of coconut plantation, a new project was initiated specifically to study different ornamental crops under coconut plantation. The study was aimed at introduction of new, high value exotic ornamental crops with low or nil maintenance to complement and supplement coconut cultivation. Seventeen new heliconia types were introduced and evaluated for more than one year. Morphological observations like suckering habit, leaf and flower characters were recorded. At the end of one year maximum number of sucker per mat (22.75) was produced in Kenya Red followed by Adrian (22.00). H Pink took 237 days for first flowering and was the earliest. Spike length was maximum (108.15cm cm) in Sexy pink followed by Kenya Red (67.83). Length of bract was maximum (24.33 cm) in H-02 followed by Sexy pink (23.56cm).



*Glimpse of different exotic heliconia collection under Goa condi*





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

### Evaluation of cashew hybrids

#### Objective

- To evaluate the hybrids among different cashew accessions of Goa.

#### Methodology

Treatments – 12 Design - RBD

#### Results

##### Progressive trend of 1st set of hybrids

All the hybrid seedlings of the first set planted flowered during the season. Although, the hybrids 31/05, 21/05 and 11/5 showed precocious nature and continued to show early yielding trends, nut yield during current season (2010) was observed to be 1.0, 0.95 and 0.55 kg/tree as compared to the previous season due to unfavourable weather (Table).

Table. Performance trends of first set of hybrids

Hybrid	Parental combination	First Flowering	Nut Wt. g	Nut yield (kg/tree)	Shelling (%)
H- 5/05	Goa – 1 (B2) x Tiswadi –3	2010	7.2	0.09	-
H- 14/05	Goa – 1 (B2) x Tiswadi –3	2009	8.1	0.1	-
H- 11/05	Goa – 1 (B2) x KN 2/98	2008	8.0	0.55	28.7
H- 12/05	Valpoi - 7 x V – 4	2009	7.8	0.15	-
H- 13/05	GNJ – 2 x Goa-1 (B2)	2010	-	-	-
H- 21/05	Valpoi – 7 x Tiswadi-3	2008	8.3	1.25	28.4
H- 22/05	Goa – 1 (B2) x Valpoi – 2	2009	7.9	0.15	-
H- 23/05	Goa – 1 (B2) x Valpoi – 2	2009	7.5	0.16	-
H- 27/05	V – 4 x Tiswadi – 3	2011	-	-	-
H- 29/05	Goa – 1 (B2) x V – 4	2009	7.4	0.08	-
H- 30/05	Goa – 1 (B2) x V – 4	2010	-	-	-
H- 31/05	Goa – 1 (B2) x V – 4	2008	7.0	1.0	28.6

Mean nut weight of these hybrids were 7.0, 8.3 and 8.0 respectively during the current year. All the three hybrids showed the high shelling percent in the range of 28.4 – 28.6. The performance of cashew hybrid seedlings under evaluation was adversely affected by unfavourable weather.

#### Conclusion

The hybrid cashew, H-21/05 yet performed better compared to other hybrid seedlings and continued to record bold nut and higher nut yield trends.

### Hybridization in cashew

#### Objective

- To attempt new cashew hybrids between parenting of high yielding and bold nut size.

#### Methodology

No. of parents : 3

No. of crosses direct and reciprocal : 6

#### Results and Conclusions

Parents with contrasting morphometric traits (nut size and yield) and having higher dissimilarity coefficient values were selected for crossing (Table).

Table. Parental combinations and results of crossing

Parental combination	No. of crosses	No. of nuts set
A. Bold nut size Vs High yielding		
Tis-3 X Red Local	65	8
Bardez-9 X GNJ-2	163	17
Tis-3 X Vengurla-4	88	4
B. High yielding Vs Bold nut size		
Red Local X Tis-3	112	6
GNJ-2 X Bardez-9	134	14
Vengurla-4 X Tis-3	116	4
	678	48

Three pairs of parental combinations and their reciprocals were used for crossing and out of 678







crosses made, 48 hybrid seed nuts were obtained and the hybrid seedlings were raised for planting.

### Molecular analysis in cashew hybrids using RAPD

#### Objective

- To assess genetic diversity in cashew hybrids and their parents using RAPD Markers.

#### Methodology

A total of 35 genotypes (eight parental genotypes and 27 hybrids), maintained at ICAR Research Complex for Goa, Old Goa, were analysed using 12 RAPD Primers.

#### Results and Conclusions

The details of the cashew genotypes and hybrids selected for the study are given below in Tables.

**Table. Details of cashew genotypes used as parents in crossing**

Genotypes	Nut Size (g)	Nut yield	Remarks
GNJ-2	7.8-8.2 (Bold)	High	Local accession
BLI-2	7.6-7.8 (Bold)	High	Released variety
Tis-3	9.2-9.6 (Jumbo)	Medium	Local accession
KN-2/98	7.6-8.0 (Bold)	High	Local accession
V-4	7.5-7.8 (Bold)	High	Released variety
RL	6.7-7.2 (small)	High	Local accession
15-A	7.8-8.2 (Bold)	Medium	Local accession
8-A	8.8-9.4 (Jumbo)	High yield	Local accession

#### Profile of polymorphism in 1st set of hybrids and primer efficiency

Comparison of three cashew genotypes namely Ganje-2, Balli-2 and Tiswadi-3 with their hybrid seedlings to study their genetic relatedness was

carried out using RAPD markers. 105 consistent RAPD markers (scorable bands) were seen out of which 95 were polymorphic with an average of 88.5 per cent polymorphism. Number of markers varied from 4 in primer OPP-12 to 13 in primer OPM-05. The number of polymorphic bands also varied from 2 (OPP-12) to 13 (OPM-05). In general, the primers OPN-03, OPN-06, OPQ-03 and OPZ-11 recorded higher values for Marker Index (MI), Mean Marker Index (MMI), Polymorphic information content (PIC) and Resolving Power (Rp). The highest Resolving power (Rp) was observed in the primer OPQ-03 (14.17) followed by OPQ-15 (12.17), OPS-11 and OPN-06.



**Fig. Amplification profile of the DNA of some cashew varieties with the primers OPP-12(left) and OPQ-3 (right)**



**Fig. Amplification profile of the DNA of some cashew varieties with the primers OPM-5**

#### Similarity coefficients for 1st set of nine hybrids

The similarity coefficients of three cashew genotypes namely Ganje-2, Balli-2, Tiswadi-3 and their hybrid seedlings were studied. The results indicated that similarity coefficients varied from 0.37 (Balli-2 and H-28/10) to 0.73 (H-8/09 and H-23/10). Ganje-2 genotype showed similarity coefficient value of 0.42 with Balli-2 and 0.53 with Tiswadi-3, while the genotype Balli-2 showed similarity value of 0.58 with Tiswadi-3. Ganje-2, a maternal parent for all the nine hybrids, recorded the genetic similarity coefficients in the range of 0.39 (H-04/09) and 0.56 (H-27/10 & H-28/10).





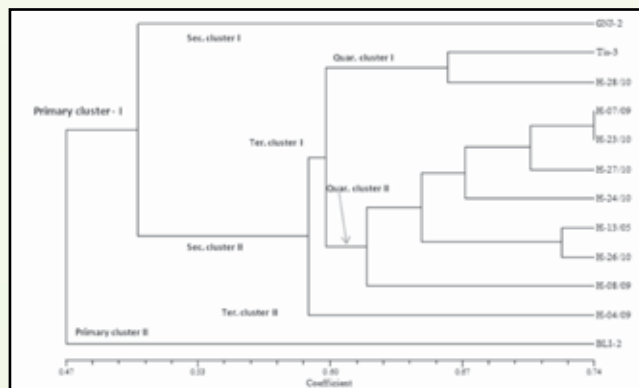
**Table. Hybrid genotypes and their parental combinations in 1st set of nine hybrids**

Sl. No.	Hybrid genotypes	Parental combinations
H1	H-04/09	GNJ-2 X BLI-2
H2	H-07/09	GNJ-2 X BLI-2
H3	H-08/09	GNJ-2 X BLI-2
H4	H-13/05	GNJ-2 X BLI-2
H5	H-23/10	GNJ-2 X Tis-3
H6	H-24/10	GNJ-2 X Tis-3
H7	H-26/10	GNJ-2 X Tis-3
H8	H-27/10	GNJ-2 X Tis-3
H9	H-28/10	GNJ-2 X Tis-3

On the other hand, Balli-2, a male parent for four hybrids, showed genetic similarity coefficients ranging in between 46 and 0.5. while the other male parent, Tiswadi-3, showed slightly higher genetic similarity values in the range of 0.57 (H-27/10) and 0.66 (H-28/10) with its five hybrid seedling genotypes. Pair-wise comparison among all the nine hybrids indicated that the first set of nine hybrids involving the three common parents had the genetic similarity values in between 0.53 ( H-28/10 & H-27/10) and 0.73 ( H-07/09 & H-23/10).

**Clustering pattern of 1st set of nine hybrid genotypes and their parents**

The dendrogram constructed using Jaccard's similarity coefficient values indicated the genetic relatedness based the pattern of clustering of genotypes. All the genotypes, comprising of three parents and nine hybrids, were distributed broadly in to two primary clusters which separated by the lowest similarity coefficient of 0.47. Primary



**Fig. Dendrogram depicting the clustering pattern of nine hybrid genotypes and their parents**

cluster-1 comprised of 11 genotypes (two parents and nine hybrid genotypes) which further formed two secondary clusters at similarity coefficient level of 0.49. On the other hand, the primary cluster-2 had only one genotype (Balli-2) forming the extreme end of the dendrogram. Ganje-2, a solitary genotype, in the secondary cluster-1, formed the other extreme end. Similarly, Tiswadi-3 formed a solitary cluster in Quaternary cluster-1. Most hybrids grouped together in Quaternary cluster-2 at different levels of similarity coefficients.

**Profile of polymorphism in 2nd set of hybrids with their parents and primer efficiency**

The total number of bands observed among the second set of seven hybrid genotypes and their parents based on RAPD analysis with 12 primer pairs was 111. The number of scorable markers produced per primer ranged from 4 to 13. The total number of polymorphic markers and the percentage of polymorphism were 111 and 100 respectively. Higher values for Marker Index (10.85, 8.471, 8.2897.81) were observed with the primers OPR-01, OPM-05, OPN-06 and OPZ-11 which had the corresponding values of 0.835, 0.77, 0.754 and 0.781 for Mean Marker Index (MMI). The PIC values, a reflection of allele diversity and frequency among the varieties, were almost uniformly higher for all the RAPD loci tested. The PIC value ranged from 0.463 (OPP-12 & OPS-11) to 0.63 (OPR-01) with a mean of 0.497. The Resolving power (Rp) values varied from 3.455 for the OPR-15 primer to 14.91 for the OPN-03 primer.

**Table. Hybrid genotypes and their parental combinations in 2nd set of seven hybrids**

Sl. No.	Hybrid genotypes	Parental combinations
H10	H-02/10	15-A X V4
H11	H-04/10	15-A X V4
H12	H-05/10	15-A X V4
H13	H-06/10	15-A X GNJ-2
H14	H-07/10	15-A X GNJ-2
H15	H-14/10	15-A X RL
H16	H-15/10	15-A X RL

**Similarity Coefficients for 2nd set of seven hybrids and their parents**

The similarity coefficients based on 111 RAPD markers ranged from 0.12 to 0.72. Of the 55 pair wise







combinations generated by seven cashew hybrids and four parents, hybrid genotypes H-06/10 and H-07/10 showed the highest similarity coefficient index (0.72) followed by the genotypes H-14/10 and Red Local (0.63), whereas, GNJ-2 and H-5/10 showed the lowest similarity coefficient index (0.12) followed by 0.13 between the genotypes 15-A and H-5/10. The mean similarity index was 0.677.

### Primer efficiency for polymorphism in 3rd set of hybrids with their parents

Amplification profiles of total genomic DNA from six hybrid genotypes and their parent genotypes with 12 random primers produced a total of 85 consistent RAPD markers (bands), out of which 82 were polymorphic with an average of 96.25 per cent polymorphism. Number of markers varied from 5 in primers OPM-05, OPQ-03 and OPR-01 to 13 in primer OPM-06. The number of polymorphic bands also varied from 4 (OPP-05) to 13 (OPM-06).

**Table. Hybrid genotypes and their parental combinations in 3rd set of six hybrids**

Sl. No.	Hybrid genotypes	Parental combinations
H17	H-05/05	BLI-2 X Tis-3
H18	H-14/05	BLI-2 X Tis-3
H19	H-11/05	BLI-2 X KN-2/98
H20	H-29/05	BLI-2 X V-4
H21	H-30/05	BLI-2 X V-4
H22	H-31/05	BLI-2 X V-4

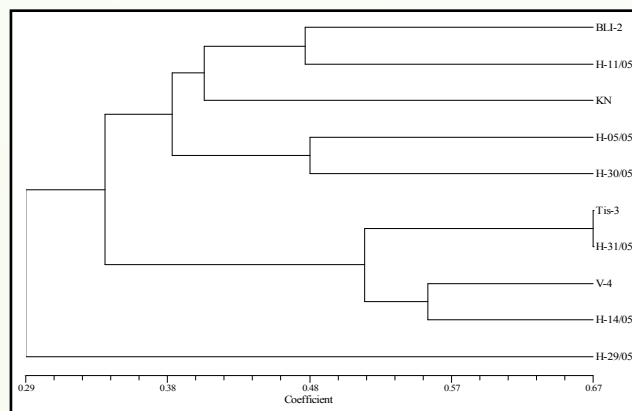
In general, the primer OPN-06 showed higher values for Marker index (11.98), Mean Marker Index (0.922), Polymorphic Information content (0.471 and Resolving power (6.4).

### Similarity Coefficients for 3rd Set of six hybrids and their parents

Pair wise Jaccard's similarity coefficient values varied from 0.12 ((H-11/05 and H-29/05) to a maximum of 0.66 (Tiswadi-3 and H-31/05). In this set of analysis, all four parents recorded a lower level similarity index values (between 0.14 -0.5) with one another. Pair wise comparison among all the hybrids also recorded a similar trend with less than 50 per cent genetic similarity.

### Clustering pattern of 3rd set of six hybrid genotypes and their parents

Clustering pattern of dendrogram for 3rd set of hybrid genotypes and their parents is depicted in Fig. which out grouped the hybrid genotype H-29/05 in a solitary cluster totally separated from



**Fig. Dendrogram for 3rd set of six hybrid genotypes and their parents**

rest of the hybrid genotypes and their parents at 29 per cent similarity index. The other major cluster in turn formed two sub clusters with four (Tiswadi-3, H31/05, Vengurla-4 and H-14/05) and five genotypes (Bali-2, H-11/05, KN-2/98, H05/05 and H-30/05) in sub cluster-1 and sub cluster-2, respectively. In sub cluster-1, Tiswadi-3 and H-31/05 grouped together with 66 per cent similarity index.

### Primer efficiency for polymorphism in 4th set of hybrids with their parents

Analysis of results of 4th set of hybrid genotypes with their parents revealed that 12 random primers produced a total of 109 markers of which 99 were observed to be polymorphic with an average polymorphism of 89.23 per cent. The primer OPN-06 produced the highest number of bands (15) followed by OPR-01 and OPO-14 with 14 and 13 bands respectively. The random primer OPN-06 recorded higher values for of Marker index (MI), Mean Marker Index (MMI), Polymorphic Information content (PIC) and Resolving Power (Rp) with corresponding values of 9.797, 0.653, 0.497 and 16.25 respectively, followed by other primers namely, OPR-01 and OPS-11.





### Similarity Coefficients for 4th set of five hybrids and their parents

PCR products generated by using the 12 random primers were used for developing Jaccard's similarity coefficients for the 4th set of hybrid genotypes and their parents.

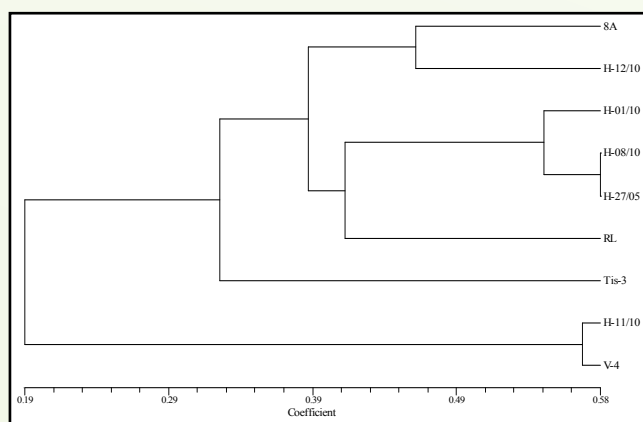
**Table. Hybrid genotypes and their parental combinations in 4th set of five hybrids**

Sl. No.	Hybrid genotypes	Parental combinations
H23	H-01/10	8-A X V-4
H24	H-08/10	Tis-3 X RL
H25	H-11/10	Tis-3 X V-4
H26	H-12/10	Tis-3 X V-4
H27	H-27/05	V-4 X Tis-3

The results indicated the highest genetic similarity index of 0.58 between H-08/10 and H-27/10 followed by 0.57 between H-11/10 and Vengurla-4. On the other hand, the least similarity indices of 0.08 and 0.1 were recorded between H-08/10 and H-11/10, and 8-A and Vengurla-4, respectively.

### Clustering pattern of five hybrids and their parents in 4th Set

Clustering pattern of dendrogram for 3rd set of hybrid genotypes and their parents is Done. All the genotypes were scattered in two main clusters which differed from each other with 81 per cent dissimilarity index. The first main cluster grouped



**Fig. Dendrogram of clustering for 4th Set of hybrids and their parents**

hybrid H-11/10 and Vengurla-4 genotypes together with 57 per cent similarity. While the second main cluster further formed two sub clusters Which out

grouped Tiswadi-3 in a solitary sub cluster-1 and grouped other six genotypes (8-A & H-12/10 in one group; H-01/10, H-08/10, H-27/05 and Red Local in another group) in cluster-2.

### Molecular diversity analysis in nutmeg using RAPD

#### Objective

- To assess the genetic diversity in nutmeg germplasm of Goa

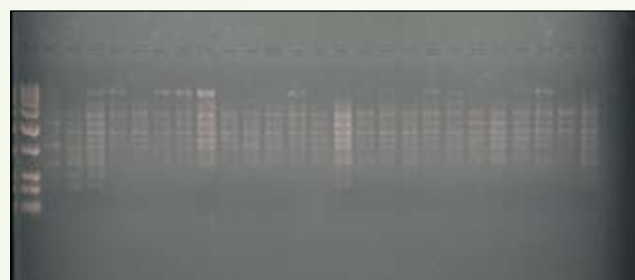
#### Methodology

A total of forty four nutmeg genotypes were used for this study. Twenty two genotypes of Nutmeg were collected from three locations in North Goa District of Goa, 3 from Keri (1,10,19), 14 from Lamgaon (2-8, 11-12, 14-18) and 5 from Khandola (20-24) and twenty two (9, 13, 25-44) genotypes from the farm of ICAR Research Complex for Goa, Old Goa.

#### Results

##### Primer efficiency

It was observed that out of 195 RAPD markers, 162 produced by 19 RAPD primers showed on an average of 77.47 per cent polymorphism. In general, the primers namely, OPM-05, OPN-14, OPM-09, OPN-03, OPN-17 and OPR-15 recorded higher polymorphic bands with higher values for MI,MMI, PIC and Rp, indicating that these primers employed in the study returned a high degree of confidence in molecular comparative analysis of 44 nutmeg genotypes. And could be considered as the most informative primers.



**Fig. Amplification profile of the DNA of some nutmeg accessions with the primer OPM-5**







### Jaccard's similarity coefficient matrix and clustering pattern of nutmeg genotypes

Jaccard's similarity coefficients for 44 genotypes observed in the range of 0.54 and 0.92 indicated only 46 per cent of dissimilarity at molecular level among the nutmeg accessions studied. That means, the group of genotypes studied is not from a highly diversified genetic spectrum though being the derivatives of open pollinated seedling progeny. This implies in itself that the open pollinated seeds have higher degree of tendency to breed the seedling population with 54% genetic make up being true to type. Based on this, it can be inferred that the genetic spectrum of the germplasm collection analysed in the present studies is narrow with inadequate variability for crop improvement programmes. However, The lowest similarity coefficient of 0.54 was observed between the genotypes Keri-C (S.No.1) and N 6/1(Sl. No.28), the former being a male tree while the latter is a female genotype with medium fruit size. These two genotypes might be from diverse sources of origin.

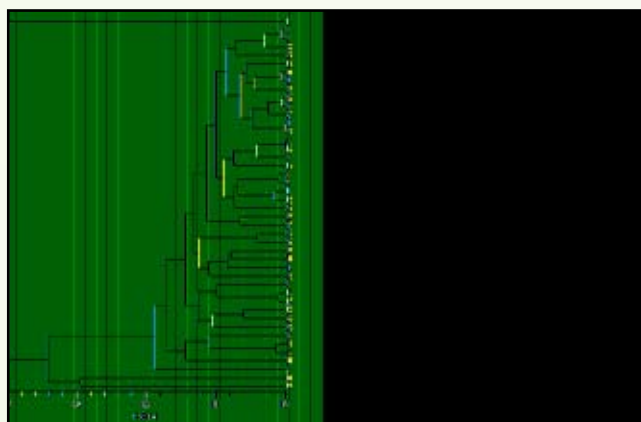


Fig. Dendrogram depicting the Clustering pattern of 44 nutmeg genotypes

Further, the dendrogram clearly depicted that the genotype Ker-C (male genotype), though totally separated from the remaining 43 genotypes, yet recorded an average similarity coefficient of 0.59 with all the 43 genotypes. Other male genotypes scattered themselves in different groups within the broader primary cluster-1. For instance, male genotypes LG-D and LG-F (Sl. Nos. 2 and 3) grouped together due to the highest similarity of 92 per cent, both of which in turn shared about 90 percent genetic similarity with a solitary female genotype N-5/3 (Sl. No.38) which is medium tall genotype bearing medium sized fruits. Similarly, male genotypes, LG-I and LG-O (Sl. Nos. 4 and 5) shared genetic similarity with a

female genotype LG-L (Sl. No. 16) which is bearing oval shaped fruits. All the three genotypes are from the same location (Lamgaon). Likewise, male genotypes LG-R and N-2/1 (Sl. Nos. 8 and 9), though from different sources formed a cluster with 0.91 similarity coefficient value, while other male genotypes such as LG-P and L-Q (Sl. Nos. 6 and 7) formed solitary clusters at different levels in the dendrogram.

The genotypes namely, Keri-A and Keri-B (sl. Nos. 10 & 19) and Keri-C a male genotype formed the two extreme ends of the entire dendrogram, in between which all other genotypes formed clusters at various levels depending on their genetic relatedness. The genotypes namely, N-2/4, 1/5, 2/5, and 4/5 from ICAR source, having medium sized fruits and vigorous growth formed a group together which recorded more than 80 per cent genetic relatedness. On the contrary, genotypes such as N-6/2, 7/2, 2/3, 3/3 and 1/2 (Sl. Nos. 33-36 and 44), all from the same source, having genes for medium fruit size and dwarf canopy structure, scattered in different clusters in the dendrogram.

### Conclusions

The genotypes having bigger fruits scattered within the broader primary cluster-1 at various sub cluster levels. For example, genotypes K-1 and K-3 (Sl. Nos.20 &21) with similarity coefficient of 0.92 clustered together for having genetic make up for bigger fruit size and vigorous growth. Another genotype N - 4/2 also shared genetic relationship very closely with K-1 and K-3 with an average similarity of 87.5 per cent, but differed from both of them in respect of growth habit. N - 4/2 is dwarf growth habit while K-1 and K-3 are vigorous genotypes. At another level of sub clustering, the genotypes LG-J and LG-K (Sl. Nos. 11 and 12) with for bigger fruit size and vigorous growth habit, paired together with 0.91 similarity coefficient. Other genotypes namely Keri-B (Sl. No. 10) and Khandola-4 (Sl. No.22) formed solitary clusters in different positions in the cluster diagram. On the other hand, the highest similarity coefficient of 0.92 was between the male genotypes LG-I and LG-O (Sl. Nos.4 and 5), and the genotypes LG-I (male) and LG-L (Sl. Nos. 4 and 16) followed by similarity coefficient of 0.91 between the genotypes LG-F & LG-L (Sl.Nos. 3 & 16), LG-R & N - 2/1 (Sl.Nos. 8 & 9) and LG-M & LG-E ( Sl. Nos. 14 & 17). The latter most genotypes are high yielders with small – medium fruit size.





## Project : Breeding of Brinjal for High Yield and Resistance to Bacterial Wilt through Conventional and Molecular Approaches (PI: M Thangam)

### Study on assessment of genetic diversity in brinjal germplasm using RAPD primers

#### Objectives

- To screen local and introduced brinjal types for identification of stable / durable resistant source.
- To evaluate the brinjal germplasm for yield and other traits.
- To attempt the introgression of resistance to popular local brinjal cultivars
- To develop suitable mapping population for horticultural traits.
- To undertake phenotypic and genotypic screening for identification of molecular markers linked to resistance and other horticultural traits.

#### Methodology

##### RAPD Markers

Treatments. Accessions from Goa ; 12 (14-25)  
Accessions from other State : 13 (1-12)



Brinjal lines used in genetic diversity analysis

#### Results

Out of 24 RAPD primers screened, a total of 195 bands were scored, of which 134 were polymorphic between the screened genotypes accounting for 70.25 % polymorphism. The genetic dissimilarity coefficient for the 25 genotypes of brinjal germplasm obtained with RAPD markers ranged from 0.013 to 0.275. Seven primers viz., OPN-03, OPN-14, OPO-19, OPP-01, OPR-15, OPS-11 and OPZ-16 recorded 100 percent polymorphism.

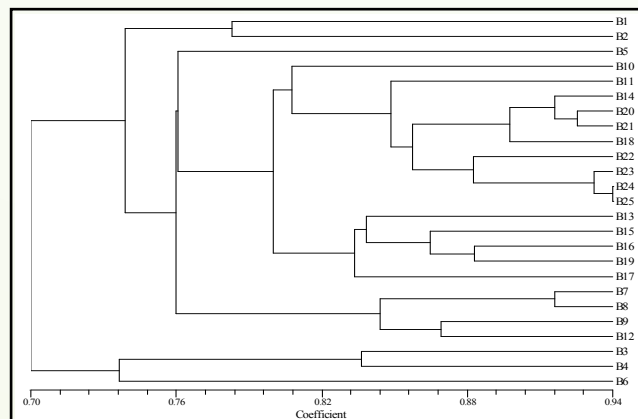


Fig. Dendrogram showing clustering pattern of brinjal germplasm accessions by RAPD primers

In the Dendrogram, four genotypes belong to Goa state also clustered in the major cluster B indicating its affinity towards the introduced varieties of brinjal. In the sub cluster B2, bacterial wilt resistant brinjal lines viz., Arka Nidhi and *Solanum melongena* 6-6 clustered in the same group along with other line 09/ BRBWRES-6 which is also introduced as bacterial wilt resistant.

#### Conclusion

Seven primers viz., OPN-03, OPN-14, OPO-19, OPP-01, OPR-15, OPS-11 and OPZ-16 recorded 100 percent polymorphism. Therefore, these primers could be employed in future RAPD based diversity analysis of brinjal germplasm.







## Project : Collection, Conservation, Evaluation and Cataloguing of Germplasm of Ornamental crops of Goa and Adjoining Regions (PI: S. A. Safeena)

### Objectives

- To collect and conserve local accessions of flower crops like Marigold, jasmine and crossandra for evaluation and utilization in future.
- To determine the genetic diversity in germplasm of flower crops like Marigold, jasmine and crossandra
- To introduce and evaluate the high yielding marigold, crossandra and jasmine varieties from other research stations and private companies.
- To evaluate the performance of the flower crops like Marigold, jasmine and crossandra under Goan conditions
- Selection of promising accessions of marigold, jasmine and crossandra for desired traits.
- To establish and maintain germplasm bank of promising genotypes of flower crops like Marigold, jasmine and crossandra

### Methodology

Survey to locate the promising genotypes of marigold, jasmine and crossandra in Goa. Evaluation of selected accessions in Goa and promising ones will be conserved in germplasm bank and utilized in future. Promising varieties/ accessions will be introduced for commercial cultivation in Goa.



Field view of marigold as pure crop

### Results and Conclusions

#### Marigold

Field surveys were conducted in different talukas of Goa viz., Pednem, Salcette, Bardez –Mapusa and Ponda for collection of local accessions of Marigold. Further evaluation of local accessions and known



Field view of marigold as intercrop in cashew

varieties of marigold was carried out in replicated trials both under open field and as intercrop in cashew orchard to standardize the production technology. Production technologies with respect to spacing and nutrient requirements were standardized for marigold flower production both as pure crop and as intercrop in cashew orchard under Goan condition. The observation on the performance of different types of marigold were being recorded. Forty types of marigold were evaluated. But since marigold is a highly cross pollinated crop, lot of segregants were found and about 69 types were identified.

Salient features	Range
Peduncle length (cm)	15.06 – 4.54
Bud length (cm)	4.82 – 2.42
Diameter of the flower (cm)	7.62 - 2.76
Number of ray florets	218.4 - 8.00
Length of ray florets (cm)	5.04 – 2.76
Width of ray florets (cm)	2.00 – 0.288
Disc floret length (cm)	3.7- 0.00
Disc floret width (cm)	1.10 – 0.00





## Jasmine

Jasmine is an important flower crop belonging to the Genus *Jasminum* and botanical family Oleaceae.

**Table. Morphological description of *Jasminum* types being conserved at the Institute**

	Diameter of bud (cm)	Length of the bud (cm)	No. of Petals/flower (cm)	Corolla tube length (cm)
Line 1	0.316	1.413	5.000	2.196
Line 2	0.664	1.636	8.160	1.568
Line 4	0.812	1.436	7.360	1.632
Line 5	0.264	0.754	6.930	1.793
Line 6	0.594	2.254	6.600	2.540
Line 7	1.002	1.120	34.200	0.860
Line 8	1.140	2.372	14.160	1.664
Line 9	0.944	1.532	7.700	1.652
Line 11	0.718	1.600	7.820	1.490
Line 12	0.696	1.636	7.180	1.712
CD (5%)	0.061	0.234	1.916	0.206
CV	6.665	11.555	14.232	9.550

Due to the advent of cut flowers and impact of Western culture, the demand and popularity for traditional flowers like jasmine has come down in the state of Goa. So an attempt was made to collect, conserve and evaluate Goa's precious local jasmine

germplasm at ICAR Research Complex for Goa. A total of eleven local accessions of Jasmine comprising of three different *Jasminum species viz.*, *Jasminum sambac*, *Jasminum grandiflorum* and *Jasminum auriculatum* are being conserved in the Institute's germplasm bank. During the current season, six more new accessions were collected from Bardez, Palye, Sirigao, and Ponda for adding to the existing Germplasm Bank.

## Crossandra

Crossandra is an important commercial loose flower crop belonging to the family Acanthaceae. The flowers are commonly used for hair adornment. Though not fragrant, flowers are very popular because of its attractive bright colour, light weight and good keeping quality. These are used for making garland, either alone or in combination with jasmine flowers. Using Crossandra flowers in combination with jasmine is becoming increasingly popular in India, particularly in southern parts, because the jasmine flowers provide colour contrast and the desired fragrance. An attempt was made to collect and conserve Goa's local germplasm of crossandra at the institute which can be useful in further crop improvement programmes. Seeds of five different types of crossandra *viz.*, dark red, yellow, orange, dark orange and light orange were collected from different parts of Goa *viz.*, Bhutwadi, Saligao, Palye, Kodar, Sirigao and Mapusa.







## Animal Sciences

**Project : Characterization of Natural Microflora from Fermented Cashew Apple Juice and Cashew Apple Waste and its Utilization (PI: S.B. Barbuddhe)**

### Characterization of microflora from fermented cashew apple juice for optimum yield of distillate and biodegradation of cashew apple waste

#### Objectives

- To isolate different yeast involved in natural fermentation of cashew apple juice and waste
- To utilize characterized strains for fermentation under laboratory conditions
- To biodegrade the cashew apple waste in controlled conditions employing the characterized strains.

#### Methodology

A total of 17 distillation units were visited to see the method of fermentation and distillation used for feni making. A total of 23 samples of cashew apple were also collected. The naturally fermented cashew apple juice samples were collected and distilled in the laboratory. The natural microflora was isolated using sabouraud's agar (Fig). The yeasts were characterized by PCR. Yeast were identified by sequencing 26s rDNA region. Samples of cashew apple waste collected from distilleries. The natural flora from the waste was isolated and characterized.

A total of 34 samples of naturally fermented juice were collected from different places. The samples were distilled in the laboratory. The yield of distillate was recorded.

The cashew apple waste samples were biodegraded with different yeasts isolated. The proximate analysis of the cashew apple waste samples was performed. The samples were incubated at room temperature for 4 and 8 days by inoculating the characterized yeasts. The samples were then subjected to crude fibre, ether extract and ash estimation.

#### Results

The predominant yeasts identified were *Saccharomyces cerevisiae*, *Pichia species* and *Issatchenkia orientalis*. Other yeasts species isolated



Morphological diversity among yeasts isolated from fermented cashew apple juice

were *Candida ethanolica*, *Lachancea fermentati* and *Pyrenochaeta nobilis*.

The predominant yeasts identified from cashew apple waste were *Saccharomyces cerevisiae*, *Pichia species* and *Issatchenkia orientalis*. The cashew apple waste samples were biodegraded with different yeasts isolated. The proximate analysis of the cashew apple waste samples was performed.

Twenty one isolates found to be from *Issatchenkia spp.*, 15 were *Pichia spp.*, 5 were of *Saccharomyces spp* and 7 were other yeast spp. The yield feni varied from 4.33 to 19.66 % with an average yield of 13.94 %. The values of the proximate components in biodegraded CAW varied, crude fibre from 10.94 to 11.52, ether extract from 1.99 to 3.93 and ash from 2.44 to 3.09 %.

#### Conclusions

It was found that the process of feni making is highly traditional except at one location. The process for extraction of juice is not hygienic. Use of tin or iron containers for storing of juice during fermentation process leaves blackening of the juice. The predominant yeasts identified were *Saccharomyces cerevisiae*, *Pichia species* and *Issatchenkia orientalis*. The yield of feni varied from samples collected from different places.





**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 probiotic and yeast supplementation on production performance of Vanaraja laying hens**

**Objective**

- To study the effect of dietary supplementation of Improval (mixture of probiotic, *Lactobacillus sporogenes*, 5X10<sup>7</sup> cfu/g and yeast, *Saccharomyces cerevisiae*, 1.5X10<sup>8</sup> cfu/g) in Vanaraja laying chickens.

**Methodology**

An experiment was conducted to study the effect of dietary supplementation of Improval (mixture of probiotic, *Lactobacillus sporogenes*, 5X10<sup>7</sup> cfu/g and yeast, *Saccharomyces cerevisiae*, 1.5X10<sup>8</sup> cfu/g, Cadila Health Care Ltd., Ahmadabad, India) on performance of Vanaraja laying chickens during a period of 14 weeks. 51 weeks old, 60 laying hens were randomly distributed into 5 equal groups (duplicated into 4 groups of 3 laying hens

Deoiled rice bran, 15.4%, Di-calcium phosphate, 1.5%, Limestone, 9.12%, Common salt, 0.5%, Ventrimix, 0.01%, Ventribee, 0.03%, Mineral mix., 0.15%. The laying hens were fed each of these diets ad libitum. The standard management practices were followed in rearing the layers throughout the experimental period. Data were recorded on weekly feed intake, daily egg production and egg weight. The egg quality parameters like shape index, shell thickness and shell percent were recorded once in a week. The data pertaining to various parameters were analysed statistically.

**Results**

Supplementation of probiotics and yeast did not affect the egg production and feed conversion efficiency. Feed intake was decreased (P<0.05) due to addition probiotics and yeast @ 1.5 or 2.0 g/kg diet. The egg weight, shell thickness, shell per cent, albumen and yolk per cent increased (P<0.05) due to

**Table. Effect of probiotic and yeast supplementation on the performance and egg components of Vanaraja laying hens**

Parameters	T <sub>0</sub>	T <sub>0.5</sub>	T <sub>1.0</sub>	T <sub>1.5</sub>	T <sub>2.0</sub>	SEM
<b>Performance</b>						
Egg Prod. (Dozen)	5.69	5.52	5.27	5.46	5.48	0.256
Egg Wt. (g)	55.60 <sup>a</sup>	55.17 <sup>a</sup>	55.36 <sup>a</sup>	56.57 <sup>ab</sup>	57.70 <sup>b</sup>	0.320
Egg Shell	0.352 <sup>c</sup>	0.370 <sup>bc</sup>	0.370 <sup>c</sup>	0.380 <sup>a</sup>	0.393 <sup>a</sup>	0.004
Feed Intake (Kg)	11.18 <sup>c</sup>	11.10 <sup>c</sup>	10.99 <sup>b</sup>	10.87 <sup>a</sup>	10.98 <sup>b</sup>	0.026
Feed efficiency	1.971	2.015	2.087	2.000	2.007	0.026
Shape Index	72.77 <sup>a</sup>	75.33 <sup>b</sup>	73.33 <sup>a</sup>	77.03 <sup>c</sup>	75.70 <sup>c</sup>	0.452
<b>Egg Components</b>						
Egg contents	87.38	88.40	87.81	86.88	87.66	0.219
Moisture	74.77	74.78	74.32	73.80	74.30	0.160
Yolk	33.95 <sup>c</sup>	33.42 <sup>bc</sup>	31.68 <sup>a</sup>	32.32 <sup>ab</sup>	31.55 <sup>a</sup>	0.314
Albumen	53.43 <sup>a</sup>	54.79 <sup>ab</sup>	55.59 <sup>ab</sup>	54.56 <sup>ab</sup>	56.37 <sup>b</sup>	0.361
Shell (%)	11.20 <sup>a</sup>	12.30 <sup>b</sup>	12.30 <sup>b</sup>	12.80 <sup>b</sup>	12.27 <sup>b</sup>	0.157

Means bearing different superscripts in a column differ significantly (P<0.05)

each) in wiremesh floored cages. Five experimental diets were formulated by supplementing 0, 0.5, 1.0, 1.5 and 2.0 g of improval/Kg diet to the control diet. The control diet was composed of ground maize, 48%, soybean meal, 25%,

probiotic and yeast supplementation @ 1.5 or 2.0g/ Kg diet. Highest net profit was recorded in laying hens fed probiotics and yeast @ 1.5g/Kg diet (₹ 23.7/-) compared to that of control diet (₹ 20.95/).







**Table . Cost benefit analysis**

Parameters	T <sub>0</sub>	T <sub>0.5</sub>	T <sub>1.0</sub>	T <sub>1.5</sub>	T <sub>2.0</sub>
Feed intake (Kg)	11.18	11.10	10.99	10.87	10.98
Cost of feed (₹)	171.95	171.50	170.57	169.46	171.95
Cost of bird (₹)	80	80	80	80	80
Cost of lab & electricity (₹)	7.5	7.5	7.5	7.5	7.5
Total cost (₹)	259.45	259.00	258.07	256.96	259.45
Wt. of bird (Kg)	2.194	2.191	2.281	2.338	2.233
Income from sale of bird (₹)	109.7	109.6	114.1	116.9	111.7
Income from sale of eggs (₹)	170.7	165.6	158.1	163.8	164.4
Total income (₹)	280.4	275.2	272.2	280.7	276.1
Net profit/bird (₹)	20.95	16.20	14.13	23.74	16.65



*Feeding trial on probiotic and yeast on Vanaraja laying hens*

### Conclusion

Supplementation of probiotic and yeast @ 1.5-2.0 g/Kg diet in Vanaraja laying hens is beneficial in terms of better egg size, shape, stronger shell, increased albumen and more net profit.

### Effect of probiotic and yeast (improval) on growth, carcass characteristics and economics of production in broiler chickens

#### Objective

- To assess the performance, carcass characteristics and organ weights in commercial broiler chickens from 1st day to 6 week of age.

#### Methodology

One hundred and twenty 1-day old commercial Vencobb broiler chicks were received from the local hatchery and distributed randomly in to four groups of 30 chicks each with 3 replicates in each group. Two basal diets for starter and finisher phases were formulated

as per the standard nutrient requirements. Four diets each in starter and finisher phases were prepared by supplementing 0, 0.5, 1.0 and 1.5 g improval (mixture of probiotics, *Lactobacillus sporogenes*, 5X10<sup>7</sup> cfu/g and yeast, *Saccharomyces cerevisiae*, 1.5X10<sup>8</sup> cfu/g, Cadila Health Care Ltd., Ahmadabad, India ) per kg of basal diet. The CP contents were 22.8% and 19.9% and ME contents were 2900 Kcal/Kg and 3000 Kcal/Kg for starter and finisher diet, respectively. The proximate composition of starter and finisher diets was estimated. Three replicates from each group were fed on each one of the experimental diets. The diets were fed ad libitum from 1 to 42 days of age. Replicate-wise body weight and feed intake was recorded at weekly intervals. The feed conversion ratio was calculated as the feed intake per weight gain. Mortality was recorded daily. On day 42, three birds per treatment (2 male and 1 female) were killed by cervical dislocation and eviscerated weight, weight of cut up part yields, abdominal fat and organs viz., liver, spleen, heart and bursa of Fabricius were recorded. The relative weight of the same were calculated as [Weight of respective parts/eviscerated weight X 100]. Data were subjected to statistical analysis.



*Feeding trial on effect of probiotics and yeast in broilers*





## Results

Body weight gain and feed efficiency of broilers fed diet supplemented with probiotics and yeast mixture @1g/Kg were significantly ( $P<0.05$ ) higher than those recorded on control diet. Significantly

content was reduced significantly due to probiotics and yeast supplementation @ 1g/kg diet. The relative weight of caeca was significantly increased due to addition of probiotics and yeast in the diet.

**Table. Effect of probiotic and yeast feeding on body weight, feed consumption and feed efficiency of broilers**

Treatments	T <sub>0</sub>	T <sub>0.5</sub>	T <sub>1.0</sub>	T <sub>1.5</sub>	SEM
Body weight gain (g)	1893.0 <sup>a</sup>	1918.8 <sup>a</sup>	1968.3 <sup>b</sup>	1916.0 <sup>a</sup>	9.33
Feed consumption (g)	3604.7	3578.2	3592.3	3610.8	7.93
Feed conversion ratio	1.904 <sup>b</sup>	1.865 <sup>b</sup>	1.825 <sup>a</sup>	1.885 <sup>b</sup>	0.010
Expenditure/bird (₹)	100.1 <sup>a</sup>	99.4 <sup>ab</sup>	100.1 <sup>ab</sup>	100.6 <sup>b</sup>	0.19
Income/bird (₹)	155.5 <sup>a</sup>	157.5 <sup>a</sup>	161.4 <sup>b</sup>	157.2 <sup>a</sup>	0.74
Net profit (₹)	55.3 <sup>a</sup>	58.1 <sup>b</sup>	61.3 <sup>c</sup>	56.3 <sup>ab</sup>	0.77
Benefit cost ratio	1.55 <sup>a</sup>	1.59 <sup>bc</sup>	1.61 <sup>c</sup>	1.57 <sup>ab</sup>	0.008

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

**Table. Effect on carcass characteristics and organ weights**

Treatments	T <sub>0</sub>	T <sub>0.5</sub>	T <sub>1.0</sub>	T <sub>1.5</sub>	SEM
Eviscerated yield (%)	63.97 <sup>a</sup>	64.40 <sup>a</sup>	66.97 <sup>b</sup>	64.97 <sup>a</sup>	0.38
Cut up part yields					
Breast	27.75 <sup>a</sup>	27.64 <sup>a</sup>	30.85 <sup>b</sup>	30.47 <sup>b</sup>	0.46
Thigh	17.77 <sup>b</sup>	16.14 <sup>a</sup>	16.49 <sup>a</sup>	16.12 <sup>a</sup>	0.24
Drumstick	15.86	15.23	15.28	15.28	0.12
Back	18.52 <sup>bc</sup>	19.27 <sup>c</sup>	17.33 <sup>a</sup>	17.53 <sup>ab</sup>	0.27
Wing	7.42	7.58	7.69	7.44	0.05
Neck	4.53	4.39	4.26	4.32	0.07
Abd. fat	1.934 <sup>b</sup>	1.669 <sup>a</sup>	1.709 <sup>a</sup>	1.652 <sup>a</sup>	0.036
Caecal wt.	1.044 <sup>d</sup>	1.004 <sup>c</sup>	0.917 <sup>a</sup>	0.970 <sup>b</sup>	0.015
Organ weights					
Liver	3.080 <sup>a</sup>	3.567 <sup>b</sup>	4.000 <sup>c</sup>	3.500 <sup>b</sup>	0.108
Heart	0.752 <sup>a</sup>	0.811 <sup>b</sup>	0.823 <sup>b</sup>	0.853 <sup>b</sup>	0.012
Gizzard	3.426 <sup>b</sup>	2.952 <sup>a</sup>	3.096 <sup>a</sup>	3.069 <sup>a</sup>	0.059
Giblets	7.257 <sup>a</sup>	7.330 <sup>a</sup>	7.920 <sup>b</sup>	7.422 <sup>a</sup>	0.102
Spleen	0.240 <sup>a</sup>	0.246 <sup>a</sup>	0.293 <sup>b</sup>	0.234 <sup>a</sup>	0.007
Bursa of Fab.	0.283 <sup>a</sup>	0.321 <sup>b</sup>	0.337 <sup>b</sup>	0.317 <sup>b</sup>	0.007
Thymus	1.689	1.722	1.726	1.749	0.011

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

higher dressing percentage, breast and back yield, were observed in chicks fed diet added with 1g/kg improvial. The relative weights of liver, heart, spleen and bursa were higher for chicks fed probiotics and yeast mixture @ 1g/Kg diet. The abdominal fat

## Conclusion

Supplementation of probiotic and yeast mixture @ 1g/Kg diet to the broiler diets improved the body weight gain, feed efficiency, carcass traits, organ weights, leanness of meat and profit margin.







## Project : Utilisation of Palm Oil and Other Unconventional Feed Resources for Efficient Poultry Production (PI: B. K. Swain)

### Effect of feeding brewers' dried grain (BDG) on the performance of Vanaraja chicks

#### Objective

- To evaluate brewers dried grain in Vanaraja chicks in terms of their performance, nutrient utilization, carcass traits and economics of production.

#### Methodology

Brewery waste was collected from the local Brewery and sun dried by spreading on polythene sheet. After complete drying this was designated as brewers' dried grain (BDG). Ninety six, 3 weeks old Vanaraja chicks were distributed randomly in to 3 dietary groups with four replicates of eight chicks each. Three diets were formulated by replacing maize, soybean meal and deoiled rice bran by incorporating 0, 10 and 20 % level of brewer's dried grain (BDG) to the control diet (Table). The proximate composition was analysed. Four replicates from each group were



Feeding of Brewer's dried grain (BDG) in Vanaraja Chicks

fed on each one of the experimental diets. The diets were fed ad libitum from 4 weeks to 9 weeks of age. Weekly body weight and daily feed consumptions were recorded from 4th to 9 weeks of age. The feed conversion ratio was calculated as the ratio between the feed intake and body weight. At the end of 9 weeks one bird from each replicate/3 birds per treatment were slaughtered after 4 hours of feed withdrawal and eviscerated weight, weight of cut up part yields, abdominal fat and organs viz., liver, spleen and heart were recorded. The relative weight of the same were

calculated as [Weight of respective parts/eviscerated weight X 100]. Data were subjected to statistical analysis.

Table. Composition (%) of experimental diets

Ingredients	T <sub>0</sub>	T <sub>10</sub>	T <sub>20</sub>
Yellow ground maize	50.00	46.00	43.00
Soybean meal	28.00	25.00	21.00
Deoiled ricebran	19.00	16.00	13.00
Brewers' dried grain	--	10.00	20.00
Dicalcium Phosphate	1.11	1.28	1.17
Ground Limestone	1.29	1.15	1.21
Common salt	0.50	0.50	0.50
L-Lysine HCl	--	--	0.03
DL-Methionine	0.07	0.07	0.06
Vitamin Mixture <sup>a</sup>	0.04	0.04	0.04
Mineral Mixture <sup>b</sup>	0.15	0.15	0.15
Chemical Composition (%) Analyzed			
Dry matter	89.9	90.3	90.9
Crude protein	20.80	21.40	21.50
Crude fat	3.24	2.57	2.26
Crude fibre	6.78	8.26	9.24
Total Ash	7.80	7.65	7.56
Acid insoluble ash	1.49	1.47	1.55

#### Results

Feeding of BDG at 20% level did not affect (P<0.05) the body weight gain of vanaraja chicks at 9 weeks of age (Table). The feed consumption of chicks increased (P<0.05) due to incorporation of BDG at 10 and 20% level. Feed conversion of chicks (FCR) of chicks fed diet incorporated with 10% BDG was similar to those fed control diet. FCR of chicks fed 20% BDG increased ((P<0.05). The fat retention of chicks given 10 and 20% BDG diets increased (P<0.05). The eviscerated yield % increased (P<0.05) in chicks fed 10 and 20% BDG compared to control group (Table).





**Table. Effect of brewers' dried grain on performance and nutrient utilization**

Parameters	T <sub>0</sub>	T <sub>10</sub>	T <sub>20</sub>
Body weight gain (g)	1065.27	1063.87	1043.59
Feed consumption (g)	3086.2 <sup>a</sup>	3184.7 <sup>b</sup>	3177.8 <sup>b</sup>
Feed conversion ratio	2.873 <sup>a</sup>	2.995 <sup>a</sup>	3.046 <sup>b</sup>
Nutrient retentions (g/bird/3d)			
Dry matter	127.1	126.3	125.4
Protein	23.72	23.02	24.39
Fat	5.63 <sup>a</sup>	4.52 <sup>b</sup>	4.24 <sup>b</sup>

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

The relative weight of drumstick decreased (P<0.05) when BDG was incorporated at 20 % level in the diet.

**Table. Effect of feeding brewers' dried grain on carcass traits and organ weights**

Parameters	T <sub>0</sub>	T <sub>10</sub>	T <sub>20</sub>
Eviscerated yield (%)	63.9 <sup>b</sup>	66.3 <sup>a</sup>	65.8 <sup>a</sup>
Breast	22.4	20.9	21.8
Thigh	15.83	16.03	15.23
Drumstick	16.20 <sup>a</sup>	16.43 <sup>a</sup>	14.87 <sup>b</sup>
Back	21.1	20.6	22.4
Wing	8.83 <sup>ab</sup>	9.43 <sup>a</sup>	9.50 <sup>b</sup>
Neck	4.00 <sup>b</sup>	4.97 <sup>a</sup>	5.07 <sup>a</sup>
Abd. fat	2.047 <sup>a</sup>	1.711 <sup>b</sup>	1.676 <sup>b</sup>
Caecal wt.	1.963 <sup>a</sup>	1.611 <sup>b</sup>	1.563 <sup>b</sup>
Liver	3.10	2.93	3.03
Heart	0.787	0.834	0.820
Gizzard	2.73 <sup>b</sup>	3.30 <sup>a</sup>	3.50 <sup>a</sup>
Spleen	0.276	0.261	0.278
Thymus	0.628 <sup>c</sup>	0.753 <sup>b</sup>	0.830 <sup>a</sup>

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

The relative weights of wing and neck increased (P<0.05) at both the levels of BDG in diet. Relative weights of abdominal fat and caeca reduced (P<0.05) in chicks fed BDG incorporated diets. Organ weights i.e. gizzard and thymus increased (P<0.05) due to incorporation of BDG at both levels in the diet of chicks. Highest net profit was recorded in chicks fed diet containing 20% BDG (Table).

**Table. Cost benefit analysis**

	T <sub>0</sub>	T <sub>10</sub>	T <sub>20</sub>
Feed consumed per 100 birds (Kg)	308.6	318.5	317.8
Cost of feed/Kg (₹)	16.24	14.94	13.46
Total Cost of feed (₹)	5011.7	4758.4	4277.6
Cost of 100 chicks (₹)	900	900	900
*Total cost (₹)	6911.7	6658.4	6177.6
Weight of 100 birds	122.2	122.1	120.0
Income from sale of birds (₹)	8520	8512	8352
Misc. income (₹)	321.6	328.2	333.1
Total income (₹)	8841.6	8840.2	8685.1
Net profit (₹)	1929.9	2181.8	2507.5
Profit (%)	27.92	32.77	40.59

\*Includes cost of electricity, medicine and labour

### Conclusion

Brewers' dried grain can be incorporated up to a level of 20% in the diet of Vanaraja chicks by replacing maize, soybean meal and deoiled rice bran partially for higher eviscerated yield, better nutrient utilization and higher profit margin.







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

### Objective

- To isolate *Salmonella* and *Listeria* from capture and culture fisheries environment and analysis of physico-chemical parameters in culture environment

### Methodology

A total of 121 fish samples, 34 swab samples and 10 pond water samples were analysed for different parameters. The fish samples were analysed for isolation using specific media. For isolation of *Salmonella sp* samples were enriched in tetrathionate broth and incubated at 37°C for 12 h then each of samples was streaked on Brilliant green agar plates and further incubated for 24 h at 37°C. Peculiar colonies suspected for *Salmonella* were subcultured and subjected to further various biochemical characterization. Isolation of *Listeria* from the samples was attempted as per ISO 11290-1, 2. The samples (approximately 5-10 gm each) were inoculated into 45 ml of half Fraser broth and incubated for enrichment of *Listeria* at 37°C for 18-24 h. Further enrichment of *Listeria* was carried by inoculating 10 ml of full Fraser broth supplemented with acriflavin and nalidixic acid with 0.1 ml of turbid broth of half Fraser broth. Inoculated full Fraser broth was incubated further for 24-36 h at 37°C. A loopful of enriched broth of full Fraser broth was streaked directly on PALCAM agar for selective isolation of listerial colonies (ISO 11290-1, 2). The inoculated agar plates were incubated at 37°C for 48 h.

The isolated pinpoint grayish-green colonies surrounded by black zone of esculin hydrolysis were presumed as *Listeria*. These colonies were further purified on PALCAM agar and stored in refrigerated conditions in BHI broth. Morphologically typical colonies were verified by Gram's staining, catalase reaction, tumbling motility at 20–25°C, methyl red-Voges Proskauer (MR-VP) reactions, CAMP test with *S. aureus* and *R. equi*, nitrate reduction, and fermentation of sugars (rhamnose, xylose, and α-methyl-D-mannopyranoside). The isolates were further tested for their phospholipase C activity.

### Results

Thirteen *Listeria* and eleven *Salmonella* strains were isolated. The water samples were analysed for coliform count, nitrate, nitrites, salinity, dissolved oxygen, temperature and pH. The coliform counts varied from 7 to 1600 /100 ml. The values for temperature, pH, dissolved oxygen and salinity varied from 28 to 30°C, 5.84 to 7.42, 1.1275 to 4.2282 ml/L and 0.354 to 1.418, respectively.

### Conclusions

The prevalence of pathogens is more in areas handled unhygienically such as landing and transportation. The water samples showed higher coliform counts. Prevalence of *Salmonella sp.* and *L. monocytogenes* in fresh seafood is of significance as it may contaminate and persist in the processing environment.

## Project : Impact of Microclimatological Changes on Livestock Production and Ameliorative Measures through Managerial Intervention (PI: S K Das)

### Effect of microclimatological changes on milk production of cow, growth of rabbit and pig

### Objective

- To quantify effect of different microclimatological changes on livestock production.

### Methodology

Five milking cows of each of three breeds in Sahiwal, Deoni and CB. Six growing pigs of GL, LWY and CB, twenty growing rabbits each of NZW, SC, Bb and GG were considered randomly for the experiment. Milk production data and live wt. of pig, rabbit were taken at certain interval. Daily all the meteorological data were recorded. Data were analysed statistically by SPSS programme.





## Results

Multiple regression analysis revealed that in Sahiwal cow daily change of relative humidity had highly significant ( $P < 0.01$ ) effect on daily milk yield, in Deoni cow daily change of air temperature, relative humidity and maximum temperature had highly significant effect on daily milk yield and in Crossbred cow daily change of relative humidity and maximum temperature had highly significant effect on daily milk yield.

Daily milk yield in Sahiwal cow was decreased by 16 ml ( $P < 0.01$ ), 8 ml ( $P > 0.05$ ) and 28 ml ( $P > 0.05$ ) per unit increase of relative humidity, THI and maximum temperature respectively. In Deoni cow daily milk yield was decreased by 18 ml ( $P < 0.01$ ), 13 ml ( $P > 0.05$ ) and 181 ml ( $P < 0.01$ ) per unit increase of relative humidity, THI and

Monthly average milk yield of cow was reduced by 1.002 l ( $P > 0.05$ ), 1.136 l ( $P > 0.05$ ) and 1.769 l ( $P > 0.05$ ) in Sahiwal, Deoni and Crossbred cow per unit increase of monthly average air temperature respectively. So the effect of air temperature was most pronounced on CB cows. Overall monthly average milk yield was reduced by 1.639 l ( $P > 0.05$ ), 20 ml ( $P > 0.05$ ) and 185 ml ( $P > 0.05$ ) per unit increase of monthly average air temperature, monthly average relative humidity and monthly average THI respectively. So, the effect of average air temperature was highest.

In cattle shed of our institute in the year 2010, highest air temperature was observed in the month May ie 30.46 0 C with an average value of 27.64 0 C. Highest THI (86.56) and highest minimum temperature (28.25 0 C) were also found in the month

**Table. Effect of micro climatological changes on daily milk yield of cows**

$$\begin{aligned}
 Y_1 &= 4.198 + 0.064 X_1 - 0.016 ** X_2 - 0.008 X_3 - 0.028 X_4 - 0.060 X_5 \\
 Y_2 &= 1.698 + 0.284 ** X_1 - 0.018 ** X_2 - 0.013 X_3 - 0.181 ** X_4 - 0.037 X_5 \\
 Y_3 &= 13.240 + 0.091 X_1 - 0.022 * X_2 - 0.019 X_3 - 0.316 ** X_4 + 0.072 X_5 \\
 Y_4 &= 5.670 + 0.010 X_1 - 0.019 ** X_2 - 0.014 X_3 - 0.144 ** X_4 + 0.079 X_5
 \end{aligned}$$

Where  $Y_1$  = Daily Milk Yield in Sahiwal cows,  $Y_2$  = Daily Milk Yield in Deoni cows,  $Y_3$  = Daily Milk Yield in Cross bred cows,  $Y_4$  = Overall Daily Milk Yield in cows.

$X_1$  = Daily Air Temperature,  $X_2$  = Daily Relative Humidity,  
 $X_3$  = Daily Temperature Humidity Index,  $X_4$  = Daily Maximum Temperature,  
 $X_5$  = Daily Minimum Temperature.  
 \* =>  $P < 0.05$ , \*\* =>  $P < 0.01$

maximum temperature respectively. In Crossbred cows daily milk yield was reduced by 22 ml ( $P < 0.05$ ), 19 ml ( $P > 0.05$ ) and 316 ml ( $P < 0.01$ ) per unit increase of relative humidity, THI and maximum temperature. When data were analyzed as a whole considering all the cows of all the breeds together it was observed that overall daily milk yield was reduced by 19 ml ( $P < 0.01$ ), 14 ml ( $P > 0.05$ ) and 144 ml ( $P < 0.01$ ) per unit increase of relative humidity, temperature humidity index and maximum temperature respectively.

The overall weekly average milk yield of cows was reduced by 34 ml ( $P > 0.05$ ), 78 ml ( $P > 0.05$ ) and 333 ml ( $P > 0.05$ ) per unit increase of weekly average relative humidity, weekly average THI and weekly average maximum temperature respectively.

May. Overall mean value of THI and minimum temperature in the year 2010 were recorded to be 79.38 and 24.56 0 C respectively. Maximum relative humidity was observed in the month July (91.41 %) with an average value of 82.17 %. Highest maximum temperature was observed in the month March (32.97 0 C) with an average value of 30.79 0 C.

The change of both maximum and minimum temperature had highly significant ( $P < 0.01$ ) effect on live weight of all the four breeds of rabbit. Maximum reduction of fortnightly live weight was observed in GG rabbit (116.45 g) followed by BB (101.43 g), SC (93.98 g) and NZW (85.90 g) rabbit per unit increase of maximum temperature. However, per unit rise of minimum temperature, maximum reduction of live weight was recorded in GG (85.29







g) followed by BB (77.89 g), NZW (68.64 g) and SC (62.92 g) rabbit.

None of the micro environmental components had significant ( $P > 0.05$ ) effect on live weight of pigs in any breeds. However, weekly air temperature had negative influence on weekly live weight which was reduced by 4.26, 3.89 and 5.26 kg in a week per degree centigrade rise of air temperature in a week in Large White Yorkshire (LWY), Goa Local (GL) and Cross bred (CB) pigs respectively.

### Conclusions

The effect of change of relative humidity, temperature humidity index and maximum temperatures were more pronounced on Cross

bred cows than that of Deoni and Sahiwal cows. Between the two indigenous cows effects were more pronounced on Deoni breed than Sahiwal breed of cow indicating maximum heat tolerance of Sahiwal cow. Effect of micro environmental changes on rabbit revealed that adverse effect of both maximum and minimum temperature was most pronounced on Gray Giant and Black Brown rabbit indicating maximum adaptability of New Zealand White and Soviet Chinchilla rabbit. Impact of micro environmental changes on the live weight of pig revealed that influence of change of average air temperature was most pronounced on Cross Bred pigs followed by Large White Yorkshire and Goa Local pigs.

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

### Status of dairy farmers and dairy animals in Goa

#### Objectives

- To study the status of dairy farmers and dairy animals in Goa
- To find out the availability of feeds and feeding practices of dairy animals in Goa.

#### Methodology

In the survey work, a total of 66 farmers were selected randomly from different talukas of Goa, which included 1170 dairy animals. A comprehensive questionnaire was prepared and information was collected through personal visit. The socio-economic status of the farmers was assessed by number of milch animals possessed and land holding size. Based on the number of milch animals viz. < 5, 5-<10, 10-<20 and 20 or above, the farmers were divided as marginal, small, medium and large dairy farmers, respectively. However, the farmers were grouped as marginal, small, medium and large farmers based on the land holding size viz., 0.01-1.00 ha, 1.01-2.00 ha, 2.01-4.00 ha and > 4.00 ha, respectively. The wet average of the dairy herd was calculated as total milk production divided by the total number of milking animals; while the herd average of the dairy herd was calculated as

total milk production divided by the total number of milking plus dry animals. During the visits, feed samples were collected and analyzed for proximate principles. The data were compiled and analyzed statistically to draw the inference.

#### Results

##### Status of dairy farmers and dairy animals

In Goa, 90.9% dairy farmers had concrete housing and only 9.1% had mud housing for their dairy animals.



Concrete housing

24.2% and 21.2% of the dairy farmers of the state possessed chaff cutter and milking machine, respectively.







*Mud housing*

Only 4.6% of the dairy farmers had generator set. As the dairy farming is mostly integrated with agricultural or horticultural activities, 40.9% of the dairy farmers had biogas plant.



*Chaff cutter*

Only 84.8%, 83.3% and 54.5% of the dairy farmers were aware of feed quality, mineral mixture feeding and common salt feeding. The advantage of fodder feeding, hay making and silage making was known by 77.3%, 24.2% and 10.6% of the dairy farmers, respectively. Only 4.5% and 3.0% of the



*Milking machine*

dairy farmers were aware of the bypass protein and bypass fat feeding technologies, respectively.

The concept of total mixed ration was known by only 16.7% of the dairy farmers. Only 33.3% of the dairy farmers had knowledge on calf starter. Only 15.2%, 4.5% and 4.5% of the dairy farmers were aware of urea molasses mineral block, urea ammoniation of crop residues and complete feed block feeding.



*Biogas plant in horticulture based dairy farming*

During the study, the total number of cattle population was 1170. The number of indigenous cows was very less i.e. only 2.05% of the total cattle population. The population of crossbred cows was 50.42% of the total animals. Very few dairy farmers were keeping female buffaloes (7.95% of the total cattle population) for milk production. The total milch animals and dry animals constituted 43.93 and 15.64, percent of the total cattle population, respectively. The wet average (total milk production/ total number of milch animals) was 7.62 kg/ day while the herd average (total milk production/ total number of milch and dry animals) was 5.79 kg/ day.

The 1<sup>st</sup> calving age of cows and buffaloes were observed as 26.5 month and 46.3 month, respectively. The calving interval of cows and buffaloes were 14.9 month and 17.0 month, respectively. 22.7% and 27.3% of the dairy animals have anoestrus and repeat breeding problems.

### **Availability of feeds and feeding practices of dairy animals in Goa**

Only 24.2% of the dairy farmers were using exclusively purchased concentrate pellet while 1.5% of the dairy farmers were using exclusively homemade concentrate mixture. The physical composition of the home made concentrate mixture varies among the dairy farmers, which was generally 2-5 ingredients based. Generally, the home made concentrate mixture consisted of ground maize + rice bran/ wheat bran or ground maize + cotton seed cake







*Fodders grown by dairy farmers*

or rice bran/ wheat bran + cotton seed cake. Most of the dairy farmers (74.2%) used purchased concentrate pellet mixed with only ground maize or homemade concentrate mixture in the ratio of 1:1-4:1. There was variation in the chemical composition of the concentrate feeds. The CP content of the purchased concentrate pellet ranged from 17.32 to 20.78% with mean value of 18.75 %, while the CF ranged from 8.06 to 12.07% with mean value of 9.37%. The CP content of the home made concentrate mixture ranged from 9.70 to 19.01% with mean value of 14.24%, while the CF ranges from 3.89 to 21.04% with mean value of 11.76%. Only 47% of the dairy farmers were cultivating fodder for feeding of the

fed to the dairy animals were green karad grass and mixed grasses.

The nutritive values of the karad grass and mixed grasses were lower than the cultivated fodders. The mean values of the CP content of the karad grass and mixed grasses were 4.93% and 8.12%, respectively. Very few farmers were using subabul tree leaves and sugarcane tops for animal feeding. The CP % of the subabul tree leaves and sugarcane tops were 26.29% and 6.87%, respectively.

The dry roughages used for feeding of the dairy animals were paddy straw, dry karad grass and jowar straw (kadaba kutti) either exclusively or in combination of two.



*Feeding naturally grown Karad grass during monsoon only*

dairy animals, while only 53% of the dairy farmers feed naturally grown grasses to their dairy animals during monsoon only

The cultivated fodders were mostly non-leguminous fodders (Hybrid Napier). The CP content of the cultivated fodder varied from 6.67 to 19.63% with mean value of 11.42% while the CF content varied from 21.11 to 41.42% with mean value of 32.90%. During the monsoon seasons, the grasses

Paddy straw, Dry karad grass and jowar straw (kadaba kutti) were fed exclusively by 25.8%, 22.7%, and 21.2% dairy farmers, respectively. 13.6%, 10.6% and 6.1% of the dairy farmers were feeding their dairy animals dry karad grass + kadaba kutti, paddy straw + kadaba kutti and dry karad grass + paddy straw, respectively. The nutritive values of the dry roughages were very poor (low CP and high CF) and provided only bulk to the dairy animals. The CP%







*Paddy straw for feeding of dairy animals*



of paddy straw, dry karad grass and jowar straw (kadaba kutti) was 3.81, 2.68 and 3.88, respectively, while the CF% of paddy straw, dry karad grass and jowar straw (kadaba kutti) was 33.78, 44.68 and 34.14, respectively. Very few dairy farmers were

Only 16.7% of the dairy farmers were feeding un-conventional feeds to their dairy animals. The un-conventional feeds mostly used were brewery waste, arecanut sheath (stalk) and banana leaves.



*Naturally grown dry Karad grass*

Among the dairy farmers using un-conventional feeds, 63.6% were using brewery waste whereas, only 36.4% were using arecanut sheath (stalk) or banana leaves or both. The CP and CF contents of brewery waste varied from 17.8-25.2% and 18.1-19.4%, respectively. Dry arecanut sheath contained 3.4% CP, 39.2% CF and 7.2% condensed tannins. The CP% of banana leaves and stem was 19.1 and 4.1, respectively.

feeding their dairy animals maize stover and guar stovers, which were grown in their own fields. The CP content of maize stover and guar stover was 2.90% and 1.88%, respectively, while CF content was 42.45% and 35.92%, respectively.



*Fresh brewery spent grain for animal feeding*



*Storage of dry karad grass by farmers*

Only 47.0% of the dairy farmers were feeding their animals based on milk yield and 25.8% of the dairy farmers were feeding their animals based on the requirement of lactational stages. Exclusive stall feeding was practiced by 68.2% of the dairy farmers, while other allowed their animals to graze for 2-8 hours/ day with a mean value of 5.1 hour/ day. In general, the dairy animals were fed twice daily. In the morning, they were provided







with concentrate mixture during milking followed by grazing/ green fodder and then dry roughages. Similarly in the afternoon, concentrate mixture was fed during milking followed by green fodder and then dry roughages.

The concentrate mixture offered varied from 2-10 kg/ animal/ day in milch animals and 2-6 kg/ animal/ day in dry animals. During monsoon period, both milch and dry animals were offered 10-20 kg green karad grass/ animal/ day. However, the amount of cultivated fodder offered varied from 3.0-30.0 kg/ milch animal/ day and 3.0-15.0 kg/ dry animal/ day. The dry roughages available to both the milch and dry animals varied from 2-15 kg/ animal/ day. Few farmers offered brewery waste, areca nut sheath (stalk) and banana leaves 4-10 kg, 05-2.0 kg and 0.5-5.0 kg per animal per day.



*Drying of areca nut stalk for animal feeding*

### **Conclusion**

The farmers should be made aware of scientific feeding of their animals by using the local resources to improve their socio-economic status.

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

### **Production potential of fodder maize as intercrop with cashew**

#### **Objective**

- To study on the production potential of fodder maize as intercrop with cashew

#### **Methodology**

South African Tall fodder maize (*Zea mays L.*) was sown in line strips with spacing of 30 cm between the lines in the inter spaces with a five year old cashew (variety Goa-I). All the recommended packages of practices were followed for the fodder cultivation.

#### **Results**

In the total area of 0.238 ha (2378.5 sq m) of the cashew plot, the available inter space area for fodder maize cultivation was only 0.135 ha (1349.65 sq m). This indicated that in a cashew field, 56.72% of the total area could be utilized for fodder cultivation with intercrop approach. The total yield of the fodder maize on fresh basis was 2.13 tonnes (2, 128 kg) i.e. 15.78 tonnes/ ha, which is 3.63 tonnes/ ha on dry matter (DM) basis, indicating good potential for the crop cultivated.

The average DM (on fresh basis) of the fodder maize was 23.01%. The crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE) and total ash (TA) contents of the cultivated fodder maize were 10.67, 2.27, 25.92, 51.78 and 9.36, percent, respectively.



*African Tall fodder maize as intercrop with cashew*

### **Conclusion**

Fodder cultivation as intercrop with cashew is a good approach to meet the fodder scarcity for dairy production in the coastal region particularly for Goa as in cashew field approximately 57 per cent of the total area could be utilized for fodder production.





## Performance of dairy cows on fodder maize based ration

### Objective

- To find out the effect of feeding fodder maize as replacement of concentrate mixture on the performance of dairy cows

### Methodology

Ten dairy cows (avg. 276.80 kg BW; avg. milk yield 4.90 kg/day; avg. lactation number 3.5, avg. 113 lactation days) were divided into two groups i.e. Control Group (CG) and Treatment Group (TG) of five animals in each, based on body weight, lactation number, lactation days and daily milk yield to find out the effect of feeding fodder maize as replacement of concentrate mixture on the performance of crossbred cows. Randomly, animals of the CG were offered daily 4 kg concentrate mixture (CM) along with 1 kg fresh green fodder maize and ad lib. jowar straw (*Kadaba kutti*); while in the TG, half of the CM as offered in the CG was replaced by 20 kg fresh green fodder maize and thus, animals in the TG were offered 2 kg CM along with 20 kg green maize and ad lib. jowar straw for a period of 45 days.

### Results

The intake of dry matter (DM) fodder maize in the TG was higher than the CG; while the intake of jowar straw was higher ( $P < 0.05$ ) in the CG (9.11 kg/day) than the TG (4.80 kg/day). However, the total DM roughage intake (9.20 to 9.33 kg/day) was similar ( $P > 0.05$ ) in both the groups. The total DM intake in TG (13.20 kg/day) was higher ( $P < 0.05$ ) than the CG (11.33 kg/day). The roughage: concentrate ratio in the CG was higher ( $P < 0.05$ ) than the TG.

There was no difference ( $P > 0.05$ ) in the BW changes and BW gain of the animals between the groups. Similarly, the milk yield (4.69 to 4.72 kg/

day) and fat corrected milk (FCM) yield (4.00 to 4.28 kg/day) of the animals of the CG were similar ( $P > 0.05$ ) to the animals of the TG and not affected by the treatment. The milk compositions i.e. fat% (3.01 to 3.49) and solid not fat (SNF) content (8.51 to 8.88, %) of the milk of the animals of both the groups were within the normal range and similar ( $P > 0.05$ ).



Feeding of green fodder to lactating cows

### Conclusion

During feeding dairy cows yielding around five kg milk daily, one kg standard concentrate mixture could be replaced by ten kg good quality fresh green fodder without affecting the daily milk yield, provided that the bulk of the animal should be fulfilled by *ad lib.* roughage like jowar straw (*Kadaba kutti*).







## Fishery Science

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

### Objective

- To prepare a digitalized inventory of marine and inland aquatic and fisheries resources through collection of available secondary data.

### Methodology

To develop a dynamic and compatible information system using a backend and a scripting language to form a HTML web page. The information system is to be developed for providing adequate information on aquatic and fisheries resources of Goa. Secondary data will be collected, collated and uploaded into the database for easy access and retrieval. The system will also be designed in such a way data can be updated, modified or corrected periodically so that end users will get the latest and correct information on the aquatic and fisheries resources of Goa.

to PHP in the current version as there were some technical problems like image loading and retrieval in the PERL based previous version.

This web-based information system is an initiative taken to digitally document all the information available from secondary sources on various aquatic and fisheries resources of Goa. User can get instant information on marine and inland fisheries information and species-wise details of fisheries resources available in Goa region by using the system.

Some pages of the system are static and some are dynamic in nature. The system is linked to backend MySQL server with PHP scripting language. The system features comprehensive search based on common name, scientific name etc.. Upon clicking on the specific record, complete information of a



Web page of the digitalized database

### Results and Conclusions

Fisheries resources of Goa (FROG) database and web-based retrieval system was developed using scripting language PHP and the relational database, MySQL. The present system is an updation over the system developed in the previous year with the PERL and MySQL. Scripting language has been changed

selected species will be displayed to the user along with the image. System has the provision for all database manipulations like adding new records, updating records and deleting unwanted records.

As the scripting language was shifted from PERL to PHP, all data uploaded have to be uploaded again. Information on new and additional species has to be added.





# Agro- Eco- Tourism

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

## Objective

- To conduct a survey of key stakeholder groups to know the status of agro-eco tourism in Goa.

## Methodology

Appropriate linkages were developed with agripreneurs. Research instruments included stakeholder interviews. The existing agro-eco-tourism centers were surveyed using a survey proforma. A total of nine farmers were visited to collect information on various aspects including the facilities available, type of tourists visiting, type of cropping/farming systems, services offered, constraints and expectations from the government and ICAR institutes was collected. The secondary sources were reviewed to gather information on the following topics: Definition of agro-eco-tourism in existing scenario; characteristics of agro-eco-tourism products in other states; public policy for agro-eco-tourism in other states.

Relevant literature on agro-eco tourism was collected and compiled.

The agro-eco-tourism operations were compiled and operations were classified:

- Type of farming systems practiced
- Farm retail/hospitality
- Agricultural entertainment (amusement) or
- Agricultural lodging

It included the following information:

- Total number of agro-eco-tourism operations;
- Total count of agro-eco-tourism operations by type (farming systems, farm retail/ hospitality, agri-entertainment, and agri-lodging).

Nine agro-tourism farmers were personally interviewed. The survey covered the following topics:

- General characteristics of the operation, pricing, number of employees, length of operation, types of agro-eco-tourism activities
- Importance of agro-eco-tourism and other alternative enterprises to their business

- Reasons for becoming involved in agro-eco-tourism
- Qualitative measures of the motivation for involvement in agro-eco-tourism
- Identification of constraints
- Identification of agro-eco-tourism opportunities
- Operation capacity and visiting frequency levels
- Identification of positive and negative impacts of agro-eco-tourism and
- Suggestions for policy recommendations.

## Results

Classification of Agro-eco-tourism Activities in Goa

Vegetable farms      Horticulture/Forest Nursery  
Herb Walks      Commercial floriculture

Spice agro-farms      Coconut based farming system

Arecanut based farming system

Animal related

Poultry farm      Love bird rearing

Dairy cattle farms      Bee keeping

Piggery/Rabbit farming

Food Processing

Cashew processing

Feni making

Vanilla processing

Income generation activities

Vermi-composting      Elephant riding

Organic food centers      Water Sports

Arts & Crafts Demonstrations      Accommodation

Tree huts      Swimming

Farm retail/dining

Educational Tours for school children, officers and progressive farmers

Workshops on interesting, emerging agriculture topics







*View of entrance at a Agro-tourism centre*

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

The difficulties were classified as follows: competition from other large businesses and from other local retail/agro-eco-tourism businesses, business development/financing, geographic such as seasonality and weather, labour, marketing/promotion, and land use.

### **Expectations of farmers promoting agro-eco-tourism**

As the agro-tourism industry is developing at great pace some norms has to be finalizing by the Government authority in order to develop these new innovative industry in proper directions. Documentation of norms and keeping proper check on it for setting agro-tourism enterprise should be given top priority. Financial support and

encouragement should be provided to the farmers interested for setting new agro-eco tourism centre by the Government.



*Crafts offered for sale at Agro-tourism centre*

### **Conclusions**

A majority of respondents (77 percent) considered themselves to be farm retail/dining agro-eco-tourism providers. Agro-eco-tourism providers, on average, attributed approximately 10-50 percent of their total on-farm net revenue to agro-eco-tourism. Agro-eco-tourism operators were guided by a variety of motivations for their involvement in the agro-eco-tourism industry. The data gathered can facilitate the policy makers to produce strategic agro-eco tourism schemes and plans incorporating agriculture and nature eco-tourism for the region on a larger perspective. Drawing of exclusive banking policies for supporting agro-eco tourism projects open up new vista and has vast scope. Local government needs to recognize potentiality of agro-eco-tourism industry.





## Externally Funded Projects

**Project : Development of INM Package for Commercially Important Plantation Crops  
(PI: R. Ramesh)**

### **Microbial inoculants based nutrient management in Cashew**

#### **Objective**

- Evaluation of bio-fortified and non bio-fortified cashew grafts in the main field.

#### **Methodology**

Cashew seedlings were raised in bio-fortified nursery including bio-inoculants consortium, chemical fertilizers as different treatments. Growth of cashew seedlings in terms of plant height, number of leaves was recorded. The grafts were made from the seedlings raised in the above experiments. Bio-fortified and non bio-fortified cashew grafts (variety Goa 1) from nursery were planted and assessed for their performance in the field. Bio-inoculants consortium and chemical fertilizers were applied during planting under seven different treatments.



*Establishment of bio-fortified cashew grafts in the field*

#### **Results**

Cashew seedlings were raised in bio-fortified nursery including bio-inoculants consortium, chemical fertilizers as different treatments. Growth of cashew seedlings in terms of plant height, number of leaves is highest in treatment where bio-inoculants alone were used. In another experiment, the seedlings were raised without any bio-inoculants

application where, chemical fertilizer application alone did not provide any improvement.

The grafts were made from the seedlings raised in the above experiments. Maximum number of leaves and plant height of grafts were recorded in the treatment where 100% NPK+ bio-inoculants consortium were used. Percentage increase in cashew growth parameters after three months of grafting indicated that significant increase was recorded in the bio-inoculants consortium treatment. In case of non bio-fortified grafts the percentage increase was not significantly different among the treatments.

These preliminary results indicate that application of bio-inoculants consortium at the time of raising seedlings had beneficial effect on the growth of cashew seedlings as well as of grafts. This leads to the production of healthy and vigorous planting material.

Bio-fortified and non bio-fortified cashew grafts (variety Goa 1) from nursery were planted and assessed for their performance in the field. Bio-inoculants consortium and chemical fertilizers were applied during planting under seven different treatments. The grafts established well in the field and the growth parameters and nutrient uptake in the seedlings were recorded.

In bio-fortified experiment, number of leaves and girth of cashew grafts was maximum in the treatment where 75% NP + 100%K + Bio-inoculant were used. The highest plant height among the treatments was recorded in 100% NPK + bio-inoculant and in 75% NP + 100%K + Bio-inoculant treatments. 50% NP, 100% K + bio-inoculant treatments were also found to improve the plant growth. Per cent increase in the number of leaves, plant height and plant girth were high in 75% NP + 100%K + Bio-inoculant treatment till twelve months of plant growth. 100% NPK treatment and 100% NPK + bio-inoculant recorded highest shoot and root biomass of seedlings. Better nutrient uptake was recorded in plants treated with recommended dose of NPK + bio-inoculant; 50% NP and 100% K + bio-inoculant.







In non non-biofortified experiment, number of leaves in the grafts was maximum in the treatment where 25% NP, 100% K + bio-inoculant and in 50% NP, 100% K + bio-inoculant was applied. Highest plant height was recorded in Bio-inoculants treatment. Plant girth is maximum in 50% NP, 100% K + bio-inoculant treatment. Maximum root and shoot biomass of seedlings was recorded in the treatment where 100% NPK was applied. Improvement of soil nutrient status is being studied in both the experiments.

### Conclusions

Bio-inoculant based INM treatments in performed better than control in improving the growth of cashew grafts in nursery as well as in field. Initial leads suggested that about 25 to 50% NP could be replaced with the use of bio-inoculants without compromising the growth.

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

### Objective

- To examine the genetic diversity of the *Listeria* strains isolated from various sources, to establish a standard set of strains for diagnosis and research purposes and to develop assays for diagnosis.

### Methodology

A total of 120 *L. monocytogenes*, 49 from clinical and 71 from different food isolates belonging to various serogroups were examined for antimicrobial susceptibility towards 11 different antibiotics that are commonly used for clinical therapies using disc diffusion assay.

### Results and Conclusions

Large numbers of isolates were resistant to sulphadiazine (82.5 %) and penicillin (78.33%) while few isolates were resistant to ampicillin (36.66%) and vancomycin (15.83%). None of the isolates could exhibit resistance against meropenem, ciprofloxacin, chloramphenicol and gentamicin. Serogroup wise sensitivity against antibiotics tested is shown in Fig.

The presence of *Listeria* in milk processing environments as a potential source of milk contamination was assessed. Swab samples (n=210) taken from milk processing plants were examined. Sample sites included the milk processing equipment, besides areas handling raw and pasteurised milk.

The USDA *Listeria*-selective enrichment procedure was used to process the samples. Forty one (19.52%) *Listeria* isolates were recovered. The isolates were further subjected to biochemical and genotypic characterization. Out of 41 isolates, 16 (39.04%) were confirmed as *Listeria monocytogenes*, 2 (4.87%) as *L. ivanovii*, 19 (46.34%) as *L. innocua*. 1 (2.43 %) as *L. seeligeri* and 3 (7.31%) as *L. grayi*. The incidence of *L. monocytogenes* and *L. ivanovii* was found to be 7.62% and 0.95%. All the *L. monocytogenes* isolates were positive for the hlyA gene. PCR based serotyping revealed all *L. monocytogenes* to be of 1/2a, 1/2c, 3a and 3c serovar group. PFGE analysis of the selected strains demonstrated variability. AscI and ApaI restriction analysis yielded 4 PFGE types for 16 *L. monocytogenes* isolates obtained from raw milk collector, milk silos, raw milk processor, cheese and other milk product processor (Fig).

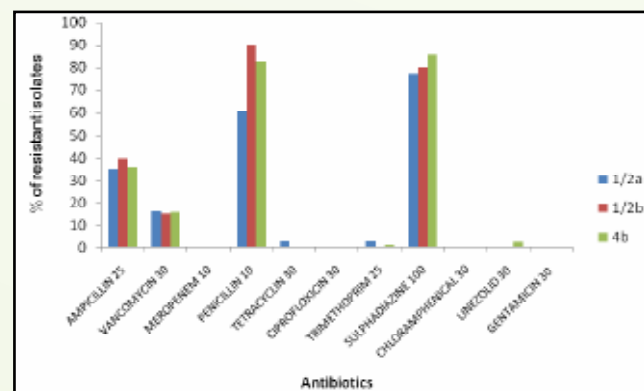


Fig. *L.monocytogenese* serogroups 1/2a\*, 1/2b\* and 4b\* and antibiotic resistance





No predominant PFGE type was observed among these *L. monocytogenes* isolates. The main sources of *L. monocytogenes* were found to be raw milk collector and milk silos.

A study was conducted to isolate *Listeria* spp. from environmental and clinical samples. Fourteen environmental and 133 clinical samples were screened for presence of *Listeria* spp. Out of 14 environmental samples, 2 (14.28%) and of 133 clinical samples, 25 (18.79 %) were positive for *Listeria* spp. Biochemical and genetic studies confirmed that 11(7.48%) were pathogenic strains of *L. monocytogenes*. CAMP and ALOA tests were performed to confirm the isolates. Further serotyping study of 11 pathogenic strains revealed 5 isolates to be of 4b serotype and 6 of 1/2b serotype.

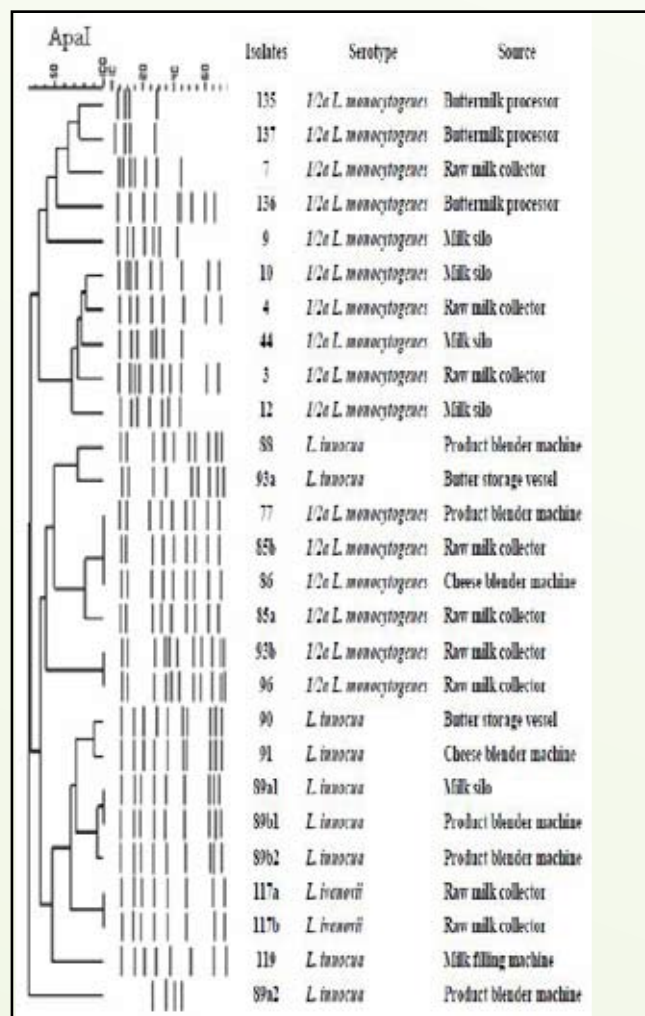
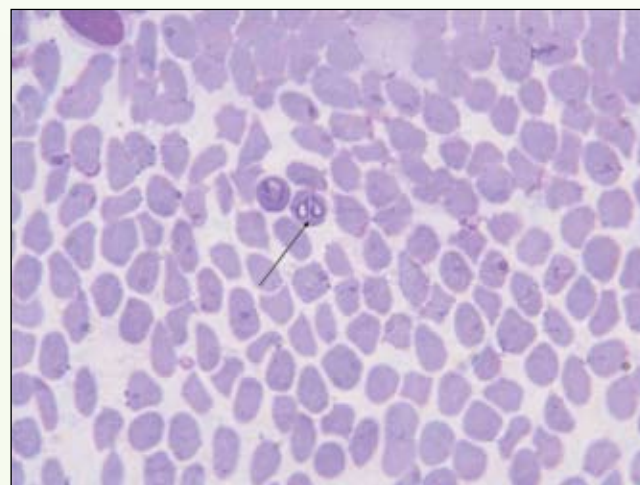


Fig. Dendrogram derived from a PFGE profile of Apal macrorestriction showing restriction patterns among the *L. monocytogenes*

Other species detected were *L. ivanovii* and other *Listeria* spp. No environmental samples contained pathogenic species of *Listeria*. Isolates were sensitive toward the antibiotics viz. ampicillin, doxycycline, ciprofloxacin, vancomycin and showed intermediate resistances toward the chloramphenicol, penicillin, gentamicin.

An ELISA based diagnostic protocol has been standardized using peptide based antigen. A real time PCR based protocol for diagnosis of listeriosis from clinical samples has been developed.

Indian *Listeria* Culture Database (ILCD) is an online databank of profiles developed for the *Listeria* strains isolated in India from various sources. The database has been updated to view images of the different strains. The database can also give a glimpse of state wise isolation of the *Listeria* strains.



Bovine blood smear showing Babesia

### Animal disease investigations

A total of 122 samples (Milk samples: 73, Clinical material including blood smears : 18, Serum samples : 31) were received/collected from the field for diagnosis of various diseases. Tuberculosis and Johne's disease testing was done in 50 cattle and buffaloes.

The important diseases diagnosed were theileriosis, babesiosis, brucellosis, Q fever and mastitis. In each case proper treatment was suggested.







**Project : Validation of Potential Fishing Zone (PFZ) Advisories along Goa Coast with Studies on their Advantage for Different Types of Fishing (PI: S. Subramanian)**

**Objective**

- To study their advantages for different types of fishing along Goa coast, including the economic benefit and study on the biological aspects of two major marine species.

**Methodology**

PFZ advisories received via satellite on the cloud free days were disseminated to the boat owners at the Malim, Vasco and Cutbona landing centers through the EDBs, fax and e mails. The PZF disseminated by the INCOIS has helped the Goan pelagic fishing industry to proliferate by the timely location of fish shoals resulting in the saving of valuable human efforts and fuel consumption.

During 2010-11, a total of 53 PFZ advisories were received for the Goa state, out of which only 33 advisories were validated. The remaining 20 were not possible to be validated as either because the PFZ were far off the coast of Goa or was at a depth wherein the boats were unable to venture (1000 to 2000 m depth). A total of 94 field visits were made to fish landing and 143 feedbacks on the catches of fish landed were collected from the boat owners from the three jetties during this period.

Length, weight, gut contents and chemical

composition of two major marine species landed are recorded.

**Results**

Out of the 33 PFZ validated during this period, as per the feedback received from 79 purse seine operates utilizing the advisories, 100 percent boat reported availability of fish. The highest catch obtained using PFZ advisories were 7 tons for Indian mackerel, 15 tons for oil sardine, 8.0 tons for tuna, and 5.00 tons for Horse mackerel and 6.0 tons for seer fish. Out of the 55 non PFZ feedback responses recorded during year, the purse-seine fish catches ranged from 500 kg to 2.5 tons which were less than the catches from boats using PFZ advisory.

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*) and Horse mackerel (*Megalapsis cordella*). The other species were White fish (*Lectarus lectarus*), lesser sardines (*Sardinella fimbriata*), solar shrimps and Moon fish. The month-wise availability of major fish species in response to PFZ advisories received is furnished in Table.

**Table. The month-wise availability of major fish species**

Month	Common name of the fish species landed at the jetties
April' 10	Oil sardines
May'10	Oil sardines, White fish
June'10	Indian mackerel
July'10	Indian mackerel, Oil sardines
August'10	Solar shrimps, Moon fish
September'10	Indian mackerel, Oil sardines, Seer fish
October'10	Indian mackerel, Oil sardines, Seer fish, White fish
November'10	Indian mackerel, Oil sardines, Horse mackerel
December'10	Indian mackerel, Oil sardines, Seer fish, Tuna, Horse mackerel
January'11	Indian mackerel, Oil sardines, Seer fish, Horse mackerel
February'11	Indian mackerel, Oil sardines, Horse mackerel, Lesser sardines
March'11	Indian mackerel, Oil sardines, Horse mackerel, Lesser sardines, Seer fish, Tuna





From the 143 feedbacks received this year, 62 were from the Indian mackerel contributing around 43.36 % of the total catch. Oil sardine ranked second by contributing 20.98 % followed by Tuna (15.38%). Seer fish was found to be less this year contributing around 7 % and Horse mackerel around 5%. Other fishes contributed to around 6%. Percentage wise distribution of fish catch is shown in the Fig.

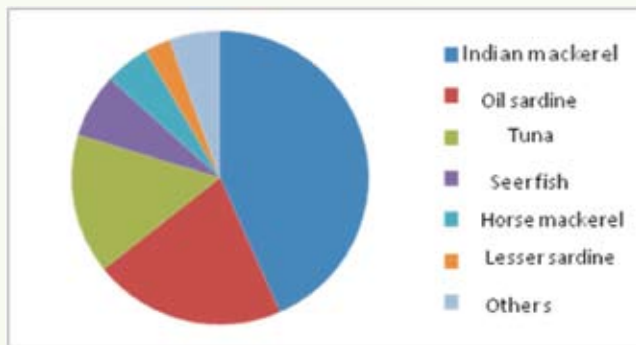


Fig. Percentage wise distribution of fish catch for the year 2010-11

The time of receiving of PFZ to the boat owners plays a vital role and affects the quantity of the catch by the purse seine operators. Out of the 79 feedbacks received from boats using PFZ advisories, 22 boats fished on the first day of receipt of the advisory, 47 on the second day and 10 on the third day. The CPUE ranged from 3.5 ton to 15.0 ton on the first day fishing average of 9.0 ton. The range for the second day of fishing was from 1.0 to 7.0 ton with an average of 4.0 ton and for the third day the catch ranged from 0.5 to 2.5 ton with an average of 1.5 ton (Table).

It is observed from the data that if the fishing is carried out on the first day of the receiving of the PFZ advisory then the amount of fish catch is more than the following days. The percentage of the fish catch on the first day was found to be 62% which reduced to 27% on the second day and 10.34 % on

the third day (Fig.). 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.

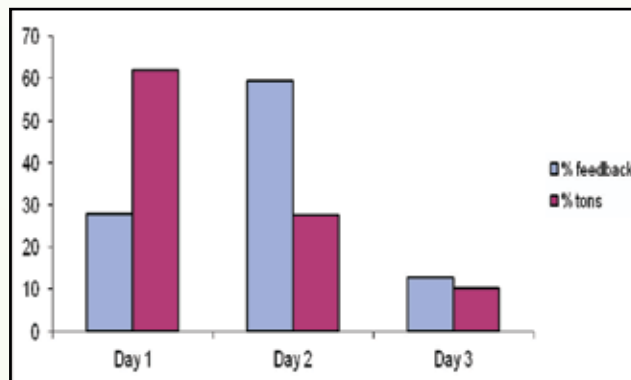


Fig. Percentage feedback and related tons received on different days of receiving of PFZ advisory

### Gut content analysis of major species caught in PFZ

The two major pelagic species caught in the purse seine operations by the boats at Goa jetties namely Oil sardine and Indian mackerel were subjected to gut content analysis. The observations revealed that the food of Indian mackerel and Oil sardine mainly consisted of zooplankton, phytoplankton, blue green algae and semi digested unidentified matter. Zooplankton formed the major food item of Indian mackerel wherein copepods dominated the gut for the entire year. In oil sardine, it was noted that though all the above groups were present, phytoplankton constituted the chief item of the food. Phytoplankton mainly comprised of the diatoms and the dinoflagellates.

Table. Effect of fishing on the 1st, 2nd & 3rd day of receipt of PFZ advisories based on feedbacks from Purse seine boats

Day of fishing after of after receipt of PFZ advisory	No of feedbacks from boats using PFZ	The minimum CPUE (ton)	The maximum CPUE (ton)	Average CPUE (ton)
Day 1	22	3.5	15.0	9.0
Day 2	47	1	7.0	4.0
Day 3	10	0.5	2.5	1.5

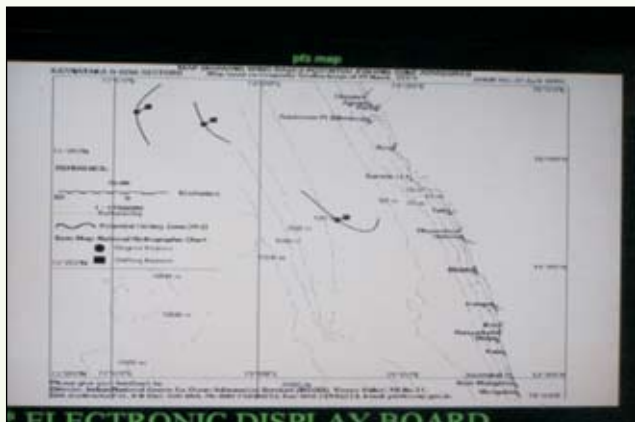






### Length and weight frequency of major species caught in PFZ

The length and weight ranges of major species of fish viz., Indian mackerel and Oil sardine, sampled from purse seine catches relating to the PFZ forecast was studied fortnightly for the entire period. During months when PFZ forecast was not available, fish samples were collected from the local market to have the continuity of year round data.



PFZ map displayed on EDB at Vasco jetty

The size of Indian mackerel ranged from 15.95 to 23.08 cm for the year whereas for Oil sardine, it ranged from 14.63 to 17.45 cm. Larger size mackerels and sardines were found during August, September and October. Weight of mackerel ranged from 64.55 to 137.37 g whereas that of oil sardine ranged from 26.65 to 53.29 g.

The variation of length and weight of Indian mackerel and Oil sardine is given in figs.

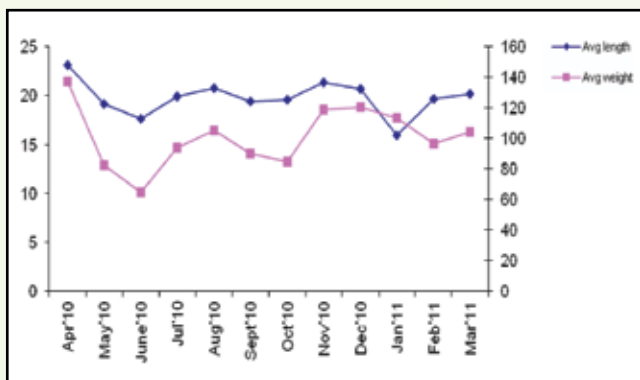


Fig. Length and weight of Indian mackerel for 2010-11

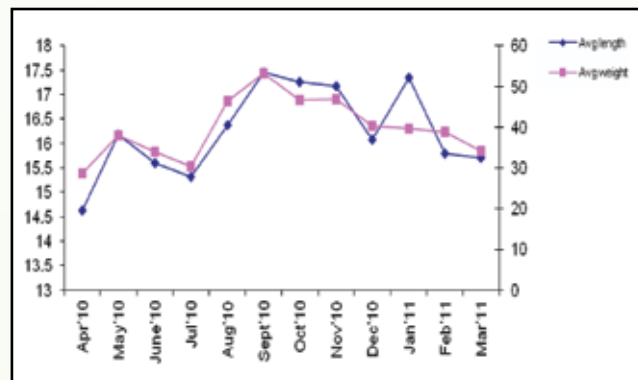


Fig. Length and weight of Oil sardine for 2010-11.

### Gonadal conditions of mackerel and oil sardine

Condition of gonads was recorded for the two major species namely oil sardine and mackerel in terms of maturity stages for the entire year and is given in the Table below. It was seen that the ripe stage of gonad ready for spawning was present in both oil sardine and mackerel in the month from May to November. The spent stage of gonads was seen in the month of August, September, October and November indicating the peak breeding season. In the month of October, both the spent and maturing gonads were observed in both Oil sardine and Mackerel indicating the redevelopment of gonad in different stages. It may also be noted that the recovery stage after the spent stage was not recorded in any of the catches for Oil sardine and Mackerel during any of the months. Similarly, fully spent gonads were also not seen in any of the month particularly in breeding season in the pelagic waters. Therefore, it may be possible that the Oil sardine and mackerel dive down to deeper regions for spawning.

### Chemical composition of oil sardine and mackerel

It was felt that the Oil sardine and Mackerel, the two important marine species contributing to the fisheries, have to be observed for variation in the chemical composition, as they are highly migratory fishes. Fortnightly samples of Indian mackerel and Oil sardine were analyzed for moisture, crude protein, fat, ash and calculated carbohydrate values.

It was observed that the percentage of crude protein was higher in Indian mackerel (68.0 to 9.29 %) than in the oil sardine (48.0 to 68.74 %)





*Oil sardine catch by purse seine, unloaded at Cutbona jetty*

for the entire year. whereas the lipids were higher in Oil sardine (24.44 to 44.79 %) than that found in the Indian mackerel (15.45 to 23.36 %). Ash and carbohydrates were found to have similar values in both the species.

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

The economics of operations of identical vessels i.e., 60-65 ft length and 6 cylinder capacity, using purse seine nets on the same day in PFZ and non PFZ areas for 9 experiments conducted, were computed along with their average CPUE, species caught,

distance from the shore and depth of the area of the catch and the following observations were made:

- From all the nine experiments conducted during 20010-11, it was observed that the fish catch was higher in PFZ area than that in the non PFZ area. The CPUE ranged from 1.0 to 7.0 tons in PFZ area and from 0.5 to 2.5 tons in non PFZ area. Similarly, the profit to the boat owners was higher in the catches obtained in PFZ area than that of the non PFZ area catch. The value of fish catches ranged from ₹ 0.80 to 1.80 lakhs in PFZ area and from ₹.0.22 to 1.05 lakhs in non PFZ areas.
- The highest value of CPUE obtained in PFZ areas where 7.00 tons each for Indian mackerel, 6.0 tons of Oil sardine and Tuna, 3.5 tons of Horse mackerel when compared to 1.50 ton of Mackerel, 2.5 tons of Oil sardine, 3.0 tons of Tuna and 2.0 tons of Horse mackerel
- The fish catch in PFZ area was 0.5 times to 5.0 times more than that of the non PFZ areas, the highest difference recorded when 7.0 ton of Indian mackerel was caught in the PFZ area while 1.5 tons of the same was caught in the non PFZ area and the lowest (0.5 times) difference was when, 1.0 ton of oil sardine was obtained in PFZ area compared to 0.5 tons of oil sardine in non PFZ area.

**Table. Month wise gonadal condition of Indian mackerel and Oil sardine**

Month	Indian mackerel	Oil sardines
Apr' 10	Maturing-III and mature-IV	Maturing-III and mature-IV
May'10	Ripe-VI and Late mature-V	Late maturing-III and Early maturing-I
June'10	Ripe-VI and Mature-V	Maturing-III and Mature-V
July'10	Late maturing-III and Early maturing-II	Early maturing-I and Latematuring-III
Aug'10	Ripe-VI and Spent -I	Ripe-VI and Late maturing-IV
Sept'10	Ripe-VI, Maturing-IV and Ripe-VI	Spent-I and Ripe-VI
Oct'10	Spent-VII, Ripe-VI and Early maturing -IV	Late mature-V, Early mature-IV, Immature-I
Nov'10	Late mature-V, Ripe-VI and Spent-VII	Early mature-IV, Late mature-III and Spent-VII
Dec'10	Late mature-V and Late maturing-III	Early mature-IV, Maturing-VI and Late mature-V
Jan'11	Immature -I and maturing	Early maturing II
Feb'11	Maturing-III and mature-IV	Early maturing-III
Mar'10	Maturing-III and mature-IV	Maturing -III and Mature-IV







- The net profit was definitely more in the catches of PFZ area than that of non PFZ area in all the 9 experiments. The difference in net profit between in PFZ and non PFZ catches were ranging from ₹ 3.86 lakhs when the difference was highest to ₹ 0.31 lakhs when the difference was lowest.
  - In one experiment it was observed that seven tons of Indian mackerel were caught in the PFZ area that yielded around ₹ 4.65 lakhs at the local market (sold at a rate of ₹ 80/- per kilo) whereas in the non PFZ area only 1.5 tons was caught that yielded a profit of ₹ 0.79 lakhs. Thus the percentage net profit of fishing in the PFZ area was 85 %.
  - Profit margin depended on species caught and the price prevailing. Mackerel fetched ₹.80-110/- per kg and oil sardine were sold only at ₹ 20-30/-per kg during November and December. In January to march 2011 the prices ranged from ₹ 75- 85/- per kg for Indian mackerel, ₹ 80-85/- per kg of tune, ₹ 50/- per kg for oil sardines, ₹ 200-250 /- per kg for seer fish depending upon the local demand. The PFZ advisory catches actually helped to realize more profit in locating high value fish in PFZ area and also helped in getting better value of low value fish because of the comparatively higher catch in the PFZ area.
- ### Conclusions
- The boats using PFZ forecast complete the fishing activities within one to two days where those not using PFZ advisories take more than two days and can even last for more days .The average time taken to complete one fishing trip (from landing centre to fish catch site and back to the landing centre) including search time was 48.50 hours for purse seine vessels not using PFZ advisories where as it was 23.00 hours for vessels using PFZ advisories, saving 25.5 hours with a corresponding fuel saving of ₹ 15,000 to 16,000/- per trip.
  - The shifting phenomenon of the PFZ helps the fishermen to get a good catch. If the direction of the PFZ is studied than the direction of the movement of the fish is known for the coming days and hence can fetch a good catch.
  - Fishing at the end of the PFZ advisory yields a low catch than fishing in the middle of the advisory
  - Direction of the PFZ shift is also important to get a good catch. Fishing carried out on the opposite side of the shifting PFZ yields a smaller catch. A smaller catch of mackerel of 1.5 tons was found on the western side of the PFZ which was moving towards the north east direction. The fish caught in the eastern side was 6.5 tons which was several times more the western catch.
  - Boats did not venture in the sea to catch fish when there was no PFZ marking off Goa coast and when the PFZ markings are far away at depths more than 500 m thus reducing their chances of returning empty handed and saving on fuel cost.
  - Fishing carried out in-between two close PFZ lines and middle of curved PFZ marking, gave high fish catches of oil sardines of around 15 tons, indicating the possibility of getting high fish catch in such areas.
  - Fishing was normally carried out during evening and night time. The boat crew would stay in the sea after the fish was caught and come to the jetty in the early morning with the onset of the sunrise.





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

**Agricultural Crops**

**Objectives**

- To enhance the quality seed production of agricultural crops
- To undertake rapid multiplication and sapling production
- To improve the quality of farm saved seed and on-farm demonstration of production technology
- To meet seed requirement in different areas of fisheries sector
- To undertake human resource development through training of trainers and seed producers.

**Methodology**

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 by the council, seed production was undertaken during *kharif* 2010 both in Institute farm and in farmers fields. The details of crops and varieties are as follows:-

**Table. Details of high yielding varieties of rice seed production**

Rice varieties	Karjat -3
Area covered	1.0 ha
Targeted production	30.0 Q
Target achieved	25.0 Q

An area of 2.0 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.

**Results and Conclusions**

A total of 2000 kg foundation seed of rice (variety Karjat-3) was produced by procuring the Breeder seed from Regional Agricultural Research

Station (K.K.V., Dapoli), Karjat. The seed material produced was sold to State Directorate of Agriculture and to the farmers.

Further, coastal salinity being the major problem in



*The demand driven rice (Karjat-3) under seed multiplication*

the region accounting to 18,000 ha. in Goa, the breeder seed of proven salt tolerant rice variety CSR-27 was procured from CSSRI, Karnal and seed multiplication was taken up. The seeds were supplied to State Directorate of Agriculture, Government of Goa.



*Salt tolerant rice variety (CSR-27)*

**Rice seed production during *rabi* season**

Breeder seed of high yielding rice variety Naveen which was found suitable for the region was procured from CRRI, Cuttack. The lowlying rice fields which was inundated with water in an area of about 5000 sq. m was brought under cultivation of rice during *rabi* season.







**Table. Details of rice seed production during *rabi* season**

Rice varieties	Karjat -3
Area covered	1.0 ha
Targeted production	30.0 Q
Target achieved	25.0 Q



*High yielding rice variety Naveen*

### Groundnut seed production

Groundnut (*Arachis Hypogaea L.*) has established as an economically potential crop in Goa for cultivation in rice fallows under residual moisture situations.



*High yielding groundnut variety - TG 37 A*

The research and development efforts of ICAR and Krishi Vigyan Kendra, Goa since early 90's has established the high potential of this crop in paddy fallows. It is however paradoxical that the coverage under this potential crop has been stagnating over the years due to several reasons among which timely availability of quality seed has been a major constraint in addition to other socio-economic reasons.

Considering the high potential, efforts were made to evaluate promising high yielding groundnut varieties which suit local environmental conditions both in terms of oil as well as protein as groundnut has recently being looked upon as food crop in terms it's high protein value. 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 2010, seed production of proven high yielding varieties of groundnut varieties TG-37A was taken up in an area of about 1.0 ha under sloping upland situations. During *rabi*, high yielding groundnut variety TG-37A was taken up in rice fallows.

**Table. Details of groundnut seed production**

	<i>Kharif</i>	<i>Rabi</i>
Variety	TG 37 A	TG 37 A
Class of seed	Foundation	TL
Area of seed production	1.0 ha	0.10 ha
Targeted production	10.0 Q	2.0 Q
Target achieved	6.0 Q	1.5 Q

### Cowpea seed production

Improved local cowpea selections which are known for their bold size, preferred taste and attractive market price are being multiplied during the year, in an area of about 2500 sq.m. The seeds were sown separately with a spacing of 45 cm and



*Seed production in local cowpea selection*







selections were made keeping in view the number of pods/plant, pod length, seeds per pod, etc. The selections multiplied during the year included

1. Alsondo-1 (Determinate type)
2. Nadora Bardez-4 (Indeterminate type)
3. Dulape Utorda-3 (Indeterminate type)

The selections are being purified and being harvested.

The proven forage varieties evolved at the IGFRRI, 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*



High yielding Hybrid Napier selections on multiplication

### Green manure seed production

Seed production was taken up in green manure crops like *Sesbania rostrata* (TSR-1) and local strain of Dhaincha. The seeds were distributed to State Directorate of Agriculture, Government of Goa.

### Fisheries

#### Objectives

- Standardization of breeding and seed raising techniques for popular freshwater ornamental fish species to popularize among small scale operators
- To encourage the production of quality seeds.

#### Methodology

Breeding and seed raising methods of both egg layers and live bearers of seven varieties of freshwater ornamental fishes namely Gold fish (normal, Shubunkin, red cap, black moor), Koi carp, Gourami (blue and golden), Angel, Sword tail, Guppy and Molly (black and white) evolved after repeated trials.



Gold Fish-common



Gourami



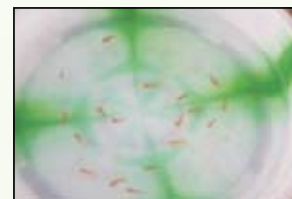
Guppy



Black molly



Shubunkin



Sword tail

Ornamental fish seed produced

#### Results and Conclusions

During the year about 80,000 spawn were produced 20,000 salable stock of seeds are available. The broodstock of gold fish, angelfish, black molly, koi carp, blue gourami and guppy are being developed in the Fishery Science Section for the ensuing breeding season. Live feeds such as green water, *Spirulina* and *Moina* are produced and fed to young ones and adults. Standard nutritious feeds were formulated from the locally available feed ingredients based on the nutritional requirement and fed to ornamental fishes. This rear too, Guppy seeds were supplied to Brittona Panchayat for control of mosquito larvae in stagnant water bodies under malaria control programme.







## Project : *Phytophthora*, *Fusarium* and *Ralstonia* Diseases of Horticultural and Field Crops (PI: R. Ramesh)

### **Ralstonia (Brinjal and Chilli)**

#### **Objectives**

- To Study the diversity of *R. solanacearum*
- To developing race/ biovar specific diagnostics of *R. solanacearum*
- Identification of stable bacterial wilt resistance source of brinjal and development of mapping population
- Isolation of antagonistic bacteria from xylem and their evaluation

#### **Methodology**

A total of 212 *R. solanacearum* isolates collected from different states viz. Goa, Kerala, Karnataka, and Andaman Islands are being maintained in the culture collection. Pathogenicity of the isolates was tested on eggplant, tomato and chilli. 92 isolates were selected based on geographical distribution, pathogenicity and virulence for studying genetic diversity by PFGE, rep-PCR and sequencing of vir genes.

Sequencing was carried out by using automated DNA sequencer (ABI PRISM™ 310 Genetic Analyser from Applied Biosystems Inc). Sequences were edited manually and aligned using Clustal W. All the sequences were deposited with NCBI, USA. Phylogenetic analysis was performed using MEGA version 4.0 by using neighbor-joining (NJ) and the algorithm with 1000 bootstrap re-samplings.

PFGE was used to determine the diversity amongst the 92 *R. solanacearum* strains belonging to phylotype I biovar 3. Rare cutting restriction enzymes Xba I and Dra I were used for determining the genetic diversity by restriction digestion of the whole genome.

PFGE protocol for *R. solanacearum* was standardized in CHEF-DR-II drive module, Biorad, USA. The whole cell DNA was digested with XbaI and DraI; electrophoresis is carried out at 14 °C, 6V/cm.

Specific primers of *R. solanacearum* ITS (RS-ITS FP and RS-ITS RP) were designed and used to amplify ITS region; the PCR reaction and conditions

were standardized. Sequencing was carried out as described above.

Seeds of bacterial wilt resistant varieties have been obtained from GBPUAT, KAU, OUAT, NBPGR and IIHR in addition to 44 local accessions. Total of 57 varieties were screened in glasshouse. Three *R. solanacearum* isolates which differ in the virulence (highly, moderately and mildly virulent isolates) are used in the screening.

Out of 57 varieties, 13 cultivars were short listed for 2nd time screening under stringent conditions in glasshouse. In the second screening the same quantity of *R. solanacearum* inoculum was used as of initial screening. The same plants were again inoculated with the higher concentration of *R. solanacearum* inoculum after 20 days of the 1st inoculation. Development of F1 population between Agassaim and Surya is in progress.

Xylem residing bacteria was isolated and the isolates are being screened for their antagonism to *R. solanacearum*. Promising xylem bacteria are being evaluated in glasshouse

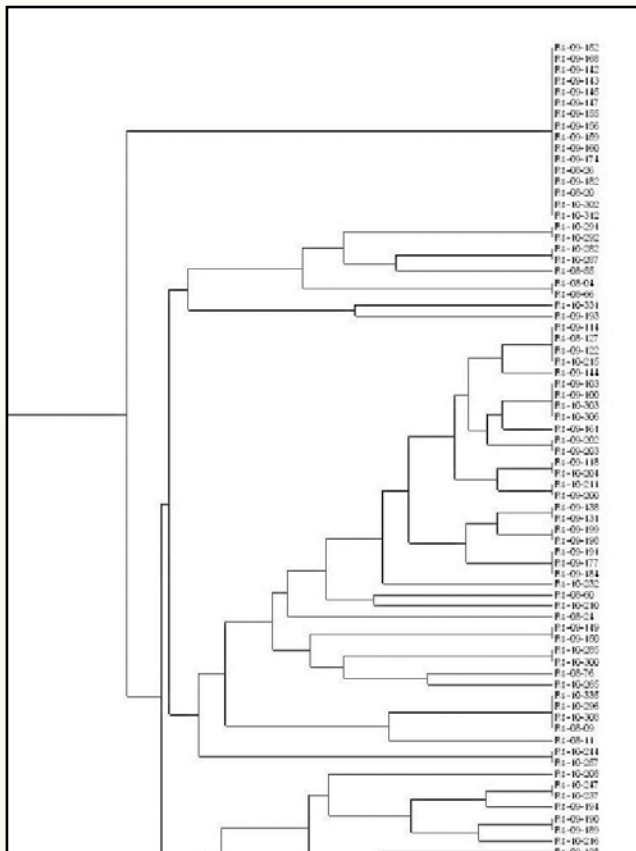
#### **Results**

##### **Diversity of *R. solanacearum***

A total of 212 *R. solanacearum* isolates collected from different states viz. Goa, Kerala, Karnataka, and Andaman Islands are being maintained in the culture collection. All the isolates are biovar 3 and belong to Phylotype I. More than 90% of the isolates are pathogenic to all the three hosts. Incidence of wilt started very early in case of tomato (3-4 days after inoculation in case of some isolates). In chilli, only few isolates (27) caused typical wilting and more than 85 per cent of isolates produced chlorotic symptoms and stunted growth but not death of plant.

Based on the rep-PCR analysis, significant similarity among all the strains of *R. solanacearum* collected from same geographical origin was observed. BOX-PCR was not able to distinguish all the isolates distinctly based on region, host or phylotype.

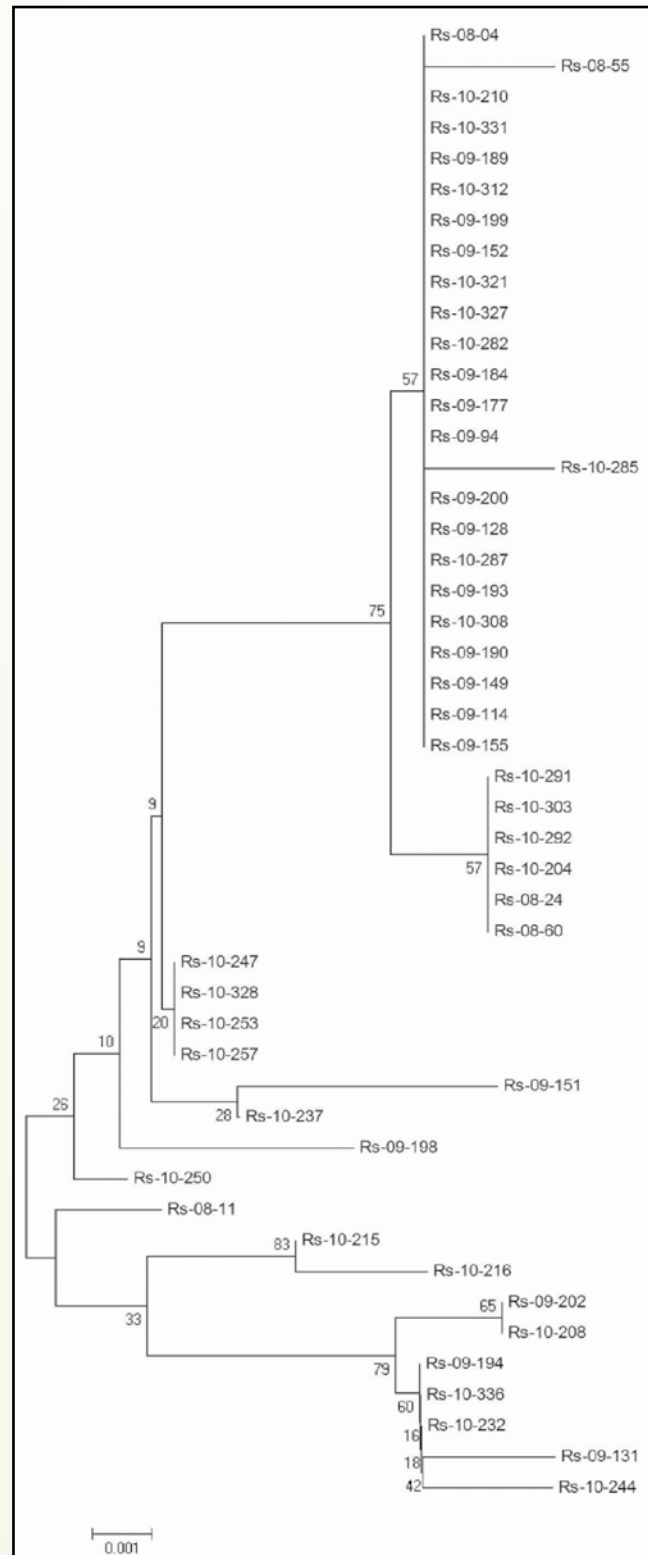




**Fig. Dendrogram generated by UPGMA showing the similarity among the *R. solanacearum* isolates by BOX PCR**

Based on the *egl* sequences, 20 of our isolates from the selected 92 are designated sequevar numbers. All other sequences constitute unknown sequevars. Isolates from our collection cluster together with Phylotype I isolates described earlier from elsewhere. Our isolates within the major cluster (Phylotype I) did not group based on the host/ geographical location. The only exception is clustering of isolates from A&N islands in a different sub cluster.

Based on *pga* sequence our isolates cluster together in a single group along with the other *R. solanacearum* isolates described (M33692 and UW551 from Kenya). Sequences from the other isolates *viz.* IPO1609, GMI1000 and MolK2 cluster in a separate group from our isolates. Isolates in the cluster could not be delineated according to host, origin or biovar characterization. The grouping is not in consistent with Phylotyping classification as observed in *egl* sequences.



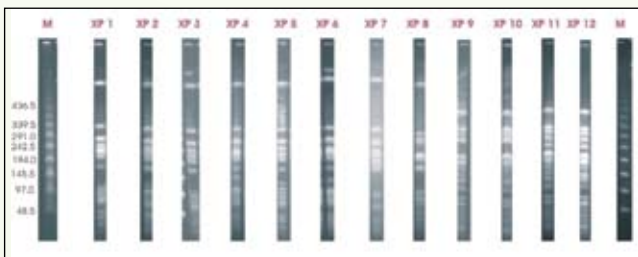
**Fig. Phylogenetic NJ tree of *R. solanacearum* based on partial polygalacturonase precursor (*pga*) gene sequences. Number at each node is the bootstrap value (1000 re-samplings). Scale bar represents 1 nucleotide substitution per 1000 nucleotides**



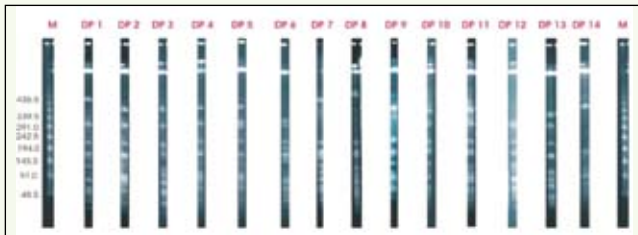




By employing RC PFGE our phylotype I biovar 3 strains could be clustered into diverse pulsotypes representing the clonal lines of the *R. solanacearum* species complex. The pulsotypes obtained by both the restriction enzymes (Xba I, Dra I) were difficult to be grouped based upon the geographical location, host crop or the year of isolation, with an exception being the isolates from Andaman and Nicobar Islands which clustered separate. Nevertheless, the technique proved useful for determining the number of different pulsotypes which could be present in a particular geographical location.



PFGE profiles of total genomic DNA from *R. solanacearum* with Xba I



PFGE profiles of total genomic DNA from *R. solanacearum* with Dra I

### Diagnostics

A high level of sequence similarity in ITS region was observed among our isolates. Based on the sequence similarity among the isolates, specific primers were designed for selective identification of our *R. solanacearum*. One forward primer and two reverse primers were designed for validation.



Utkal Madhuri



Swetha

Screening of eggplant varieties / cultivars for bacterial wilt resistance

### Host resistance

Total of 57 varieties were screened in glasshouse. Three *R. solanacearum* isolates which differ in the virulence (highly, moderately and mildly virulent isolates) are used in the screening. Incidence of wilt was recorded regularly starting from 7 days after inoculation and continued up to 45th day after inoculation. Local susceptible cultivar Agassaim was used as control along with the test varieties. Wilting started 7th day in most of the varieties whereas in resistant types no wilt was recorded till the end of the experiment. Out of 57 varieties, 13 cultivars were short listed for 2nd time screening under stringent conditions in glasshouse. Incidence of wilt was not recorded in any of the test varieties up to 20 DAI. The same plants were again inoculated with the higher concentration of *R. solanacearum* inoculum after 20 days of the 1st inoculation. Based on the screening of resistant varieties to bacterial wilt we conclude that Surya, Swetha and Utkal madhuri could be used as donor parent in resistant breeding as these varieties did not wilt and did not allow the pathogen to multiply in the tissue even under high inoculum concentration which is evident from the population analysis from the tissues of resistant and susceptible varieties. Anatomical studies indicated damaged vascular tissues in the susceptible plants and intact tissues in the resistant plants after pathogen inoculation. Development of F1 population between Agassaim and Surya is in progress. Crosses are made and seeds will be collected from the successful crosses for developing F2 population.

### Disease management

Xylem residing bacteria was isolated and the isolates are being screened for their antagonism to *R. solanacearum*. Promising xylem bacteria are being evaluated in glasshouse for possibility of using them as biocontrol agents because they share a common niche as of *R. solanacearum*.





### Conclusions

All the *R. solanacearum* isolates are biovar 3 and belong to Phylotype I. More than 90% of the isolates are pathogenic to all the three hosts. Based on the rep-PCR analysis, significant similarity among all the strains of *R. solanacearum* collected from same geographical origin was observed. Based on the *egl* sequences, 20 of our isolates are designated sequevar numbers. All other sequences constitute unknown sequevars. Based on *pga* sequence our isolates cluster together in a single group along with

the other *R. solanacearum* isolates described. PFGE can also be used in studying the genetic diversity of this pathogen as it differentiates different pulsotypes. From the above techniques, isolates could not be delineated according to host, origin or biovar characterization. A high level of sequence similarity in ITS region was observed among our isolates. Based on the screening of resistant varieties to bacterial wilt we identified that Surya, Swetha and Utkal madhuri could be used as donor parent in resistant breeding.

## Project : AICRP on Vegetable Crops (PI: M.Thangam)

### Evaluation of brinjal AVT-II lines

#### Objective

- To evaluate different AVT-II brinjal lines for yield and quality

#### Methodology

Design: RBD, Treatments: 8, Replications: 4

#### Results and conclusions

Varietal trials in brinjal AVT-II were conducted during 2010-11, in which six AVT-II lines were evaluated including local check. The national check KS-331 recorded the highest yield per hectare (333.73 q) followed by BCB-11 (317.70 q). The local check also recorded good yield (289.29 q).

Earliest flowering was recorded in KS-331 (60 days) followed by BCB-11 (61.75 days). The highest number of fruits per plant was recorded in Punjab Sadabahar (26.35) followed by PB-71 (25.61 fruits per plant). Highest fruit yield per plant was recorded in BCB-11 (1.32 kg/plant).

### Evaluation of IET and AVT – II Chilli lines

#### Objective

- To evaluate chilli varieties for suitability to Goa.

#### Methodology

Design : RBD, Treatments - AVT : 9  
IET - 10

#### Results and Conclusions

Varietal trial in chilli AVT-II was conducted during 2010-11, in which nine AVT lines were evaluated. The highest yield of red ripe chilli was recorded in LCA-206 (96.54 q/ha) followed by ACS-06-1(94.97 q/ha) variety. Out of nine varieties evaluated during *rabi* season, the earliest flowering was noticed in LCA-206 (60 days) followed by ACS-06-1(62 days).

Highest number of fruits per plants were recorded in ACS-06-1 (99.71) followed by JCA-283 (90.70) where the local check recorded 33.34 fruits per plant. Beside, the highest individual fruit weight (7.70g) and yield per plant (0.38 kg per plant) were recorded in local check and ACS-02-2 respectively.

New varietal trial in Chilli IET was initiated during 2010-11 with 7 lines two National checks and one local check. The lines were evaluated for days to first flowering, number of fruits per plant, single fruit weight, yield per plant and yield per hectare. Among the lines evaluated, the highest red ripe chilli was recorded in KA-2 (103.83 q/ha) followed by 09/CHIVAR-1 (95.13 q/ha).

The local check recorded 77.86 q/ha of red ripe chilli. The earliest flowering was noticed in KA-2 (64 days) followed by 09/CHIVAR-1 (66 days). The individual fruit was weighed and the highest fruit weight was recorded in local check (7.26g), but the highest per plant yield was recorded in KA-2 (0.42 kg/plant) due to many fruits per plant.







## Trial on resistance to bacterial wilt in brinjal

### Objective

- To evaluate the brinjal varieties for resistance to bacterial wilt disease

### Methodology

Design : RBD; Treatments :9

### Result

New trial on brinjal bacterial wilt was initiated during the year. Five entries and four susceptible

checks viz., SM-6-6, Arka Nidhi, Pusa Purple Long and local susceptible type (Agassaim) were evaluated. The incidence of bacterial wilt was recorded one, two and three months after planting apart from yield data.

### Conclusion

The results showed that the incidence of bacterial wilt ranged from 0.00 % (SM-6-6) to 33.33 % (Pusa Purple Long). The highest yield per hectare was recorded in SM-6-6 (319.46 q/ha.) followed by Arka Nidhi (237.21 q/ha.)

## Project : AICRP on Cashew (PI: A.R.Desai)

### Germplasm collection, conservation, evaluation, characterization and cataloguing

#### Objective

- To collect, characterize, evaluate and document cashew germplasm of Goa.

#### Result and conclusion

A total of 73 local germplasm accessions of cashew are being maintained in the institute which are represented in the following broad groups and utilized in crop improvement programmes.

- Jumbo Bold nut types : 14 accessions
  - Bold nut types : 24 accessions
  - Medium nut and high yielders : 12 accessions
  - Remaining : high yielders / cluster bearers irrespective of nut size
  - Dwarf canopy types : 3 accessions
  - New addition : 2 bold nut accessions.
- Total germplasm collection : 73 + 2

Softwood grafts of the following the six new accessions from Nagargao and Bhironda villages in Sattari zone and Rivona village in Quepem zone,

selected for their bold nut and bigger apple size, were prepared for planting in Clonal germplasm bank. Two new accessions, DPKJ-1 and 2 were identified for promising traits during the year from Dhawe village in Sattari for higher nut yield and bold nut size.

#### Nucleus Scion Bank

Grafts of Goa-1 and other promising accessions namely, Tiswadi-3, Ganje-2, KN 2/98 have been prepared for establishing the nucleus scion bank.

### Evaluation of new hybrids / varieties (MLT-VI) introduced from other cashew research stations

#### Objective

- To evaluate new cashew varieties / hybrids developed elsewhere for suitability in Goa

#### Methodology

Design : RBD

Replication : 3

Treatments : Seven 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.





**Table. Initial trends of growth and yield on different introduced varieties of cashew**

Variety	Height (m)	Canopy Spread		Nut yield (Kg/tree)		Nut weight (g)		Apple weight (g)	
		N x S	E x W	09-10	10-11	09-10	10-11	09-10	10-11
Vengurla-8	2.8	1.8	2.3	0.28	0.55	8.6	8.9	75.8	78.5
Dhana	2.2	2.1	2.0	-	1 <sup>st</sup> Flowering	-	7.66	-	-
Raghava	2.5	1.8	1.6	-	1 <sup>st</sup> Flowering	-	7.82	-	-
Priyanka	3.0	1.6	1.9	-	0.35	7.8	7.83	59.3	54.6
Bhaskara	2.6	2.1	1.9	0.33	0.95	7.86	7.78	62.3	59.65
Ullal-3	2.3	1.8	2.2	-	1 <sup>st</sup> Flowering	-	8.35	-	-
Tiswadi-3	2.5	1.9	1.8	0.1	0.21	9.1	9.3	96.8	91.4
CD (5%)	NS	NS	NS	-	-	-	-	-	-

### Result and Conclusions

The growth of the graft trees was observed to be satisfactory. But all the trees of all the varieties were severely affected by Tea mosquito bugs. Early varieties like Tiswadi-3, Priyanka were very severely affected. Bhaskara variety though was affected, showed mid season flowering and resulted in nut set.

All the varieties that had not flowered previously, came to flowering in the current season. During the year, Priyanka, Bhaskara, V-8 and Tiswadi-3 recorded nut yield of 0.35, 0.95, 0.55 and 0.21 kg/tree of nut yield with 54.6, 59.68, 78.5 and 91.4 g of apple weight respectively.

## Project : AICRP on Pigs (PI: E. B. Chakurkar)

### Synchronization of estrous and early pregnancy diagnosis in pigs

#### Objective

- To study response of female pigs for synchronization treatment

#### Methodology

An experiment involving 72 sows was designed. Prostaglandin F2 $\alpha$  analogue (Dinoprost) was used for the synchronization of estrous in the sows at the dose rate of 7.5 mg/animal and 10mg/animal. Scanning of sows for pregnancy in farmers field. The scanning was done with abdominal probe of 3.5 Mhz frequency.

#### Results

The results indicated that synchronization of estrous was better in group where 7.5 mg Dinoprost was given. Female pigs which were examined were not known for the breeding history. It was observed that some of sows were in advance stage of pregnant of about 75-80 days but farmer was unaware of it. Female which were mid pregnant of 60-65 days and early pregnant of about 35-50 days were considered by farmer as non pregnant.

#### Conclusion

The demonstration synchronization and pregnancy diagnosis with ultra sonograph has shown that synchronization of estrous was better in group where 7.5 mg Dinoprost and scanning with ultrasonograph has brought awareness for the losses with pig farming.







## Reproductive performance of female cross breed pigs

### Objective

- To study the reproductive maturity of crossbred pigs

### Methodology

Animals in all the groups were fed the standard starter CM up to the attainment of 20 kg body weight. Observations were recorded for first appearance of estrous (age of puberty) and age of maturity. Estrous observations include enlargement and hyperemia of vulva scanty discharge and attraction towards male. Intensity of estrous and estrous length was also observed. The first appearance of estrous signs was taken as age of puberty. When two consecutive estrous cycle lengths were 18 to 20 days the age was considered as age of maturity. After sexual maturity these gilts were subjected to estrous synchronization using 7.5 mg dianoprost per animal. After exhibition of the estrous gilts were served naturally. Pregnancy was confirmed with ultrasonographic examination on 40 days post service. Frequency used for this was 3.5 Mhz with trans abdominal probe.

### Results

Age of puberty in these cross breed pigs ranged from 175 to 214 days and average age of puberty was 189.3 days. Once estrous was set i.e. exhibited regularly with interval of 18-20 days the age was considered as age of maturity. Age of maturity ranged between 203 to 233 days and average age of maturity was 219.20 days. Average weight at puberty was 33.03 kgs where as average body weight at maturity was 54.8 kgs. These mature female pigs were subjected for synchronization of estrous and then served naturally. Out of then six females responded for the treatment (60%). After natural service these female pigs were scanned for the pregnancy with ultrasonography and five females (83.34 %) were pregnant. It can be concluded that cross breeding has reduced the age of puberty and maturity than pure exotic breeds.

### Conclusion

Age of puberty, sexual maturity was less in crossbred pigs as compared to the pure Large White Yorkshire.

## Performance of different breeds of piglets on standard starter diet

### Objective

- To evaluate performance of pure and cross breed pigs

### Methodology

Large White York shire (LWYS) pure, Goa Local (L) pure and Goa Local X Large White York Shire (LWYS x L) 50% cross containing six piglets in each group were made based on the age (avg. age 70 days) and body weight (avg. BW 6.47 kg). A standard starter (creeper) concentrate mixture (CM) fed the standard starter CM up to the attainment of 20 kg body weight For each group, the feed offered and left over were weighed and samples were calculated for dry matter (DM) percentage to know the exact daily DM consumption of the group. The body weights (BW) of the animals were recorded weekly for two consecutive days before offering feed and water in the morning and the mean values were taken as actual BW. The feed conversion ratio (FCR) was calculated as the amount of total feed consumed (g) divided by the total weight gain(g) by the pig during the experimental period. The feeds offered were analyzed for proximate principles and fiber fractions. The data were analyzed statistically for test of significance.

### Results

The CP, EE, CF, NFE, TA and AIA content of the CM were respectively 19.60, 3.76, 4.92, 63.81, 7.91 and 0.80, per cent respectively and met the BIS specifications of the starter pig feed. Although, the DM intake of the LWYS x L Cross group was higher ( $P < 0.05$ ) than the LWYS group and L group, but when expressed as percentage of BW, it was similar and ranged between 7.24 to 7.62% of the BW. The growth rate (g/day) in LWYS group (363.89) and LWYS x L Cross group (398.41) was similar ( $P > 0.05$ ), but higher ( $P < 0.05$ ) than the L group (288.10). The FCR in LWYS x L Cross group (2.26) was similar to the LWYS group (2.45) and lower ( $P < 0.05$ ) than the L group (2.91), indicating better feed conversion efficiency.





**Table. Performance of pigs**

Parameters	LWYS	Local	LWYS x Local
Feed intake			
Dry matter intake (g/ day)	969.93 <sup>b</sup>	903.20 <sup>a</sup>	982.75 <sup>c</sup>
Dry matter intake (% BW)	7.39	7.62	7.24
Growth Performance			
Initial live weight (kg)	6.42	6.37	6.52
Final live weight (kg)	21.70 <sup>ab</sup>	18.47 <sup>a</sup>	23.25 <sup>b</sup>
Total live weight gain (kg)	15.28 <sup>b</sup>	12.10 <sup>a</sup>	16.73 <sup>b</sup>
Growth rate (g/day)	363.89 <sup>b</sup>	288.10 <sup>a</sup>	398.41 <sup>b</sup>
Feed conversion ratio	2.45 <sup>ab</sup>	2.91 <sup>b</sup>	2.26 <sup>a</sup>

### Conclusion

In Goa condition, the growth rate and feed conversion efficiency of the Large White Yorkshire x Local (LWYSxL) 50% cross piglets are better than the pure Large White Yorkshire (LWYS) and pure Local (L) piglets.

### Traditional Vs scientific feeding practices of 50% crossbred (Goa local X large white Yorkshire) pigs in Goa

#### Objective

- To study the performance of crossbred pigs under traditional and scientific feeding practices in Goa.

### Methodology

Twelve 50% cross bred (Goa local X large white Yorkshire) castrated male piglets (Avg. age 60 days, Avg body weight 8.39 kg) were divided into four groups of three piglets in each group. Randomly, one group was maintained at the institute farm as Control Group under scientific feeding practices. The other three groups were distributed to three pig farmers maintaining their units under different feeding practices. The piglets of treatment groups were fed randomly bakery waste (TBW), kitchen waste (TKW) and cooked broiler offal and wheat bran mixed in the ratio of 100: 3 (TPO+WB) 150 days. The live body weights of the animals were recorded monthly for two consecutive days before offering feed and water in the morning and the mean values were documented as actual body weight. The feeds offered were analyzed for proximate principles.



*Trial in farmers field*

### Results

There was significant ( $P < 0.05$ ) difference in the CP content among the feeds. The CP% of TPO+WB (36.15) and TKW (14.49) and TBW (9.69) are lower than the Control (19.70), respectively. The ether extract contents of all the treatment diets are similar

**Table. Chemical composition of the different Feeds**

Nutrient (on % DM Basis)	Control	T <sub>BW</sub>	T <sub>KW</sub>	T <sub>BO+WB</sub>	SEM
Crude Protein*	19.70 <sup>c</sup>	9.69 <sup>a</sup>	14.49 <sup>b</sup>	36.15 <sup>d</sup>	3.01
Ether Extract*	3.69 <sup>a</sup>	14.66 <sup>b</sup>	14.97 <sup>b</sup>	15.22 <sup>b</sup>	1.48
Crude Fiber*	4.97 <sup>a</sup>	4.14 <sup>a</sup>	4.40 <sup>a</sup>	21.85 <sup>b</sup>	2.27
Nitrogen Free Extract*	63.96 <sup>b</sup>	68.44 <sup>c</sup>	62.52 <sup>b</sup>	5.25 <sup>a</sup>	7.83
Total Ash*	7.68 <sup>b</sup>	3.07 <sup>a</sup>	3.62 <sup>a</sup>	21.53 <sup>c</sup>	2.26

Control: Scientific feeding; TBW: Bakery waste; TKW: Kitchen waste; TBO+WB: Broiler offal and wheat bran

\*Means bearing different superscripts in a row differ significantly







(14.66-15.22) and higher ( $P<0.05$ ) than the control diet. There was higher ( $P<0.05$ ) CF content of TPO+WB (21.85%) than the other three diets (4.14-4.97%). The TA content of TPO+WB (21.53%) was higher than the other three diets. There was no difference in the body weight of the pigs up to 30 days of the experimental feeding. From 30 days onwards up to 90 days, the growth performance of TPO+WB was higher than the TBW and TKW but similar with the Control.

**Table. Body weight changes at different post-experimental period**

Body weight at post-experimental period	Control	T <sub>BW</sub>	T <sub>KW</sub>	T <sub>BO+WB</sub>
0 day (kg)	8.40	8.10	8.87	8.17
30 days (kg)	14.23	13.67	11.70	17.67
60 days (kg)*	24.03 <sup>b</sup>	14.87 <sup>a</sup>	14.17 <sup>a</sup>	24.17 <sup>b</sup>
90 days (kg)	36.67 <sup>b</sup>	17.17 <sup>a</sup>	18.33 <sup>a</sup>	32.00 <sup>b</sup>
120 days (kg)*	46.63 <sup>c</sup>	21.37 <sup>a</sup>	21.67 <sup>a</sup>	37.67 <sup>b</sup>
150 days (kg)*	54.67 <sup>c</sup>	25.03 <sup>a</sup>	25.57 <sup>a</sup>	43.83 <sup>b</sup>
Weight gain (kg)	46.27 <sup>c</sup>	16.93 <sup>a</sup>	19.70 <sup>a</sup>	35.67 <sup>b</sup>
Weight gain (g/day)	308.44 <sup>c</sup>	112.89 <sup>a</sup>	111.33 <sup>a</sup>	237.77 <sup>b</sup>

However, with advancement of experimental feeding (from 120 days to 150 days), although the growth performance of TPO+WB was higher than the TBW and TKW but lower than the Control. The daily body weight gain of TPO+WB (237.77 g) was higher than the TBW (112.89) and TKW (111.33), but lower than the control group (308.44).

### Conclusion

Growth performance of crossbred pigs was higher when fed with poultry offals plus wheat bran as compared to crossbred pigs fed with either kitchen waste or bakery waste, but growth performance of crossbred pigs fed with standard ration was better amongst all experimental crossbred pigs.

### Meat characteristics of different breeds of pigs

### Objective

- To study yield and meat quality of different breeds of pigs

### Methodology

Pigs of Goa Local, Large White Yorkshire and Local X Large White Yorkshire were reared under similar management and provided with feed of same quality and composition. These animals were slaughtered at 10 months of age and parameters like dressing percentage, back fat thickness, weight of different cuts was recorded.

### Results and Conclusions

As per as dressing percent was concerned local and Yorkshire were at par whereas crossbred was significantly different than these two and was having higher dressing percent.



*Back fat thickness in Yorkshire pig*

**Table. Carcass characteristics of pigs**

Parameter	Local	LWYS	Local x LWYS
Dressing percent	84.34	86.01	87.01
Back fat thickness (cm)	4.99	5.27	3.36
Carcass length (m)	57.36	70.76	69.26
Internal loose fat (kg)	2.73	3.36	3.36
Ham weight (kg)	13.93	23.43	21.23
Shoulder weight (kg)	16.80	26.80	23.46
Loin weight (kg)	4.53	6.83	2.60
Ribs weight (kg)	7.03	12.26	10.56

Carcass length, internal loose fat and loin weight





was similar in all the groups and there was no statistical difference. A very important characteristic of meat i.e. back fat thickness was less in crossbreed and differed significantly than local and Yorkshire. As far as ham, shoulder (picknik) and loin weight is

concerned all the groups were statistically different. These weights were more in Yorkshire followed by crossbreed and followed by local.

## Project : AICRP on Integrated Farming Systems (Project Leader: N. P. Singh)

### Objectives

- Characterization of existing farming systems of Goa
- Development of on-farm participatory farming systems for enhancing farm income
- Sustainable improvement of farm resources, nutritional and livelihood options
- Modeling of ideal integrated farming systems to suit different farming systems

### Methodology

As per the objectives, field survey was conducted in all the 10 talukas of Goa to characterise the existing farming systems covering 100 farmers with information on land holdings, crops and crop production, technologies adopted and socio-economic status of farmers.

### Results and Conclusions

The salient features of the survey results are as follows:

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

of seeds/ varieties, fertilizer to be used, means of irrigation, labour to be hired, marketing / storage of farm produce, purchase and sale of farm animals, purchase and sale of farm mach, construction of farm buildings, borrowing and repayment of farm credit.

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 modified 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

#### Plantation Crop Based Integrated Farming Systems for Upland Area

The following components have been included in the development of the model Components

- Plantation Crops + Piggery+ Fishery + Poultry + Apiary + Vermi-compost
- Area:0.8 ha
- Main crops: Cashew, Arecanut, and Coconut
- Cashew + Pineapple (in contour trenches)-0.28 ha
- Coconut + spices -0.12 ha
- Arecanut + Banana -0.26 ha
- Forage crop along peripheral bunds
- Kokum at the corners
- Water Harvesting Pond (Plastic lined)
- Vermicompost-2 pits
- Apiary-2 units
- Poultry-100 nos.
- Piggery- 4 nos.

The initial fertility status of the soil was analysed through collection of representative sample from all the three subsystems viz. cashew based system, coconut based system and arecanut based system.







*Plantation crop based model for uplands*

The average bulk density of the site was 1.06 g/cc while the particle density of the soil was 2.30 g/cc with a porosity of 54 %. The average pH of the soil was 5.41 with no salt contents. While the organic carbon content of the soil was fairly higher (2.34%) in arecanut system, it was relatively lower (1.74 %) in coconut system with an average of 2.1 % organic carbon for the plot as a whole. The available nitrogen content of the soil followed a similar trend as that of organic carbon with arecanut system plot recording medium level available nitrogen (364 kg/ha) while the coconut system plots recording lower available nitrogen (272 kg/ ha). The available phosphorous content of the upland model site was relatively lower (from 10.8-12 %). While the potassium content of the soil in arecanut system was relatively in higher range (412 kg/ha), it was in the medium range in coconut and cashew systems.

All the crops have been managed with recommended package of practices. Cashew (variety Bhaskara) grafts have started yielding along with the intercropped pine apple.

The observations are being recorded on all the growth and yield parameters. The middle terrain of the plot measuring about 0.12 ha is planted with local cultivar Benaulim coconut selection and intercropped with elephant foot yam. The high yielding arecanut variety Mangala was procured from RRS, Viittal and are being evaluated with inter crop of tissue cultured banana (Grand Naine). Observations are being recorded on yielding banana along with arecanut. A vermicompost unit was initiated with an aim to obtain on-farm availability of organics. Two integrated structures one each on poultry and piggery have been constructed through CPWD.

## Model II

### Rice based Integrated Farming Systems

The following components have been included in the development of the model Components

- Field Crops + Horticulture + Dairy + Poultry + Mushroom Production + Rice – cum – fish culture + Biogas Production + Vermicompost Unit + Fodder Cultivation.
- Area: 0.5 Ha
- Rice-groundnut/cowpea=0.20 ha
- Rice-brinjal/sweet corn=0.20 ha
- Rice cum fish=0.05 ha
- Fodder= 0.02 ha
- Dairy =0.01 ha
- Vermicompost unit=0.01 ha
- Biogas unit= 2 m<sup>3</sup>
- Backyard poultry=0.01 ha
- Mushroom production
- Rice followed by vegetables, pulses and oilseeds as second crop. Paddy straw will be recycled to cultivate Oyster mushrooms.
- Rice cum fish culture by modifying existing field. Indian major carps will be cultured.



*Pineapple on contour trenches as intercrop in cashew*

During *kharif*, rice (varieties Karjat-3 and CSR-27) were taken up in the entire area of one acre and the relevant observations recorded. During *rabi*, all the four rice based crops viz., groundnut (Variety TG 37A), brinjal (Local cultivar Agassaim), cowpea (Local selection) and sweet corn (Variety Madhuri) have been cultivated with recommended package of practices. The observations were recorded on all the growth and yield parameters. Impact of growing different rice based crops on soil and the economics of their cultivation is being assessed. Two integrated structures one each on poultry and dairy have been pursued for their construction.





# **ICAR RC Goa**

## **Annual Report**

### **2010-11**

# **Institutional Activities**

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











## Transfer of Technology

### Demonstration of High Yielding Rice Varieties

Demonstration plots were laid out in three groups representing medium duration, aromatic and salt tolerant rice varieties at the Institute farm. Eight of the medium duration rice varieties viz., Naveen, Swarna (sub-1), Pusa-44, Chandan, Karjat-3, Akshayadhan, Karjat-7, TRC-2005-1 are taken along with the check variety Jaya, two aromatic rice varieties viz., Pusa Sugandh-5 and Bogavathy with Pusa Basmati-1 as a reference variety and three salt tolerant rice varieties viz., CSR-27, CSR-36 and Vikas are demonstrated with local salt tolerant rice variety Korgut as a check.



*Demonstration of rice varieties in the Institute plot*

### Front Line Demonstrations in Rice

Front Line Demonstrations sponsored by Ministry of Agriculture, Government of India in high yielding and salt tolerant rice through DRR, Hyderabad was taken up. The demonstrations were conducted in high yielding varieties of rice-Akshayadhan against ruling variety Jaya and salt tolerant rice variety CSR-27 against the local cultivar Korgut in farmer's fields during kharif season of 2011 in Mandur village of Tiswadi taluka in Goa and Pilerne village in Bardez taluka of Goa. Seeds of high yielding varieties of rice (Akshayadhan and CSR-27) were procured from DRR, Hyderabad and CSSRI, Karnal, respectively and assessed for their suitability or otherwise in farmer's fields. A total of 24 farmers with different holding size were selected for demonstration of



*High yielding rice - Akshayadhan*

both the varieties. 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 19 % increased yield with rice variety Akshayadhan and 100% with salt tolerant rice CSR-27 against the respective checks.

### Cultivation of Red Kernel Rice (Revati and MO-9)

Total 67 demonstrations were conducted at farmers field of Adcona, Dhulapi, Taleigao, Chodan and Pillar villages covering an area of 10.5 ha. An average of 4.42 q/ha was observed in the demonstrated variety (Revati and MO-9).



*Cultivation of red kernel rice*







### Optimization of Yield of Cowpea (Alsando-1) under Residual Moisture in Rice Fallows

A total of five trails covering an area of 1.80 ha in four villages namely Pilar, Chodan, Bhironda & Taleigao were conducted during rabi 2010-11 to assess the performance of cowpea selection “Alsando-1”.



Optimization of yield of cowpea (Alsando-1)

### Assessment of Groundnut, Cowpea and Urid under Residual Moisture in Rice Fallows

An area of 3.75 ha was covered to assess the performance of groundnut TG-37A, cowpea (Alsando-1) and Urid (DU-1) at 8 farmers in Pilar, Goa Velha, Taleigao, Bhironda and Chodan during rabi 2010-11.



Assessment of groundnut under residual moisture in rice fallows

### Cultivation of Groundnut Cv. TG-37A and Quality Seed Production during Kharif

The improved variety TG-37A was demonstrated in an area of 1.5 ha at 3 farmers fields of Priol and Velling village during Kharif, 2010. The demonstrated cv TG-37A was produced an average of 15.64 q/ha pod yield which has used for seed purpose during rabi 2011.



Groundnut cv. TG-37A

### Promotion of Groundnut Cv. TG-37A under Residual Moisture in Rice Fallows

The groundnut TG-37A was planted at farmers field of Bhironda, Taleigao, Chorraa village in 3.5 ha area.



Groundnut cv. TG-37A

### Management of Root Rot in Chillies

To manage the root rot disease in chilli through treatments viz: Spacing 45x 45cm and treating the seedlings with Blitox/Fytolon @ 3g/l of water and spacing 45x45 cm and nursery bed drenching and







seedling treatment with *T. viride* @ 50g/l of water along with farmers practice were assessed in Chodan village in 2.0 ha area at 10 farmers field.



*Management of root rot in chillies*

### Management of Fruit Fly in Cucurbits

The demonstration was conducted at Karmali in 1.0 ha area involving 10 farmers on squirting with jiggery solution (5%) and mass trapping of fruit flies. An average of 8.3 fruits flies were trapped / week and the infestation was reduced from 14.52% to 4.19%, however the fruit yield was increased from 75.3 q/ ha to 135.6 q/ha.



*Management of fruit fly in cucurbits*

### Management of Cashew Stem and Root Borer

In demonstration on management of cashew stem and root borer conducted with drenching of the bark (up to) 1m with chloropyriphos (0.01%) and stem injection with dimethoate (0.01%) in 2.0 ha area of Pilar and Adcona villages.



*Management of cashew stem and root borer*

### Production Technology of Turmeric and Ginger

Production technology of turmeric using high yielding varieties (Prabha, Pratibha and Meghalya turmeric selection-1) with improved package of practice has been successfully transferred to progressive farmers namely Shri Shrihari Khurade in Sanguem zone who took up the production on large scale during the year. He produced about 25 tons of fresh rhizomes and supplying the seed rhizomes to other farmers on commercial scale.



*Ginger plot*

Similarly, production technology of ginger with high yielding varieties Himachal and Varada was also adopted by Sri Krishnaparasad Gadgil in Sattari zone, who could produce about 17 tonnes/ha of fresh ginger during the current season.







### Cultivation of Turmeric Cv. Pratibha under Coconut Garden

The turmeric cv. Praibha was planted under coconut garden to utilize interspace in a area of 0.5 ha at 10 farmers field in Chodan, Bhironda, Adcona and Corlim village.



*Cultivation of turmeric cv. Pratibha under coconut garden*

### Cultivation of banana, pineapple, nutmeg and pepper in coconut garden

The efficient utilization of natural resource especially interspaces under coconut garden, banana, pineapple, nutmeg and peppers were planted at four farmers field of Chodan, Adcona and Pillar village in 1.0 ha area.



*Cultivation of banana, pineapple, nutmeg and pepper in coconut garden*

### Integrated Nutrient Management in Malcurado Mango

The different treatments viz. 1500:500:500g NPK/tree/year through inorganic fertilizer (RFD), 300kg/tree/year, 50%NPK (inorganic) + 50%

FYM (organic) along with farmers practice (no fertilizer application) were assessed to increase the productivity of Malcurado Mango in 1.0 ha area at five locations of Chodan village.



*Integrated nutrient management in Malcurado mango*

### Evaluation of Chinese Cabbage Variety under Rice Fallow Land

Two variety of Chinese Cabbage viz: Solan Band and Palampur Green were assessed during Rabi season 2010-11 at five locations of Chodan, Pilar and Taleigao villages covering an area of 0.20 ha to find out the feasibility of crop cultivation under the agro climatic conditions of Goa. The Chinese cabbage cv. Solan Band performed well, produced an average of 170.32 q/ha. leaf yield with 2.58 BCR ranging from 164 to 172 q/ha.



*Chinese cabbage variety under rice fallow land*

### Assessment of Capsicum in Open and Shade Net

Capsicum cv. California Wonder and Solan Bharpur were assessed under open and shade net at







five locations of Chodan, Pilar and Taleigao villages in 0.25 ha area to ascertain the performance of the varieties under open and shade net conditions in Goa.



*Assessment of capsicum in open and shade net*

### **Cultivation of Capsicum cv. California Wonder**

The cultivation practices of Capsicum cv. California Wonder was demonstrated at five farmers fields of Pilar and Chodan village covering an area of 0.2 ha during rabi 2009-10. An average of 154.4 q/ha fruit yield /ha was observed.



*Cultivation of capsicum cv. California Wonder*

### **Early Pregnancy Diagnosis in Pigs with Ultrasonography**

For the pregnancy diagnosis of pigs in farmers field the major problem was of restraining the animal. The scanning was done with abdominal probe of 3.5 Mhz frequency. Female pigs which were examined were not known for the breeding history. It was observed that some of sows were in advance stage of pregnant of about 75-80 days but farmer was

unaware of it. Female which were mid pregnant of 60-65 days and early pregnant of about 35-50 days were considered by farmer as nonpregnant. The demonstration of pregnancy diagnosis with ultrasonography has brought awareness for the losses with pig farming.



*Early pregnancy diagnosis in pigs with ultrasonography*

### **Pig excreta based Biogas**

Biogas is a combination of natural gasses mostly methane and carbon dioxide produced after anaerobic decomposition of organic waste material like animal excreta (faecal material) and biomass.

Like dairy farming pig rearing is also one of important subsidiary enterprise in Goa State. The disposal of pig waste is very important from health, social and economic point of view. On the basis of technical requirements pig manure also can be used for the production of biogas. For the demonstration of the biogas plant using pig faecal material a biogas plant is constructed at the Institute under All India Coordinated Research Project on pigs.

Type : Fixed dome type

Capacity : Six cubic meter



*Pig excreta based biogas*







Cost of the Unit An amount of Rs.54000[- was spend for the construction of unit including pipeline and stove. Waste utilized pig excreta (faecal material about 100 to 110 kgs) is used for this plant. Gas with full pressure is available for 6-7 hours which is equivalent for energy of 53 units of electricity per day. Economics estimated savings are about ₹.2100 per month.



*Biogas at farmers field*

### Production of Green Fodder Round the Year

Four grasses (CO-3, DHN-6, IGFRI-3 and IGFRI-7) were assessed in 1.5 ha area at 4 farmers field in Priol, Valpoi and KVK farm.



*Production of green fodder*

### Management of Sub Clinical Milk Fever

Frontline demonstrations were taken covering 30 animals in Priol village to manage the sub clinical milk fever.



*Management of sub clinical milk fever*

### Popularization of Vanraja and Grampriya Birds for Backyard Poultry Farming

Ten demonstration on the performance of Vanraja and Grampriya poultry bird was taken in Pilar village under backyard poultry farming.



*Gramapriya in farmers field*





## Education and Training

### Education

#### Lectures delivered by the Scientist

Date	Lecture Topic/Programme	Participants	Venue
<b>S. Subramanian</b>			
5.5.2010	Freshwater ornamental fish seed production and aquarium management	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
<b>B. L. Manjuanth</b>			
7.5.2010	Quality hybrid rice seed production	Progressive farmers	KVK, ICAR Goa
6.10.2010	Production practices of suitable fodder crops for Goa	Extension personnel of developmental departments / Progressive farmers	ICAR Goa
16.10.2010	Rice varieties suitable for Goa	Progressive farmers	ICAR Goa
2.11.2010	Seed production in groundnut and pulses	A.A.O/A.O of Directorate of Agriculture	State Directorate of Agriculture, Panaji, Goa
7.1.2011	Resource management technologies	A.A.O/A.O of Directorate of Agriculture	ICAR Goa
8. 2. 2011	Importance of quality seed in agricultural production	Progressive farmers	ICAR Goa
9.2.2011	Quality seed production in pulse crops	Progressive farmers	ICAR Goa
18.3.2011	Profitable forage production	Progressive dairy farmers	Goa Dairy, Ponda Goa
19.3.2011	Profitable forage production	Progressive dairy farmers	Goa Dairy, Ponda Goa
21.3.2011	Profitable forage production	Progressive dairy farmers	Goa Dairy, Vithalpur, Sanquelim, Goa
22.3.2011	Profitable forage production	Progressive dairy farmers	Municipality Office, Bicholim, Goa
23.3.2011	Profitable forage production	Progressive dairy farmers	Veterinary Hospital, Valpoi, Goa
24.3.2011	Profitable forage production	Progressive dairy farmers	Panchayat Office, Colvale, Goa
<b>B. K. Swain</b>			
26.9.2010	Role of probiotics, prebiotics and synbiotics in poultry	Students	Smt. Parvatibai Chowgule College of Arts and Science, Madgaon, Goa.
<b>P. K. Naik</b>			
06.05.2010	Feeding of green fodder to dairy animals	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
30.07.2010	Feeds and feeding of rabbits	Progressive rabbit farmers	ICAR Goa







06.10.2010	Feeding strategy for sustainable dairy production in Goa	Veterinary Officers and Progressive Dairy Farmers	ICAR Goa
29.10.2010	Feeds and feeding of dairy animals for optimum milk production	Progressive dairy farmers	Netravali, Goa
17.12.2010	Feeds and feeding of rabbits	Progressive rabbit farmers	ICAR Goa
<b>A. R. Desai</b>			
21.09.2010	Home grown spices for culinary and processing purpose and spice culture	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
22.09.2010	Common medicinal and aromatic plants in Goa.	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
10.03.2011	Nucleus seed and breeder seed production and seed chain Production	Trainees in training programme	KVK, ICAR Goa
<b>M. Thangam</b>			
03.05.2010	Quality seed production in ornamentals crops	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
04.05.2010	Production of seeds and planting material under protected condition	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
21.09.2010	An overview of kitchen gardening and Importance of vegetables in human nutrition and health	Trainees at Workshop on Kitchen gardening	ICAR Goa
22.9.2010	Layout and establishment of kitchen gardening and herbal garden	Trainees at Workshop on Kitchen gardening	ICAR Goa
11.03.2010	Seed Processing and Grading	Trainees Seed production Training	ICAR Goa
<b>S. Priya Devi</b>			
21.9.2010	Importance of fruits in Human Nutrition and Health and Fruit culture	Trainees at Workshop on Kitchen gardening	ICAR Goa
22.9.2010	Nutraceutical and medicinal uses of medicinal and aromatic plants	Trainees at Workshop on Kitchen gardening	ICAR Goa
<b>R. R. Verma</b>			
01.05.2010	Perspectives of conservation agriculture	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
05.05.2010	Integrated nutrient management (INM) in horticultural and field crops	Trainees at Entrepreneurship Development Programme	KVK, ICAR Goa
<b>S. A. Safeena</b>			
21.09.2011	Flower culture	Trainees at Workshop on Kitchen gardening	ICAR Goa
22.09.2011	Minimal processing of home grown medicinal plants	Trainees at Workshop on Kitchen gardening	ICAR Goa
22.10.2010	Technical aspects and experiences in production of cut flowers in Goa	For farmers and Agriculture Officers	Krishi Bhawan, Tonca Panaji, Goa
02.11.2010	Modern and Scientific methods of Jasmine Cultivation	For students and farmers	S.V.Wagle High School, Mardol, Goa





## Trainings

### *Training programmes organized by the Institute*

Name of the Training	Venue	Period
Commercial dairy farming	ICAR, Goa	April 12, 2010
Entrepreneurship development in seed and planting material production	KVK, ICAR Goa	April 29 – May 4, 2010
Commercialized rabbit farming	ICAR Goa	May 10-12, 2010
Commercialized rabbit farming	ICAR Goa	July 29-31, 2010
Nutrition, reproduction and management of dairy animals	Netravali	October 29, 2010
Commercialized rabbit production	ICAR Goa	December 16-18, 2010
Seed production in agricultural crops with special reference to pulses and oilseeds	ICAR Goa	March 10-11, 2011
Clean milk production	KVK, ICAR Goa	March 19-26, 2011



*Training on nutrition, reproduction and management of dairy animals at Netravali, Goa*



*Training on commercialized rabbit farming*







## Awards and Recognition

### Dr. N. P. Singh

- Member of the task Force Committee constituted for Review and Restructure of the Biotechnology Policy- 2006
- Member of Task Force Sub- Committee constituted by Directorate of Insutries, Trade & Commerce to prepare a report on the “Development of co-operative sector, farmers clusters, cottage industries, self help groups, etc.
- Nominee of the Chancellor on the Academic Council of Goa University
- Member of the Sub- group on agriculture of the Goa Golden Jubilee Development Council for preparing the Vison Document, Goa – 2035
- Member of Rashtriya Krishi Vikas Yojna (RKVY) Cell
- Member of State Level Executive Committee (SLEC) for National Horticultural Mission (NHM)
- Member of Managing Committee of the Goa State Medicinal Plant Board
- Member of the State Level Committee of Coconut Development Board
- Member of the State Level Committee of Oil Palm Development
- Member of the State Variety Release Committee, Govt. of Goa
- Nominee of the Chancellor in the Selection Committees of Life Sciences, Goa University

### Dr. S. B. Barbuddhe

- Received the International Travel grant of DST, Govt. of India to attend XVII International Symposium on Problems of Listeriosis (ISOPOL) held in Porto, Portugal during May 5-8, 2010
- Conferred with the Fellow of IAVPH specialists during the National Symposium on “Veterinary Public Health: New Horizon for Integrating the Animal Production, Food Safety and Human Health” organized by Mumbai Veterinary College, Mumbai held during January 28-29, 2011

### Dr. P. K. Naik

- Awarded Membership of National Academy of Veterinary Sciences (I) on October 30, 2010 by the National Academy of Veterinary Services (I), New Delhi

### Dr. R. Ramesh

- Selected for DBT- CREST award (Cutting Edge Research Enhancement and Scientific Training Awards) 2010-11
- Awarded first prize for poster presentation for the paper “Diversity of *Ralstonia solanacearum* infecting solanaceous vegetables” at the National symposium on perspective in the plant health management held during. December 14-16, 2010 at AAU, Anand, Gujarat, India
- Awarded first prize for oral presentation for the paper “Genetic diversity of *Ralstonia solanacearum* from Goa” and first prize for poster presentation for the paper entitled “Antagonistic and growth promotion activity of xylem residing bacteria isolated from eggplant and chilli” at the National symposium on “Microbial diversity and its applications in health, agriculture and industry” held during March 4-5, 2011 at ICAR RC for Goa, Goa, India

### Dr. S. Priya Devi

- Scientist (Horticulture) received Dr.K Balaraman Gold Medal for best thesis in Horticulture during 31<sup>st</sup> Convocation held in TNAU on July 14, 2010

### Mrs. S. A. Safeena

- Awarded the best poster award for the paper “Post harvest management of Liliium cut flower cultivars for enhanced vase life under coastal humid condition of Goa” during Fourth Indian Horticulure Congress – 2010 organised by HSI during November 18-21, 2010 at New Delhi





## Ongoing Research Projects

### Institute Projects

Sr. No.	Project Title	PI	Co - PI	Duration
<b>Resource Management and Integrated Production</b>				
1.	Development and evaluation of soil and water conservation measures for sustainable production of major horticultural crops in Goa	RR Verma	BL Manjunath	2008 – 13
2.	Integrated nutrient management in coastal saline soils of Goa for sustainable crop production	RR Verma	BL Manjunath	2008 -11
3.	Standardization of management practices for organic rice production	BL.Manjunath	RR Verma R Ramesh	2009 -14
<b>Crop Improvement and Protection</b>				
4.	Breeding salt tolerant rice cultivars suitable for Coastal Saline Soils of Goa and Evaluation of varieties / hybrids for their suitability for cultivation in Goa	KK Manohara	JR Faleiro BL Manjunath	2010 – 15
5.	Development of high yielding disease and insect resistant Cowpea varieties with desired seed quality parameters suitable for cultivation in Goa State	KK Manohara	JR Faleiro	2010 – 14
6.	Development of potential bacterial biocontrol agents for plant disease management under coastal ecosystem	R.Ramesh		2008 –11
<b>Horticulture</b>				
7.	Survey, collection, introduction and evaluation of kokum and other <i>Garcinia</i> species	S Priya Devi	M Thangam	2005 -14
8.	Evaluation of commercial cultivars of fruit crops under the agro-climatic conditions of Goa	S Priya Devi		2006 -14
9.	Post harvest management of horticultural crops	S. Priya Devi		2006 - 11
10.	Hybridization of local coconut cultivars with dwarf varieties	AR Desai		2007-11
11.	Standardization of production technologies for flowers and vegetables under protected structures (Polyhouses) and under coconut plantations	M. Thangam	SA Safeena	2007 – 13
12.	Integrated strategies through classical and modern techniques for crop improvement in cashew and spices	AR Desai	J Ashok Kumar	2009 – 14
13.	Breeding of brinjal for high yield and resistance to bacterial wilt through conventional and molecular approaches	M. Thangam	SA Safeena R Ramesh	2009 - 14
14.	Collection, conservation, cataloguing and evaluation of germplasm of ornamental crops of Goa and adjoining regions	SA Safeena	M Thangam S Priya Devi	2010 -13
<b>Animal Sciences</b>				
15.	Characterization of natural microflora from fermented cashew apple juice and cashew apple waste and its utilization	SB Barbuddhe	BK Swain A R Desai	2008 – 11
16.	Effect of supplementation of feed additives (Probiotics, enzymes and yeast) on the performance and economics of production of broilers, layers and backyard poultry	BK Swain	PK Naik	2009 – 13
17.	Utilization of palm oil and other unconventional feed resources for efficient poultry production	BK Swain	EB Chakurkar SB Barbuddhe	2009 -13







Sr. No.	Project Title	PI	Co - PI	Duration
18.	Prevalance and persistence of pathogens of public health significance from culture and capture fisheries environment	SB Barbuddhe	S Subramanian KN Mohanta BK Swain	2010 -13
19.	Impact of microclimatological changes on livestock production and ameliorative measures through managerial intervention	SK Das	EB Chakurkar	2010-13
20.	Survey on the feeds and feeding practices of the livestock in Goa	PK Naik	EB Chakurkar	2009 – 13
21.	Nutritional interventions for optimization of economical milk production in Goa	PK Naik	EB Chakurkar SK Das	2010 – 14
<b>Fishery Science</b>				
22.	Digitalized database of aquatic and fisheries resources for Goa	S Subramanian	J Ashok Kumar KN Mohanta	2008 – 11
<b>Agro –Eco- Tourism</b>				
23.	Agro-eco tourism : Impact and popularization	SB Barbuddhe	J Ashok Kumar KN Mohanta M Thangam	2010-12

### Externally Funded Projects

Sr. No	Project Title	PI	Co-PI (s)
<b>DBT</b>			
1.	Development of INM package for commercially important plantation crops	R Ramesh	
2.	Indo German Consortium for epidemiology and collaborative genomics of <i>Listeria</i>	SB Barbuddhe	J Ashok Kumar EB Chakurkar BK Swain
<b>INCOIS</b>			
3.	Validation of potential fishing zone advisories along Goa coast with an attempt to study the possible advantages of PFZ advisories for different types of fishing activities.	S Subramanian	
<b>ICAR</b>			
4.	Seed production in agricultural crops and fisheries	BL Manjunath	S Subramanian MS Ladaniya KK.Manohara KN Mohanta
5.	<i>Phytopthera, Fusarium</i> and <i>Ralstonia</i> diseases of horticultural and field crops	R Ramesh	M Thangam
6.	All India Co-ordinated Project on Pigs	EB Chakurkar	PK Naik
7.	All India Co-ordinated Project on Vegetables	M. Thangam	
8.	All India Co-ordinated Project on Cashew	AR Desai	
9.	All India Co-ordinated Research Project on Integrated farming System	NP Singh	S Subramanian SK Das EB Chakurker BL Manjunath BK Swain AR Desai S Priya Devi RR Verma





## Human Resource Development

### Participation in Conference / Seminar/ Symposia/ Workshops

Date	Name	Programme	Venue
April 4 – 6 , 2010	Dr. B. L. Manjunath Dr. K. K. Manohara	45 <sup>th</sup> Annual Rice Group Meeting	AAU, Anand
April 21-22, 2010	Dr. N. P. Singh Dr. S. Subramanian	National Conference on Expert Consultation on Marine Biotechnology and Biodiversity Conservation	International Centre, Goa
April 26, 2010	Dr. S. Subramanian	PFZ Validation Project Annual Review Workshop National	INCOIS, Hyderabad
April 27, 2011	Dr. S. Subramanian	Workshop on Exercise on Logistic Framework Approach	INCOIS, Hyderabad
May 5-8, 2010	Dr. S. B. Barbuddhe	XVII International Symposium on Problems of Listeriosis	Porto, Portugal
May 8-9, 2010	Dr. S. Priya Devi Dr. M. Thangam	National Symposium on <i>Garcinia</i> .	Forestry College, Sirsi
May 27-28, 2010	Dr. K. K. Manohara	26 <sup>th</sup> Annual workshop on Arid Legumes	VPKAS, Almora
June 10, 2010	Dr. S. K. Das	Seminar on Food, Agriculture, Fisheries and Biotechnology	NIO, Goa
June 21-22, 2010	Dr. R. Ramesh	Statistical software (SAS) installing Programme.	UAS, Bangalore
June 25-28, 2010	Dr. N. P. Singh	National seminar on mango bio-diversity	CISH, Lucknow
July 6, 2010	Dr. S. B. Barbuddhe	National symposium on Recent Trends in Control of Zoonotic Diseases	Nagpur
July 19-20, 2010	Dr. B. L. Manjunath	Review meeting of Mega Seed Project in Agricultural crops and Fisheries	DSR Mau. U.P
July 19-23, 2010	Dr. N. P. Singh	Management Development Programme on Leadership for Innovation in Agriculture”	MANAGE, Hyderabad
August 24-26, 2010	Dr. N. P. Singh	International Conference on Agriculture Education and Knowledge Management	Pragna Bhawan, Agratala, Tripura
August 25, 2010	Dr. M. Thangam	Workshop on Linking agriculture producers to the export market from the state of Goa	Goa Bagyatdar, Ponda, Goa
Sep. 16-18, 2010	Dr. B. K. Swain	National Symposium of Indian Poultry Science Association (IPSACON 2010) on “Indian Poultry Sector & Global Scenario”	Madras Veterinary College, Chennai
Sept.22, 2010	Dr. S. Subramanian	Brainstorming session on enhancing the role of IASRI in R & D	IASRI, New Delhi
Sept.24-26, 2010	Dr. S. Priya Devi	National Seminar on Technical Interventions for Sustaining Production of Commercially Viable Medicinal Crops in India	TNAU, Coimbatore
Oct. 27-30, 2010	Dr. N. P. Singh Dr. S. K. Das Dr. B. L. Manjunath Dr. B. K. Swain Dr. R. Ramesh Dr. P. K. Naik Dr. M. Thangam Dr. R. R. Verma Dr. K. K. Manohara Mrs. S. A. Safeena	9 <sup>th</sup> National Symposium on recent outlook on sustainable agriculture, livelihood security and ecology of coastal region	Calangute, Goa







Date	Name	Programme	Venue
Oct. 29-30, 2010	Dr. N. P. Singh	Curtain Raiser Meet on Research Needs Arising due to Abiotic Stresses in Agriculture Management in India under Global Climate Change Scenario	Baramati, Maharashtra
Nov.10-13, 2010	Dr. S. K. Das	International conference on Physiological Capacity building in livestock under changing Climate Scenario	IVRI, Izatnagar
Nov.18-21, 2010	Dr. M. Thangam Mrs. S. A. Safeena	4 <sup>th</sup> Indian Horticulture Congress	NPL, Pusa, New Delhi
Nov.26, 2010	Dr. V. Arunachalam Dr. M. Thangam	Workshop on packaging of processed food	Vivanta, Panaji
Nov.26-28, 2010	Mrs. S. A. Safeena	National Conference on Plant Diversity for Aesthetic Values and Landscape Gardening	TNAU, Coimbatore.
Nov., 27-29	Dr. N. P. Singh	7 <sup>th</sup> convention of Grameen Gyan Abhiyan- Rural Knowledge Movement	University of Mumbai, Mumbai
Nov.30, 2010	Dr. S. Subramanian	Seminar on Marine Biodiversity and sustainable utilization	Vasco Goa
Dec.2-4, 2010	Dr. N. P. Singh Dr. B. L. Manjunath	National Symposium on Resource Management Approaches Towards Livelihood Security	UAS, Bangalore
Dec.2-4, 2010	Dr. N. P. Singh	XXI meeting of ICAR Regional Committee No. VII	Bhopal, M.P.
Dec.10-13, 2010	Dr. B. L. Manjunath	Biennial workshop of AICRP on Integrated Farming Systems	Hyderabad
Dec.14-16, 2010	Dr. R. Ramesh	National symposium on “perspective in the plant health management	Anand Agricultural University, Anand
Jan. 17-20, 2011	Dr. S. Subramanian	Asia-Pacific Conference on Aquaculture and Giant Prawn-2011	Kochi- Kerela
Jan. 20-23, 2010	Dr. N. P. Singh	National seminar on climate change and food security challenges and opportunities for tuber crops	CTCRI, Thiruvanthapuram
Jan. 27 - 30, 2011	Dr. M. Thangam	29 <sup>th</sup> workshop on AICRP (Vegetable Crops)	JAU, Junagadh,
Jan.28-29, 2011	Dr. S. B. Barbuddhe	National Symposium on Veterinary Public Health: New Horizon for Integrating the Animal Production, Food Safety and Human Health	Mumbai Veterinary College, Mumbai
Feb. 17-18, 2011	Dr. R. Ramesh	Second annual review meeting of outreach project on <i>Phytophthora</i> , <i>Fusarium</i> and <i>Ralstonia</i> diseases of horticultural and field crops	IISR, Calicut
Feb. 20-22, 2011	Dr. N. P. Singh	National consultation for production and utilization of orchid	NRC for Orchid, Sikkim,
March 11-12, 2011	Dr. A. R. Desai Ms. Anuradha Naik	Group meeting - cum - workshop of IPM and transfer/commercialization of Agriculture Technology Scheme	CIRCOT, Mumbai
March 23-26, 2010	Dr. V. Arunachalam Dr. E. B.Chakurkar	International conference on Tropical island ecosystems	CARI, Port Blair





## Trainings attended

Date	Name	Programme	Venue
August 30, 2010	Dr. K. K. Manohara	Global Plan of Action, Conservation and Sustainable Utilization of Plant Generic Resources for Food and Agriculture	NBPGR, New Delhi
Oct.11-15, 2010	Dr. K. K. Manohara	Leveraging Innovation in Scientists and Technologists (LIST)	IMTR, Goa
Nov.8 – 28, 2010.	Dr. S. Priya Devi	Winter school on ‘Molecular Techniques in gene isolation and characterization’	NRC for Plant Biotechnology, New Delhi
Nov. 11, 2010	Dr. R. Ramesh	Training on PIMS-ICAR	CIAE, Bhopal
Jan.17-21, 2011	Dr. S. Priya Devi Ms. S. A. Safeena	DST sponsored Training Programme on Ladies Excellence and Attitude Programme	Madgaon, Goa
March 28 – April 6, 2011	Dr. V Arunachalam Ms. S. A. Safeena	National training on current approaches and bioinformatics applications in agricultural research	CTCRI Thiruvanthapuram
March 28 – April,1 2011	Dr. R. R. Verma	Training on Data Mining and GIS for Decision Support in Agriculture	IIM, Lucknow







## List of Publications

### Research Articles

- Chakurkar, E. B., Naik, P. K., Swain, B. K. and Singh, N. P. (2011). Performance of different breeds of piglets on starter diet in Goa. Indian Veterinary Journal (In press).
- Desai, A. R., A. N. Mokashi, V. S. Korikanthimath, B. Fakrudin, R. V. Patil, R. V. Hegde and Raveendra, N. Gadag (2010). Comparative Analysis of Morphometric and Molecular Diversity in Cashew (*Anacardium occidentale L.*) Genotypes. Indian J. Plant Genetic Resoueres.23 (1) : 104-109.
- Desai, A.R. and S. P. Singh (2010). Performance of local cashew accessions. The Cashew. 25 (2).
- Desai, A. R., A. N. Mokashi, V. S. Korikanthimath, B. Fakrudin, R. V. Patil, R. V. Hegde and Raveendra, N. Gadag (2011). Identification of potential parents using RAPD marker for hybridization in cashew. Euphytica (In press).
- Godinho, A., Ramesh, R. and Bhosle, S. (2010). Bacteria from sand dunes of Goa promoting growth in eggplant. World journal of agricultural sciences. 6: 555-564.
- Kumar, K., Verma, R. R., Tripathi, A. K. and Kanoujia, V. K. (2010). Impact of various conservation measures on physical properties and erodibility behaviour of soil. Current advances in agricultural sciences 2(1)13-17.
- Manjunath, B. L., R. Ramesh and V. S. Korikanthimath, (2010). Feasibility of ramie intercropping in coconut, Journal of Plantation Crops, 38(3) :207-210.
- Naik, P. K., Chakurkar, E. B., Manjunath, B. L., Swain, B. K. and Singh, N. P. (2011). Production potential of fodder maize as intercrop with cashew. Indian Veterinary Journal (In Press).
- Priya Devi, S., Balamohan, T. N., Thangam, M., Ramachandrudu, K. and Korikanthimath, V. S. (2010). Genetic diversity in fruit characters of kokum (*Garcinia indica* (Choisy) Thouars) in Goa, South Indian Hort.58:10-14.
- Ramachandrudu, K., M. Thangam and V. S. Korikanthimath (2010). Performance of baby corn genotypes under high rainfall conditions of Goa. Indian J. Hort.:67(3): 414-417.
- Swain, B. K. and Chakurkar, E. B. (2011). Effect of maxigro supplementation of sunflower based diets on production performance of Vanaraja laying hens. Indian Veterinary Journal, 88:51-53.
- Swain, B. K. and Chakurkar, E.B. (2011). Effect of replacing soyabean meal by fish meal in growing Vanaraja chickens. Indian Veterinary Journal (In press).
- Swain, B. K., Naik, P. K., Chakurkar, E. B. and Singh, N. P. (2011). Effect of probiotics on the performance of Gramapriya chicks. Indian Veterinary Journal (In press).
- Swain, B. K., Chakurkar, E. B. and Barbuddhe, S. B. (2010). Effect of feeding processed poultry hatchery waste on the performance of Vanaraja chicks. Indian Journal of Poultry Science (In press).





## Paper Presented/ Conference Abstracts

- Achari, G. and Ramesh, R. (2011). Antagonistic and growth promotion activity of xylem residing bacteria isolated from eggplant and chilli. National symposium on “Microbial diversity and its applications in health, agriculture and industry”. 4-5<sup>th</sup> March, 2011 held at ICAR Research Complex for Goa, Old Goa, Goa, India, pp. 51-52.
- Arunachalam, V. (2011). Sequence diversity and pathogenicity of *Pseudomonas*. National seminar on Microbial diversity in agriculture health and industry March 4-5, 2011 at ICAR Research Complex for Goa, Goa.
- Arunachalam, V., Singh, N. P., Thangam, M., Priya Devi, S. (2011). Ethnobotany and underutilized plants of Goa state, India. International conference on tropical island ecosystems Tiecon 2011 held at Central Agricultural Research Institute Port Blair March 23-26, 2011.
- Barbuddhe, S. B., Malik, S. V. S., Ashok Kumar, J., Kalorey, D. R., Kurkure, N. V, Rawool, D. B, Swain, B. K., Korikanthimath, V. S. and Chakraborty, T. (2010). Foodborne listeriosis in India: An update. Paper presented at XVII – International Symposium on Problems of Listeriosis, Porto, Portugal, May 5-8, 2010, No.C/O/25.
- Barbuddhe, S. B., Malik, S.V. S., Kalorey, D.R. and Poharkar, A.G. (2010). Zoonoses: classification causes of emergence and socioeconomic concerns. National symposium on “Recent trends in control of zoonotic diseases”, Nagpur, 6 July, 2010, pp. 1-7.
- Barbuddhe, S. B. and Kalorey, D.R. (2010). Climate change and zoonoses. National symposium on “Recent trends in control of zoonotic diseases”, Nagpur, 6 July, 2010, pp. 12-18.
- Barbuddhe, S. B. and Poharkar, A.G. (2010). Intersectoral collaboration between veterinary and human medicine. National symposium on “Recent trends in control of zoonotic diseases”, Nagpur, 6 July, 2010, pp. 12-18.
- Barbuddhe, S. B. (2010). Conservation of indigenous livestock: sustaining biodiversity. Seminar on “Ecosystems and biodiversity: Goan perspective”, ICAR Research Complex for Goa, Old Goa, 4 September, 2010.
- Barbuddhe, S. B. (2010). Microbial biodiversity: A boon to mankind. Seminar on “Ecosystems and biodiversity: Goan perspective”, ICAR Research Complex for Goa, Old Goa, 4 September, 2010.
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Improved Production Technology for Rice in Goa; Technical Bulletin No. 24. pp.1-18.	B. L. Manjunath, H. R. Prabhudesai, R. Ramesh, K. K. Manohara and N. P. Singh
Byabasaik Sasपालन ( <i>Marathi version</i> ).	E. B. Chakurkar, P. K. Naik, B. K. Swain and N. P. Singh
<b>Extension Folders</b>	
Goa-1: A Cashew Variety for Goa; Extension Folder No. 36.	A. R. Desai, S. P. Singh, M. Thangam, S. Priya Devi, S. A. Safeena and N. P. Singh
Improved Package of Practices for Cashew Production; Extension Folder No. 37.	A. R. Desai, S. P. Singh, M. Thangam, S. Priya Devi, S. A. Safeena and N. P. Singh
Castration of Pigs; Extension Folder No. 38.	E. B. Chakurkar, P. K. Naik and B. K. Swain
Feeds and Feeding of Dairy Animals in Goa; Extension Folder No. 39.	P. K. Naik, E. B. Chakurkar, B. K. Swain and N. P. Singh
Quail Production and Management Technology; Extension Folder No. 40.	B. K. Swain, N. P. Singh, E. B. Chakurkar and P. K. Naik
Broiler Production Technology for Goa; Extension Folder No. 41.	B. K. Swain., N. P. Singh, E. B. Chakurkar and P. K. Naik
Gramapriya – A Backyard Poultry for Egg Production; Extension Folder No. 42.	B. K. Swain, E. B. Chakurkar, P. K. Naik and N. P. Singh
<b>News Letter</b>	
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## Workshops, Seminars and other Events

### Visit of Additional Secretary, DARE and Secretary, ICAR

Shri. Rajiv Mehrishi, IAS, Additional Secretary, DARE and Secretary, ICAR, New Delhi visited the Institute on July 18, 2010. Dr. N. P. Singh, Director apprised the Additional Secretary about the activities being undertaken by the Institute. He visited different laboratories, field units, KVK and interacted with the Scientists and staff of the Institute.



Visit of Shri. Rajiv Mehrishi, Secretary, ICAR

### Seminar on Improving Fertility in Dairy Animals

A seminar on improving fertility in dairy animals was organised at this Institute on August 14, 2010 in collaboration with Indian Society for Study of Animal Reproduction, Goa Chapter. Shri Ganesh Koyu, Secretary (AH&VS) Government of Goa was the Chief Guest and Shri Madhav Sahakahari, Chairman, Goa State Co-operative Milk Producers Union Curti, Ponda Goa was the Guest of Honour. The



Inauguration of seminar on improving fertility in dairy animals

other dignitaries on dias were Dr. N. M. Markandya, Professor and Head, Dept. of Veterinary Gynaecology and Obstetrics, Veterinary College, Parbhani and Dr. N. P. Singh, Director of the Institute. Dr. E. B. Chakurkar, Senior Scientist (Animal Reproduction) was the Organising Secretary.

### Seminar on Cashew Production in Goa on the Current Trends of Climate Changes

A state level seminar on new challenges in cashew production under current trends of climate change was organized at this Institute in collaboration with Directorate of Cashew nut and Cocoa Development, Cochin and Zuari Industries Limited, Goa on August 21, 2010. Shri V.K.Jha, Secretary (Agriculture) Government of Goa was the Chief Guest and Shri B. K. Kinekar, General manger (Sales), Zuari Industries Ltd was the Guest of Honour. The other dignitaries on dias were Shri. S.S.P.Tendulakar, Director of Agriculture, Government of Goa, Shri. V. N. Hubbali, Director, DCCD, Cochin and Dr. N. P. Singh, Director of the Institute. Dr. A.R Desai, Senior Scientist (Horticulture) was the Organising Secretary.

### Recommendations

- In order to cushion the unpredictable impact of climate changes on cashew crop, multilocational trials of improved varieties need to be initiated and location specific multiple varieties be identified for recommendation.
- Initiation of pest surveillance programmes to develop effective management strategies,



Inauguration of seminar on cashew production







including such techniques like fogging, on priority.

- Emphasis need to be laid on the development and recommendation of the micro nutrient management strategies that may immunize the cashew trees against biotic and abiotic stress including climate changes.
- Adoption of site / location specific customized fertilizers, as a step towards precision farming, for cashew crop may be explored for realizing the higher yield potential.
- Trials to standardize canopy management may be initiated to include in the recommended package of practices.

### Visit of DDG (NRM)

Dr. A.K.Singh, Deputy Director General (NRM), ICAR visited the Institute on September 4, 2010. Dr. N.P.Singh, Director apprised the DDG (NRM)



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

about the activities being undertaken by the Institute. He visited different field experiments, laboratories of the Institute and interacted with the Scientists and staff of the Institute. He also visited the Krishi Vigyan Kendra, North Goa and various technology demonstrations in the farmers fields.

### Seminar on Ecosystems and Biodiversity : Goan Perspective

A seminar on Ecosystems and Biodiversity : Goan perspective was organized at this Institute in collaboration with Centre for Environment Education (CEE Goa State Office) and Association for Coastal Agricultural Research on September 4, 2010. The seminar was inaugurated by Shri. Aleixo Sequeira,

Hon. Minister for Power, Environment, Printing and Stationery, Government of Goa and presided over by Dr. A. K. Singh, DDG (NRM). ICAR. The other dignitaries present on the dias were Dr. Sujeetkumar Dongre, Dy. Programme Co-ordinator, CEE, Goa and Dr. N. P. Singh, Director of the Institute. Dr. S.B.Barbuddhe, Senior Scientist (VPH) was the Organising Secretary.



*Inauguration of seminar on ecosystems and biodiversity*

### Recommendations

- The rich floral biodiversity in Goa region need to be documented and preserved for future generations. Systematic studies on threatened flora such as mangroves needs special attention.
- It is necessary to enhance public awareness of the importance of conserving biodiversity and of the underlying threats to biodiversity.
- Various organizations and NGOs need to be encouraged to prevent the biodiversity loss.
- The enormous diversity in horticultural crops in Goa region needs to be surveyed, documented and preserved.
- The rich marine, microbial diversity need to be harnessed for effective use in biotechnological research.

### Workshop on Kitchen Gardening for Nutrition and Health

State level workshop on kitchen gardening for nutrition and health organized by Fr.Agnel College of Arts and Commerce, Pilar in collaboration with this Institute on September 21-22, 2010 at the Institute. The workshop was organized in a series of programme under the theme area of “Be your own Boss-Level III” by Fr.Agnel College. Mr. Piyush Mehta, Director and Vice President, Manufacturing





Operations, Syngenta India Ltd., Goa was the Chief Guest and Dr. N. P. Singh, Director ICAR Goa, and Father Fredrick Rodrigues, Principal, Fr.Agnel College of Arts and Science, Pilar were guests of honour. Dr. M. Thangam, Senior Scientist (Horticulture) was the Organising Secretary.



*Inauguration of workshop on kitchen gardening*

During the two days, students were presented with series of lecture on homestead farming, kitchen gardening, vegetables, fruits, flowers and spices culture in the kitchen garden, medicinal and aromatic plants and its uses and establishment of kitchen garden for nutrition and health with above mentioned crops was highlighted. The lecture was followed by live demonstration on different methods of seed sowing, planting and establishment of vegetable garden, visit to herbal garden and getting familiarized with common medicinal plants of Goa. In the valedictory function Dr. N. P.Singh, Director distributed certificates to all the participating students.

### **Visit of Dr. M. S. Swaminathan**

Padma Vibhushan Dr. M. S. Swaminathan, Honourable Member of Parliament (Rajya Sabha), Chairman, MSSRF, Chennai and Former Director General, ICAR, New Delhi and IRRI, Philippines visited the Institute on September 27, 2010. Dr. N. P. Singh, Director and Shri Madhav Sahakhari, Chairman. Goa State Co-operative Milk Producers Union Ltd., Ponda Goa gave a brief description of agricultural scenario of Goa. Around 100 farmers from diverse agricultural enterprises of Goa had an interactive discussion with Dr. Swaminathan on various problems on the agricultural, animal and



*Visit of Dr. M.S.Swaminathan, Hon'ble M.P (RS)*

fisheries production in Goa. Dr Swaminathan also visited the rice breeding experiment plots of the Institute.

### **Workshop on Nutritional Interventions for Sustainable Dairy Production in Goa**

A state level workshop for veterinary officers and progressive dairy farmers on Nutritional Interventions for Sustainable Dairy Production in Goa was organized at this Institute with the collaboration of ACAR, Goa during October 6-7, 2010. The main objectives of the workshop was to bring the Scientists of ICAR, Veterinary Officers of the Department of AH & VS and Goa Dairy and Progressive Dairy Farmers and Members of Farmers' Club at one platform to discuss on the current major nutritional challenges to come up for solution and plan future agenda for achieving optimal milk production in Goa.

Shri Ravi S. Naik, Hon'ble Minister of AH&VS, Government of Goa was the Chief Guest. Shri S. S. Naik, Director, Department of AH & VS, Goa and Shri Madhav A. Sahakari, Chairman, Goa Dairy were the Guests of Honour. Dr. N. P. Singh, Director presided over the function and Dr. P. K. Naik, Senior Scientist (Animal Nutrition) was the organizing Secretary.

The workshop was attended by a about one hundred fifty delegates including scientists, technicians, veterinary officers, dairy farmers, members of farmers' club, bankers etc. During the workshop, a 'Souvenir and Concept Papers' containing fifteen chapters and an extension folder







on 'Feeds and Feeding Practices of Dairy Animals in Goa' were released. The two days workshop encompassed three Technical Sessions including nine lectures and open discussion session.



*Inauguration of animal nutrition workshop*

### Recommendations

- The Regional Research Station, Indian Grassland and Fodder Research Institute (IGFRI), Dharwad is requested to provide seeds and planting materials of high yielding nutritious fodder crop varieties suitable for Goa condition along with the package of practices for cultivation.
- The three organizations i.e. ICAR Goa, Department of AH & VS and Goa Dairy will develop facilities for distribution of the seeds and planting materials to the lead farmers, which will be taken up by the other farmers in a chain system.
- The natural karad grass of the state should be protected with the joint venture of the Department of AH & VS and Forest Department.
- A Feed Quality Testing Laboratory may be set up in the Department for the quality control of the livestock and poultry feeds and feed ingredients. The ICAR Research Complex for Goa, Goa will provide technical help for the establishment of the laboratory along with training for feed analysis to the concerned officials.
- New technologies like by-pass fat feeding technology and one day packed ration technology will be introduced and popularized by ICAR Goa with the collaboration of Goa Dairy and Department of AH & VS.

### Kissan Mela

Kissan Mela was organized on October 16, 2010 in association with Krishi Vigyan Kendra, North Goa on the occasion of World Food Day. The progressive farmers from all the Zones of the State



*Inauguration of kisaan mela*

have participated in the programme through the co-ordination of state Directorate of Agriculture, Government of Goa. Package of practices of high yielding production technology for rice and other crops were discussed and field visits were made to the rice and other experimental plots and farmers were appraised about the latest technical know-how of the Institute.

### Visit of Secretary (DARE) and DG (ICAR)

Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR) visited the Institute on October 26, 2010 on his transit to Dharwad. Dr. N.P.Singh, Director of this Institute apprised him about the different activities of this Institute.



*Visit of Dr. S. Ayyappan, Secretary DARE*







### Visit of Advisor (Agriculture), Planning Commission

Shri. V. V. Sadamate, Advisor (Agri), Planning Commission, New Delhi visited the Institute on December 15, 2010. Dr. N.P.Singh, Director apprised the Advisor about the activities being undertaken by the Institute. He visited different field experiments,



Advisor (Agriculture), Planning Commission addressing the meeting

laboratories of the Institute and interacted with the Scientists and staff of the Institute.

### Visit of Agriculture Minister, Government of U.P

Shri. Yogiraj Singh, Honourable State Minister, Department of Agricultural Education & Research, Government of Uttar Pradesh visited the Institute on December 24, 2010. Dr. N.P.Singh, Director apprised the Minister about the activities being undertaken by



Agriculture Minister, Government of U.P releasing the folder

the Institute. He visited different field experiments, laboratories of the Institute and interacted with the Scientists and staff of the Institute. A folder on Quail

produton and technology was released in the hands of the Minister.

### Rice Field Day

With a view to sensitize the farmers of the area on the latest production technology of rice, a Rice Field Day was organized on February 26, 2011 in the Panchayat Office, Cortalim, with the co-ordination of Directorate of Agriculture, Government of Goa and Zuari Industries Ltd, Goa.



Inauguration of rice field day

Dr. Mohan Joseph Modayil, Member ASRB New Delhi was the Chief Guest and Dr. N.P.Singh, Director was the Guest of Honour. On the occasion, a publication on “Improved Production Technology for Rice in Goa” was released for distribution to the farmers. Farmers were apprised of the latest production technology in rice. Field visits were made with the farmers and arranged for the demonstration of blast management in rice.

### National Symposium on Microbial Diversity and its Applications in Health, Agriculture and Industry

A National Symposium on Microbial Diversity and its applications in Health, Agriculture and Industry was organised by this Institute during March 4-5, 2011. Shri Rasik Ravindra, Director, NCAOR, Vasco-da-Gama inaugurated the symposium. Prof. D. K. Arora, Director, NBAIM, Mau, U. P presided over the function. Shri Govind Tiwari, Vice President, United Breweries was the guest of honour. Dr. N. P. Singh, Director, was the Patron and Dr. S.B.Barbuddhe , Senior Scientist (VPH) was the Organising Secretary.







*Inauguration of Symposium on Microbial Diversity*

### Recommendations

- A vast diversity of beneficial microorganisms existing in Western Ghat region needs to be harnessed for enhancing agricultural productivity.
- Metagenomics, may be applied to identify novel compounds for agricultural, medical and industrial use.
- Diversity in plant pathogenic microbes may be studied in the current climate change scenario.
- Intellectual property rights in microorganism need to be understood.
- Efforts should be made to trap the potential of marine micro-organisms.
- Novel strains of actinomycetes may be exploited for industrial applications.
- The use of fungi isolated from various sources such as solar salterns, arctic region in industry should be maximized.
- Gene banks for halophilic or hypersaline tolerance microbes should be developed.
- Efforts should be made to study molecular epidemiology of bovine mastitic pathogens particularly, Staphylococcus and Escherichia coli through nationwide networks. Efforts should also be made to develop indigenous vaccine for control of bovine mastitis.
- Diversity of Rumen Microbes should be harnessed for their optimum utilization in animal production
- Molecular diversity studies on foodborne pathogens should be intensified for planning effective control strategies.

### Visit of Member, ASRB

Dr. Mohan Joseph Modayil Member, ASRB, New Delhi visited the Institute on February 4, 2011.



*Dr. M. J. Modayil Member, ASRB addressing the staff members*

N. P. Singh, Director apprised the Minister about the activities being undertaken by the Institute. He visited different field experiments, laboratories of the Institute and interacted with the Scientists and staff of the Institute.

### Training-cum-Awareness programme on "Protection of Plant varieties and Farmers' Rights Act, 2001"

A farmers training-cum-awareness programme on the Protection of Plant Varieties and Farmers Right was at this Institute in collaboration with Protection of Plant Varieties and Farmers' Rights Authority, New Delhi was organised at the Institute on March 1, 2011. The training programme was inaugurated by Shri.



*Inauguration of training-cum-awareness programme*

Pratapsingh Rane, Hon'ble Speaker, Goa Legislative Assembly, Govt. of Goa in the presence of Dr. P. K. Singh, Registrar, PPV&FRA, New Delhi; Shri. Satish Tendulkar, Director, Dept. of Agriculture, Govt. of Goa. The programme was presided by Dr. N. P. Singh, Director and Dr. Manohara K.K, Scientist (Plant Breeding) was the Organising Secretary.





### **Recommendations**

- ICAR Goa will facilitate in evaluating the local materials available with the farmers them both in agricultural and horticultural crops of Goa and in identifying the novel characters.
- ICAR Goa to facilitate the farmers in getting the Distinctiveness, Uniformity and Stability testing done from the DUS testing centres.

### **Celebrations of Hindi Pakhwada**

Hindi Pakhwada was celebrated at this Institute commencing on September 14, 2010. Different competitions and programmes like Geet Gayan, Hindi General Knowledge, Essay Writing, and Art competition were organised. Prize distribution ceremony was organised on 30 September, 2010 in which Shri Pandurang Madkaikar MLA was the chief guest. Ms. Janik Madkaikar, Sarpanch was the Guest of Honour. Dr. N. P. Singh Director briefed about



*Prize distribution ceremony*

the activities of the Institute as well as programme of Hindi in the Institute.

Chief guest Mr. Madkaikar emphasized the use of Hindi in day to day working in organization helps to coordinate among fellow cliques of different states and languages. Programme concluded with vote of thanks by Dr. R. R. Verma, Hindi Coordinator Rajbhasha.







## Committees and Meetings

### Research Advisory Committee

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

<b>Dr. Kirti Singh</b> Ex-Chairman, ASRB Near TD College, Jaunpur (UP)	Chairman
<b>Dr. U. S. Singh</b> STRASA Co-ordinator IRRI, Indian Liason Office, New Delhi	Member
<b>Dr. P. K.Chhonkar</b> IARI Adjunct Professor & ICAR Emeritus Scientist Dwarka, New Delhi	Member
<b>Dr. P. Rethinam</b> Former ADG (PC), ICAR Lakshmi Nagar, S.N.Palayam, Coimbatore (TN)	Member
<b>Dr. H. Rahman</b> Director, PDADMAS Bangalore	Member
<b>Dr. M. Sinha</b> Advisor (Fisheries) Govt. of Tripura , Pandit Nehru Complex, Agratala	Member
<b>Prof. B. S. Hansra</b> School of Agriculture IGNOU, Maidan Garhi, New Delhi	Member
<b>Dr. P. S. Minhas</b> ADG (S&WM) ICAR, New Delhi	Member

<b>Mr. Madhav Sahakari</b> Chairman, Goa State Co-operative Milk Producers' Union Limited, Curti, Ponda, Goa	Member
<b>Fr. Almeida</b> Pillar Education Society, Bhironda, Goa	Member
<b>Dr. N. P. Singh</b> Director ICAR RC Goa, Old Goa	Member
<b>Dr. B.K.Swain</b> Sr. Scientist (Poultry Science) ICAR RC Goa, Old Goa	Member Secretary

### 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.

<b>Dr. N. P. Singh</b> Director ICAR RC Goa, Old Goa	Chairman
<b>Shri P. Tufani</b> Deputy Director (Plant Protection) Directorate of Agriculture, Tonca, Caranzalem-Goa.	Member
<b>Dr. Parag Haldankar</b> Prof. & Head Department of Horticulture, Dr.BSKKV, Dapoli, Ratnagiri – 415 712 (Maharashtra)	Member
<b>Dr. B. B. Jadhav</b> Director of Research Dr. BSKKV, Dapoli Dapoli – 415 712, Dist. Ratnagiri (Maharashtra)	Member





**Shri Madhav Sahakari** Member  
Chairman, Goa State Co-operative Milk Producers' Union Limited, Curti, Ponda, Goa

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

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

**Dr. A. R. Desai** Member  
Senior Scientist (Hort.)  
ICAR RC Goa, Old Goa.

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

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

**Dr. P. S. Minhas** Member  
ADG (SW&M)  
ICAR, KAB-II  
New Delhi -12

**Finance & Accounts Officer** Member  
CIRCOT, Adenwala Road,  
Matunga, Mumbai - 400 019

**Mr. K. R. Naik** Member Secretary  
Asst. Admn. Officer (Estt)  
ICAR RC Goa, Old Goa

**Dr. N. P. Singh** Chairman  
Director,  
ICAR RC Goa, Old Goa

**All Project Leaders** Members

**Dr. B. L. Manjunath** Member Secretary  
Senior Scientist,  
ICAR RC Goa, Old Goa

### PMC Review Meeting of DBT Projects

The 4th PMC meeting of the DBT project on Development of INM packages for commercially important plantations crops was held at this Institute during October 8-9, 2010. The Chairman and



*Inaugural session of PMC review meeting of DBT Projects*

members of the PMC, DBT advisor and Director of this Institute reviewed the progress made in the projects being implemented across the country by several research organizations.

### Interface Meeting with Directorate of Agriculture, AH & VS and Fisheries, Govt. of Goa

An interface meeting with Directorate of Agriculture, Govt. of Goa was held on January 7, 2011 at the Institute. Shri C.P.Tripathi, Secretary (Agriculture), Govt. of Goa chaired the meeting. Dr. N.P.Singh, Director of the Institute and Shri S.S.P Tendulkar, Director of Agriculture along with Scientists of the Institute and other officers from the Directorate of Agriculture participated in the deliberations. The research highlights suitable for

### Institute Research Council

The Annual Institute Research Committee meeting of the Institute was held in the conference hall of the Institute. The IRC reviewed the progress made under various research projects for the year 2009-10 and finalized the technical programmes of the ongoing research projects for the year 2010-11. The Committee of the IRC is as follows.







*Release of Newsletter during interface meeting*

technology transfer was presented and the relevant points were discussed.

The interface meeting with Directorate of AH&VS and Fisheries, Govt. of Goa was held on January 25, 2011 at the Institute. Shri V.P.Rao, Secretary (AH&VS), Govt. of Goa chaired the meeting. Dr. N.P.Singh, Director of the Institute along with Scientists of the Institute and other officers from the Directorate of AH&VS, Govt. of Goa participated in the deliberations. The research highlights was presented and the relevant points were discussed.





## Infrastructure Development

### Agricultural Research Information System (ARIS) Cell

#### Facilities available

- Networking
- Network services
- Internet access
- Database service
- Hardware and software trouble shooting
- Virus alerts
- Institute e-mail handling

#### Configuration the new IBM server

The IBM server (IBM SYSTEM STORAGE DS3200) was configured with Ubuntu 8.10 Desktop Edition. It was configured with web server - apache, mail server, web based mail application - squirrel mail, proxy server, file server and network. Also php and mysql was configured on the new server. Our website is hosted on this server.



*Agricultural Research Information System Cell*

Leased line connectivity by BSNL under the National Knowledge Network. As high speed internet connectivity under the National Knowledge Network is provided and the new IBM server is linked to it.

### Agricultural Technology Dissemination Centre (ATDC)

#### Services available

- Sensitizing interested farmers and formulations of norms for establishing Agro- tourism units.
- Formulating priorities and research programmes to promote Agro-Eco tourism.
- Offering guidance and helping farmers for developing spice gardens/plantations, herb

garden, floriculture, biogas plant, vermi-compost unit, rabbitry, poultry units, goatery, piggery and integrated farming units.

### New Initiation

Efforts have been initiated to develop a model agro-tourism unit at ATDC. A vermi-compost unit has been installed in the block. A demonstration plot



*Agricultural Technology Dissemination Centre*

for coconut based multistoried cropping system is being developed. A number of spices have been planted and a trail to walk around has been put in place.

### Estate Management

#### Establishment of visitors room

A seven seated air conditioned visitor's room was established in the main office building for the visitors.



*Front view of visitors room*







Inside view of visitors room

### Renovation of exhibition hall and Mandovi guest house

The exhibition hall and Mandovi guest house of the institute was renovated.



Exhibition hall



Guest house

### Intellectual Property Rights (IPR) Cell

#### IPR related issues

- All Consultancy related issues
- Paid Training Programmes
- Patenting of the Institute Technology

- Technology Commercialization
- Copyright of Research and technical publications
- Germplasm Registration (Plant/Animal/Fish)

#### Activities

- Meeting was organised on April 17, 2010 at the Institute to brief scientists about the updates of the ZTMC meeting held at Nagpur and to highlight the importance of protecting intellectual property and the need to commercialize technologies developed at this Institute.
- SRF participated in Seminar /workshop on IPR “CII-MoSME Workshop on IPR for MSME-Focus Clusters - Drug & Pharma” organised by Confederation of Indian Industry (CII) and MSME during November 2-3, 2010 at Panjim Goa.
- IPR Cell co-ordinator and SRF participated in “ICAR– ZTM-BPD meeting cum workshop -West Zone” organised at CIRCOT, Mumbai on March 11-12, 2011 and IPR Cell co-ordinator made a presentation on the activities of ITMU at the Institute for year 2010-11.
- Application is put up to NBPGR for Registration of Mango variety “Cardozo Mankurad” to obtain germplasm registration number.



IPR Cell

- Consultancy training on commercial rabbit farming.
- Contract services such as qualitative analysis of livestock and poultry feeds.





- Initiative has been taken up for obtaining copyrights for the softwares/ databases developed at this institute, by coordinating with ZTMC Zone West.

## Library

### Books

Animal Science	:	414
Crops Science	:	615
Horticulture	:	361
Fishery Science	:	179
Computer Science	:	58
Food Science	:	18
Agroforestry	:	9
Agricultural Statistics	:	18
Hindi Books	:	328
General	:	474
Total	:	2474

### Journals

#### (Indian Journals)

1. Agricultural Science Digest
2. Current Science
3. Environment and Ecology
4. Fishing Chimes
5. Indian Coconut J.
6. Indian J. of Animal Production & Management
7. Indian Food Industry
8. Indian Horticulture
9. Ind. J. of Genetics and Plant breeding
10. Indian J. of Horticulture
11. J. of Food Legumes
12. Ind. J. of Soil Conservation
13. Indian Phytopathology
14. Indian J. of Animal Nutrition
15. Indian J. of Animal Research
16. Indian J. of Fertilizers
17. J. of Indian society of Coastal Agrl. Research
18. The Indian J. of Small Ruminants
19. Indian Sugar
20. J. of Biosciences
21. J. of Indian Society of Soil Science
22. J. of Mycology and Plant Pathology
23. J. of Spices & Aromatic Crops
24. Reasonance-J. of Science Education
25. Spice India
26. The Cashew and Cocoa J.
27. The Indian Veterinary J.
28. The Indian J. of Animal Reproduction

### (International Journal)

1. Agronomy Journal
2. Crop Science
3. Hort Science
4. J. of Animal Science
5. Hortl. Sc. & Biotechnology
6. Plant Disease
7. Poultry Science
8. J. of American Society for Hort. Science



*Institute library*

### Periodicals

1. Annual Review of Agricultural Entomology (Vol.93 to 98)
2. Annual Review of Plant Pathology (Vol. 84 to 89)

### Miscellaneous Literature

1. Fishery Technology
2. Indian Farming
3. Kheti (Hindi)
4. Kissan World
5. Phal Phool
6. Poultry Punch
7. Annual Reports of ICAR Institutes/SAU's
8. Current Contents of Life Science
9. Catalogues
10. Dictionaries
11. Soil Science Maps
12. ICAR News/Bulletins
13. Agris/Hort/Vet CD's







## Distinguished Visitors

Date	Name of Visitor	Designation/ Institute/ Place
18.07. 2010	Shri. Rajiv Mehrishi, IAS	Additional Secretary, DARE & Secretary, ICAR, New Delhi
14.08. 2010	Shri Ganesh Koyu, IAS	Secretary, AH&VS, Govt. of Goa
21.08. 2010	Shri. V.K.Jha, IAS	Secretary, Agriculture, Govt. of Goa
4.09. 2010	Shri. Aleixo Sequeira	Hon'ble Minister for Power, Environment, Printing and Stationery, Govt. of Goa
4.9.2010	Dr. A. K. Singh	DDG (NRM), ICAR, New Delhi
27.09. 2010.	Dr. M. S. Swaminathan	Hon'ble Member of Parliament (Rajya Sabha), Chairman, MSSRF, Chennai
6.10. 2010	Shri Ravi Naik	Minister for Home and AH&VS, Govt. of Goa
16.10, 2010	Shri Shripad Naik	Hon'ble Member of Parliament, North Goa (Lokh Sabha)
26.10. 2010.	Dr. S. Ayyappan	Hon'ble Secretary (DARE) and Director General (ICAR), New Delhi
15.12. 2010	Shri. V. V. Sadamate,	Advisor (Agri), Planning Commission, New Delhi
24.12. 2010.	Shri. Yograj Singh Ji	Hon'ble State Minister, Department of Agricultural Education & Research, Government of Uttar Pradesh
4.02. 2011	Dr. Mohan Joseph Modayil	Member, ASRB, New Delhi





## Personnel

### Institute

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







Sr. No.	Name	Designation	Additional Charge
<b>Administrative &amp; Accounts Staff</b>			
1	Ms.. Maria Teresa Nilgli	Assistant Administrative Officer (Stores)	DDO
2.	Shri Krishnanath R Naik	Assistant Administrative Officer (Establishment)	AAO (KVK)
3.	Shri K. Yesodharan	Assistant Administrative Officer (Works)	
4.	Ms. Lizette Noronha	Personal Assistant	
5.	Shri Agostinho Fernandes	Assistant	
6.	Ms. Asha Manjrekar	Assistant	
7.	Ms. Montia Rita D'Silva	Assistant	
8.	Ms. Pratibha Revodkar	Assistant	
9.	Ms. Sunanda Chopdekar	Assistant	
10.	Ms. Tarika Maoulignkar	Stenographer Grade.III	
11.	Mr. Vinod Pagi	LDC	
<b>Skilled Supporting Staff</b>			
1.	Shri Subhash Melekar		
2.	Ms. Rukma R. Naik		
3.	Shri Francisco Fernandes		
4.	Shri Dugu Khandeparkar		
5	Shri Ashok Gadekar		
6.	Ms. Farida Jabbarkhan		
7.	Shri Ravi S. Kadam		
8.	Shri Chimmnu Tivrekar		
9.	Shri Umakant Haldankar		
10.	Ms. Sunitha Salgaonkar		
11.	Shri Anil Khandeparkar		
12.	Ms.Maria S. Varella		
13	Shri Giri Madkaikar		
14	Shri Gokuldas Kasker		
15.	Shri Umesh Marcelkar		
16.	Shri Vittal Porwar		
17.	Ms. Prafulla Gadekar		
18.	Ms. Rekha V. Naik		
19.	Ms. Lalitha Gadekar		
20.	Ms. Partibha Folkar		
21.	Shri Vilas P. Gaonkar		
22.	Shri Prabhakar Goankar		
23.	Shri Gokuldas P. Gauns		
24.	Shri Sitaram Kuncolikar		
25.	Ms. Janika S. Shirodkar		
26.	Shri Shanu G. Velip		
27.	Shri Datta G. Velip		
28.	Miss. Chitra Madkaikar		





## Krishi Vigyan Kendra

Sr. No.	Name	Designation
<b>Scientific</b>		
1.	Dr. Raj Narayan	Programme Co-ordinator
<b>Technical Staff</b>		
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 Irappa M Chalwadi	Driver-cum-Mechanic T-3
<b>Administrative</b>		
1.	Shri Mario Fernandes	Personnel Secretary
<b>Skilled Supporting Staff</b>		
1.	Shri Prakash Parwar	
2.	Shri Payak J. Padkar	

## Staff Activities

### Appointments

Name	Post	Date of Joining
Dr. V. Arunachalam	Principal Scientist (Horticulture)	18-11-2010
Dr. M. J. Gupta	Scientist (AS & PE)	19-03-2011
Shri Shashi Vishwakarma	Programme Assistant T-4 (Lab Technician)	20-12-2010
Shri Prajapati Vishwajeet Sushilkumar	Programme Assistant T-4 (Computer)	27-12-2010

### Promotions

Name & Designation	Post held	Promoted Post	Date of promotion
Shri K. Yesodhran	Assistant	Asst. Admn. Officer	13-09-2010
Shri Mario Fernandes	Personal Assistant	Private Secretary	14-09-2010
Smt. Pratibha Sawant	UDC	Assistant	02-11-2010
Smt. Sunanda Chopdekar	UDC	Assistant	30-11-2010
Shri Minanath M Zalmi	T-1	T-2	27-09-2010







## Transfer

Name	Post Held	Transferred To	Date of Transfer
Dr. K. N. Mohanta	Senior Scientist (Fish & Fishery Science)	CIFA, Bhubaneswar	1-5-2010
Shri J. Ashok Kumar	Scientist (Computer Application)	CIBA, Chennai	1-5-2010
Smt. Reshma Naik	Skilled Support Staff	CIFE, Mumbai	1-5-2010

## Retirement

Name	Post held	Date of Retirement
Dr. J. R. Faleiro	Principal Scientist (Agril Entomology)	27-7-2010
Dr. H. M. Wasnik	Senior Scientist(Soil Science)	30-4-2010
Shri K. K. Metar	T-5 (Technical Officer)	31-5-2010
Shri Pandurang Mazgaonkar	Skilled Support Staff	31-7-2010

## Obituary

Name	Post Held	Date of Death
Dr. S. P. Singh	Senior Scientist (Horticulture)	27-8-2010





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

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