वार्षिक प्रतिवेदन
ANNUAL REPORT
2009-2010

CENTRAL AGRICULTURAL RESEARCH INSTITUTE
CARI
ICAR
तमसो मा ज्योतिर्गमय

केन्द्रीय कृषि अनुसंधान संस्थान
पोर्ट ब्लेयर-७४४ १०१, अंडमान और निकोबार द्वीप

Central Agricultural Research Institute
Port Blair - 744 101, Andaman & Nicobar Islands

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Hindi Translation Dr. S.K. Verma

Layout, Graphics & Cover Design Dr. M. Balakrishnan
Dr. S.K. Zamir Ahmed

Type setting Mrs Rina Saha

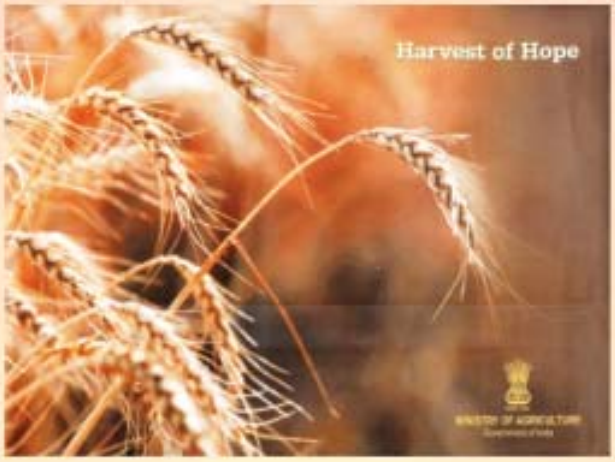
Photography Shri K. Ali Akbar

Overall Compilation & Editing Dr. S.K. Zamir Ahmed
Incharge PMC Cell

Printed at M/s Capital Business Service & Consultancy
B-51, Sahid Nagar, Bhubaneswar-751 007
E-mail : capital_a1press@yahoo.com

MOMENT OF THE YEAR

Triumph of CARI Technologies



CONTENTS

आमुख

मुझे केंन्द्रीय कृषि अनुसंधान संस्थान की वर्ष 2009-10 की वार्षिक रिपोर्ट प्रस्तुत करते हुए हर्ष का अनुभव हो रहा है । यह वर्ष हमारे लिए बहुत से गर्व भरे क्षणों को संजोये हुए बहुत ही यादगार वर्ष रहा । हमारे लिए 3 सितम्बर 2009 का दिन स्वर्णिम दिन था जब महामहिम डॉ.ए.पी.जे. अब्दुल कलाम, पूर्व राष्ट्रपति तथा आधुनिक भारत के मार्गदर्शक हमारे संस्थान में पधारे । उन्होंने हमारे सभी वैज्ञानिकों के साथ ही साथ पोर्ट ब्लेयर में स्थित अन्य संस्थानों के समस्त वैज्ञानिकों के साथ विचारों का आदान प्रदान किया । उन्होंने हमारी अनुसंधान व प्रसार गतिविधियों में बहुत ही रुचि दिखाई और हमें और अधिक कार्य करने के लिए प्रोत्साहित किया । दूसरा उल्लासपूर्ण दिन 26 फरवरी 2010 को था जब हमारे संस्थान द्वारा प्रोद्योगिकीय सहायता प्राप्त पांच किसानों को माननीय श्री शरद पवार जी द्वारा सम्मानित किया गया तथा उनकी सफलता की गाथा को कृषि मंत्रालय द्वारा प्रकाशित हार्वेस्ट ऑफ होप नामक कॉफी टेबल बुक में सम्मिलित किया गया जिसमे पूरे भारत वर्ष के 101 किसानों की सफलता की गाथा का उल्लेख किया गया है । यह के.कृ.अनु.सं. की प्रोद्योगिकियों की किसानों के खेतों तक पहूँच का परिणाम है ।

द्वीपीय कृषि के विभिन्न घटकों के लिए नीतियों का विकास करने के उद्देश्य के साथ जुलाई 2009 में एक विज्ञ मंडल सत्र का आयोजन किया गया जिसका निचोड़ 'अंडमान निकोबार द्वीप समूह के लिए जल नीति' नामक दस्तावेज के रुप में सामने आया । इस दस्तावेज को वृहद रुप में सराहा गया और अंडमान निकोबार प्रशासन ने इसके अध्ययन व इस नीति को कार्यान्वित करने के लिए एक कार्यबल का भी गठन किया । इसके अतिरिक्त जल स्रोतों के विकास हेतु हमारी प्रोद्योगिकी के आधार पर अंडमान निकोबार प्रशासन ने नारियल के बगीचों को सिंचाई उपलब्ध कराने के लिए रुपये 64.5 लाख की एक पायलट परियोजना की भी स्वीकृति प्रदान की ।

इस अवधि के दौरान उत्तरी व मध्य अंडमान के दिगलीपुर में नाबार्ड द्वारा वित पोषित एक बहिर्गम केंन्द्र की भी स्थापना की गयी । इस केंन्द्र द्वारा उत्तरी व मध्य अंडमान के किसानों के साथ हमारा प्रसार तंत्र और अधिक मजबूत हुआ है । हमने दक्षिणी द्वीप समूह के किसानो के साथ भी अपने संबंधों को मजबूत किया है । सुनामी के पश्चात उत्पन्न हुए कृषि परिदृश्य का अध्ययन करने तथा अनुसंधान व विकास कि संभावनाओं को तलाशने के लिए मैंने जनवरी 2010 में भारत वर्ष के सुदूर दक्षिणी छोर कम्पबैल बे का दौरा किया । दक्षिणी द्वीप समूह की विभिन्न कृषि उत्पादों की मांग को पूरा करने के लिए इस द्वीप को एक 'प्रोडक्सन हब' के रुप में विकसित किया जा सकता है । आने वाले वर्षो में के.कृ.अनु.सं. इस दिशा में महत्वपूर्ण कदम उठाने वाला है तथा अगले पांच वर्षों में केम्पबेल बे को निकोबार और ननकौडी द्वीप समूह के लिए 'एग्रीकल्चरल प्रोडक्सन हब' के रूप में विकसित किया जायेगा ।

मैं माननीय डॉ. मंगला राय, पूर्व सचिव, कृषि अनुसंधान व शिक्षा विभाग एवं पूर्व महानिदेशक, भा.कृ.अनु.प. और डॉ. एस. अयप्पन, सचिव, कृषि अनुसंधान व शिक्षा विभाग एवं महानिदेशक, भा.कृ.अनु.प. के प्रति आभार प्रकट करना चाहूँगा जिनके निरंतर मार्गदर्शन और प्रोत्साहन से ही हम उन्नति के पथ पर अग्रसर हुए है । माननीय डॉ. एच.पी. सिंह, उप महानिदेशक (बागानी) हमेशा से ही हमारे प्रेरणा स्रोत रहे है और ये सभी उपलब्धियां उनके कुशल नेतृत्व के कारण ही प्राप्त हो सकी है । मैं प्रभावी नेतृत्व व समर्थन के लिए उनका धन्यवाद करना चाहूँगा । मैं डॉ. एस.एस. मगर, अध्यक्ष, अनुसंधान सलाहकार समिति व समस्त समिति सदस्यों का भी आभारी हूँ जिन्होंने इस उपक्रम को पूरा करने में अपना भरपूर समर्थन दिया । मैं डॉ. उमेश श्रीवास्तव, सहायक महानिदेशक (बागानी-२) का भी आभारी हूँ जिनका सहयोग हमें निरंतर प्राप्त होता रहा ।

मैं माननीय ले. जनरल (अवकाश प्राप्त) भूपेंद्र सिंह, उपराज्यपाल, अंडमान निकोबार द्वीप समूह और श्री विवेक रे, मुख्य सचिव, अंडमान निकोबार प्रशासन का भी आभारी हूँ जिन्होंने हमेशा ही हमें प्रोत्साहित किया और अपना समर्थन दिया । उन्होंने हमारी गतिविधियों में गहरी रुचि ली, हम उनके आभारी है । हम अंडमान निकोबार प्रशासन के सभी अधिकारियों का धन्यवाद करते है जिन्होंने हमेशा ही हमें सहयोग प्रदान किया । अंत में मैं कैरी परिवार के सभी सदस्यों का आभारी हूँ जिन्होंने संस्थान के उद्देश्यों को पूरा करने के लिए वर्ष भर कडा परिश्रम किया तथा सफलता के पथ पर अग्रसर हुए ।

जय किसान । जय हिंद ।

मई, 2010
पोर्ट ब्लेयर

रमेश चंद्र श्रीवास्तव
निदेशक

PREFACE

It is my privilege to present annual report of Central Agricultural Research Institute, Port Blair for year 2009-10. The year has been a memorable year with many proud moments to cherish. The golden moment was 3rd September, 2009 when the institute hosted Dr. A.P.J. Abdul Kalam former President of India and a visionary of modern India. He interacted with our scientists as well as scientists of fellow scientific organizations of city. He showed keen interest in our activities and motivated us to achieve big. Another cherished day was 26th February, 2010 when five farmers technologically supported by CARI were honoured by Hon'ble Shri Sharad Pawar, Union Minister of Agriculture on their inclusion in 101 success stories of farmers of all over the country in 'Harvest of Hope' a Coffee Table Book brought by Ministry. It was indeed a great honour for five island farmers to be among 101 from all over country. It was triumph of CARI technologies in the field.

Continuing our effort to develop policies for different components of island agriculture, a brain storming session was conducted in July, 2009 and outcome was a document on Water Policy for A & N Islands. This document has been widely appreciated and A & N Administration has formed a working group to study it and suggest ways to implement it. Further based on our technology for water resource development, A & N Administration has sanctioned a pilot project at a cost of Rs. 64.5 lakh for providing irrigation to a coconut plantation.

During the report year, an Out Reach Centre was established at Diglipur in North & Middle Andaman District with financial support from NABARD. This center has strengthened our extension network with farmers of this northern district. We have also strengthened our link with southern group of islands. In January, 2010, I visited Campbell Bay which is the southern most part of India to study the agricultural scenario post tsunami and explore the research and development agenda for post permanent shelter period. It has a potential to be developed as a production hub for different agricultural products to fulfill the need of islands of Southern group. During the coming years CARI is likely to take lead in this direction and hope that within next few years the Campbell Bay will be developed as 'Agricultural Production Hub' for Nicobar and Nancowry group of Islands.

I express my sincere gratitude to Hon'ble Dr. Mangala Rai, Former Secretary, DARE & DG ICAR and Hon'ble Dr. S. Ayappan, Secretary, DARE & DG ICAR for their constant guidance and encouragement. Hon'ble Dr. H.P. Singh, DDG (Hort.) has been our source of inspiration and all the achievements have been possible only due to his able leadership. I express my sincere thanks for providing an effective leadership and support. I am grateful to Dr. S.S. Magar, Chairman,

Research Advisory Committee and all members of RAC for their unflinching support in our endeavors. I shall also thank Dr. Umesh Srivastava ADG (Hort. II) for his support.

I am grateful to Hon'ble Lt. Gen. (Retd.) Bhopinder Singh, Lt. Governor, A & N Islands and Shri Vivek Rae, Chief Secretary, A & N Administration for their encouragement, and support. They have shown keen interest in our activities and we thank them for their support. I am thankful to officers of A & N Administration, for their support & cooperation in our activities. Lastly but not least I am thankful to all member of CARI family who have worked hard for whole year to achieve our goals and go beyond normal call of duty.

Jai Kisan, Jai Hind.

May, 2010
Port Blair

R.C. Srivastava
Director

कार्यकारी सारांश
EXECUTIVE SUMMARY

प्राकृतिक संसाधन प्रबंधन
Natural Resource Management

- खारे पानी पर आधारित समेकित कृषि प्रणाली में बत्तख एक महत्तवपूर्ण घटक के रूप में समाहित की जा सकती हैं क्योंकि जब खारे पानी की सांद्रता 15 पी.पी.टी. तक बढाई गई तब भी कोई मृत्यु दर नहीं देखी गई । सांद्रता की विभिन्न अवस्थाओं में भी एक, दो व तीन सप्ताह के अंतराल पर देहभार में कोई विशेष अंतर नहीं देखा गया । छह सौ वर्ग मीटर के तालाब क्षेत्रफल से बत्तख घटक द्वारा चार महीनों में अण्डों की बिक्री द्वारा रूपये चार हजार की प्राप्ति संभव है ।

  In brackish water based integrated farming system, ducks can serve as an important component as no mortality was observed when introduced gradually to saline water of different concentrations up to 15 ppt. The body weight recorded at different week intervals do not pronounce much difference in different concentration of salinity for a period of one, two and three weeks interval. A return of Rs 4000/- from 600 m^2 pond area can be obtained from the duck component within four months through sale of eggs.

- पहाडी जगहों में सूक्ष्म सिचांई तंत्र का डिजाइन बनाने के लिए पारम्परिक भूसतह सर्वेक्षण तथा आकाशीय तरीकों जैसे रिमोट सेंसिंग एवं जी.आई.एस. आदि का प्रयोग करते हुए एक नए तरीके का विकास किया गया ताकि बनाये गए जल स्रोतों का सफलतापूर्वक उपयोग किया जा सके ।

  A new procedure using conventional topographic survey and spatial tools i.e. remote sensing and GIS for design of micro-irrigation system in undulated terrains has been developed for efficient utilization of created water resources.

- अभेद छतों या प्लास्टिक मल्च से बने सब्जी क्षेत्रों से भरे जाने वाले लाइंड तालाब के उपयुक्त आकार का डिजाइन करने के लिए जल संतुलन विधि का प्रयोग किया गया । दस में से आठ वर्षों में शुष्क काल में पचास वर्ग मीटर छत क्षेत्रफल से लाइंड तालाब में इकठ्ठा किए गए वर्षाजल से 361 घन मीटर क्षमता वाले तालाब से IW/CPE अनुपात 0.5 के साथ एक हजार वर्ग मीटर के क्षेत्र में लगाये गए नारियल के 18 पौधों या 322 घन मीटर क्षमता वाले तालाब से सुपारी के 160 पौधों को पूरक सिंचाई दी जा सकती है । एक हजार वर्ग मीटर के प्लास्टिक मल्च क्षेत्रफल के वर्षाजल को 290 घन मीटर क्षमता वाले तालाब में एकत्रित करके IW/CPE अनुपात 0.5 द्वारा 2778 शिमला मिर्च के पौधों को सिंचित किया जा सकता है ।

  Water balance approach was used to design the optimal size of lined tank fed from impermeable rooftop or plastic mulched vegetable area. In case of 50 m^2 rooftop area to harvest rainwater in lined tank, 361 cu m and 322 cu m capacity tank can provide supplemental irrigation at IW/CPE ratio 0.5 to 18 coconut plants or 160 arecanut plants in 1000 m^2 in 8 out of 10 years during the dry period. In case of plastic mulched area of 1000 m^2 to harvest rainwater, 290 cu m capacity tank can provide supplemental irrigation at IW/CPE ratio 0.5 in the same area with 2778 capsicum plants.

- प्रयोगों द्वारा ज्ञात हुआ है कि वर्मीकम्पोस्ट के साथ नारियल की भूसी के मिश्रण का प्रयोग करके मिट्टी की अम्लता को संतुलित रखा जा सकता है । कम निवेश वाले कृषि तंत्र में लाइमिंग के वैकल्पिक स्रोतों को पहचानने के लिए और अधिक अध्ययन की आवश्यकता है ।

  Experimental results have indicated that coconut husk along with vermi-compost can be used as potential material for managing acid soil. Further study is needed to identify the alternative sources of liming in low input agricultural system.

- अनुसंधान प्रक्षेत्र परिस्थितियों में लंबी समयावधि वाली प्रजाति रंजीत ने 3.57 टन/हे. की उपज दी है जो कि वर्षाधान (3.4 टन/हे.) के लगभग बराबर है, सावित्री (2.85 टन/हे.) तथा गायत्री (2.3 टन/हे.) की उपज इससे कम थी जबकि इसकी तुलना में माध्यम समयावधि वाली प्रजाति ताईचुंग सेन यू ने 2.05 टन/हे. की उपज दी है । खेत परिस्थितियों में भी इस जैसा ही झुकाव देखने में आया ।

  Long duration rice variety Ranjit recorded higher grain yield of 3.57 t ha^{-1} though at par with Varshadhan (3.4 t ha^{-1}) followed by Savitri (2.85 t ha^{-1}) and Gayatri (2.3 t ha^{-1}) as compared to medium duration Taichung Sen Yu (2.05 t ha^{-1}) at on station condition. Similar trend has been observed at on farm condition.

- तर मौसम में नारियल के बगीचे में खाने वाली मूंगफली के बीज का उत्पादन लाभकारी रूप में किया जा सकता है । ICGS76 या TG37A प्रजाति में ज्यादा मात्रा में बीज की उपज के लिए गोबर की खाद का 10 टन/हे. की दर से प्रयोग किया जाना उपयुक्त पाया गया है । दस वर्ष से अधिक पुराने बगीचे की अपेक्षा नए बगीचे में गिरी की उपज लगभग 62% अधिक पाई जा सकती है । किसान गिरी को बीज के लिए बेचकर अपनी आय को 19% तक बढा सकते हैं ।

  Seed production of table purpose groundnut can be taken up profitably in coconut plantation during wet season. Application of 10 t ha^{-1} of FYM with ICGS76 or TG37A variety is found suitable for higher kernel seed yield. Around 62% higher kernel seed yield can be obtained in younger plantations than old plantations (>10 years). Farmers can increase their net income by 19%, if selling kernels as seed instead of pods for seed.

- FPARP परियोजना में किसानों के खेतों में चौडी क्यारी व नलिका पद्धति के प्रदर्शनों में यह पाया गया कि क्यारियों में सब्जियों कि खेती करने पर ग्यारह महीनों में रूपये 67091 से रूपये 89000 की कुल प्राप्ति संभव हुयी जो कि किसान द्वारा किए गए फसल प्रबंधन पर निर्भर थी ।

  In case of broad bed and furrow system demonstrated in farmers fields under FPARP project, the net returns from vegetable cultivation in beds ranged from Rs 67091 to as high as Rs 89000 /ha in 11 months depending on the crop management by the farmers.

- वर्षा की भविष्यवाणी किए गए व दर्ज किए गए आकडों के सत्यापन से यह ज्ञात हुआ कि मानसून पश्चात मौसम में इन दोनों में औसतन 53.7% समानता थी जबकि मानसून के दौरान यह मात्र 23.4% थी ।

Verification of forecasted and observed values of rainfall revealed that on an average forecasted and observed values of rainfall are matching to the tune of 53.7 % during post monsoon period while it is only 23.4 % for monsoon period.

बागानी व वानिकी
Horticulture & Forestry

- स्थानीय सब्जियों के रूपात्मक विवरण तथा पोषकता प्रोफाइल का विकास किया गया । *सेंट्रेल्ला एशियाटिका, सौरोपस अंडरोगाय्नस* और *अमरैन्थस ट्राईकलर* में कुल निर्धारित संरक्षक तत्व जिनमे सूक्ष्म पोषक तत्व तथा एंटीआक्सीडेंट यौगिक भी सम्मिलित है की मात्रा प्रति ईकाई खाद्य पदार्थ में सर्वाधिक थी ।

  Morphological descriptors and nutritional profile of indigenous vegetables has been developed. Total estimated protective elements including micronutrient and antioxidant compounds in per unit edible portion were highest in *Centella asiatica, Sauropus androgynus* and *Amaranthus tricolor*.

- पोलीहाऊस परिस्थितियों में टमाटर की अर्का अनन्या (1.67 किग्रा./पौधा), अर्का विकास (1.59 किग्रा./पौधा) तथा DARL-3 (1.43 किग्रा./पौधा) किस्मों का प्रदर्शन अच्छा रहा ।

  Tomato cv. Arka Ananya (1.67kg/plant), Arka Vikash (1.59kg/plant) and DARL-3 (1.43kg/plant) performed well in polyhouse condition.

- लोबिया की अर्का गरिमा, काशी कंचन और 09/ COPBVAR 4, डॉलीकस बीन की IIVR SEM-II, स्वर्ण उत्कृष्ट और IIVR SEM-186, फ्रेंच बीन की अर्का अनूप, कंटेंडर और DWD FB-57 और संकर भिन्डी की 09/OKHYB-10, 09/OKHYB-9 तथा 09/OKHYB-2 किस्मों ने अच्छा प्रदर्शन किया ।

  Cowpea cv. Arka Garima, Kashi Kanchan and 09/COPBVAR 4, Dolichos bean cv. IIVR SEM-11, Swarna Utkrist and IIVR SEM-186, French bean cv. Arka Anoop, Contender and DWD FB-57 and Okra hybrids 09/OKHYB-10, 09/OKHYB-9 and 09/OKHYB-2 were found promising.

- आलू की कुफरी सूर्या नामक प्रजाति द्वीपीय परिस्थितियों के लिए सबसे उपयुक्त पाई गई ।

  Potato cv. Kufri Surya was found suitable in Island conditions.

- कंद फसलों के जर्मप्लाज्म पूल में पांच नए एक्सेसंस् को सम्मिलित करने के साथ कुल 36 एक्सेसंस् का प्रबंधन किया जा रहा है ।

  With addition of five new accessions in all 36 accessions are being maintained at the germplasm pool of tuber crops.

- पोलीहाऊस परिस्थितियों में जरबेरा की जुडी किस्म में सर्वाधिक रे फ्लोरेट दर्ज किए गए जबकि मनिजेल्स किस्म में एक मौसम में सर्वाधिक फूल पाए गए ।

Under polyhouse, maximum number of ray florets was recorded in Gerbera cv. Judy while maximum number of flowers/season was observed in cv. Manizales.

- रूपात्मक गुणों के आधार पर आम बगीचों के मुख्य रोगजनक *कोलेटोट्राईकम मैन्जिफेरी* को दो समूहों *सी. मैन्जिफेरी–I* और *सी. मैन्जिफेरी–II* में विभक्त किया गया है ।

  Based on morphological characteristics *Colletotrichum mangiferae* a major pathogen in mango orchards was grouped into *C. mangiferae*-I and *C. mangiferae*-II.

- ट्राईकोडर्मा आईसोलेट्स द्वारा रोगजनकों की वृद्धि में *सी. मैन्जिफेरी–I* और *सी. मौन्जिफेरी–II* का इन्हिबिसन प्रतिशत क्रमशः 47.1 से 60.0% व 46.1 से 60.0% था ।

  The percent inhibition of mycelial growth of pathogens by *Trichoderma* isolates was ranged from 47.1 to 60.0% (*C. mangiferae* I) and 46.1 to 60.0% (*C. mangiferae* II).

- सुपारी की कैरी–सिलेक्सन–I से अधिकतम 6.1 किग्रा. छाली प्रति वृक्ष प्राप्त की गई ।

  Arecanut selection (CARI-selection-1) produced maximum chali weight/tree (6.1kg).

- एले फसल प्रणाली में छटाई बायोमास के 10 टन/हे. से चौलाई दाने की अधिकतम उपज 770 किग्रा./हे. प्राप्त की गई जो कि 2.5 टन/हे. छटाई बायोमास से प्राप्त की गई उपज (624 किग्रा./हे.) से सार्थक रुप से अधिक थी ।

  The highest grain yield of Grain Amaranthus (770 kg ha^{-1}) was recorded with the incorporation of 10 t ha^{-1} pruned biomass in the alley cropping system which was significantly higher than yield obtained with incorporation of 2.5 t ha^{-1} (624 kg ha^{-1}).

- के.कृ.अनु.सं. में स्थानीय व मुख्यभूमि से एकत्रित *जैट्रोफा* तथा *पोंगेमिया पिन्नाटा* की किस्मों से बगीचे की स्थापना की गई ।

  Seed orchard for *Jatropha* species and *Pongamia pinnata* was developed from local and mainland collections at CARI.

- खुली स्थितियों में घासपात का उत्पादन 88.6 टन/हे. था जो कि कैनोपी के मध्य (79.9 टन/हे.) व कैनोपी के नीचे (69.6 टन/हे.) से सार्थक रुप से अधिक था ।

  Herbage yield in open condition (88.6 t ha^{-1}) was significantly higher than between canopy (79.9 t ha^{-1}) and under canopy (69.6 t ha^{-1}).

- सभी घासों से घासपात का उत्पादन 60 किग्रा. नाईट्रोजन / हे. के प्रयोग से 95.2 टन/हे. प्राप्त किया गया जो कि 40 किग्रा. नाईट्रोजन/हे. के प्रयोग से प्राप्त 87.9 टन/हे. उत्पादन से सार्थक रुप से अधिक था ।

  The highest herbage production from all grasses was recorded with 60 kg N ha^{-1} (95.2 t ha^{-1}) which was significantly higher than 40kg N ha^{-1} (87.9 t ha^{-1}) irrespective of canopy and grasses.

- कुल पॉलीफिनोल की अधिकतम मात्रा *मोरिंडा* जीनोटईप TRA-2 (300 मिग्रा./100 ग्रा.) और एन्थोसायनिन की अधिकतम मात्रा (91.8 मिग्रा./100 ग्रा.) JGH-I में दर्ज की गई ।

The highest total polyphenol was recorded in Morinda genotype TRA-2 (300mg/100g) and anthocynin in JGH-1 (91.8mg/100g).

क्षेत्रीय फसलें
Field Crops

- के.कृ.अनु.सं. ने अंडमान निकोबार द्वीप समूह की स्टेट सीड सब कमेटी के माध्यम से धान की पांच प्रजातियां रिलीज की । इनमें से दो प्रजातियां विशेष रुप से तटीय लवणता युक्त परिस्थितियों के लिए विकसित की गयी थी जबकि अन्य तीन सामान्य मृदा के लिए हैं । ये सब प्रजातियां शीथ ब्लाईट, बी.एल.बी., लीफ स्पोट, तना छेदक तथा लोजिंग के प्रति सहनशील हैं ।

  CARI released five rice varieties through State Seed Sub Committee for A & N Islands. Out of these, two varieties were specially developed for coastal salinity conditions and other three for normal soils. All these selections are tolerant to sheath blight, BLB, leaf spot, stem borer and lodging.

- ए.आई.सी.आर.पी. परीक्षणों के अंतर्गत बहुत अगेती धान की सौ दिन परिपक्वता वाली ANR-I नामक लाईन मूल्यांकन हेतु तैयार है । यह वर्षा आधारित निचली भूमि की परिस्थितियों में उगाई जाने वाली लघु कद काठी (90-100 सेमी.) की, प्रभावी कल्लों (7 से 8 प्रति पौधा) वाली, अच्छी पेनिकल लम्बाई (25 सेमी.) वाली, मध्यम मोटे दाने वाली व 4.0 से 4.5 टन/हे. उपज देने वाली प्रजाति है ।

  A very early rice line (ANR-1) with 100 days maturity is ready for evaluation under AICRP trials. It is short stature (90-100 cm), effective tiller (7 to 8 per plant), good panicle length (25 cm), medium bold grain with 4.0 to 4.5 ha^{-1} yield under rainfed lowland condition. It is tolerance to sheath blight, leaf spot, bacterial light and lodging.

- सात फसलों के चार सौ पचहत्तर जीनोंटाईप अर्थात धान (375), मूंग (15), चना (10), मक्का (11), लोबिया (4) और तिल (60) का संग्रह किया गया ।

  Four hundred seventy five genotypes of seven crops viz. rice (375), green gram (15), black gram (10), maize (11), cowpea (4) and sesame (60) were collected/procured.

- धान की अगेती तथा मध्यम अगेती एक सौ तिरासी लाईनों का मूल्यांकन निचली भूमि में किया गया । करजात-3 (6.66 टन हे.), IR-78555-3-2-2-2 (5.69 टन/हे.) और IR-78581-12-3-2-2 (5.40 टन/हे.) आशाजनक पाई गई ।

  One hundred eighty three early and medium early lowland rice lines were evaluated in the replicated trials. Karjat-3 (6.66 ha^{-1}), IR-78555-3-2-2-2 (5.69 ha^{-1}) and IR-78581-12-3-2-2 (5.40 ha^{-1}) found promising.

- धान की निन्यानवे लवण सहनशील लाईनों का 4-5dSm^{-1} ई.सी. और 8.7 पी.एच. वाली मृदा में मूल्यांकन किया गया । IR-759418-7B-21-3, IR 7646-B-B-10-1-1-1 तथा CSR 28 प्रजाति 4.34 टन/हे. उपज के साथ सबसे अधिक आशाजनक पाई गई ।

Ninety nine salt tolerant rice lines were evaluated under soil having EC 4-5 dSm^{-1} and pH 8.7. The lines IR-759418-7B-21-3, IR 7646-B-B-10-1-1-1 along with check variety CSR 28 were found most promising with yield of 4.34 ha^{-1} each.

- वर्षा आधारित परिस्थितियों में धान के पांच संकरों का मूल्यांकन किया गया । SPH-168 की उपज सर्वाधिक (5.30 टन/हे.) पाई गई ।

  Five rice hybrids were evaluated under rainfed conditions. The highest yield were recorded for SPH-168 (5.30 ha^{-1}).

- शुष्क मौसम (जनवरी से मार्च) के दौरान मूंग की सोलह तथा उर्द की पन्द्रह लाईनों का स्थानीय प्रजातियों के साथ मूल्यांकन किया गया ।

  Sixteen promising lines of green gram and 15 lines of black gram along with local check varieties were evaluated during dry season (January to March).

- धान का 101 किग्रा., तिल का 3 किग्रा. और मूंग का 5 किग्रा. बीज तथा कुल 109 किग्रा. प्रजनक बीज उत्पन्न किया गया ।

  Total 109 kg breeder seed of rice (101 kg), sesame (3 kg) and green gram (5 kg) were produced.

- वर्षा आधारित निचली भूमि की परिस्थितियों में धान की लंबी अवधि की चौहत्तर किस्मों/उन्नत लाईनों का संग्रहण और मूल्यांकन किया गया । अधिकतम उपज जगबन्धु (4.49 टन/हे.), MTU-2067 (4.39 टन/हे.) और MTU-1075 (4.32 टन/हे.) से प्राप्त की गयी ।

  Seventy four long duration rice cultivars/improved lines were collected and evaluated under rainfed lowland condition. The maximum yield was recorded for Jagabandhu (4.49 ha^{-1}), MTU-2067 (4.39 ha^{-1}) and MTU-1075 (4.32 ha^{-1}).

- सामान्य खेत परिस्थितियों में धान की तीन सौ पिचहत्तर लाईनों को मुख्य बीमारियों और कीडे मकोडों के प्रति परखा गया जिनमे से उनतीस लाईनों को बीमारियों और कीडे मकोडों के प्रति सहनशील पाया गया ।

  Three hundred and seventy five lines of rice were screened against major disease and insects under natural field condition, out of which twenty nine lines were found tolerance to insects and diseases.

- वर्षा आधारित निचली भूमि की परिस्थितियों में धान के विभिन्न परिपक्वता समूहों में 103 लाईनों में गंधी बग के आक्रमण के कारण उपज पर प्रभाव का अध्ययन किया गया । गंधी बग का अधिकतम आक्रमण देर से पकने वाली लाइनों में तथा उसके बाद मध्यम अवधि की लाइनों में पाया गया परन्तु यह बहुत अगेती, अगेती व मध्यम अगेती लाईनों में बहुत कम था । अध्ययन से ज्ञात हुआ कि अगेती व मध्यम अगेती लाईनों की अपेक्षा मध्यम तथा देर से पकने वाली लाइनों में उपज ह्रास 44-49% तक था ।

  Yield loss was studied due to Gundhi bug incidence in 103 lines of rice different maturity groups under rainfed low land condition. The maximum Gundhi bug incidence was recorded

in late maturing lines followed by medium duration, but it was very low in very early, early and medium early lines. The study reveals that there was 44-49% yield reduction in medium and late duration liens as compared to early and medium early.

- जंगली जामुन के 23 विभिन्न नमूनों में आनुवंशीय समानता का पता लगाने के लिए 20 आर.ए.पी.डी. और 30 आई.एस.एस.आर. मार्कर्स का प्रयोग किया गया । जंगली जामुन के सभी नमूनों में आर.ए.पी.डी. प्राईमर द्वारा 67% समानता तथा आई.एस.एस.आर. प्राईमर द्वारा 44% समानता डेन्डरोग्राम द्वारा विभेदित की गयी ।

  20 RAPD and 30 ISSR markers were used to infer genetic similarity among 23 different samples of wild *Jamun*. The dendrogram differentiate all the samples of wild *Jamun* at 67 % similarity with RAPD primers and 44 % similarity with ISSR primers.

- PCR-RELP में सात विभिन्न रेस्ट्रिकसन एंजाइमों का प्रयोग करके केला और धान के राईजोस्फीयर से आईसोलेट किए गए कुल 43 PGP जीवाणु आईसोलेट्स का चिह्नीकरण किया गया । 16s rRNA जीन सीक्वेंसिंग और ब्लास्ट समानता खोज से इन आइसोलेट्स को बेसिलस और सूडोमोनास प्रजाति का पाया गया ।

  A total of 43 PGP bacterial isolates from banana and rice rhizosphere were characterized by PCR-RFLP using 7 different restriction enzyme. 16s rRNA gene sequencing and BLAST similarity search identified these isolates as *Bacillus* sp. and *Pseudomonas* sp.

- PCR-RFLP में तीन विभिन्न रेस्ट्रिकसन एंजाइमों का प्रयोग करके ट्राईकोडर्मा प्रजाति के 15 एंटागोनिसट आईसोलेट्स का चिह्नीकरण किया गया । rRNA जीन सीक्वेंसिंग और ब्लास्ट समानता खोज से इन आईसोलेट्स को *ट्राईकोडर्मा ओवालिस्पोरम, ट्राईकोडर्मा विरिडी* और *ट्राईकोडर्मा हर्जियानम* के रुप में चिह्नित किया गया ।

  15 antagonistic isolates of *Trichoderma* sp. were characterized by PCR-RFLP using 3 different restriction enzyme. rRNA gene sequencing and BLAST similarity search result identified these isolates as *Trichoderma ovalisporum, Trichoderma viride* and *Trichoderma harzianum*.

- दस फरवरी और दस मार्च को लगाई गई टमाटर की दोनों किस्मों एस–22 और पूसा रुबी तथा मिर्च की के–2 किस्म में मुरझान रोग पर अधिक सापेक्षिक आर्द्रता का प्रभाव पडा । मिर्च के पत्ती मुडन रोग में तीन कारकों जैसे अधिकतम व न्युनतम तापमान व वर्षा दिनों की संख्या का रोग के विकसित होने पर पच्चीस जनवरी, पच्चीस फरवरी और दस मार्च को रोपित की गयी फसल पर सार्थक प्रभाव पडा । पच्चीस फरवरी और दस मार्च में अधिकतम तापमान का रिग्रेसन कोफिसियेंट मान, दस मार्च के लिए वर्षा दिनों की संख्या तथा पच्चीस जनवरी के लिए न्युनतम तापमान सार्थक पाया गया ।

  High relative humidity influenced wilt in tomato in February 10th and March 10th planted crops of both varieties S-22 & Pusa Ruby of tomato as well as chilly (K2). In the case of chilly leaf curl- 3 factors viz., maximum and minimum stemperature & rainy day (RD) was significant influencing disease development on January 25th, February 25th & March 10th planted crops. In February 25th & March 10th the regression co-efficient value of maximum temperature & rainy days for March 10th and January 25th minimum temperature was found significant.

- टमाटर में रोग में प्रतिशत कमी व उपज बढाने के लिए सस्य क्रियाओं, जैव नियंत्रक एजेंटों और फफूंदी नाशक के मिले जुले मोड्यूल को सबसे अधिक प्रभावी पाया गया । परिणामों से यह भी ज्ञात हुआ कि गैर होस्ट फसल के साथ फसल चक्र तथा टमाटर की फसल के साथ बर्मा धनिये की खेती करने से रोग नियंत्रण में सहायता हुई और टमाटर की उपज भी अधिक प्राप्त हुई ।

  Module consists of combination of cultural practices, biocontrol agents and fungicides were most effective in percent reduction of disease incidence and increasing yield of tomato. The results also suggested that crop rotation with non host crop and intercropping with Burma dhania with tomato resulted into improved disease control and yield of tomato.

- टमाटर में रोग प्रबंधन हेतु किए गए किसान के खेत पर परीक्षणों से यह ज्ञात हुआ कि सभी पांच किसानों के खेतों में टमाटर में जीवाणु मुरझान, पत्ती मुडन, तना गलन और फुसेरियल मुरझान रोग की घटनाओ में प्रतिशत कमी लाने के लिए बीज उपचार+कापर ओक्सीक्लोराईड में पौध का डुबाना+गोबर की खाद और नीम की खली (5.0 किग्रा./वर्ग मीटर) के साथ The-CARI-5 का मृदा में मिलाना + नीम के तेल (2%) के दो छिडकाव को सबसे अधिक प्रभावी पाया गया ।

  OFT trial on disease management of tomato revealed that seed treatment + seedling dip with copper oxychloride + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/ m^2) + two sprays of neem oil (2 %) was found most effective in percent reduction in disease incidences of bacterial wilt, leaf curl, basal stem rot and fusarial wilt of tomato in all five farmer's field.

- ट्राईकोडर्मा के चौदह आईसोलेट्स का काली मिर्च में फुट रोट रोग और एन्थरक्नोज बीमारी पैदा करने वाले *पी.कैपसिसी* और *सी. कैपसिसी* के विरुद्ध द्वि कल्चर परीक्षण द्वारा मूल्यांकन किया गया । पी. कैपसिसी के लिए अधिकतम प्रतिशत निषेध Tv-CARI-27 द्वारा दर्ज किया गया जबकि *सी. कैपसिसी* Tv-CARI-27 द्वारा सर्वाधिक पैरासिटाइज्ड किया गया ।

  Fourteen isolates of *Trichoderma* isolates were evaluated against *P. capsici* and *C. capsici* causing foot rot and anthracnose disease in Black pepper by dual culture test and highest percent inhibition of *P. capsici* was recorded with Tv-CARI-27 whereas *C. capsici* was most parasitized with Tv-CARI-27.

- ट्राईकोडर्मा के चौदह आईसोलेट्स का *पी. कैपसिसी* और *सी. कैपसिसी* के विरुद्ध नॉन वोलेटायिल एंटीबायोटिक उत्पादन द्वारा मूल्यांकन किया गया । *पी. कैपसिसी* और *सी. कैपसिसी* के विरुद्ध क्रमशः Tv-CARI-26 और Tv-CARI-33 को प्रभावी पाया गया ।

  Fourteen isolates of *Trichoderma* isolates were evaluated against *P. capsici* and *C. capsici* by production of non-volatile antibiotics and Tv-CARI-26 and Tv-CARI-33 were found most effective against *P. capsici* and *C. capsici*, respectively.

- बैविसटीन, साफ और क्रिलाक्स्यल गोल्ड नामक फफूंदी नाशकों को *सी. कैपसिसी* की अपेक्षा *पी. कैपसिसी* के विरुद्ध प्रभावी पाया गया जबकि मैन्कोजैब और सीओसी *पी. कैपसिसी* के प्रतिशत निषेध में सबसे कम LC_{50} मान के साथ सबसे अधिक प्रभावी थे ।

The fungicides Bavistin, Saaf and Krilaxyl Gold were more effective against *C. capsici* than *P. capsici* whereas Mancozeb and COC were more effective in percent inhibition of *P. capsici* with lowest LC_{50} value.

- *पी. कैपसिसी* और *सी. कैपसिसी* का अधिकतम प्रतिशत निषेध तीन प्रतिशत नीम तेल के साथ दर्ज किया गया और इसके बाद करंज तेल और बर्मा धनिया सत्व के साथ ।

  Highest percent inhibition of *P. capsici* and *C. capsici* was recorded with Neem oil at 3% followed by Kranj oil and extracts of *Burma dhania*.

- Th-CARI-37, Tv-CARI-32 और Th-CARI-27 आईसोलेट कापर ओक्सीक्लोराईड, मैन्कोजैब और क्रिलाक्सयल गोल्ड के साथ सबसे अधिक संगत थे ।

  The isolates Th-CARI-37, Tv-CARI-32 and Th-CARI-27 were most compatible with Copper oxychloride, Mancozeb, Moximate and Krilaxyl Gold.

- काली मिर्च के फुट रोट के विरुद्ध ट्राईकोडर्मा प्रजाति के ग्रीन हॉउस में किए गए मूल्यांकन से ज्ञात हुआ कि Th-CARI-33 सबसे अधिक उपयुक्त पाया गया तथा इससे बीमारी की घटना में 63.9% की कमी आई । इसके पश्चात Tv-CARI-32, Tv-CARI-14, Tv-CARI-16 तथा Tv-CARI-27 को पाया गया जिसमे फुट रोट की बीमारी की घटना में 42.6% की कमी आई ।

  Green house evaluation of *Trichoderma* spp against Foot rot of Black pepper revealed that the isolate Th-CARI-33 was most effective with 63.9% reduction in disease incidence, followed by Tv-CARI-32, Tv-CARI-14, Tv-CARI-16 and the isolate Th-CARI-27 was noted with least reduction in disease incidence of foot rot (42.6%).

- काली मिर्च के फुट रोट के विरुद्ध फफूंदी नाशक के ग्रीन हॉउस में किए गए मूल्यांकन से ज्ञात हुआ कि काली मिर्च के फुट रोट को दबाने में मृदा डरेन्चिंग और बोडॉक्स मिश्रण का पन्द्रह दिनों के अंतराल पर छिडकाव सबसे अधिक प्रभावी पाया गया जिससे बीमारी की घटना में 96.0% की कमी आई । इसके पश्चात कापर ओक्सीक्लोराइड व मैन्कोजैब से क्रमशः 88.8 व 75.6% की कमी आई ।

  Green house evaluation of fungicides against Foot rot of Black pepper revealed that the soil drenching and spray of Bordeux mixture at 15 days interval was found very effective in suppression of foot rot of Black pepper with 96.0% reduction in disease incidence followed by Copper oxychloride (88.8%), Mancozeb (75.6%).

- पोलू बीटल के लिए समेकित कीट प्रबंधन से ज्ञात हुआ कि काली मिर्च में दाने को सबसे कम प्रतिशत हानि तथा अधिकतम उपज अन्य मोडयुल्स की अपेक्षा उस समेकित मोड्यूल में दर्ज की गई जिसमे कांट छांट, नीम की खली का मृदा में उपयोग और नीमबान का पतियों पर छिडकाव और क्विनाल्फोस उपचार (3.13%) था ।

  IPM module for Pollu Beetle showed that lowest percent berry damage and highest yield of Black pepper was recorded in integrated module with pruning, soil application of neem cake

and foliar spray of Neembaan and Quinalphos treatment (3.13%) as compared to other modules tested.

- फल मक्खी *(बैक्ट्रासेरा कुकुरबिटी)* के लिए प्रयोगशाला अवस्थाओं में प्रतिरोधक क्रिया का परीक्षण किया गया । परीक्षण किए गए छह पौधों में से *साइँजाईजियम एरोमैटिकम, एमोमम एक्यूलिएटम* और *मोरिंडा सिट्रीफोलिया* को फल मक्खी के विरुद्ध सबसे अधिक प्रभावी पाया गया । इनकी LC_{50} क्रमशः 8.83, 10.67 और 10.85% पाई गयी ।

  To test repellency action against fruit fly, *Bactrocera cucurbitae* under laboratory conditions. Out of 6 plants tested, *Syzygium aromaticum, Amomum aculeatum* and *Morinda citrifolia* were found effective against fruit fly as LC_{50} (median lethal concentration) was 8.83, 10.67 and 10.85%, respectively.

- भिंडी के तना व फल छेदक के लिए विकसित किए गए समेकित मोड्यूल, जिसमे सस्य, यांत्रिक और जैव कीट नाशी प्रबंधन क्रियाओं का समावेश किया गया था । इस समेकित मोड्यूल में किसान की पद्धति (7.31%) की अपेक्षा छेदक की कम घटनाएँ (5.64%) मिली तथा चालीस प्रतिशत अधिक उपज दर्ज की गई ।

  Integrated module developed for okra shoot and fruit borer combining cultural, mechanical and bio-pesticides management practices had less incidence of borer (5.64%) as compared to farmer practice (7.31%). Fourty percent higher yield was recoded in integrated module as compared to farmers practice.

- नील व हैव्लोक द्वीपों से एकत्रित किए गए अस्सी आइसोलेट्स को जैवनियंत्रक और पीजीपी गुणों हेतु कडाई से परखने पर 27 आइसोलेट्स का चयन किया गया । सबसे अधिक संख्या में बैसिलस प्रजाति पाई गई । ट्राईकोडर्मा की बारह प्रजातियों का अध्ययन किया गया जिनमे *टी. इरीनेसियम, टी. ओवेलीस्पोरम, टी. एस्पेरीलम और टी. ब्रेविकोमपैकटम* की भारत में यह सबसे पहली रिपोर्ट है ।

  The rigorous screening of the 80 isolates from Neil & Havelock Islands for biocontrol and PGP attributes finally led to the selection of 27 isolates. The dominating organism was *Bacillus* sp. Twelve *Trichoderma* spp were studied in that *T. erinaceum, T. ovalisporum, T. asperellum* and *T. brevicompactum* are the first report from India. Twenty one *Colletotrichum* spp were studied for morphological and molecular level suggests that the variation in *Colletrotrichum* was more in A & N Islands.

- सब्सट्रेट स्टीम परीक्षणों से यह ज्ञात हुआ कि ज्वार के दानों को बीस मिनट तक भाप देने से तेरहवें दिन सबसे अधिक कवकजाल वृद्धि (12.0 सेमी.) पाई गई जबकि धान के चैफी दानों में यह 9.0 सेमी., केला और सुपारी पत्ती में 8.5 सेमी., गेहूँ दाने में 8.3 सेमी., धान के भूसे और दाने में 8.0 सेमी. पाई गई । सबसे कम वृद्धि (7.7 सेमी.) सूखे नारियल की भूसी में पाई गई । विभिन्न परीक्षणों के मध्य तीस से पैतालीस मिनट तक भाप द्वारा उपचार करने पर भी कवकजाल में कोई सार्थक वृद्धि देखने को नहीं मिली ।

  Substrates steamed experiment revealed that 20 minutes steaming had highest mycelial growth at 13th day in sorghum grain (12.0 cm) followed by rice grain (chaffy) (9.0 cm), banana and

arecanut leaf (8.5 cm), wheat grain (8.3 cm), paddy straw and rice grain (8.0 cm) and least growth was observed in dry coconut husk (7.7 cm). In 30 and 45 minutes steaming timings non significant mycelial growth was obtained among treatments.

- सर्वेक्षण आंकडों से ज्ञात कि इन द्वीपों में नारियल, आयल पाम, बैंगन, व टमाटर कृंतक गतिविधियों द्वारा प्रभावित है । इसकी मार क्रमशः 8-26, 40-50, 5-46 और 8-34 प्रतिशत पाई गई ।

  Survey data revealed that coconut, oil palm, brinjal and tomato are seriously affected by rodent infestations. It ranged from 8-26, 40-50, 5-46 and 8-34 percent respectively in the Islands.

पशु विज्ञान
Animal Science

- काली, सफेद और भूरी निकोबारी मुर्गियों का बारहवें सप्ताह में देह भार के आधार पर चयन किया गया । इनमें वयस्कता की आयु क्रमशः 22.21 और 22 सप्ताह थी तथा पचास दिनों का अंडा उत्पादन क्रमशः 18, 25 और 22 अंडे प्रति पक्षी था ।

  Black, White and Brown Nicobari Fowl were selected on the basis of 12th week body weight. The Age at sexual maturity of Black, White and Brown Nicobari fowls were 22, 21 and 22 weeks respectively and the respective 50 days egg production were 18, 25 and 22 eggs per bird.

- वनराजा मुर्गियों का देह भार हेतु मूल्यांकन किया गया । वनराजा मुर्गियों का छह व दस सप्ताह पर देह भार क्रमशः 431.53 और 924.35 ग्राम था ।

  Vanaraja birds were procured and evaluated for body weight. The average 6th and 10th week body weight of Vanaraja birds were 431.53 and 924.35 g respectively.

- ILI 80 व भूरी निकोबारी मुर्गी की संकर मुर्गियाँ अन्य संकर मुर्गियों की अपेक्षा बेहतर अंडा देने वाली सिद्ध हुयी । काली निकोबारी व काली रोक की संकर मुर्गियाँ अन्य संकर मुर्गियों की अपेक्षा द्विकाजी मुर्गियों के रुप में अच्छी सिद्ध हुयी ।

  The ILI 80 x Brown Nicobari crossbred showed better than all other crosses as good layers and Black Nicobari x Black Rock cross showed as dual purpose as compared to other crosses.

- पेकिन और चारा–चमेली संकर बत्तख अन्य दूसरे संकरों से बेहतर है तथा इनका उपयोग मांस हेतु किया जा सकता है ।

  The Pekin and Chara-Chembelli crossbred was better than all other crosses and may be used as meat purpose duck.

- लार्ज व्हाइट यार्कशायर सूअरों की प्रजनन क्षमता प्रदर्शन से ज्ञात हुआ कि अरबी, धान की भूसी या धान/गेहूँ के टूटे दानों द्वारा बनाये गए दाने की अपेक्षा मक्का आधारित दाना अधिक उपयुक्त है ।

  Reproductive performances of Large White Yorkshire pigs revealed that maize based diet was found the best when compared with the ration consist of colocasia, rice bran or broken rice / wheat based diet.

- सुअरों में पीठ पर चढी हुयी वसा की मोटाई के अल्ट्रासोनोग्राफिक परीक्षण से यह ज्ञात हुआ कि छोटे व व्यस्क सुअरों में इसकी मोटाई क्रमशः 19.00 और 33.17 मिमी. थी । यह भी बताया गया कि छोटे व व्यस्क सुअरों में वसा जमा होने की प्रक्रिया में सार्थक रुप से अंतर है । इस विधि का प्रयोग देशी तथा विदेशी सुअरों की वसा तथा मांसपेशियों की गुणवत्ता जानने में किया जा सकता है ।

  Ultrasonographic evaluation of back fat thickness was observed to be 19.00 and 33.17 mm in young and adult pigs respectively. It is suggested that the process of fat deposition in young and adult pigs varies significantly and this method is found to be useful in characterizing the fat and muscle of indigenous and exotic pigs.

- कार निकोबार में सुअरों के पोषण मान स्तर से ज्ञात हुआ कि दुध पिलाने वाली मादाएं प्रोटीन ऊर्जा कुपोषण (PEM) सिंड्रोम से ग्रसित थी जिसके कारण उनकी प्रजनन क्षमता पर बुरा प्रभाव हुआ ।

  Nutritional status of pigs at Car Nicobar showed that nursing sows were suffering from severe protein energy malnutrition (PEM) syndrome resulting in poor reproductive performance.

- *मोरिंडा सिट्रीफोलिया* पत्ती और फल के क्लोरोफार्म और एसीटोन में बनाये गए सत्व की *शल्सटोनिया सोलेनेसियेरम* के दो विभिन्न विल्गनों RSN 6 और RSN 12 के विरुद्ध जीवाणुरोधी गतिविधि पाई गई । अधिकतर जीवाणु रोधियों की अपेक्षा मोरिंडा सिट्रीफोलिया के सत्व को अधिक उपयोगी पाया गया । इसका उपयोग पौधों के राल्सटोनिया के संक्रमण के उपचार हेतु भी किया जा सकता है ।

  The chloroform and acetone extract of *Morinda citrifolia* leaf and fruit produced antibacterial activity against two different isolates of *Ralstonia solanacearum*; RSN 6 and RSN 12. The potential of the *Morinda citrifolia* extracts was found much better than most of the antibiotics and the same may be useful against the treatment of Ralstonia infection in plants.

- *मोरिंडा सिट्रीफोलिया* फल का सत्व गाय को 100 मिली. प्रतिदिन की दर से पिलाने पर थनैला रोग से ग्रस्त गायों के दूध की पी.एच., कंडक्टीविटी और जीवाणु भार में कमी दर्ज की गई ।

  Feeding of *Morinda citrifolia* fruit juice @ 100 ml daily to cattle reduces the pH, conductivity, and microbial load in the milk of mastitis affected cow.

- *मोरिंडा सिट्रीफोलिया* के सूखे फल के दानों द्वारा बीस प्रतिशत तक दाना प्रतिस्थापित करने पर भी जापानी बटेर में पांच सप्ताह की आयु तक देह भार वृद्धि और अच्छी एफ.सी.आर. देखी गई ।

  Replacement of 20% concentrate feed with dried fruit granules of *Morinda citrifolia* enhanced the body weight gain in Japanese quail and better FCR at 5th week of age.

- अल्ट्रासोनोग्राफिक परीक्षण के एक परिष्कृत तरीके में पानी की नांद का प्रयोग करते हुए गाय के थन के शरीररचनात्मक गुणों को साफ साफ देखा गया था उनका नाप भी लिया गया ।

  A modified method for ultrasonographic examination using water bath allowed clear visualization and measurement (sonometry) of teat anatomical characteristics in cows.

- बकरी में जन्म के समय बच्चों के संगठन से ज्ञात हुआ कि सामान्य रुप से मेमने एकल या युगल रुप में पैदा हुए । एकल मेमनों के पैदा होने की दर 53.33 प्रतिशत थी जबकि युगल मेमने 46.66 प्रतिशत की दर से पैदा हुए । एकल व युगल रुप में पैदा हुए मेमनों का जन्म भार क्रमशः 1.60 ± 0.14 और 1.48 ± 0.14 था । नर में कारकस उपज (50.13 ± 1.18) मादी की कारकस ईल्ड (41.36 ± 0.98 से सार्थक रुप से ($p<0.01$) अधिक थी ।

  Composition of birth in goats revealed that the usual number of kids born at one time varied from single to twins, of which percentage of singles (53.33) were more frequent than twins (46.66). The overall birth weight of kids born as single and twins was 1.48±0.14 and 1.60±0.14 respectively. The carcass yield was significantly ($p<0.01$) higher in males (50.13±1.18) than females (41.36±0.98).

- देशी बकरियों में माइक्रोसेटेलाइट विश्लेषण से यह ज्ञात हुआ कि पन्द्रह विभिन्न लोसाई में कुल पचास प्रकार के जीनोटाइप होते है । जीनोटाइप की संख्या (MAF70; SRCRSP3) 1 व 6 (SRCRSP15) के बीच रही । टेरेसा बकरी के प्रभावी एलिल्स (Ne) की संख्या 2 से 6.98 के बीच तथा देशी बकरी में 2 से 4.31 के बीच रही । टेरेसा व अंडमानी बकरी के लिए FIS का मान ऋणात्मक था जो इस बात का द्योतक है कि इन बकरियों में अन्तःप्रजनन ना होकर बाह्य प्रजनन हुआ । टेरेसा व अंडमानी बकरी में मोड सिफ्ट टेस्ट द्वारा जेनिटिक बोटलनेक परिलक्षित हुयी और इन दानों प्रजातियों के इन सीटू/एक्स सीटू संरक्षण पर और अधिक ध्यान देने की आवश्यकता है ।

  Microsatellite analysis of indigenous goats revealed that a total of 50 genotypes were observed across the 15 loci. The number of genotype varied between (MAF70; SRCRSP3) 1 and 6 (SRCRSP15). The effective number of alleles (Ne) varied from 2 to 6.98 in Teressa goat and 2 to 4.31 in local goats. All the values of FIS obtained for the Teressa and Andaman local goats were negative which is suggestive of no inbreeding within the populations and the animals were outbred. The mode-shift test indicated the genetic bottleneck in Teressa and Andaman Local goats and needs greater attention towards *in situ/ex situ* conservation.

- इन द्वीपों के देशी प्रजाति के सूअरों के खून को एकत्रित कर उनकी जाँच की गई और माइक्रोसेटेलाइट मार्कर के चार नमूनों का प्रयोग करके सूअर के डी.एन.ए. के एम्प्लिफिकेसन के लिए पी.सी.आर. प्रोटोकाल का मानकीकरण किया गया ।

  Blood samples from newly identified indigenous breed of pigs of these islands were collected and PCR protocol was standardized for amplification of pig DNA using 4 set of microsatellite markers.

मत्स्य विज्ञान
Fisheries Science

- अंडमान के संरक्षित पानी में ग्रुपर्स की पिंजडा खेती की गयी । जब 201.73 ± 27.57 मिमी. आकार तथा 90.06 ± 41.40 ग्रा. वजन वाली ग्रुपर्स को पिंजडे में रखा गया तो छह महीनों में 79.17% बढवार व 96.81% जीविता दर्ज की गयी । उत्तरोत्तर कल्चर परीक्षणों से यह ज्ञात हुआ कि उचित पोषण द्वारा ग्रुपर्स में स्वजातिभक्षण को रोका जा सकता है ।

Cage culture of groupers was done in protected waters in Andaman. The grouper stocked at the size of 201.73 ± 27.57 mm and weight 90.06 ± 41.40 g recorded a growth of 79.17% in six months with 96.81% survival. Successive culture experiments suggested that the cannibalism in the groupers can be checked by resorting to proper feeding.

- कैट फिश लार्वा विकास इकाई का विकास किया गया जिसमें नियंत्रित परिस्थितियों में मागुर प्रजनन करवाकर 60 प्रतिशत जीवित सफलतापूर्वक प्राप्त की गयी । एक मामले में नियंत्रित परिस्थितियों में *क्लारियास बटराकस* का प्राकृतिक प्रजनन कराया गया जिसमे नर मछली की बलि भी नहीं देनी पडी । यद्यपि मागुर प्रजनन प्रोद्योगिकी में परिष्करण प्रगति पर है ।

  The cat fish larval development unit has been developed wherein breeding of magur has been carried out successfully with a survival of 60% under controlled condition. There was an instance of natural breeding of *Clarias batrachus* in controlled condition where the male was not sacrificed. However, refinement of the magur breeding is underway.

- *क्लारियास बटराकस* में लवण सहनशीलता अध्ययन भी किया गया ताकि इनको हल्के लवणीय क्षेत्रों में भी पाले जाने की संभावनाओं का पता लगाया जा सके । यह देखा गया कि मछलियों की बढवार 0 पी.पी.टी. लवणता पर अच्छी हुयी । मागुर की मृत्यु दर 8 पी.पी.टी. लवणता पर सर्वाधिक थी (16.7%) । जैवरासायनिक मानकों के अध्ययन से यह पता चला कि 8 पी.पी.टी. लवणता पर अधिकतर मानक जैसे एस्कोर्बिक अम्ल, रुधिर ग्लुकोस तथा यकृत ग्लाइकोजन कम हो गए ।

  Salinity tolerance study was also conducted in *Clarias batrachus* to explore the possibility of culturing them in slightly saline areas. It was observed that fishes grow better at 0 ppt salinity. Mortality rate of magur was highest at 8 ppt salinity (16.7%). Studies on biochemical parameters revealed that most of the parameters like ascorbic acid, blood glucose and liver glycogen levels were reduced drastically at 8ppt.

- डेम्शेल मछली *(प्रेम्नस बायाकुलेटस)* को जंगली अवस्था से एकत्रित किया गया तथा प्रजनन जोडा बनाने के लिए स्फुटनशाला में दशानुकुलिन किया गया । मछली का पकड अवस्था में सफलतापूर्वक प्रजनन कराया गया तथा भ्रूण विकास की अंडे से हैच्लिंग तक की अवस्था का रिकोर्डिंग किया गया तथा फोटोग्राफी की गयी । स्फुटन के पश्चात लार्वा (3.724 ± 0.05 सेमी.) अच्छे तैराक थे तथा योक अवशेषण (12-24 घंटे) के पश्चात उन्होंने रोटीफर्स को खाना आरम्भ कर दिया ।

  The damsel fish, *Premnas biaculeatus* was collected from wild and acclimatized in the hatchery for forming breeding pairs. The fish has been successfully bred in captivity and details of embryonic development from egg to hatchlings were recorded and photographed. The larvae (3.724 ±0.05 cm) after hatching were active swimmers and started feeding on rotifers after yolk absorption (12-24 hr.).

- नोर्थ बे और पुंगी बालू में उपस्थित समुद्री स्पंज की जैव विविधता का दस्तावेजीकरण किया गया । पुंगी बालू से एकत्रित किए गए चार स्पंजों जैसे *सिरेल्ला स्याथोफोरा, ओसीनेपिया सैजिटेरिया,* प्लाकोरतिस प्रजाति व मोनंचोरा प्रजाति का अध्ययन विभिन्न चुनिन्दा रोगजनक जीवाणुओं के विरुद्ध जीवाणु रोधी गुणों के लिए किया गया । प्रारंभिक गुणात्मक द्वि कल्चर अस्से से ज्ञात हुआ कि *ओसीनेपिया सैजिटेरिया* तथा मोनंचोरा प्रजाति की जीवाणुरोधी गतिविधियां मुख्य रुप से

होस्ट मेटाबोलाईट के कारण थी । *सिरेल्ला स्याथोफोरा* तथा *प्लाकोरतिस* प्रजाति में 75 प्रतिशत संबध जीवाणुओं ने चुनिन्दा रोगनकों के प्रति सार्थक (पी < 0.05) जीवाणुरोधी गतिविधि प्रदर्शित की ।

The biodiversity of marine sponges from North Bay and Pongi Baalu has been documented. Four sponges collected from Pongibaalu *viz., Crella cyathophora, Oceanapia sagittaria, Plakortis* sp and *Monanchora* sp were studied for their antimicrobial properties against selected pathogenic bacteria. Preliminary qualitative dual culture assay revealed that in case of *Oceanapia sagittaria* and *Monanchora* sp, the antimicrobial activity was primarily due to the host metabolites. In *Crella cyathophora* and *Plakortis* sp., over 75% of the associated bacteria exhibited significant (P<0.05) antimicrobial activity against the selected pathogens.

- निकोबार द्वीप समूह में मौसम परिवर्तन से उत्पन्न हुए खतरों के मूल्यांकन हेतु कार निकोबार का विभिन्न मानकों जैसे समुद्र सतह से ऊंचाई, समुद्र तल में 0.3 से 0.5 मीटर की अपेक्षित वृद्धि, मृदा गुणवत्ता/गहरे तथा भू उपयोग आदि पर आधारित कृषि असुरक्षा मानचित्र बनाया गया । यह पाया गया कि कार निकोबार में लगभग 20 प्रतिशत क्षेत्रफल विश्वव्यापि मौसम परिवर्तन के कारण पैदा होने वाले खतरों के प्रति अधिक से बहुत अधिक असुरक्षित है ।

  In order to assess the threats due to climate change in Nicobar group of Islands, agricultural vulnerability map of Car Nicobar was prepared based on multiple parameters viz., elevation above mean sea level, estimated sea level rise of 0.3-0.5m, soil quality/depth and land use pattern. It was observed that about 20% of the area in Car Nicobar has high to very high vulnerability to climate change as predicted globally.

- अंडमान निकोबार द्वीप समूह की मूंगा चट्टानों तथा कच्छ वनस्पति की जैव विविधता का दस्तावेजीकरण किया गया तथा अंडमान निकोबार द्वीप समूह की कच्छ वनस्पतियों को पहचानने के लिए एक क्षेत्र मार्गदर्शिका का भी प्रकाशन किया गया ।

  The coral reef biodiversity and mangrove biodiversity of the A&N Islands were documented and a field guide for the identification of mangroves of A&N Islands has been published.

सामाजिक विज्ञान
Social Science

- सब्जियों के मूल्यों के उत्तार चढाव के कारणों को बता पाना काफी मुशिकल था । द्वीपवासी फरवरी से अप्रैल के मध्य उपयुक्त मात्र में अधिकतर सब्जियां उगाते हैं । विपणन सुविधाएँ जिनमे परिवहन तथा शीतगृह की सुविधा भी सम्मिलित हैं का बहुत ही कम विकास हुआ है । फूलों तथा सब्जियों की बाजार सूचना के द्वितीय स्रोतों का दस्तावेजीकरण भली–भांति नहीं किया है ।

  Prices of vegetables depict very unpredictable behaviour. Islanders produce most of vegetables in sufficient quantity from February to April. Market infrastructure including transportation and cold storage facilities are poorly developed. Secondary sources of market information about flowers and vegetables are not well documented.

- अंडमान निकोबार द्वीप समूह में विभिन्न परिस्थितिकियों में उगाई जाने वाली धान की किस्मों से सम्बंधित सूचनाओं का बायोटिक व एबायोटिक मानकों के साथ संग्रह किया गया । मॉडल का विकास करने के लिए एकत्रित सूचनाओं का परीक्षण आर्टिफिसियल न्यूरल नेटवर्क (ए.एन.एन.) द्वारा किया गया ।

  Compiled the available information on rice varieties grown in different ecologies of A & N Islands along with biotic and abiotic parameters. All the compiled information has been tested using Artificial Neural Network (ANN) for developing model.

- खाडी द्वीपों में पाई जाने वाली चारा फसलों से सम्बंधित आंकडों का संग्रह किया गया तथा इसका नाम FIRBI रखा गया ।

  Data base developed for Fodder Information Resources of Bay Islands and is named as FIRBI.

- बकरी पालन, वैकल्पिक जीविकोपार्जन के रुप में अधिकतर सदस्यों की पसंद था परन्तु इस व्यवसाय को लाभदायक ढंग से आरम्भ करने में प्रमुख कठिनाई थी प्रत्येक इकाई को अपेक्षित संख्या में मेमनों की अनुप्लब्धता ।

  Goat farming was the choice of the maximum group members as an alternate livelihood option but the problem was of non-availability of desired number of kids per unit to start the business in a profitable manner.

- उत्तर तथा मध्य अंडमान जिले के दिगलीपुर के केरलापुरम ग्राम में जुलाई 2009 में नाबार्ड की सहायता से चार वर्षों के लिए एक बहिर्गम केंद्र की स्थापना की गई । उस क्षेत्र में कृषि तथा संबद्ध क्षेत्रों में प्रोद्योगिकीय हस्तांतरण हेतु प्रोद्योगिकीय प्रदर्शन, उद्यमिता प्रशिक्षण तथा किसान मेले के दौरान प्रदर्शन भ्रमण आदि आयोजित किए गए ।

  An Out Reach Centre (ORC) was established with the support of NABARD for a period of 4 years from July, 2009 at Keralapuram village of Diglipur in North & Middle Andaman District. Technological demonstration, skill training and exposure visit during Kisan Mela were taken up with a view to transfer the technology in agriculture and allied field in that area.

कृषि विज्ञान केंद्र

Krishi Vigyan Kendra

- कृषि तथा संबद्ध क्षेत्रों में हिस्सेदारों के लाभ हेतु इक्यावन प्रशिक्षण कार्यक्रम आयोजित किए गए जिनमे 1078 लाभार्थियों ने भाग लिया । अग्रिम पंक्ति प्रदर्शन द्वारा प्रोद्योगिकीय प्रदर्शनों के अतिरिक्त खेत पर परीक्षण विधि द्वारा भी चुनिन्दा प्रोद्योगिकियों का किसानों के खेतों में मूल्यांकन किया गया । विभिन्न प्रसार विधियाँ जैसे प्रदर्शनी, खेत दिवस, कृषक भ्रमण, टेलीविजन प्रदर्शन, अभियान, नैदानिक भ्रमण, वैज्ञानिक कृषक मेल-मिलाप, रेडियो बातचीत, किसान मेला आदि का प्रयोग प्रोद्योगिकियों को लोकप्रिय करने में किया गया ।

  Fifty one training programmes covering 1078 beneficiaries were taken up in agriculture and allied fields for the benefit of the stakeholders. Beside technological demonstration through Front Line Demonstration (FLD) and assessment through On Farm Trial (OFT) in selected technologies were conducted in the farmers' field. Different extension tools like exhibition, field days, farmers visit, TV shows, campaign, diagnostic visit, Scientist farmers interaction, radio talks, Kisan Mela were used to popularize the technologies.

INTRODUCTION

ORGANIZATION

Realizing the importance of island agriculture to meet the requirement of local population and tourists, Indian Council of Agricultural Research (ICAR) established Central Agricultural Research Institute, Port Blair on June 23rd, 1978 by merging different regional research stations of ICAR institutes located in islands. The ultimate aim of CARI is the developments of island agricultural production technologies which utilizes the strengths of the island and convert the constraints in opportunities, without causing any ill effect to the fragile ecosystem of the island.

MANDATE

- To provide a research base to improve the productivity of important agri-horticulture, livestock and fisheries of A & N islands through adaptive and basic research for attaining economic self-sufficiency.
- To develop appropriate plans for conservation of natural resources and their sustainable use.
- To standardize technologies for animal health coverage and livestock production.
- To standardize techniques for capture and culture fisheries including coastal aquaculture.
- First line transfer of technology and training to the relevant State Departments.

ORGANISATIONAL SET UP

Administration of the institute rests with the Director, who receives support from both research divisions and administration. The Research Advisory Committee (RAC), Institute Management Committee (IMC) and Institute Research Council (IRC) reviews and monitor the research programmes and facilitates to identify new research thrust areas for the Institute. To accomplish the mandate, the research activities are organized under five divisions namely, Natural Resource Management, Horticulture & Forestry, Field Crops, Fisheries Science, Animal Science and one Social Science Section.

ORGANOGRAM


Research Advisory Committee
DIRECTOR
Institute Management Committee
Research Divisions / Sections
Horticulture & Forestry
Field Crops
Natural Resource Management
Animal Science
Fisheries Science
Social Science
PLAN
2238 lakhs
Budget XI Plan
NON PLAN
3700 lakhs
Supporting Units
Administration
Planning, Monitoring & Coordination Cell
RTI, ITMU, Rajbhasha Act Implementation Cell
PG Cell
Estate, Workshop & Engineering
Security
CPC
Extension
Krishi Vigyan Kendra
ATIC
Museum
Arts & Photography
Out Reach Centre
Research Farms
Garacharma (62 ha) Hilly land
Bloomsdale (3 ha) Valley land
Sippighat (32 ha) Hilly & Brackish water
Marine Hills Marine Fisheries Lab
Central Facility
Library
Computer Cell
Central Instrumentation Facility
Sub DIC

VISION

- As the island level food security is not achievable, Panchayat level food requirement should be estimated and food production planning should be tailored to provide local level food security with town area being served by food import from mainland.
- Reorientation of agricultural production system to provide local level food security and to meet the demand of perishable products, viz. milk, egg, meat, fish, fruits, vegetables and flowers with specific reference to demand of booming tourism industry.
- Making the isolation as our strength, conversion of spices cultivation in an organic farming with a decoratively packaged Andaman brand organic spices being marketed.
- Development of suitable production to consumption level chain involving SHGs and retailers / armed forces / processors.
- Biodiversity richness of the island should be preserved and exploited for national benefit.
- Proper rain water management technology to create micro level water resources to increase irrigated area from present 1% to a significant level.
- Making CARI a model for NARS of other small island nations

THRUST AREAS FOR XI PLAN

- Conservation and management of natural resources.
- Intensification and diversification of the rice based integrated cropping system by including vegetables, pulses and oilseeds through land modification, moisture conservation and supplementary irrigation.
- Development of technology for water resource development through rain water management and its efficient utilization for diverse cropping system.
- Production technology for vegetable crops for increasing productivity.
- Improving the varietal productivity of plantation and horticultural crop based systems through intercropping of spices, vegetables, fodder etc. as well as irrigation from rain water harvesting system.
- Development of fish-poultry-crop farming system for fresh and brackish water.
- Improving the productivity of cattle, goat, pig, poultry and aquaculture by cross breeding, health care and nutrition.

- Frontier research for knowledge and increased productivity.
- Undertaking basic / strategic research for generating knowledge of applied significance.
- High value agriculture with special reference to vegetables and protected cultivation of high value crops.
- Minimizing post harvest losses and maximizing value through appropriate technological intervention.
- Integrated management of existing insect, weeds and abiotic stresses with special reference to salinity.
- Production technology for inputs and their optimal utilization in organic farming.
- Transfer of technology and socio-economic impact analysis.
- Identification of appropriate technological options for rehabilitation of tsunami affected farming community.

NEW RESEARCH INITIATIVES

- Introduction of table purpose rabi groundnut alongwith seed production facility during kharif.
- Evaluation of existing long duration paddy varieties(160-170 days) as well as breeding program for new strains to take advantage of long rainy season and adding fodder component in pre and post paddy to enhance the cropping intensity to 300% under rainfed conditions.
- Rain water management technology for water resource development at hill top and valleys.
- Fodder cultivation on hill slopes through grasses and fodder trees both as sole and intercrops.
- Intensification of work on mushroom cultivation, flowers, banana, papaya, pineapple and off season mango.
- Evaluation of tropical potato varieties both TPS and tuber at Diglipur (North Andaman).
- Integrated farming system in fresh and brackish water areas.
- Induced breeding of cat fish and development of hatchery.
- Technology of captive breeding of ornamental fishes.
- Introduction of buffalos and management practices for indigenous cattle.
- Low cost and alternate feed for poultry.

- Protected cultivation for high value crops and their value addition.
- Identification of technology package for farmers of different socio-economic background.
- Germplasm collection of minor fruits viz. Rambutan, Durian, Mangosteen, Wild Cashew, West Indian Cherry etc.
- Production technology including IPM & varietal evaluation of beans, okra, brinjal & tomato.
- Cage culture of groupers in creeks and bays to enhance livelihood options.
- Pulses & oilseed breeding programme.
- Round the year fodder production including making hay & silage and its impact on cattle production & productivity.

STAFF POSITION

Sl. No.	Category	Sanctioned	Filled
1.	Scientific	56+1	35+1
2.	Technical	43	35
3.	Administrative	29	26
4.	Supporting	78	71

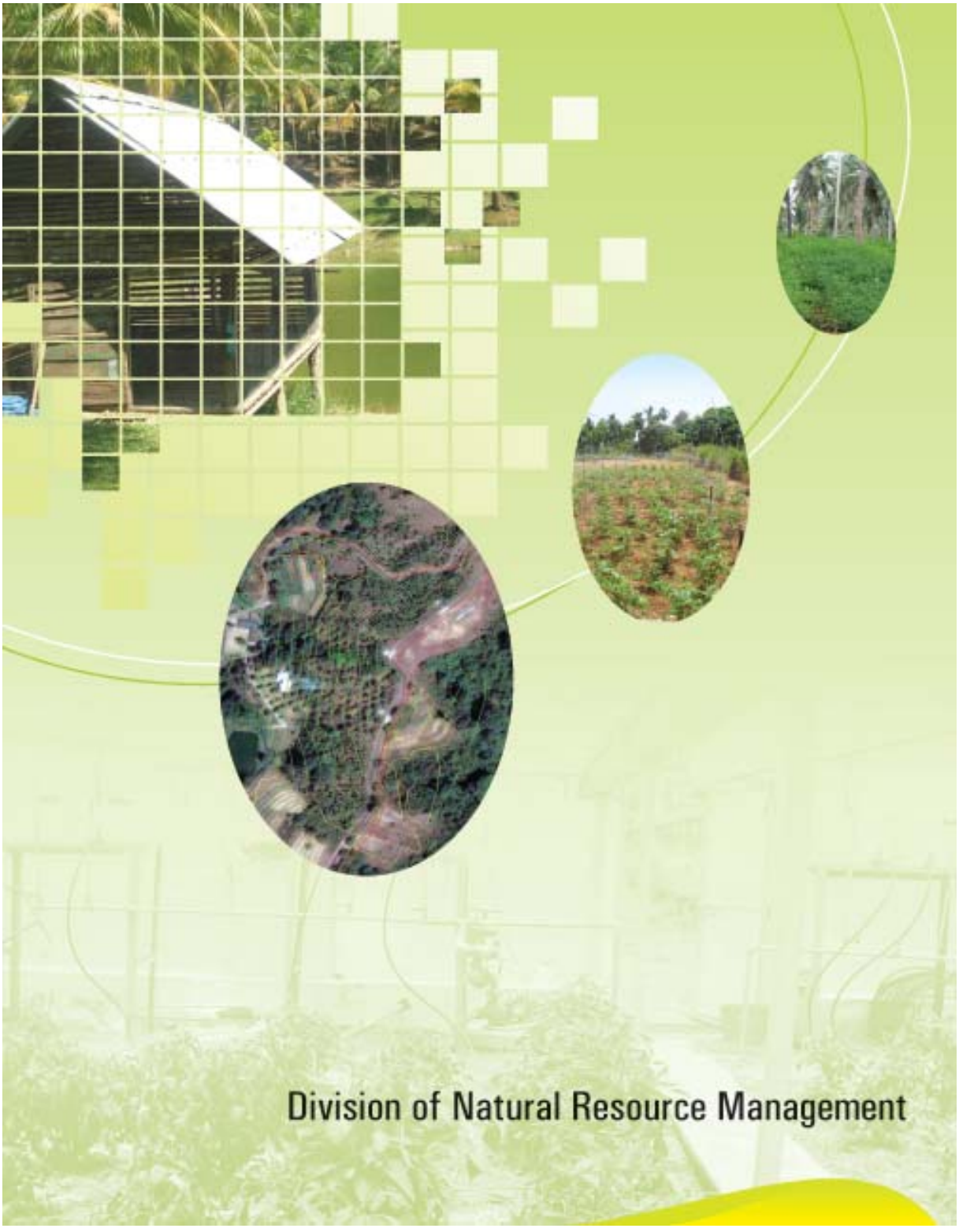
BUDGET UTILIZATION DURING 2009-2010

Head of Account	Plan (In Lakhs)		Non Plan (In Lakhs)	
Particulars	**RE 2009-10**	**Expt. 2009-10**	**RE 2009-10**	**Expt. 2009-10**
Establishment Charges	-	-	919.38	919.37
Travelling Allowances	14.00	13.97	9.18	9.18
Other charges	115.00	115.19	103.87	103.87
Equipment	118.00	118.20	-	-
Library	16.00	16.00	-	-
Works	133.00	132.60	26.74	26.74
HRD	4.00	4.00	-	-
Total	**400.00**	**399.96**	**1059.17**	**1059.16**

Research Programmes





Division of Natural Resource Management

Development of Fresh and Brackish Water Based Integrated Farming System (IFS) in Bay Islands

R.C. Srivastava, N. Ravisankar, S. Ghoshal Chaudhuri, Shrawan Singh, Abhay Kumar Singh, Subhash Chand and Grinson George

During the year, experiments on fresh and brackish water based integrated farming system was carried out at on station condition with an objective to identify, characterize and optimize the crop, animal, poultry and fish components for fresh (Plate 1) and brackish (Plate 2) water based farming system.

Fresh water based IFS

Evaluation of crops : French bean was evaluated during the dry season using the water from the pond for estimation of yield, economics and water productivity. On an average, yield of 6060 kg / ha was recorded with water productivity of Rs 22.60 / m^3 (Table 1).

Table 1. Yield, economics and water productivity of French bean

Parameters	Value
Yield	6060 kg / ha
Gross returns	Rs 72720 / ha
Net returns	Rs 52 720 / ha
B:C ratio	2.64
Water productivity	2.60 kg / m^3
	Rs 22.60 / m^3

Integration of duckery : Khaki Campbell ducks integrated under freshwater recorded an average body weight of 1654 g and 1720 g of weight at 24th and 32nd week of age respectively. The duck droppings went directly into the pond, which in turn provided essential nutrients such as carbon, nitrogen and phosphorus in the aquatic environment which stimulated the growth of natural food. Feed given to ducks were also partially utilized by the fish as while washing the shed approximately 10-20 % (23-30 g / day) duck feed was lost. This feed can be directly consumed by fish which provide the nutrient and promotes fish growth. The egg-laying Khaki Campbell produced more than 60 kg of manure / duck (on wet basis). The moisture content of duck excreta was 56.6% having the 1.8% Ca content.

Plate 1. Evaluation of french bean for water productivity and integration of ducks under fresh water system

Brackish Water based IFS

Evaluation of adaptation of ducklings in brackish water

Experiment on adaptaton of ducklings ro brackish water has been conducted at KVK complex, Sippighat for assesment of adaptation rate of ducklings under brackish water to assess their survivability and other production performances. Initially 3 weeks old 18 ducklings were put under the single compartment under brooding phase together for a period of two weeks. Later 6 ducklings each shifted to three different compartment for assessing the performance in different concentrations of brackish water i.e. 5, 10 and 15 ppt for one, two and three weeks period.

Three pits measuring sizes of 1.5 m x 1 m x 1 m were dug adjacent to the compartments. The pits were lined by silpaulin material in order to hold the brackish water throughout the trial period. All the ducklings of three different compartments were exposed to freshwater for one week and from 3rd week onwards were put under brackish water in varying concentrations. In the first pit, the ducklings were exposed to 5, 10 and 15 ppt concentrations for one week period in each concentration. In the second pit, the ducklings were exposed to 5, 10 and 15 ppt for 2 weeks period each, while in the third week, the ducklings were exposed to 5, 10 and 15 ppt for 3 weeks period. The body weight of the duckling at the end of each period were recorded to assess any abnormalities to the ducklings due to brackish water. The ducklings were provided freshwater ad-libitum for drinking purpose through rain water harvesting. The ducklings were allowed for an average of 8 to 10 hours in different concentration in brackish water up to 6th week and later this restriction was removed till the end of trial. Feeding to the ducks was given inside the compartments to avoid the wastage of feed. The different production performances mainly the growth performance, chances of any diarrhoea features throughout the trial period, mortality pattern and the age at sexual maturity (ASM) and weight at sexual maturity (WASM) were recorded precisely to ascertain the adaptability of duck under brackish water conditions.

Initially, ducks were very reluctant to move to brackish water for 3 to 4 days. No infection in eyes and diarrhoea was observed. The body weight recorded at different week intervals do not pronounce much difference in different concentration of salinity for one, two and three weeks period. No mortality was observed when birds were gradually put in water with increased salinity.

After 12th week, the ducks were shifted to farmer's field and released directly in brackish water. No mortality of the birds was recorded due to introduction of ducks in brackish water. Under on farm conditions, the birds were given freshwater for drinking and feed includes the kitchen waste, bran and the fishmeal. The sexual maturity attained at the age of 152 days and the weight at sexual maturity recorded to the tune of 1521±52.80 g. A total of 805 number of eggs worth Rs 4025/- were recorded in a period of 4 months having a stock of 12 female ducks (Table 2).

Table: 2. Production performances of ducks under brackish water

Parameters	One week in fresh water	Brackish water (from 4th – 12th weeks)		
		One week each in 5, 10, 15 ppt	Two weeks each in 5, 10, 15 ppt	Three weeks each in 5, 10, 15 ppt
Average body weight at 3rd weeks (g / bird)	194.5±27.33	-	-	-
Average body weight at 6th weeks (g / bird)	-	321.6±20.4	345.0± 19.7	356.6±24.4
Average body weight at 10th weeks (g / bird)	-	585.0±19.7	623.3±16.3	640.0±20.0
Average body weight at 12th weeks (g / bird)	-	673.6±36.7	720.0±20.9	762.5±18.9
Initial mortality (0-2 weeks)			2 no's	
Diarrhoeal complications, if any			Nil	
Mortality (3- 12th weeks)			Nil	
ASM (Age at sexual maturity)			152 days	
WASM (Average Weight at Sexual Maturity (g)			1521±52.80	

It can be concluded that ducks can serve as one of the important components under brackish water based farming system as no mortality was observed when birds were gradually released with increasing salinity. The body weight recorded at different week intervals do not pronounce much difference in different concentration of salinity for a period of one, two and three weeks interval. A return of Rs 4000 / - from 600 m^2 pond area can be obtained within four months through sale of eggs from brackish water based farming system.

Plate 2. Experimental set up of evaluation of adaptation of ducklings to brackish water and ducklings in 10 ppt brackish water

Planning, Augmentation and Efficient Utilization of Water Resources in Kaju Nallah Watershed

S.K. Ambast, R.C. Srivastava, T. Subramani, Babulal Meena and Subhash Chand

During the year, a new procedure, using conventional topographic survey and spatial tools i.e. remote sensing and GIS, for design of micro irrigation system in undulated terrains has been developed for efficient utilization of created water resources in the Kaju Nallah watershed through recharge structure cum well system. For this, initially topographic survey was conducted using total survey station and elevation contours were generated for different blocks of plantation and vegetable crops of the Garacharma farm in the Kajunallah watershed. The elevation contours were superimposed on remotely sensed image of IKONOS data to determine the required hydraulic heads and layout for different blocks considering type of plantation crop, their water requirement and water source. The elevation contours for Old Meteorology Station block and the superimposed elevation contour on satellite image are shown in Fig.1(a-b). The plantation and vegetable crop

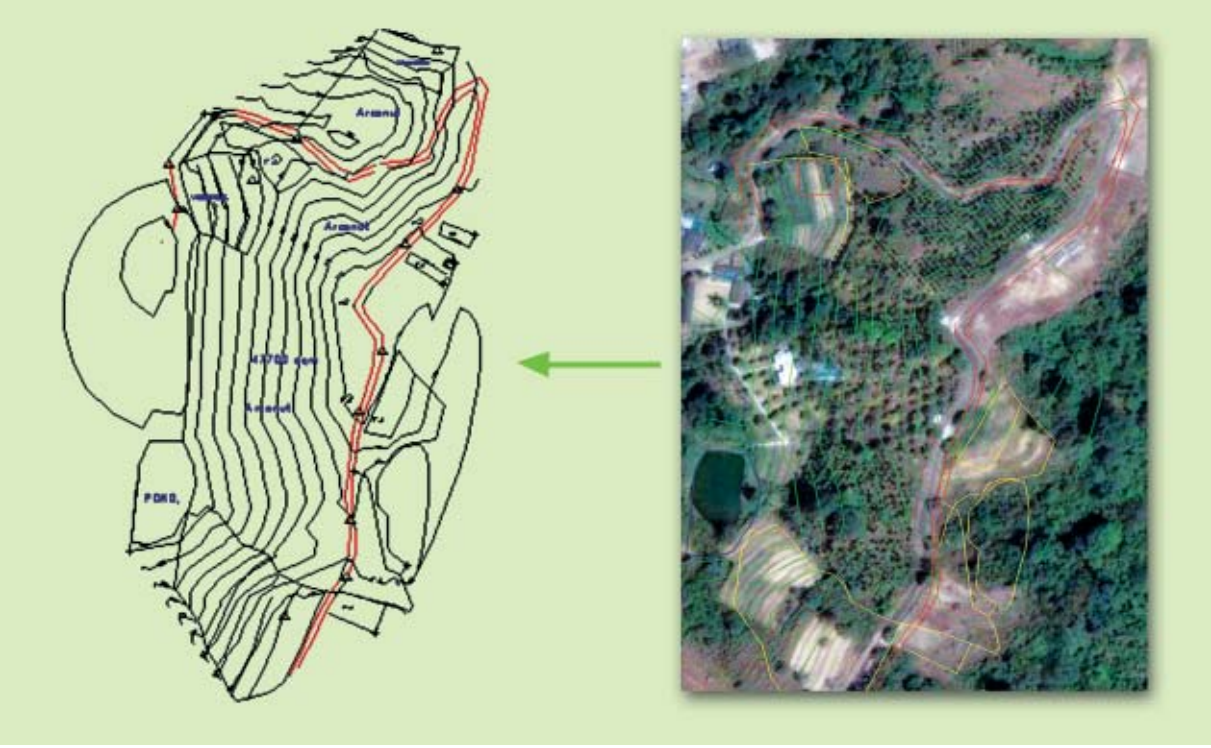


Fig.1. (a) Elevation contours and (b) satellite image with superimposed elevation contours for Old Meteorology Station block in the Kaju Nallah watershed

area (about 10.2 ha) in the Garacharma farm has been divided into five blocks and the installation of micro irrigation system has been made for all the blocks (Plate 3).

In order to establish the rainfall runoff relationship for different combination of landuse, area, topography and rainstorms, electronic water level recorders have been installed to record the water levels at three gauging stations of the Kaju Nallah (Plate 4). The analysis of the data is in progress.

Plate 3. Installation of micro sprinkler for brinjal and inline drippers for pineapple in Old Meteorology Station block of Garacharma farm, CARI

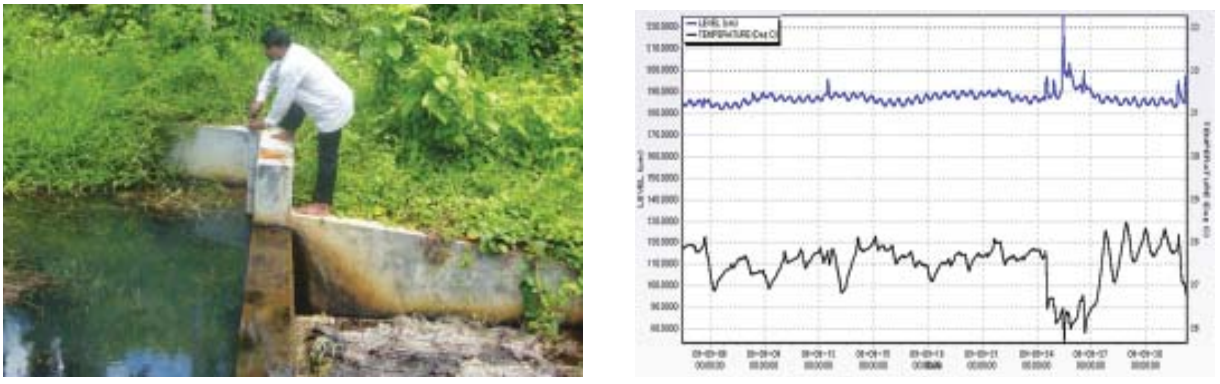


Plate 4. Electronic water level recorder at check dam and recorded water levels

Studies on Effective Storage of Water in Ponds

R.C. Srivastava, S.K. Ambast and B.K. Nanda

During the year, water balance approach was used to design the optimal size of lined tank fed from impermeable rooftop or plastic mulched vegetable area. The daily water balance used for rainwater harvesting in the lined tank to supplement irrigation to the cropped area during dry period is given below:

$$Vw_i = Vw_{(i-1)} - Vws_i + Vwr_i \quad (1)$$

$$Vwr_i = (R_i \times A_{IS}) + (R_i \times Rds \times V) - Vws_i - \{E \times 0.7 \times Rds \times Vw_{(i-1)}/1000\} \quad (2)$$

where Vw_i is the volume of water in the tank on the i^{th} day; $Vw_{(i-1)}$ is the volume of water in the tank on the $(i-1)^{th}$ day; Vws_i is the volume of water spent on i^{th} day; Vwr_i is the volume of water received in the tank on i^{th} day; R_i is the rainfall on the i^{th} day (mm); A_{IS} is the impermeable surface area (sqm); Rds is the ratio of tank depth to surface area; E is the open pan evaporation (mm) and V is the designed tank volume (litres). Vws_i can be determined by considering the irrigation interval as 2 days and taking the conditional approach as follows:

$$Vws_i = 0, \text{ If } \{R_i + R_{(i-1)} + R_{(i-2)}\} \text{ e" } 3E \quad (3)$$

$$\text{and } Vws_i = N \times S^2 \times [3E - \{R_i + R_{(i-1)} + R_{(i-2)}\}] \times Riw \text{ , if } \{R_i + R_{(i-1)} + R_{(i-2)}\} < 3E \quad (4)$$

where N is the number of plants; S is the spacing of plants (m); $R_{(i-1)}$ is the rainfall on the $(i-1)^{th}$ day (mm); $R_{(i-2)}$ is the rainfall on the $(i-2)^{nd}$ day (mm) and Riw is the IW/CPE ratio.

It is assumed that tank will be at full capacity at the beginning of the dry period (15^{th} Dec.) and the tank will not be empty during the dry period (up to 30^{th} April). Accordingly, the optimal size of the tank was determined to satisfy the imposed conditions. Historical rainfall and open pan evaporation data for 24 years were used in a time series to estimate the required water volume for a cropped area. Intermittent rainfall events during the dry period have been considered for storage in the lined tank. These data were used to get required volume of water at different probability levels. The estimated required water volume was used as the volume of water available in the beginning of the dry period for that year to check the number of days tank remain dry to find the optimal tank size. In this study, the impermeable rooftop area has been taken as 50 sq m to supplement irrigation in 1000 sq m area (18 coconut/160 arecanut) and plastic mulched area is taken as 1000 sq m to supplement irrigation in the same area (2778 capsicum plants).

In case of 50 sq m rooftop area to harvest rainwater in lined tank and supplement irrigation in 1000 sq m to 18 coconut plants, it was found that 9 years, 7 years and 5 years (out of 24 years) are deficit years at 60%, 70% and 80% probability level, respectively when tank volume is taken as required volumes for each year. The result indicated that 181, 288 and 361 cu m capacity tank can provide supplemental irrigation in 8 out of 10 years with IW/CPE ratio of 0.25, 0.4 and 0.5 (Fig.2) respectively during the dry period.

In case of 50 sq m rooftop area to harvest rainwater in lined tank and supplement irrigation in 1000 sq m to 160 arecanut pants, it was found that at 80% probability level for different IW / CPE ratios, the irrigation system can provide requisite supplemental irrigation during dry period. Accordingly, for 0.25, 0.4 and 0.5 IW / CPE ratio 161, 258 and 322 cu m tank capacity, respectively can provide supplemental irrigation to 160 arecanut plants with only four years of failure.

In case of plastic mulched area of 1000 sq m to harvest rainwater and to provide supplemental irrigation in the same area with 2778 capsicum plants, it was found that 130, 224 and 290 cu m capacity tank are the optimal size to provide irrigation at IW / CPE ratio of 0.25, 0.4 and 0.5, respectively with only four years of failure.

Further to facilitate gravity fed irrigation system to minimise energy requirement, an outlet system was made at the bottom of the lined tank to the terraces for providing gravity fed irrigation system (Plate 5).

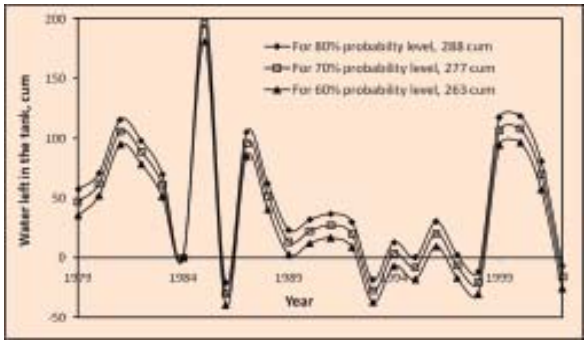


Fig.2. Water volume left in the tank before onset of rainy season for IW / CPE ratio 0.4 (Negative values means that the tank was dry)

Plate 5. Outlet for gravity fed irrigation system inside the reinforced plastered lined tank

Evaluation of Soil Management Techniques in Problem Soils of South Andaman

T.P. Swarnam, S. Ghoshal Chaudhuri, B.L. Meena and R.C. Srivastava

A confirmatory field trial was conducted based on encouraging results observed in pot experiments with five treatments viz., control, coconut husk, compost, coconut husk + compost and lime. The experiment was carried out in RBD in the plots of 16 m^2 during 2009-10. The coconut husk and compost were applied at the rate of 12 t ha^{-1} and lime as per lime requirement of the soil. The soil of the experimental site was acidic (pH 5.4) and medium in available nutrient contents. The pH of coconut husk and compost used in the study was 6.3 and 6.8, respectively. The soil pH measurements were

made at 15 days interval and are shown in Fig.3. It has been observed that the application of lime markedly improved the soil pH from 5.5 to 7.5. Soil pH increased sharply and stabilized at around 7.0 - 7.3 during the observation period.

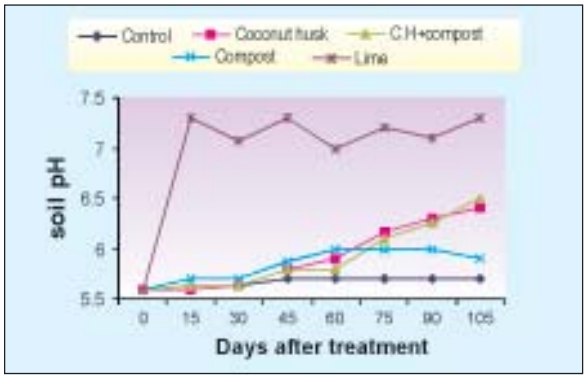


Fig.3. Effect of amendments on soil pH

Besides lime, there was a slight increase in pH (2%) in compost treated plots within 15 days of application and it has increased up to 5% after 90 days, and then decreased to 3.5% at the end of the experiment. The increase in soil pH is mainly due to initial high pH (6.8) and, Ca^{2+} and Mg^{2+} content of compost. The decrease in pH towards the end is mainly due to nitrification of N. However in coconut husk treated plots, pH has increased only after 45 days of application and it steadily increased from 5.6 to 6.4 indicating an increase of 12% over the period. This time lag before pH increase might be due to consumption of protons during microbial decomposition. The relative liming effect at the end of the experiment for different treatments were coconut husk + compost (50%) > coconut husk (44%) > compost (12%) indicating the potential of coconut husk in acid amelioration as it is 50% as effective as that of lime when applied in combination with compost. As the experiment had shown the potential for using coconut husk for managing acid soil, its impact on nutrient availability and use of other organic sources like vermicompost, poultry manure will be taken up and studied further as alternative sources of liming in low input agricultural system.

Effect of Vermicompost on Nutrient Dynamics and Yield of Vegetable Crop

A.Velmurugan, N. Ravisankar, T. P. Swarnam and R.C.Srivastava

Vermicompost is a finely derived organic material, broken down by interactions between earthworms and microorganisms in a mesophilic process to produce stabilized organic materials with high porosity, water holding capacity and low C: N ratio which contains nutrients such as N, P, K, Ca and Mg in readily available forms. Several experiments have demonstrated the presence of plant growth regulating substances such as humic acid and plant growth hormones like auxins, gibberellins and cytokinins in vermicompost which are responsible for increased germination, growth and yield of plants. However, its nutrient release pattern in different soils, environment and impact on growth and yield of vegetable crop is less studied. In Andaman Islands vegetable

production is constrained by timely availability and high cost of inorganic fertilizers. On the other hand organic materials are available in plenty which can be used as a source of plant nutrient by vermicomposting. Keeping above points in view, this study has been initiated with the objectives (i) to study the nutrient release pattern in vermicompost applied soil (ii) to study the effect of vermicompost on soil physical, chemical and biological properties and (iii) to compare and quantify the effect of vermicompost on growth and yield of vegetable crop.

An experiment has been laid out at Bloomsdale research farm of CARI during post monsoon season (D/S: 15th February 2010) to study the effect of application of vermicompost alone and in combination with inorganic fertilizer on growth and yield of Okra (Plate 6). The experiment was designed in RBD with 12 treatments and three replications. The soils of the experimental site are sandy clay loam in texture, slightly acidic (6.0), non saline (EC 0.02 dSm^{-1}), medium organic carbon (0.65%), nitrogen (298 kg ha^{-1}), low in P2O5 (10.1 kg ha^{-1}), and low in K2O (167 kg ha^{-1}) content. The observations on plant height (40 DAS) and yield are given in Table 3.

Table 3. Effect of different sources of nutrients on plant height and yield of Okra

Treatments	Details	Plant height (40 DAS) (cm)	Yield (t/ha)
T_1	Control	14.2	4.07
T_2	100% of N through VC	19.4	7.61
T_3	75% of N through VC	14.9	7.25
T_4	50% of N through VC	16.2	4.98
T_5	100% of N through VC + PM(50:50 ratio)	21.7	6.97
T_6	75% of N through VC + PM(50:50 ratio)	20.6	7.13
T_7	50% of N through VC + PM(50:50 ratio)	14.6	4.64
T_8	100% of N through Inorganic N	28.6	9.35
T_9	50% of N through Inorganic N	27.7	7.05
T_{10}	100% of N through Inorganic N + VC @50:50	20.9	8.39
T_{11}	75% of N through Inorganic N + VC @50:50	27.0	7.94
T_{12}	50% of N through Inorganic N + VC @50:50	20.1	6.89
	SEd	2.96	0.61
	CD (0.05)	6.15	1.37

P & K by SSP and MOP; DAS = Days after sowing , VC = vermicompost ; PM = poultry manure, Recommended dose of fertilizer (NPK) : 120, 70 and 60 kg ha^{-1}

The observations made at 40 days after sowing showed that application of 100 % recommended dose of N through urea (T_8) recorded highest plant height of 28.6 cm which is at par with application of 50 % of recommended dose of N by urea (T_9) and 75% of recommended dose of N supplied through urea and vermicompost at 50:50 ratio (T_{11}). The plant height is low in T_{10} due to water logging at early stages. This clearly indicated that for early growth and development, readily available form of nutrients are essential. This will help to cope with slight water logging due to excess or untimely rain which is expected in Andaman condition.

Plate 6. A view of experimental plot at Bloomsdale research farm, CARI

Among the treatments, application of 100% N through inorganic (T8) recorded higher yield which is at par with the application of 100% N through inorganic + VC @ 50:50 (T10) indicating a possibility of replacement of inorganic N by 50% through vermicompost. In general, at all the levels of N (100, 75 and 50% of recommended dose) the yield is highest in inorganic source of N followed by inorganic + vermicompost, vermicompost alone and vermicompost + poultry manure. Application of 100% of N through VC + PM @ 50:50 (T5) gave lower yield than at 75% (T6) possibly due to heating and toxic effect of poultry manure at higher doses. The lowest yield is observed in control which is at par with T4 and T7.

Effect of Nutrient Levels and Irrigation on Arecanut Yield and Soil Fertility

A.Velmurugan, T. Subramani, S.K.Ambast and R.C.Srivastava

In A&N Islands, productivity of arecanut remains low due to very less or no fertilizer application, low soil fertility, soil erosion and rapid depletion of soil moisture during the dry season. In order to improve the yield of arecanut, it is important to address these production constraints properly. The yield can be improved by supplying adequate

amount of nutrients through proper source and supplemental irrigation during the dry season. Further, nutrients should be applied in synchrony with crop demand during post-monsoon season for better utilization.

In view of this a field experiment has been initiated from November 2009 onwards in the plantation block of Garacharma farm of CARI in split plot design to study the effect of fertilizer levels, irrigation and their interaction on soil fertility and arecanut yield (Plate 7). Check basins were laid around each palm to facilitate fertilizer and irrigation treatments. Three levels of irrigation treatments based on IW/CPE ratio *viz*., control (I_0), 0.50 (I_1) and 0.75 (I_2) were imposed in the main plots. In the sub plots five levels of fertilizer treatments *viz*., Control (N_0), 100 % of N, P, K through inorganic (N_1), 50 % of N, P, K through inorganic (N_2), 100 % of N through VC : Inorganic @50:50 (N_3) and 50 % of N through V.C : Inorganic @50:50 (N_4) were given. The recommended dose of fertilizers is 100 g N, 40 g P_2O_5 and 140 g K_2O per tree/year. The irrigation treatment was applied only during dry season (February to May) and nutrients in three split doses.

The soil at the start of the experiment is slightly acidic (pH 5.2) in reaction, low in EC (0.2 dSm^{-1}) and are sandy loam to loam in texture. The experimental soil contain high organic carbon (2.2 %), low in phosphorus (7 kg/ha) and potash (75 kg/hg). The initial results showed no significant difference in height and girth of trees among different treatments. However, it is observed from the flower shedding that number of flowers retained per bunch in the irrigation treatments are higher than control. This is expected to results in the higher yield of nuts in the irrigated palms. Other yield parameters will be estimated after the monsoon season and the experiment is in progress.

Plate 7. A view of the experimental site at Garacharma farm, CARI

Salt, Water and Nutrient Dynamics in Broad Bed and Furrow System

S.K. Ambast, T. Subramani, N. Ravisankar and S. Ghoshal Chaudhuri

Broad bed and furrow system (BBF) system, one of the land manipulation techniques for crop diversification in low-lying waterlogged mono-cropped paddy lands, has been evaluated extensively for increase in cropping intensity, productivity and

economics in normal areas. Considering its prospect and potential in saline waterlogged areas, a study on salt, water and nutrient dynamics in BBF system in normal and saline waterlogged areas has been initiated. BBF system in normal area of a farmer at Badmashpahar and at Bloomsdale research farm has been selected whereas for saline area, two farmers fields in Chouldari has been selected. The soil samples have been collected up to 1 m depth at an interval of 25 cm once in a month up to December 2009 and later at 15 days interval for determining soil moisture content and salinity in selected BBF systems (Plate 8). In Chouldari, the soils are clay loam in texture on the surface (up to 30 cm) and clay at deeper depth up to 1 m (taxonomically classified as Fluventic Sulfagvents, saline phase). The measured soil salinity in the selected BBF systems is given in Table 4. Soil EC_2 values were converted to EC_e using standard methodology. It has been observed in normal area that the soil salinity was within the acceptable limit till March and in general remained static. In saline area (C1), soil salinity has shown increasing trend in sub-surface due to capillary rise during dry season. However, in case of C2 salinity reduced because of waterlogging during wet season and subsequent flushing / leaching of salts due to drainage. The drainage of water is responsible for decreased pH observed in March because of oxidation process and leaching of salts. The experiment is in progress.

Table 4. Average pH and salinity of soil in selected BBF systems

Location	Depth(cm)	Oct., 2009		Mar, 2010	
		pH_2 (-)	EC_e (dSm^{-1})	pH_2 (-)	EC_e (dSm^{-1})
B1(Normal area)	0-25	5.1	2.2	5.4	2.0
	25-50	5.5	2.0	5.2	1.8
	50-75	5.5	2.0	5.2	1.6
	75-100	5.2	1.8	5.3	1.6
B2(Normal area)	0-25	6.3	2.0	6.2	2.0
	25-50	7.4	1.8	5.2	2.0
	50-75	6.8	2.7	6.2	2.0
	75-100	6.5	2.4	6.4	1.8
C1(Saline area)	0-25	4.2	4.8	4.7	4.7
	25-50	4.9	4.5	4.8	5.4
	50-75	4.3	4.1	4.8	4.8
	75-100	5.7	4.9	4.5	4.1
C2(Saline area)	0-25	6.2	5.4	5.1	2.0
	25-50	6.0	4.0	4.9	2.2
	50-75	5.8	5.2	4.6	2.9
	75-100	6.4	4.9	4.7	3.6

Location of BBF: B1- Bloomsdale; B2 - Badmashpahar; C1- Chouldari (Madhu); C2 Chouldari (Sri Singh)

Plate 8. Soil sampling in broad bed and furrow system in saline waterlogged area

Effect of Supplemental Irrigation on Crop Yield and Water Use Efficiency in Rice Based Cropping system of A&N Islands

T. Subramani, S. Ghoshal Chaudhuri, S.K. Ambast, Babulal Meena, Subhash Chand, S.K. Zamir Ahmed and S.K. Verma

Productivity enhancement of rice through use of long duration varieties and adoption of improved management practices during monsoon season (Jun-Dec, 2009).

During the year, high yielding long duration rice varieties *viz*., Ranjit (155-160 days), Savitri (145 days) Varshadhan (160 days) and Gayatri (160 days) along with Taichung sen Yu and C14-8, as local check, were evaluated at research farm and farmer's field during 2009 to utilize the available growing period to the maximum extent under island ecosystem.

In the Bloomsdale research farm (Plate 9), long duration rice variety Ranjit recorded higher grain yield of 3.57 t ha^{-1} and at par with Varshadhan (3.4 t ha^{-1}) followed by Savitri (2.85 t ha^{-1}) and Gayathri (2.30 t ha^{-1}) as compared to medium duration Taichung sen Yu (2.05 t ha^{-1}). The higher

Table 5. Growth and yield attributes of rice varieties in Bloomsdale Research Farm

Varieties	Height (cm)	DMP at harvest (kg/ha)	Ear bearing tillers/ hill	No. of filled grains/ hill	1000 grain weight (g)
Ranjit	130	7558	15.48	726	23.52
Savitri	127	6707	13.19	666	23.86
Varshadhan	180	7820	14.22	677	27.47
Gayatri	134	6064	13.74	618	25.47
TSY	117	5653	11.44	551	27.06
SEd	5.20	334	0.75	17	0.63
CD (P=0.05)	11.33	726	1.64	36.4	1.38

yield of Ranjit and Varshadhan could be attributed to its better growth and yield attributes over other varieties (Table 5 and 6). Similarly in the farmer's field (Plate 10), long duration varieties produced significantly higher grain yield (Ranjit: 2.94 t ha^{-1}; Varshadhan: 2.83 t ha^{-1}; Savitri: 2.52 t ha^{-1}; Gayatri: 2.5 t ha^{-1}) than C 14-8 (2.1 t ha^{-1}) in spite of minimal management practices adopted by the farmer (Table 7). The increased yield of long duration varieties over the local checks under on-station and on-farm conditions has resulted in increased gross and net income per hectare and in turn resulted in higher B: C ratio (Table 7 and 8).

Table 6. Yield and economics of rice varieties in Bloomsdale Research Farm

Varieties	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B: C ratio
Ranjit	3570	3983	34328	19128	2.26
Savitri	2845	3867	28050	12850	1.85
Varshadhan	3432	4388	33560	18360	2.21
Gayatri	2300	3764	23314	8114	1.53
TSY	2050	3603	21028	5828	1.38
SEd	227	175	-	-	-
CD (P=0.05)	494	381	-	-	-

Table 7. Growth and yield attributes of rice varieties in farmer's field

Varieties	Height (cm)	DMP at harvest (kg/ha)	Ear bearing tillers/ hill	No. of filled grains/hill	1000 grain weight (g)
Ranjit	129	6707	15.23	569	22.96
Savitri	125	6374	12.92	488	22.82
Varshadhan	178	6969	13.64	436	26.57
Gayatri	131	6105	12.79	416	24.62
TSY	153	5635	12.47	388	25.86
SEd	4.35	178	0.54	22	0.53
CD (P=0.05)	9.50	387	1.17	48	1.16

Table 8. Growth and yield attributes of rice varieties in farmer's field

Varieties	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Ranjit	2943	3833	28849	13649	1.90
Savitri	2520	3724	25144	9944	1.65
Varshadhan	2832	4224	28296	13096	1.86
Gayatri	2496	3625	24841	9641	1.63
C 14-8	2107	3469	21379	6179	1.41
SEd	171	167	-	-	-
CD (P=0.05)	373	364	-	-	-

Plate 9. Long duration rice varieties at Bloomsdale farm

Plate 10. Long duration rice varieties at farmer's field

Standardization of Package of Practices for Table Purpose (HPS) Groundnut in Andamans

N. Ravisankar, M. Balakrishnan, S. Ghoshal Chaudhuri, S.K. Ambast, R. C. Srivastava and N. Bommayasamy

During the year, three experiments were conducted in order to address the potential of seed production of table purpose groundnut varieties with application of different levels of farm yard manure (FYM) levels under coconut plantations during wet season and to standardize the package of practices for dry season especially on irrigation, mulching and nutrient management.

Evaluation of table purpose groundnut for seed production in coconut plantations

On Station : Experiment was conducted during wet season of 2009 at Sippighat farm (Plate 11). Two varieties *viz.*, ICGS 76 and

TG 37A with three levels of farm yard manure (10, 15, 20 t/ha) was evaluated in factorial randomized block design (FRBD) with four replications in more than 10 year old coconut plantation having the spacing of 7.5 m between rows. Growth, yield attributes and pod yield were recorded and economics & energetics were calculated as per standard procedures.

Height of plants did not differ significantly between varieties (Table 9). Number of pods/plant, 100 pod weight, Number of kernels/plant and 100 kernel weight were significantly influenced by either FYM application or varieties. Though the number of pods/plant was higher in TG37A variety, 100 pod weight was significantly higher in ICGS76. Shelling percent did not differ significantly among the treatment. Pod yield, kernel seed yield and economics were significantly influenced by FYM application and varieties. TG37A recorded significantly higher pod and kernel seed yield (1652 and 858 kg ha^{-1} respectively) compared to ICGS 76 (1245 and 740 kg ha^{-1}). Application of 10 t FYM/ha registered higher pod and kernel seed yield in both the varieties (Table 10). Haulm yield also followed the similar trend. Net returns and B:C ratio was significantly higher with 10 t of FYM/ha application to both the varieties (ICGS76 and TG37A). Higher net returns and B: C ratio might be due to higher kernel seed yield combined with low cost of cultivation owing to application of less quantity of farm yard manure. Comparison of net returns and B:C ratio in terms of pod and kernel seed yield indicates that around 45- 55% increase in returns due to sale of kernels for seed instead of pods for seed. This is mainly due to increased value of kernels over pods. Energy ratio and specific energy was higher under 10 t FYM/ha with either ICGS76 or TG37A variety which is mainly due to increased

Table 9. Influence of varieties and FYM levels on growth and yield attributes of table purpose groundnut for seed production in Coconut plantations

Treatments	Plant height (cm)	No. of pods/ plant	100 pod weight (g)	No. of kernels /plant	100 kernel weight (g)	Shelling %
ICGS 76 + FYM @ 10 t/ha	53.8	8.6	99.8	9.0	51.9	53.8
ICGS 76 + FYM @ 15 t/ha	53.9	10.5	95.2	10.8	52.7	54.9
ICGS 76 + FYM @ 20 t/ha	58.5	6.3	124.7	7.0	100.2	66.3
TG 37A + FYM @ 10 t/ha	61.9	11.0	100.6	10.8	54.6	51.5
TG 37A + FYM @ 15 t/ha	67.0	10.0	78.4	10.5	58.2	56.7
TG 37A + FYM @ 20 t/ha	59.1	11.3	88.9	11.0	43.8	47.4
SEd	6.8	1.6	8.2	1.4	10.3	8.3
CD (*P=0.05*)	NS	3.4	17.5	3.0	22.1	NS

Table 10. Influence of varieties and FYM levels on seed yield and economics of table purpose groundnut for seed production in Coconut plantations

Treatments	Pod yield (kg/ha)	Kernel seed yield (kg/ha)	Haulm yield (kg/ha)	Net returns (Rs/ha)		B:C ratio	
				Pod + haulm	Kernel + haulm	Pod + haulm	Kernel + haulm
ICGS 76 + FYM @ 10 t / ha	1444	773	10611	30934	42545	1.34	1.64
ICGS 76 + FYM @ 15 t / ha	1222	688	9722	20879	32780	0.82	1.15
ICGS 76 + FYM @ 20 t / ha	1069	759	8056	12129	33942	0.43	1.09
TG 37A + FYM @ 10 t / ha	1778	918	12639	42962	55457	1.87	2.13
TG 37A + FYM @ 15 t / ha	1597	898	11528	33934	50399	1.33	1.77
TG 37A + FYM @ 20 t / ha	1583	758	10417	29907	36259	1.07	1.17
SEd	145	79	1433	6933	8340	0.18	0.30
CD (*P=0.05*)	307	166	3054	14776	17773	0.39	0.65

Cost of Pods : Rs 30 / kg, Cost of kernel seed : Rs 75 / kg , Cost of haulms: Rs 1 / kg

output energy by way of higher pod and haulm yield.

On an average, the light intensity of 42500 lux was recorded during flowering stage (45-55 DAS) in the plantations of more than 10 years age. Pod yield was highly influenced by the light availability (Fig.4). Though TG37A recorded higher pod yield under coconut plantations, ICGS76 also performed equally better in terms of pod yield.

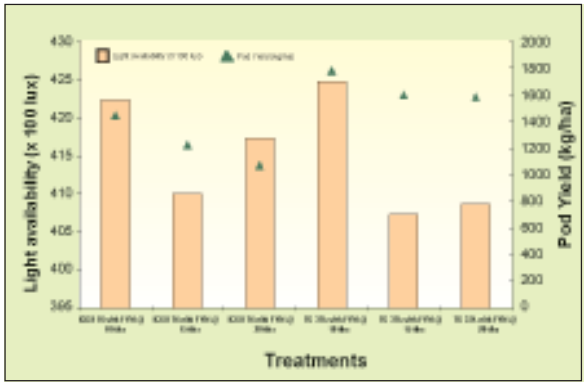


Fig. 4. Influence of light availability on pod yield of table purpose groundnut in coconut plantations

Plate 11. General view of the on station experiment on seed production of table purpose groundnut in coconut plantation and pods at the time of harvesting

On Farm : On farm evaluation of seed production experiment on table purpose groundnut under coconut plantations were carried out at six farmers' field in Calicut village (Plate 12). Among six farmers, two farmers intercropped groundnut in more than 10 years old open coconut plantations while others planted in 1-2 year old plantations. Higher pod yield (2156 kg ha^{-1}) and kernel seed yield (1587 kg ha^{-1}) was recorded with 1-2 year old plantations compared to more than 10 years old plantations which is mainly due to availability of more light in young plantations (Table 11). An increase of around 62% kernel seed yield is observed in young plantations compared to old plantations. On an average, net returns of Rs. 57,730/ha can be obtained from one ha area of coconut plantations through seed production of table purpose groundnut during wet season. Around 19% higher net returns can be obtained by farmers by selling kernels as seed instead of pods as seed. On station and on farm experiments exhibited similar trend (Fig.5) in terms of pod, kernel seed yield and net returns in more than 10 years old plantations.

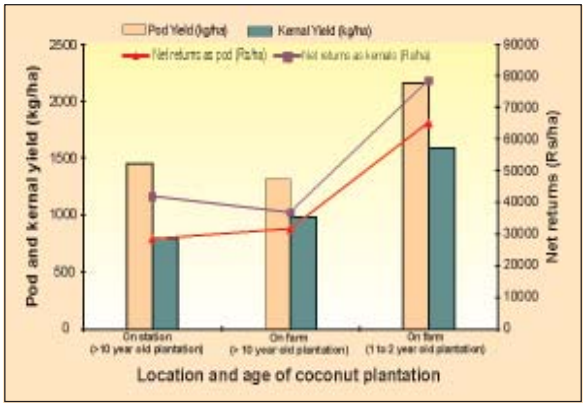


Fig. 5. Comparison of yield and net returns of on station and on farm for seed production of table purpose groundnut

Table 11. Yield and economics of table purpose groundnut for seed production in coconut plantations at Calicut village

Name of the farmer	Age of plantation (years)	Pod yield (kg/ha)	Kernel seed yield (kg/ha)	Haulm yield (kg/ha)	Gross returns (Rs/ha)	Net return sold as pods (Rs/ha)	Net return sold kernels for seed (Rs/ha)
Mr.Pacchamuthu	>10	1000	740	6400	41400	18390	21212
Mr.C.Alagumalai	>10	1633	1214	10753	67920	44910	52500
Mean	-	1317	977	8577	54660	31650	36856
Mr. K. Palsamy	1-2	2752	2034	14400	110720	87710	110203
Mr.K.Ismail	1-2	2150	1653	13200	88450	65440	83764
Mr. Chinnathami	1-2	1982	1445	11300	80682	57672	66939
Mr.Sivalingam	1-2	1738	1215	12200	73013	50003	53512
Mean	-	2156	1587	12775	88216	65206	78605

* Cost of Pods: Rs 35/kg, Cost of kernel seed: Rs 75/kg , Cost of haulms: Rs 1/kg

** Cost of cultivation for pods & kernels of general use: Rs 23010/ha, Cost of cultivation for seed kernel: Rs 25000/ha

Plate 12. View of intercropped groundnut in 1-2 year old plantation and visit of Agricultural Officers to on farm experiment

Evaluation of irrigation and mulching practices for table purpose groundnut (Confirmatory trial)

A confirmatory experiment is in progress to evaluate irrigation and mulching practices for table purpose groundnut during dry season of 2009-10 at field crops experimental research farm, Bloomsdale. The soil was sandy loam with pH 6.1, 0.74 % organic C, medium in available N, P and K. The experiment was conducted in split plot design with irrigation treatments (No irrigation, one irrigation at pegging, two irrigation at life and pegging, three irrigation at life, flowering and pegging and four irrigation at life, flowering, pegging and pod development stages) in main plot and mulching treatments (Paddy straw, Banana, *Gliricidia* and No mulch) in sub plot with three replications. The period coinciding with critical stages *viz*., life, flowering, pegging and pod development stages are 3, 45–50, 50-55 and 65–85 DAS respectively. Mulching treatment was imposed on 45 DAS. The experiment is in progress.

Evaluation of nutrient management practices for table purpose groundnut

An experiment is in progress to evaluate nutrient management practices for table purpose groundnut during dry season of 2009-10 at field crops experimental research farm, Bloomsdale. The experiment was conducted in split plot design with organic manures (Farm yard manure @ 12.5 t/ha, poultry manure @ 5 t/ha, vermicompost @ 5 t/ha, No organic manure) in main plot and sulpher sources (No sulpher, sulpher through gypsum and sulpher through single super phosphate) in sub plot with three replications. The experiment is in progress.

It can be concluded that, seed production of table purpose groundnut can be taken up profitably during wet season in coconut plantations. Applications of 10 t of FYM ha^{-1} with ICGS76 or TG37A variety are found suitable for higher kernel seed yield. Around 62% higher kernel seed yield can be obtained in younger plantations than old plantations. The net income can be raised by 19% by selling kernels as seed instead of pods for seed.

Water and Nutrient Management in Capsicum through Drip System under Protected Cultivation

T. Subramani, S.K. Ambast, N. Ravisankar, S. Bhagat and R.C. Srivastava

An experimental setup was developed for carrying the study on effect of irrigation regimes on yield and water use efficiency of capsicum under protected cultivation structure (Plate 13). Drip irrigation system was installed to control the water supply in capsicum. Six fertigation tanks of 100 liter capacities were included to impose the nutrient treatments. Four irrigation treatments based on IW/CPE ratio of 0.75 through surface irrigation (I_0), and 0.25 (I_1), 0.50 (I_2), 0.75 (I_3) through drip irrigation with five replications in RBD have been laid. Open pan evaporimeter was installed near to the polyhouse so as to give irrigation on the basis of pan evaporation values.

Water pumped through 2.0 HP motor was conveyed to fertilizer tanks fixed at 1.5 m height after filtering through screen filter. From the fertilizer tanks, laterals of 16 mm size were taken off and water goes to root zone of the crops through gravity flow (low pressure drip system). From the laterals, micro tubes were taken on both the sides. Drippers with a flow rate of 2 lph have been used.

Capsicum Hybrid 'Indra' was transplanted. The spacing of the capsicum was kept at 60 cm x 60 cm as was optimized in an earlier project under protected cultivation structure. The yield of Capsicum is being recorded. The experiment is in progress.

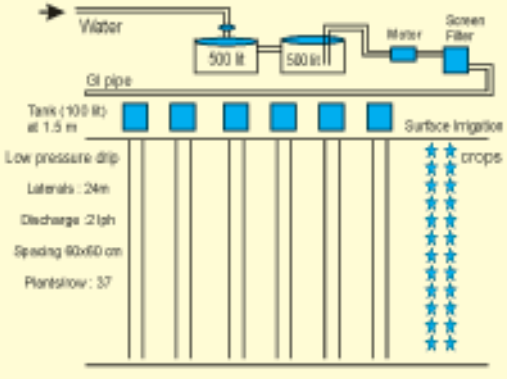


Fig.6. Layout of drip fertigation system in protected cultivation structure

Plate13. Experimental setup for water nutrient study in protected cultivation

Farmers Participatory Action Research Programme

R.C. Srivastava, S.K. Ambast, N. Ravisankar, S. Jeyakumar, Kamal Sarma and S.K. Zamir Ahmed

Farmers Participatory Action Research Programme (FPARP) was initiated to demonstrate the four technologies namely tank-well system, micro-irrigation system, pond based integrated farming system and crop diversification through broad bed and furrow system (Plate 14). All the technologies are being demonstrated in South Andaman, Little Andaman, Havelock and Neil Islands in 48 farmers field. The on station tested technology of BBF has been demonstrated in 11 farmer's field under Farmers Participatory Action Research Programme (FPARP) during the year. The demonstration have been carried out in six villages namely Calicut, Macchapahar, Indiranagar, Chouldari, Badmaspahar and Hazaribagh in South Andaman and two villages namely Netajinagar and R.K.Pur in Little Andaman Island. In general, all the farmers were satisfied with the technology for the waterlogged conditions in which they were neither cultivating any crop nor used for any other purpose earlier. All the farmers are interested on vegetable cultivation on the

Plate 14. Demonstrations on (a) tank-well system (b) pond based IFS system, (c) growing of vegetables and (d) vegetable on slope of bed and trailing in pandal over furrows in BBF system

Table 12. Net income from BBF system in farmers field under FPARP demonstration

Farmer	Net income before adoption of BBF (Rs/ha)	After adoption of BBF	
		Net income* (Rs/ha)	Duration (months)
D.N. Madhu, Chouldari	5000	67091	11
Kasinath Saha, Port Mout	7500	72544	11
Muthaiah, Indiranagar	7500	89000	11
Hamza, Calicut	5500	29660	6
Karunanidhi, Calicut	-	22996	6
Rajan Garami, Little Andaman	-	33410	6
Rupasi Biswas, Little Andaman	-	36500	6

* Income from fish not included

beds and only fish culture in the furrows. Since vegetables are costlier in the Islands during monsoon season, all the farmers are concentrating only on vegetables on the beds. The commonly grown vegetables are okra, brinjal, chillies, bitter gourd, amaranthus, radish, pumpkin. The net returns from vegetable cultivation in beds ranged from Rs 67091 to as high as Rs 89000 /ha in 11 months depending on the management of crop (Table 12). All the farmers released fingerlings in their furrows. The fish in the furrows are yet to be harvested. No one is ready to go for cultivation of rice in furrows due to high cost involved in transplanting and harvesting of rice in furrows. Few farmers have adopted their innovative utilization of area of BBF.

One farmer in Little Andaman islands did sowing of bitter gourd and bottle gourd on the slopes of beds and made machan over furrows thus saving a space of beds for other vegetables besides utilizing the vertical space of furrow. Machan over furrow also provides shade to fishes in furrows whenever there is high temperature. The other farmer in Indiranagar grown okra as first crop in beds. He planted cowpea near to okra when it is in maturity and trailed over stalk of okra thus saved cost of preparation of land and labour cost for putting sticks to cowpea.Around 75 % of the farmers are willing to extend their area under BBF in waterlogged areas. In the villages, where in the technology was demonstrated, many farmers are willing to adopt the technology provided partial financial support is given as the making cost of BBF is Rs 50000 to 65000/ha using excavator.

Integrated Agromet Advisory Services

R.C. Srivastava, S.K. Ambast, N. Ravisankar, T.V.R.S. Sharma, Ajanta Birah, Krishna Kumar, D.R. Singh, M. Sankaran, A. Kundu, S. Jeyakumar, S. Dam Roy, Kamal Sarma, Subhash Chand, M. Balakrishnan and S.K. Zamir Ahmed

Integrated Agromet Advisory Service unit has rendered its effective services through Agromet Advisory Bulletin (AAB). On receipt of forecast from Regional Meteorological Centre, India Meteorological Department, Kolkata, AAB are prepared on every Tuesday for Andaman district and Friday for Nicobar district. During the year, 46 bulletins were issued for Andaman district while 25 were issued for Nicobar district. The bulletins were regularly published in the Daily Telgrams and Dweep samachar. It is also broadcasted in Doordarshan and All India Radio. Altogether 50 farmers have been identified from various islands for collecting the feed back on the effectiveness of Agro Advisory services.

Verification of forecasted and observed values of rainfall was carried out for premonsoon, monsoon and post monsoon period (Table 13). The results reveal that on an average forecasted and observed values of rainfall are matching to the tune of 53.7 % during post monsoon period while it is only 23.4 % for monsoon period. First day forecast and observed values are matching to the tune of 75 % during post monsoon period. The per cent correctness of second, third, fourth and fifth day forecast are less compared to first day.

Out of 13 days of first day forecast for Apr – May, 2009, only 7 days of observed value and forecast value is same (53.8 %) and in the other days observed value was lower than forecast value. Out of 36 days of first day forecast for Jun. – Nov. 2009, only 7 days of observed value and forecast value is matching (19.4%) (Fig.7). Out of 32 days of

Table 13. Per cent correctness of forecasted and observed values of rainfall during pre monsoon, monsoon and post monsoon period (difference of with in 10 mm is considered as correct)

Forecast/day	Pre monsoon (Apr-May, 09)	Monsoon (Jun-Nov, 09)	Post monsoon (Dec 09 - Mar 10)	Mean
First day	53.8	19.4	75.0	49.4
Second day	16.0	22.5	50.0	29.5
Third day	33.3	30.0	56.2	39.8
Fourth day	25.0	20.0	46.8	30.6
Fifth day	0.0	25.0	40.6	21.8
Mean	25.6	23.4	53.7	34.2

first day forecast for Dec. 09 – Mar. 2010, observed value and forecast value is same for 24 days (75 %) (Fig.8). Observed value was lower than the forecast value for the remaining period.

Economic Impact: In the dry season, farmers used to raise the vegetable seedlings in the open conditions. During 2009, the forecast indicated heavy rain during the next 5 days and farmers were advised to raise the seedlings with pandal system (Machan) to protect from rain. This led to saving in cost of seeds to the tune of Rs 1500 / ha for those farmers who have adopted the practice published from AAB. Similarly, timely advice to farmers based on rainfall forecast saved two irrigations to vegetable crops during dry season. Wet poultry litter is problem during monsoon season due to high rainfall and relative humidity. After advisory, a farmer placed the 250 watts bulb in his poultry unit and saved 50 birds. Others who have not used the bulb, mortality rate was higher due to coccidiosis.

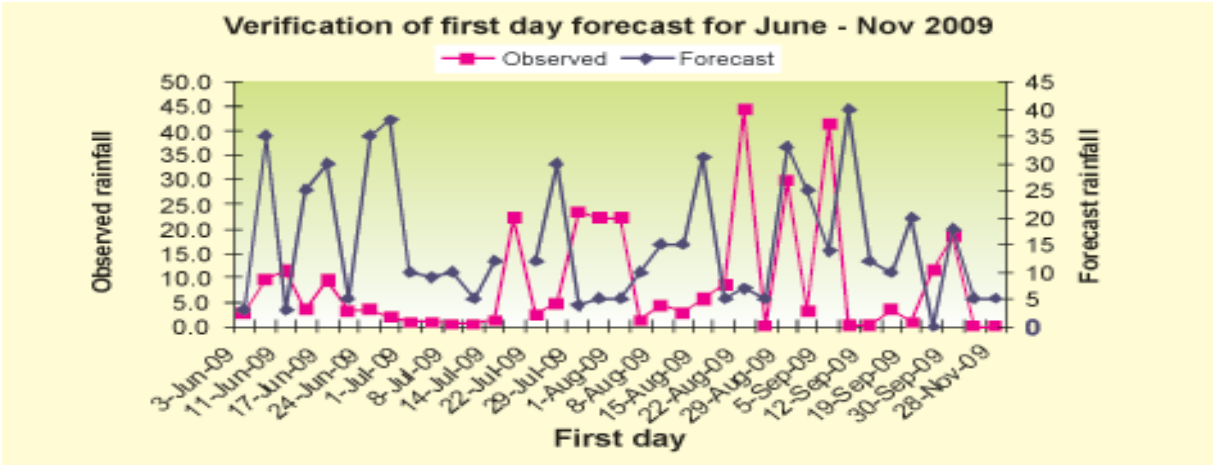


Fig.7. Verification of first day rainfall (mm) forecast for monsoon period (Jun-Nov, 2009)

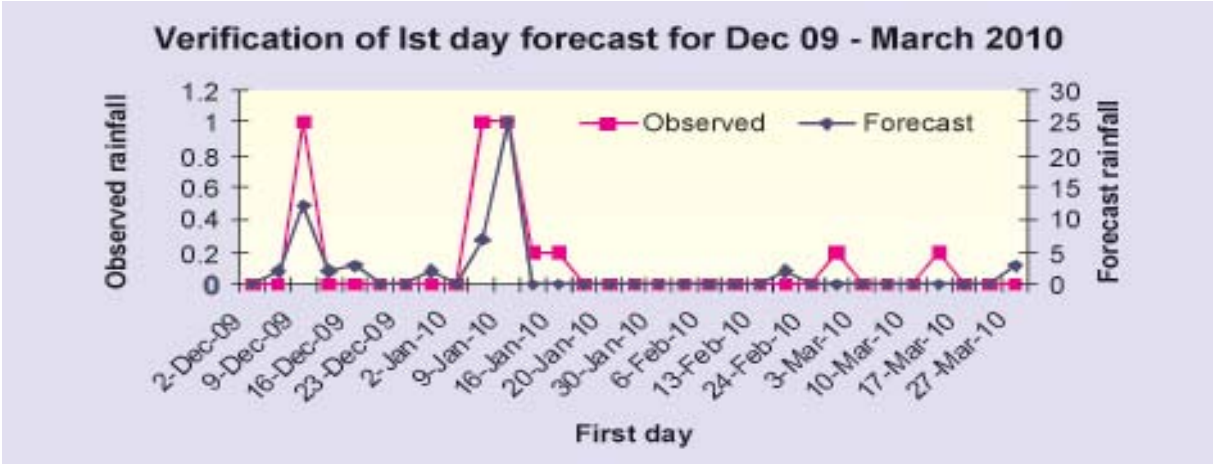


Fig.8. Verification of first day rainfall (mm) forecast for post monsoon period (Dec-Mar, 2010)

Division of Horticulture and Forestry

Collection, Conservation, Characterization and Documentation of Indigenous Vegetables of Andaman & Nicobar Islands

Shrawan Singh, D. R. Singh, V. B. Pandey, M. Balakrishnan, S. K. Zamir Ahmed, L. B. Singh and R. C. Srivastava

A germplasm block was created at CARI with 71 collections in thirteen different vegetables from Bay Islands and local knowledge about these vegetables was also documented (Plate 1). The morphological descriptors for local collections of *Momordica cochinchinensis, Oxalis corniculata, Colocasia esculenta, Centella asiatica, Capsicum spp., Ipomea aquatica, Enhydrus flactuans, Portulaca oleracea* and *Sauropus androgynus* have been prepared.

The proximate analysis (Table 1) of ten indigenous vegetables from A & N Islands revealed that the moisture content of vegetables ranged between 83.43 to 94.78 percent. Maximum ash content was recorded in *Portulaca oleracea* (21.18%) followed by *Alternanthera philoxeroides* (15.25%), *Colocasia esculenta* (13.5%) and *Centella asiatica* (13.26%). The lowest acid insoluble ash content was recorded in *Colocasia* leaves (0.32%) and *Momordica dioica* fruits (0.33%) while it was highest in *Centella asiatica* (3.24%) which reflects its low digestibility. Highest crude fat content was recorded in *Enhydra fluctuans* (4.17%) followed by *Colocasia esculenta* (3.73%) on dry weight basis. However, it was low in *Amaranthus tricolor* (0.26%) and *Centella asiatica* (0.66%). Most of leafy vegetables are rich in crude protein which ranged from 8.38% to 26.56% on dry matter basis with higher contents in *Oxalis corniculata, Alternanthera philoxeroides, Ipomea aquatica, Colocasia esculenta* and *Enhydra flactuans.*

Table 1. Proximate analysis of the traditional vegetables of A & N Islands

Sl. No.	Local Vegetable	Moisture content (%)	Ash (%)	Acid insoluble ash (%)	Crude fat (%)	Crude protein (%)
1.	*Colocasia esculenta*	92.4	13.5	0.32	3.73	20.44
2.	*Momordica dioica*	90.87	7.42	0.33	2.57	2.75
3.	*Portulaca oleracea*	94.78	21.18	0.6	2.51	21.8
4.	*Enhydra fluctuans*	86.34	10.4	1.1	4.17	19.44
5.	*Eryngium foetida*	86.57	10.21	1.76	1.95	8.38
6.	*Amaranthus tricolor*	83.78	7.64	0.85	0.26	5.94
7.	*Ipomea aquatica*	91.76	1.2	1.89	1.75	22.4
8.	*Alternanthera philoxeroides*	87.19	15.25	1.89	1.03	23.63
9.	*Centella asiatica*	83.43	13.26	3.24	0.66	13.7
10.	*Oxalis corniculata*	88.0	5.78	1.2	1.87	26.56

Through micronutrient analysis (Table 2), highest phosphorus content was recorded in *Ipomea aquatica* (75mg / 100g) and *Portulaca oleracea* (74mg / 100g), potassium in *Momordica dioica (*65mg / 100g), Mn in *Centella asiatica* (54.5mg / 100g), Cu in *Sauropus androgynous* (768.7mg / 100g) and *Portulaca oleracea* (658.63mg / 100g), Na in *Portulaca oleracea* (515.9mg / 100g), Ca in *Centella asiatica* (1900mg / 100g), Fe in *Portulaca oleracea* (237.3mg / 100g), Mg in *Amaranthus tricolor* (738.1mg / 100g) and Co in *Colocasia esculenta* (2.58mg / 100g). High Ca content considered as negative factor in leafy vegetables for health point of view. The lowest Ca content was recorded in *Portulaca oleracea* (24.3mg / 100g) and *Amaranthus tricolor* (26.2mg / 100g).

Great variability was observed for fruits, number of seeds per fruit, fruit cavity, mesocarp and aril content in local collections of *Momordica cochinchinensis* (Lour.) Spreng. from bay islands.

Analysis of antioxidant content in these traditional vegetables revealed maximum total carotenoid content in *Momordica cochinchinensis* seed membrane (1120µg / 100ml) which was significantly higher than carotenoid content in leaves of *Amaranthus tricolor* (79.81µg / 100ml). In terms of ascorbic acid, *Sauropus androgynus* reported high amount of ascorbic acid (314.3mg / 100g) followed by *Centella asiatica* (255.7mg / 100g). High amount of total polyphenol content was recorded in *Oxalis caniculata* (1400mg / 100g) and *Portulaca oleracea* (1260mg / 100g). The highest total anthocyanin content (83.49mg / 100g) was recorded in *Colocasia esculenta* and *Sauropus androgynus*. Total chlorophyll content was high in *Sauropus androgynus* (45.60µg / 100ml) followed by *Eryngium foetida* (44.31µg / 100ml).

The highest amount of total micronutrients content in local vegetables was recorded in *Centella asiatica* followed by *Amaranthus* and *Sauropus androgynus*. *Portulaca oleracea*, *Colocasia* and *Enhydra factuans* also contains high amount of micronutrients per unit of edible portion (Fig. 1).

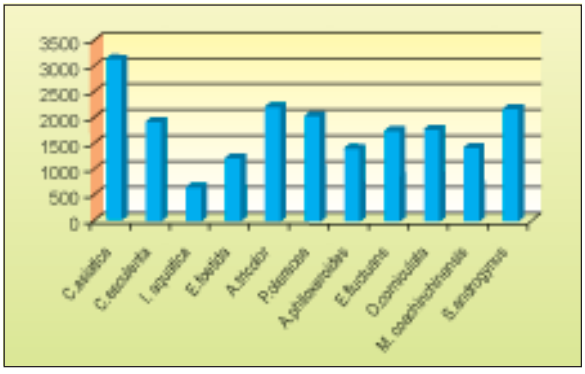


Fig. 1. Total estimated micronutrient content (mg / 100g) in selected traditional indigenous vegetables from bay Islands.

Centella asiatica

Sauropus androgynous

Colocasia esculenta

Enhydra fluctuans

Plate 1. Selected indigenous vegetables in Bay Islands

Table 2. Average nutrient composition of selected indigenous vegetables in Andaman and Nicobar Islands (dry weight basis)

Sl. No.	Local vegetables	Micronutrient content (mg/100g)									
			P	Ca	Mn	Cu	Na	Zn	Co	Fe	Mg
1.	*Centella asiatica*	60.73	58.4	1900.1	54.5	17.7	239.1	45.3	1.34	178.8	579.0
2.	*Colocasia esculenta*	64.87	57	998.5	32.8	20.7	242.8	41.7	2.89	268.8	185.2
3.	*Ipomea aquatica*	61.19	75.01	92.5	33.1	5.2	247.2	15.6	2.08	61.3	61.2
4.	*Eryngium foetida*	58.4	43	350.0	10.5	441.4	121.6	3.7	1.5	105.8	88.4
5.	*Amaranthus tricolor*	17.6	62.1	26.2	16.6)	722.5	416.5	23.9	0.84	208.5	738.1
6.	*Portulaca oleracea*	63.22	74.2	24.3	29.5	747.4	515.9	2.7	1.6	237.3	332.7
7.	*Alternanthera philoxeroides*	61.2	44.1	337.1	31.4	7.6	215.4	16.4	0.7	103.5	586.5
8.	*Enhydra fluctuans*	48.95	48.3	645.5	11.5	248.6	121.5	24.0	2.7	128.8	463.4
9.	*Oxalis corniculata*	48.5	11.2	450.5	25.3	734.3	287.9	1.6	1.64	186.8	24.1
10.	*Momordica cochinchinensis*	61.2	38	9.92	13.29	703.58	196.7	8.68	-	181.1	205.5
11.	*Sauropus androgynus*	45.7	61.2	84.4	25.6	768.7	306.3	5.9	-	212.5	664.9

Standardization of Technologies for Protected Cultivation of Vegetable Crops under Bay Island Conditions

Shrawan Singh, D. R. Singh, V. B. Pandey and Bijay Nanda

Four varieties of capsicum viz. Indra, Bamby, Orobelle and California Wonder were evaluated for crop geometric studies in polyhouse. Only initial two harvests were recorded for two cultivars Indra (4 fruits/plant) and California Wonder (3.2 fruits/plant). After this, the crop was damaged due to heavy incidence of bacterial wilt and mites. Thereafter, a plan was formulated to minimize bacterial wilt incidence with three measures viz. soil solarization, crop rotation with *Brassica spp.* and use of antagonistic agents. After soil solarization radish was taken to rotate the crop sequence. Second trial in polyhouse was conducted with 11 varieties of tomato and highest yield was recorded from Arka Ananya (1.67kg/plant) followed by Arka Vikash (1.59kg/plant) and DARL-3(1.43kg/plant). The highest bacterial wilt incidence was recorded in DARL-3 (70.0%), BT-1 (45.3%) and Arka Ananya (45.5%). The high susceptibility of these resistant genotypes in present experiment might be due to heavy load of pathogen, presence of different races of *Ralstonia solanacearum* in soil or existence of complex factors with pathogen favouring climate inside polyhouse (Table 3).

Table 3. Performance of tomato cultivars under polyhouse conditions

Entries	Wilt incidence (%)	Plant height (cm)	Fruit girth (cm)	Avg. fruit weight (g)	No. of Fruits/ plant	Yield/ Plant (kg)
BT 317	56.67	74.80	12.49	41.74	24.02	1.01
CO-3	68.87	72.16	12.24	33.10	22.82	0.96
BT-1	45.53	74.67	12.27	49.83	22.47	0.70
VR-35	62.23	71.43	12.56	46.94	21.62	0.99
VTG-106	65.53	81.81	14.11	58.84	21.52	0.81
DVRT-2	62.23	89.24	12.00	30.86	22.37	0.86
BMZ 21	53.33	104.52	12.36	47.00	21.27	0.85
PAU 2372	65.57	116.35	13.37	44.87	20.52	0.61
Arka Ananya	45.57	115.19	11.49	36.77	31.37	1.67
DARL-3	70.00	120.57	10.65	21.94	29.23	1.43
Arka Vikash	61.10	112.61	14.96	62.87	22.30	1.59
SE(m)	3.31	4.87	0.46	8.17	0.61	7.41
C.D (0.05%)	9.85	14.47	1.36	24.28	1.83	0.22
C.V.	9.47	8.98	6.28	32.80	4.51	12.31

All India Coordinated Research Project (Vegetable Crops)

Shrawan Singh, D. R. Singh and V. B. Pandey

Under AICRP (Vegetable Crops) 109 entries were tested in 16 trials with seven different vegetable crops in 2009-10. In cowpea Arka Garima (3.27 t/ha), Kashi Kanchan (3.02 t/ha) and 09/COPBVAR 4 (2.68 t/ha) entries performed well (Table 4). The yield of cowpea was low due to heavy rains in crop growing season i.e. June-September. Out of 15 entries of dolichos bean IIVR SEM-11 (7.02 t/ha), Swarna Utkrist (5.85 t/ha) and

Table 4. Performance of cowpea entries

Entries	Plant height (cm)	Days to 50% flowering	Fruit weight (g)	Fruit length (cm)	Avg. no. of fruits/ 5 plants	Green pod yield (t/ha)
COPBVAR 2	52.7	43.0	9.8	16.0	57.3	2.34
COPBVAR 3	50.1	42.8	8.3	26.0	57.8	2.25
COPBVAR 4	55.4	42.0	8.7	23.8	65.3	2.68
COPBVAR 5	58.7	43.5	7.1	16.3	60.8	2.21
Kashi Kanchan	103.7	43.3	8.8	22.5	72.0	3.02
Arka Garima	51.3	48.8	12.9	21.0	75.0	3.27
SE(±)	2.4	0.4	0.3	0.7	2.1	0.17
C.D (0.05%)	7.4	1.2	1.0	2.0	6.4	0.52
CV	7.81	1.81	6.98	6.25	6.51	13.01

Table 5. Performance of Dolichos bean entries

Entry	Plant height (cm)	Days to 50% flowering	Pod length (cm)	No. of pod/plant	Green pod yield (t/ha)
08/DOLPOVAR/1	196.3	68.3	6.9	35.3	3.48
08/DOLPOVAR/2	225.0	70.0	7.0	25.0	3.10
08/DOLPOVAR/3	243.3	70.3	7.0	36.0	3.69
08/DOLPOVAR/4	243.3	68.0	6.0	32.7	2.63
08/DOLPOVAR/5	208.3	75.7	6.3	46.0	4.88
08/DOLPOVAR/6	190.0	79.7	6.9	38.3	4.59
08/DOLPOVAR/7	175.0	78.7	6.0	33.3	3.36
08/DOLPOVAR/8	158.3	81.0	6.7	38.0	4.14
Swarna Utkrishta	149.3	84.0	6.6	76.0	5.85
Ankur Goldy	66.7	39.0	9.9	32.0	4.26
IS-1	233.3	83.3	11.9	40.0	3.92
IS-2	198.3	104.7	9.7	44.0	5.18
IIVR-Sem-11	128.3	74.7	10.2	82.7	7.00
IIVR- Sem-186	165.0	67.0	10.7	64.3	5.34
ZDL-79-1	185.0	95.7	7.0	29.3	3.09
SE(±)	7.1	1.7	0.4	4.3	0.18
C.D (0.05%)	20.5	5.1	1.2	12.5	0.53
CV	6.62	3.95	8.77	17.04	7.34

Table 6. Performance of chilli entries

Entries	Plant height (cm)	Weight of 10 fruits (g)	No. of fruits/plant	Fruit Length (cm)	Fruit Girth (cm)	Green fruit yield (t/ha)
LCA334	35.0	56.5	36.0	9.9	3.8	18.59
PC2062	49.0	31.4	36.7	9.2	3.5	10.52
KA 2	34.0	48.5	35.0	10.2	3.2	12.41
LCA 206	35.0	33.6	42.7	7.1	3.1	14.96
CCH-0-1	51.3	31.1	45.2	7.8	2.8	13.98
ACS-06-1	48.3	34.1	71.0	7.4	3.1	22.42
ACS-06-2	63.7	32.9	70.0	5.3	3.7	23.09
09CHVAR-1	60.3	26.3	23.2	5.8	3.0	6.10
09CHVAR-2	60.7	30.6	45.7	6.6	3.2	15.67
09CHVAR-3	45.3	30.5	70.0	5.2	2.9	21.45
09CHVAR-4	49.0	28.2	66.7	5.9	3.4	18.42
09CHVAR-5	61.0	29.0	46.7	6.1	2.5	13.32
09CHVAR-6	75.0	31.5	40.7	7.2	3.3	13.00
09CHVAR-7	71.7	33.0	32.7	6.4	3.4	10.26
09CHVAR-8	77.3	38.3	56.7	10.3	3.5	21.67
SE(±)	5.4	3.5	5.0	0.7	0.2	0.99
C.D (0.05%)	15.6	10.2	14.3	2.1	0.5	2.85
CV	18.22	17.07	19.90	16.61	9.83	12.03

IIVR SEM-186 (5.34 t/ha) were found promising in Islands (Table 5). Among french bean entries Arka Anoop (8.02 t/ha), Contender (7.68 t/ha) and DWD FB-57(6.19 t/ha) performed well. Chilli entries JCA 283 (17.2 t/ha) and SH KC-12 (15.82 t/ha) from 2008-09 trial and ACS-06-2(23.58 t/ha), ACS-06-01 (23.04 t/ha) and 09CHVAR-8 (21.87 t/ha) from 2009-10 trial were found promising in dry season (Table 6). Three best performing hybrids of okra in rainy season were 09/OKHYB-10 (7.05 t/ha), 09/OKHYB-9 (6.83 t/ha) and 09/OKHYB-2 (6.26 t/ha). The tomato trial was damaged completely due to bacterial wilt while brinjal varietal evaluation trial is under progress.

Development of Agro Techniques for Potato in Bay Islands

M. Sankaran, Shrawan Singh, V.B. Pandey, T. Subramani and S. Bhagat

A confirmatory trial for potato cv. Kufri Surya was conducted with local check Kufri Jyothi at Diglipur, North Andaman in randomized block design (Plate 2). It was observed that Kufri Surya outperformed the check for most of growth and yield parameters viz. plant height (64.8 cm), plant spread (31.89 cm), number of branches/plant

(3.31), number of tubers/ plant (7.82g), weight of tuber/plant (267.48), tuber length (10.84 cm) and tuber yield (10.69 t/ha) (Table 7). However, disease at late stage of the crop and rains during the period of crop harvest i.e. January and February months have damaged the crop. Therefore, proper time of sowing for potato will be standardized in coming year. The consistent performance of Kufri Surya favours its further consideration for conducting experiment for developing agro-techniques on potato production.

Plate 2. Potato cv. Kufri Surya at farmers field

Table 7. Growth and yield attributes of potato cultivars

Cultivers	Plant height (cm)	Plant Spread (cm)	No. of branches / plant	No. of tuber /plant	Weight of one tuber (gm)	Tuber weight / plant (gm)	Length of tuber (cm)	Girth of tuber (cm)	Yield of tuber t/ha
Kufri Surya	64.80	31.89	3.31	7.82	34.24	267.40	10.84	5.34	10.69
Kufri Jyoti	50.86	22.07	2.77	3.93	23.35	88.76	5.52	5.02	3.56
SE(m)	3.61	0.82	0.24	0.30	0.75	4.06	0.27	0.23	0.29
C.D (0.05%)	11.24	2.54	0.73	0.93	2.34	12.63	0.84	0.72	0.89
C.V.	22.49	10.89	27.89	18.40	9.40	8.21	11.85	16.05	14.46

All India Coordinated Research Project (Tuber Crops)

Shrawan Singh, V. Damodarn, M. Sankaran, D.R. Singh and R.C. Srivastava

Germplasm collection trips were conducted in Hut Bay, Car Nicobar and North Andaman Islands. Colocasia accessions were collected from Middle Andaman, Little Andaman and Car Niobar while *Dioscorea bulbifera* germplasm was collected from Little Andaman. New accessions collected were of Greater yam (1), Colocasia (3) and Aerial

yam (1) which are being multiplied in Germplasm Block at CARI. With addition of these five new accessions a total of 36 genotypes of tuber crops are being maintained in the germplasm pool (Table 8). Presentation with complete descriptors has been made for release of two varieties of Sweet Potato (CARI-SP-1 and CARI SP-2) (Plate 3) for releasing at state level. Field demonstrations were conducted at farmer's field in South Andaman and North Andaman in 2009-10. Three thousand cuttings of sweet potato and 150 kg yam planting materials of elephant foot were distributed to 25 farmers in April 2009.

Plate 3. Sweet potato varieties (CARI SP - 1, CARI SP - 2)

Table 8. Germplasm of tuber crops maintained under AICRP on tuber crops

Crop	No. of accessions existed	New collections added	Total germplasm available
Sweet potato	6	-	6
Greater yam	12	1	13
Colocasia	4	3	7
Cassava	3	-	3
Elephant foot yam	2	-	2
Coleus	1	-	1
Arrow root	1	-	1
Xanthosoma	2	-	2
Dioscorea bulbifera	-	1	1
Total	31	5	36

Standardization of Technology for Production of Quality Flowers under Island Ecosystem

R. Sudha and V.B. Pandey

Rose

The varietal evaluation trial (Plate 4) on rose was continued in 2009. Second year observations showed that maximum plant height was recorded in Movie Star (96.03cm) while minimum in Tineka (37.33cm). Maximum days taken to flowering were recorded in Grand Gala (70.77). Flower stalk length was maximum in First Red (16.37 cm) but no. of buds / plant was highest in Biyanka (3.67) (Table 9).

Gerbera

Varietal evaluation trial of gerbera (Plate 4) was continued for second year under protected condition. Evaluation was done on the basis of plant spread, number of leaves / plant, number of sucker / plant, flower diameter, stalk length, number of ray florets

Table 9. Performance of rose varieties under protected condition

Cultivars	Plant height (cm)	Days taken to flowering	Stalk length (cm)	No. of bud/ plant	Flower /plant /season	Flower diameter (cm)	No. of petals/ flower
Ravel	87.33	68.67	5.90	3.33	14.30	4.57	14.27
First red	67.80	59.77	16.37	2.67	24.53	3.87	13.87
Biyanka	57.93	57.00	8.87	3.67	17.43	5.07	21.40
Movie star	96.03	53.33	15.53	3.00	31.17	3.40	16.67
Tineka	37.33	44.67	12.17	2.67	32.47	5.50	19.83
Noblese	51.43	60.83	11.87	1.67	12.10	3.10	26.33
Grand Gala	43.20	70.77	15.70	2.33	15.20	3.70	17.43
SE(m)	3.52	2.13	0.32	0.47	1.40	0.43	1.01
C.D(0.05%)	10.95	6.64	0.99	1.46	4.35	1.33	3.14
C.V.	9.67	6.23	4.46	29.39	11.49	17.76	9.42

Plate 4. Rose and Gerbera under polyhouse condition

and number of flower/plant /season. The maximum plant spread was found in variety Marinilla followed by Gaalileo and Lorca. Loriana produced maximum number of sucker per plant which was at par with Manizales and Sonata. The largest size of flower was observed in Galileo followed by Palmira and Loriana. Longest stalk length was found in Palmira. The maximum number of ray florets was observed in Judy followed by Figaro and Manizales while maximum flowers/season recorded in Manizales (Table 10).

Table 10. Performance of gerbera varieties under protected condition

Varieties	Plant spread (cm)	No of leaves per plant	No of sucker/ plant	Flower diameter (cm)	Stalk length (cm)	No of ray florets	No. of flower/ plant/ season
Marinilla	70.10	17.20	3.52	8.53	60.17	152.00	8.67
Pia	65.27	13.67	2.52	8.90	55.33	194.67	24.67
Province	60.67	17.50	3.72	10.13	54.33	212.33	19.67
Antonio	63.50	16.00	2.45	10.40	51.00	222.67	7.67
Villssar	66.67	14.33	2.32	10.47	51.67	145.00	19.00
Ravel	62.50	20.33	3.17	10.53	52.67	212.00	14.67
Lorca	69.07	12.33	2.42	8.67	44.00	222.00	11.67
Galileo	69.30	15.07	3.02	13.23	55.73	223.00	21.00
Loriana	67.63	10.33	4.05	11.00	51.67	151.33	25.33
Teresa	64.57	15.40	2.65	10.07	52.67	151.67	12.33
Judy	64.27	23.67	2.77	10.47	44.50	329.33	5.67
Manizales	62.63	25.67	3.98	10.60	44.33	224.00	35.00
Figaro	66.07	13.80	2.70	9.80	47.33	225.33	6.00
Sonata	64.83	30.03	3.92	10.27	53.67	196.00	30.00
Palmira	55.17	14.33	2.05	11.23	70.60	224.00	10.33
SE(m)	1.79	2.30	0.15	0.48	2.35	5.02	1.34
C.D(0.05%)	5.22	6.69	0.45	1.40	6.83	14.62	3.91
C.V.	4.80	22.98	8.86	8.10	7.72	4.23	13.85

Collection, Conservation and Molecular Characterization of Early Flowering Open Pollinated Mango Clones of Bay Islands

D.R. Singh, M. Sankaran, R. Sudha, S. Bhaghat and V. Damodaran

The mango clones planted at CARI were evaluated for its morphological characters *viz*., plant height, number of branches and flowering (Table 11). The maximum plant height and number of branches were recorded in B1 clone (4.07m, 19) followed by KL 2 (3.39 m, 18.5) where as minimum height was recorded in ML 7 (1.4 m). The flowering was observed only in four clones viz. ML 9, M 2, KL 2 and B 1 but there was no fruit setting. This variable flowering pattern of mango clones may be due to their different genetic sources and/or lack of pollination.

Table 11. Vegetative and flowering parameters of mango OP clones

Sl. No	Name of the clone	Plant height (cm)	No. of branches	Flowering
1	KL 1	212.5	15.0	No
2	KL 2	339.0	18.5	Flowering
3	B1	407.5	19.0	Flowering
	CL 1	158.0	6.0	No
5	CL 2	160.0	6.0	No
6	ML 8	170.0	7.5	No
7	ML 9	295.0	12.0	Flowering
8	ML 10	289.0	19.0	No
9	ML 6	145.0	4.5	No
10	ML 7	140.0	6.0	No
11	ML 3	214.0	14.0	No
12	ML 4	330.0	13.5	No
13	ML 5	317.5	18.0	No
14	GL 4	185.0	10.0	No
15	M 1	307.5	13.5	No
16	M 2	304.5	16.5	Flowering
17	GL 1	259.0	7. 0	No
18	GL 2	235.0	7.5	No
19	GL 3	200.0	11.5	No
20	GL 4	185	10.0	No
	SEd	86.73	1.86	-
	CD(0.05%)	181.55	3.89	-
	CV%	35.38	15.85	-

*Mean values are given in parentheses.

Isolation of and identification of pathogen

During pathological inspection of mango orchard it was found that most of the trees were severely affected by leaf spot with typical round to irregular light brown spots. These spots subsequently changed into dark brown with short hole in centre and covered entire leaf which becomes brittle and curled upward. The infected leaf samples were symptomatically identified as anthracnose disease. The pathogen was also confirmed as *Colletotrichum mangiferae* through pathogenesis test with koch's postulate method. Based on the morphological characteristics, all isolates were grouped into two i.e. *C. mangiferae*-I and *C. mangiferae*-II

Evaluation of *Trichoderma* spp. against *C. mangiferae*-I and *C. mangiferae*-II

In vitro inhibition of two isolates *Colletotricum mangeferae* by *Trichoderma* was reported with dual culture test. The percent inhibition of mycelial growth of pathogens by *Trichoderma* isolates ranged from 47.1 to 60.0% (*C. mangiferae*-I) and 46.1 to 60.0% (*C. mangiferae*- II). The highest percent inhibition of *C. mangiferae* I was recorded with Th-CARI-20 followed by Th-CARI-25 and Tv-CARI-33 which were most effective in suppression of pathogen growth. In the non-volatile inhibitors test, the isolate Tv-CARI-14 was most effective in suppression of mycelial growth of *C. mangiferae*-I (78.0%) at 10% concentrations followed by Tv-CARI-14. At similar concentration, Tv-CARI-33 was most effective in percent inhibition of *C. mangiferae* -II.

In vitro efficacy of some fungicides against *C. mangiferae*-I and *C. mangiferae*-II

The *in vitro* evaluation of eight fungicides was done against both pathogens by poison food technique. The test fungicides were Calixin, Diphenoconazole, Saaf, Copper oxychloride, Bavistin, Mancozeb, Kavach and Krilaxyl Gold. Among the fungicides, Diphenoconazole was most effective in suppression of mycelial growth of both pathogens with lowest LC_{50} value followed by Bavistin, Calixin, Saaf, Krilaxyl Gold, Mancozeb, Kavach and Copper oxychloride with highest LC_{50} value for both pathogens. Thus, some of these fungicides can be included in integrated disease management program for effective management of anthracnose disease in mango.

Standardization of Agrotechnique for Organic Black Pepper Cultivation in A & N Islands

I.Jaisankar, Krishna Kumar and S. Bhagat

An experiment was laid out in randomized block design with four replications to standardize the organic source of nutrients for organic cultivation of black pepper and coconut under coconut based intercropping system (Plate 5). The treatments comprised Vermicompost + Biopotash (T1), reco-

mmended dose of NPK (T2), Vermicompost (T3), Gliricidia leaf manure (T4) and Control (T5). The organic sources were estimated to supply the recommended dose of NPK to black pepper (100:40:140 g/ vine) and coconut (500:320:1200 g/tree), respectively. The observations recorded on the growth and yield parameters of black pepper are presented in table 12. The highest yield of black pepper was recorded with (331kg ha^{-1}) followed by T1(300 kg ha^{-1}). This may be due to the quick release of nutrients from the inorganic sources as compared to organic sources. Among the organic sources the yield of black pepper was in the order of Vermicompost + Biopotash > Vermicompost > Gliricidia leaf manure > control. In another experiment along with the organic sources of nutrients different sprayings as per the treatments (Table 13) were given to black pepper to control the incidence of foot rot and wilt disease which is the severe constraint in black pepper cultivation. The result revealed that application of recommended dose of NPK through inorganic and spraying of black pepper with 1%Bordeaux mixture recorded the highest yield (435.2 kg ha^{-1}) followed by Vermicompost+Biopotash+Bordeaux mixture (386.6 kg ha^{-1}) with the lowest in control. In general the efficacy of sprayings on the growth and yield of black pepper was in the order of 1% Bordeaux mixture > Neem leaf decoction > *Pseudomonas*.

Plate.5 Black pepper on *Gliricidia* standards as intercrop of coconut garden

Table 12. Effect of organic & inorganic nutrients on the growth and yield of Black Pepper

Treatments	No. of vines/1m height	No. of fruiting branches	Total spikelet /tree	Berries wt/ Spikelet wt fresh(g)	Berries wt/ Spikelet wt dry(g)	Total yield (Kg/ha)
Vermicompost+Bio Potash	14.0	95.0	201.0	15.0	4.1	299.9
NPK	15.5	101.8	206.8	15.5	4.4	331.1
Vermicompost	10.5	81.0	141.3	13.3	4.1	208.2
Gliricidia leaf	9.0	67.0	120.5	11.0	3.7	162.3
Control	5.0	44.0	93.0	9.0	3.1	103.2
SEd	0.9	1.1	1.3	0.9	0.1	4.2
CD(0.05%)	1.9	2.5	2.9	2.0	0.2	9.1
CV%	11.3	2.1	1.2	9.9	3.5	2.7

Table 13. Effect of organic and inorganic nutrients along with spray formulations on the growth and yield of Black pepper

Treatments*	No. of vines/ 1m ht	No. of fruiting branches	Total spikelet /tree	Fresh spikelet wt (g)	Dry spikelet wt (g)	Total yield (Kg/ha)
Vermicompost+BP +NLD(T_1)	13.0	99.0	203.0	16.0	4.5	335.3
Vermicompost+BP+BM(T_2)	18.0	101.7	211.0	21.0	5.0	386.6
Vermicompost+BP+ Pseudomonas (T_3)	11.7	93.3	199.0	15.0	3.9	282.5
NPK+NLD(T_4)	16.0	104.7	211.3	20.0	4.9	377.0
NPK+BM (T_5)	19.0	109.0	216.0	24.0	5.5	435.2
NPK+Pseudomonas (T_6)	15.0	101.0	203.7	19.0	4.4	323.8
Vermicompost+NLD (T_7)	13.0	86.0	146.3	14.3	3.8	200.5
Vermicompost+BM(T_8)	15.0	88.7	156.7	18.0	4.1	233.8
Vermicompost+Pseudomonas(T_9)	11.0	81.7	139.3	11.0	3.0	152.2
Gliricidia leaf+NLD (T_{10})	11.0	66.0	123.7	13.3	3.8	171.0
Gliricidia leaf+BM(T_{11})	11.0	69.7	141.3	14.0	3.4	176.7
Gliricidia leaf+Pseudomonas (T_{12})	8.0	59.0	112.3	10.0	2.9	117.3
Control (T_{13})	8.0	40.0	97.0	10.0	2.9	102.4
SEd	1.2	1.3	1.9	1.0	0.2	12.0
CD(0.05%)	2.4	2.6	4.0	2.1	0.3	24.8
CV%	10.9	1.9	1.4	7.9	4.4	5.8

*BP- Biopotash; NLD-Neem Leaf decoction; BM-Bordeaux Mixture

Improvement of Coconut and Arecanut

D.R. Singh, V. Damodaran, M. Sankaran, I. Jaisankar and R.C. Srivastava

The continuous evaluation of 24 Pacific Ocean Islands collection (exotic) and six indigenous accessions from Nicobar Island maintained at WCGC, Sipighat resulted in selection of four dwarf cultivars for tender nut and ornamental purpose and the selected varieties were submitted for state variety release committee.

Inter-se-mating/selfing in coconut

Inter- se- mating and selfing was carried out in the selected accessions from the 24 exotic germplasm and 6 indigenous accessions from Nicobar Islands. The inter-se-mating/ selfing work was initiated during the second week of October, 2009 and a total of 4485 female flowers were pollinated.

Despatch of pollinated seed coconut to CPCRI, Kasaragod

A total of 482 seed coconuts harvested from previous year crosses have been sent to CPCRI, Kasaragod via PPQS, Chennai. However during the subsequent harvest

about 190 seed nuts will be sent. Apart from the above a total of 1345 open pollinated seed nuts from Acc. No.5, 8, 18, 22 and dwarf palms of CARI have been sent to CPCRI, Kasaragod.

Exploration for collection of Coconut germplasm from South Andaman District

A germplasm exploration trip was undertaken in collaboration with CPCRI, Kasaragod for collection of coconut germplasm accessions from South Andaman. The exploration resulted in identification and collection of 18 accessions including three dwarf types and a *makapuno* type. The *makapuno* type with soft endosperm is first report of collection from the A&N Islands. One set of the seed nut samples of germplasm collected have been sown in nursery for evaluation at CARI, Port Blair.

Evaluation of newly released coconut varieties and hybrids in different agro-climatic regions

As approved in the AICRP (Palms), the performance of newly released coconut varieties

Table 14. Performance of high yielding Arecanut local selection (CARI - Sel - 1)

Characters	CARI – Sel- 1	Mangala	Samrudhi	Calicut 35	SEd	CD (P=0.05)	CV
Plant height(m)	7.18	6.47	7.47	8.81	NS	-	-
Plant girth (cm)	47.6	48.4	53.6	49.2	NS	-	-
No. of scar *in l mt*	9.2	9.4	8.2	8.6	NS	-	-
Inter nodal distance (cm)	11.4	11.6	12.6	13.4	NS	-	-
No. of leaves in the crown	9.8	9.8	10.0	9.8	NS	-	-
Length of leaf(cm)	185.8	219.0	242.0	183.4	8.8	19.2	6.7
Width of leaf (cm)	80.4	81.6	87.0	82.2	NS	-	-
No of bunches / tree	6.6	6.4	5.8	7.4	0.4	0.8	8.5
Average no. of nuts / bunch	94.0	81.7	82.0	86.0	NS	-	-
Total no. of nuts / tree	620	523	476	636	51.8	112.8	14.5
Bunch weight (Kg)	5.98	5.46	4.62	4.76	NS	-	-
Avg. fresh fruit weight (g)	61.9	65.2	60.7	42.8	2.4	5.2	6.5
Avg. dry fruit weight (g)	23.5	24.8	22.0	18.3	0.81	1.77	5.79
Length of fruit (cm)	5.8	6.2	5.9	6.0	NS	-	-
Girth of fruit (cm)	15.6	16.0	18.9	14.3	0.04	0.09	0.45
Husk weight (g)	10.6	12.8	11.1	8.6	1.00	2.18	14.67
Chali weight (g)	9.8	8.5	9.6	7.6	NS	-	-
Girth of Chali (cm)	9.9	8.1	9.3	8.0	0.2	0.4	3.2
Length of Chali (cm)	1.9	2.6	2.4	2.6	0.1	0.2	6.1
Husk / nut ratio %	45.1	51.6	50.5	46.9	NS	-	-

and hybrids have to be evaluated in different agro-climatic regions. Accordingly 30 selfed seed nuts each of Kera Keralam variety from Thanjavur, Konkan Bhatye Coconut Hybrid-1, Kera Bastar and Kahikuchi Hybrid-1 received from Regional Coconut Research Station, Ratnagiri were sown in the nursery during August, 09 and March, 2010 respectively. The overall germination percentage of Kera Keralam variety was 56.7%, and the number of days taken for germination ranged from 69 to 149 days.

Arecanut local selection

The high yielding Arecanut selection (CARI-Sel-1) made from the local population of Arecanut grown in Garacharma farm and KVK, CARI has recorded maximum number of nuts/ bunch (94) compared to Mangala and Samrudhi and it has also recorded higher chali weight (9.8 g) as compared to the check variety Mangla. The brief description of the arecanut new selection (CARI - Sel - 1) and it's comparison with the other cultivable varieties in the Islands are as detailed in table 14.

Plate 6.(i) Andaman Micro Tall tree crown view

(ii) Macapuna nut cross section

(ii) Cross section view of arecanut vertices

Role of Alley Cropping System in Nutrient Conservation (nutrient build up + protection of fine soil particles from erosion) and Selection of Suitable Crop Sequence for the Cropping System for the Andaman Islands

I.Jaisankar and T.P.Swarnam

An experiment was conducted in randomized block design with 5 treatments and 4 replications to evaluate the performance of grain amaranthus in alley cropping system during the post monsoon period. The treatments comprised of incorporation of gliricidia pruned leaf biomass @ 2.5, 5, 7.5 and 10 t ha^{-1} along with control. The growth and yield attributing parameters were significantly influenced by the gliricidia leaf biomass incorporation at 45 DAS and at harvest stage in grain amaranthus. The highest yield (770.2kg ha^{-1})

Table 15. Effect of Gliricidia pruned leaf biomass on growth and yield of grain amaranthus

Treatments	Plant height (cm)	Collar diameter (cm)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Dry matter (g/plant)	Grain Yield (kg/ha)
T1: Control	87.5	1.4	16.8	2.9	21.8	468.7
T2: *Gliricidia* leaves (2.5 t ha^{-1})	88.1	1.6	19.8	2.9	22.8	623.9
T3: *Gliricidia* leaves (5 t ha^{-1})	111.5	1.6	20.9	3.1	24.0	695.2
T4: *Gliricidia* leaves (7.5 t ha^{-1})	113.5	1.8	21.8	3.2	25.0	763.2
T5: *Gliricidia* leaves (10 t ha^{-1})	114.2	1.8	22.3	3.3	25.6	770.2
SEd	0.4	0.01	0.1	0.04	0.1	27.1
CD (P=0.05%)	0.9	0.03	0.2	0.08	0.2	59.2

Table 16. Effect of Gliricidia leaf biomass on the total NPK content of the soil (kg ha^{-1})

Treatments	Nutrient content before planting			Nutrient content at harvest		
	N	P	K	N	P	K
T1: Control	151.9	9.8	86.4	158.0	11.7	93.0
T2: *Gliricidia* leaves (2.5 t ha^{-1})	168.7	11.0	133.4	178.1	12.6	136.4
T3: *Gliricidia* leaves (5t ha^{-1})	185.5	12.7	169.4	195.7	15.8	173.0
T4: *Gliricidia* leaves (7.5 t ha^{-1})	199.5	15.2	175.8	210.8	16.3	186.0
T5: *Gliricidia* leaves (10 t ha^{-1})	253.5	16.9	196.4	263.3	18.9	202.6
CV%	8.8	7.7	32.9	7.7	5.6	33.7
SEd	10.6	0.7	31.7	9.8	0.6	33.7
CD (P=0.05%)	22.6	1.6	67.3	20.9	1.3	71.4

was recorded with the incorporation of 10 t ha^{-1} pruned biomass in the alley cropping system followed by incorporation of 7.5 t ha^{-1} which recorded a yield of 763.2 t ha^{-1}. However, both the treatments were on par with each other and significantly higher as compared to incorporation of 2.5 t ha^{-1} and no incorporation (control). This indicates that application of 7.5 t ha^{-1} gliricidia pruned leaf biomass in the alley cropping system is optimum to achieve higher yield of grain amaranthus (Table 15). Soil analysis before planting and after harvest of the crop revealed that there was appreciable increase in the available N, P and K content of the soil from the initial level. The increase in available nitrogen ranged from 7.9 to 11.2 kg ha^{-1} while the increase in phosphorus ranged from 1.1 to 3.1 kg ha^{-1} and the potassium ranged from 3 to 10.2 kg ha^{-1}. This might be due to the fact that gliricidia being a N fixing legume tree and as such its incorporation of pruned biomass which on decomposition might have increased the

available N in soil and during decomposition the production of organic acids and consequent release of P fixing ions increases the available P content of the soil. Incorporation of 7.5 t ha^{-1} gliricidia pruned biomass in the alley system registered the maximum increase in available soil N and K (11.2 and 10.2 kg ha^{-1}). However, incorporation of 10 t ha^{-1} gliricidia leaf pruning registered the increase in available NPK content of the soil to the tune of 9.8 kg, 2 kg and 6.2 kg ha^{-1}, respectively (Table 16).

Germplasm Collection, Evaluation and Identification of High Yielding Genotypes of Jatropha and Karanja and their Multiplication in Bay Islands.

I. Jaisankar, Israr Ahmad and Someshwar Bhagat

An exploration survey was undertaken and identified high yielding plus trees of *Jatropha* and *Pongamia* in different locations of Andaman Islands and the seed materials were collected from the selected plus trees for evaluating variability in seed and growth characters. Significant trait differences were observed in the parameters such as seeds, seed morphology, growth characters, plant height, and fruiting and flowering ratio (Table 17). The Jatropha species collected from different part of the Island were planted on 8th of October 2009 on CARI Garacharma farm (Plate 7, Table 18). *J. podagrica* started flowering as well as fruiting in the month of January 2010 and *J. multifida* started flowering in the month of February 2010 and started fruiting in the month of April 2010. *J.gossypifolia* started flowering in the month of April 2010. The branches development in two species of *Jatropha* especially in case of *J.gossypifolia and J. curcas* were observed during the month of April 2010.

In South and Middle Andaman, Jatropha species namely *J. curcas* (50%) were found more when compared to other species such as *J. gossypifolia* (20%) *J. Podogirica* (10%) and *J. multifida* (10%), covering the land from wet to dry in the island *J. curcas* generally grown as live fence and also observed in waste land and in the same area *J. gossypifolia* were also observed. *J. multifida* was very rarely seen in some houses as ornamental plant. *Pongamia pinnata* (20%) was mostly found in seashore and Tsunami affected areas of South, Middle and North Andaman Districts of Andaman. Selection of plus trees were under taken as per the NOVOD board instructions. In South Andaman four candidate plus trees of *Jatropha curcas*, one for *J. multifida* and two for *J. gossypifolia* (Plate 8) were selected from Jirkatang, Beachdera and Mazar pahad and *J. curcas* from Farargunj, Chouldari for *J. multifida* and Sippighat and Garacharma for *J. gossypifolia.* The tree of *J. curcas* was about 3 - 5 m in height with smooth grey bark sprout readily and grows rapidly which makes it suitable for fencing.

The leaves developed from it were green to pale green, broad and usually simple 3-5 lobed. *J. curcas* is formed in the leaf axel; flowers are formed terminally, individually with female flowers usually slightly larger and occur in the hot seasons. *J. curcas* seeds resemble castor in seed shape, ovoid oblong and black in colour.

J. multifida or coral plant is a shrub or small tree with a single trunk, a loose, spreading

Table 17. Growth and yield parameters of *Jatropha curcas*

Site data	Location	Plant height (m)	Basal girth (cm)	No. of branch	No. of fruit/ bunch	100 Pod wt. (g)	100 Seed wt.(g)	Husk weight /100 pod
Jirkatang	5m, N11^0 50'12.2'' E092^0 39'15.2''	2	30	2	6	321	256.4	134.5
Beachdera	34m, N11^0 55'35.9'' E092^{0}39'01.8''	2	22	2	4	273.3	199.2	74.1
Farargunj	71m, N11^0 43'22.6'' E092^{0}39'15.8''	6	36	2	6	335	276.4	58.6
Shaitankari	63m, N11^0 43'14.8'' E092^{0}40'05.0''	2.5	18	3	4	250.8	190.4	60.4
Namunagar	33m, N11^0 40'20.3'' E092^{0}40'54.1''	3.5	26	3	3	-	-	-
Sholbay	*18m*, N11^{0}42'53" E092^{0}43'00''	3	4.5	2	4	190.9	131.4	59.5
Manarghat	*3m*, N11^{0}41'06.0'' E092^{0}42'34''	3	4	4	3	310	216.4	93.6
Tirur	*8m*, N11^{0}43'05.1'' E092^{0}36'.47.2''	2.5	30	2	3	289.6	183.8	105.8
Chidiyatapu	N11^{0}33'43.6'' E092^{0}43'16.09	15	28	2	5	276.2	153.9	122.3

Table 18. Growth and flowering parameters of Jatropha spp. at five months after planting (Garacharma farm)

Jatropha Species	Avg. plant ht(cm)	Avg. basal girth (cm)	Avg. no. of leaves	Avg.no. of flower	Avg. no. of fruit
J.curcas Diglipur Accession1	24.10	8.6	8	-	-
J. multifida	29	4.73	8.3	1	-
J. gossypifolia	30.76	7.6	12	-	-
J. podagrica	8.43	14.3	7	2	3
J. curcas	18.9	9.60	11	-	-

Plate 7. Candidate plus tree of *Jatropha curcas*

Plate 8. Candidate plus tree of *Jatropha multipada and jatropha gossypifolia*

crown and a typical height in cultivation of 6-10 ft (1.8-3.1 m), although it can grow up to 20 ft (6.1 m) tall. The very distinctive leaves are large, growing up to 12 in (30.5 cm) wide. They are cut deeply into 7-11 narrow lobes with the margins of each lobe themselves dissected into narrow pointed segments. They are dark green above and whitish beneath. The flowers are bright coral red and borne in flat topped clusters on long stalks held high above the foliage. Coral plant blooms on and off all year long, and especially during hot weather. Most euphorbs have a milky sap that flows from broken stems, but that of coral plant looks more like cloudy water (Table 19).

J. multiflora fresh pod weight was 17.03g and dry pod weight 0.45g while fresh and dry weights of seeds were 2.58g and 0.54g, respectively. The inflorescence in *J. podagrica* produces brightly coloured orange-red flowers on short pedicels. *J. podagrica* flowers round the year in favourable environment, especially in the warmer months. *J. Podagrica* produces a roundish seed pods or fruits are set freely after flowering, start off a lovely fresh green and turn blackish brown when matured. Seeds will self sown easily on suitable soil. The seeds become mature when the capsule changes from green to yellow, after two months of fruit setting. Fruit development takes place approximately 90 days after flowering. Flowering and fruiting occur on the same plant throughout the fruiting season from February to November.

Table 19. Growth and yield parameters of *Jatropha multifida*

Site data	Plant height (m)	DBH/ Basal girth(cm)	No. of branches	No. of fruiting bunches	No. of pods/bunch
Minnie bay	3.2	12	2	1	3
New Manglutan *13m*, N11^{0}33'39' E092^{0}38'45.9''	2	14	4	1	2
Chouldari 6m, N11^{0}38'04.5'' E092^{0}40'04.9''	2	15	2	8	4

Table 20. Growth and yield parameters of *Jatropha gossypifolio*

Site data	Location	Plant height (cm)	Basal girth(cm)	No. of branch	No. of flowers/ bunch	Fruits/ bunch
Laxmi nagar	22m , N11^0 42'13.2'' E092^{0}40'35.3'	0.75	5	2	-	-
Barm nagari	9m, N11^0 41'37.5'' E092^{0}40'49.1''	1.5	11	3	2	-
Calicut	63 m , N11^{0}35' E092^{0}42''	4 1	2	2	-	
Sippighat	15m, N11^0 36'00.6'' E092^{0}41'01.7''	1.0	5	3	80	50

Each fruit bears three seeds of 2 – 3 cm long and 1-1.5cm thickness. *J. gossypifolia* found was 0.5-2 m tall shrub, with deep-reddish brown stem and branches. The leaves are 5-11 x 6-13 cm 3-5 lobed, crimson red. *J. gossypifolia* produces flowers with bright coral red and borne in flat-topped clusters on long stalks held high above the foliage. Capsules of *J. gossypifolia* are of 0.8 -1.7 cm long, 3 lobed, smooth, glabrous and 1 - 3 cm thickness (Table 20).

Pongamia pinnata

Two plus trees were identified in New Wandoor (Plate 9) and Chidyatapu (Plate 9 a,b & c). The observation made on their fruiting and flowering pattern, the pod size, shape and number of seeds in candidate plus tree revealed that girth of the trees ranged from 62 and 79 cm while the pod size ranged from 6x 3.1cm and 6x3.7 cm. Seed size ranged from 2.2x1.9 cm to 2.1x1.7 cm respectively. The weight of hundred pods from each tree was taken which was 1.341kg while the weight of hundred seeds was 0.396 kg. In Havelock two plus trees were identified. The observations recorded in the tree at Vijaynagar village of Havelock revealed the girth of tree as 152 cm with pod size of 8x3.7 cm, seed size measuring 2.5x2 cm, and hundred pods weighed 775.5g with weight of hundred seeds of 359.29g. Another tree was observed near Radhanagar beach area, Havelock with a girth of 57 cm. The size of the pods was 7x3 cm and the seed size was 2.5x1.6 cm. Weight of hundred pods and seeds were taken which measured 1.715kg and 0. 581 kg, respectively.

Plate 9. Candidate plus tree of *Pongamia pinnata* in Wandoor

(a) (b) (c)

Plate 9(a-b). Candidate plus tree of *Pongamia pinnata* in Chidyatapu; (c) Establishment of *Jatropha* species at Garacharma farm

Identification, Evaluation and Development of Silvipastoral System for Bay Island Condition

I.Jaisankar T.P.Swarnam S.Jeyakumar M.Sankaran and N.C.Choudhuri

To evaluate the yield of three fodder grasses viz. Para (G_1), Guinea (G_2) and *Ischaemum rugosum* (G_3) under the four indigenous fodder trees i.e. *Mussanda macrophylla* (T_1), *Trema tomentosa* (T_2), *Ficus spp.* (T_3), *Euphorbia sp.* (T_4) *and open* (T_5) under natural forest system, an experiment was laid out in randomized block design with four replications at Garacharma farm (Plate 10). The observations on the growth parameters of fodder trees and grasses grown under the fodder trees, the influence of light on the yield of grasses and soil parameters at the initial as well as after one year of the experiment were estimated. The result revealed that the growth parameters viz, height, DBH and number of branches of the fodder trees considerably increased from the initial level (Table 21). The height of the fodder grasses and number of tillers were significantly influenced by the fodder tree canopies. The overall performance of all the three fodder grasses was superior under the canopy of *Trema tomentosa* tree in which the average height of the grasses (135.7 cm) and number of tillers (14.3) were higher followed by *Ficus sp.* Among the grasses, growth performance of para and guinea grasses were significantly higher under the tree canopies as compared to *Ischaemum rugosum* (Table 22). Maximum forage yield was recorded under *Trema tomentaosa* (104 t ha^{-1}) followed by *Ficus sp.* whereas the least forage yield was recorded in open situation (96.2 t ha^{-1}) among the grasses maximum forage yield was attributed by guinea grass (130 t ha^{-1}) followed by para grass (121.7 t ha^{-1}) while least forage yield was recorded from *Ischemum rugosum* (46 t ha^{-1}). However, the interaction effect of fodder trees and fodder grasses were non-significant. Among the grasses Guniea grass performed better under the tree canopy by recording the forage yield of 131 t ha^{-1} as compared to open condition. This might be due to the shade under the tree (46800 candles compared to 49000 candles in open condition) promoted the vegetative growth of guinea grass. It was observed that there was a significant reduction in the soil N, P and K after one year of the experiment from the initial level. In general the reduction in N ranged from 1.67 to 2.95 kg ha^{-1}, P ranged from 0.58 to 1.59 kg ha^{-1} and K ranged from 0.67 to 1.83 kg ha^{-1} (Table 23). However, among the fodder trees reduction in N (3.5 kg ha^{-1}), P (1.59 kg ha^{-1}) and K (1.83 kg ha^{-1}) was maximum in *Euphorbia sp., Treama tomentosa* and *Mussanda macrophylla*, respectively. Among the fodder grasses the reduction in N

and K (3.1 and 1.7 kg ha^{-1}) was higher under paragrass whereas the highest reduction in P (1.25 kg ha^{-1}) was observed under *Ischaemum rugosum*. All the grasses recorded higher yield under fodder trees compared to open conditions. In general the available soil N, P and K had reduced to the tune of 3 to 6 kg under various grasses and trees. Among the grasses guinea found to be better under fodder trees compared to other grasses.

Table 21. Growth parameters of fodder trees

Treatments	Initial			After one year		
	Height(m)	DBH(cm)	No. of branches	Height(m)	DBH(cm)	No. of branches
T1	6.8	4.4	4.8	7.6	4.7	5.5
T2	5.2	5.5	2.8	6.2	5.9	4.0
T3	6.9	7.2	5.0	7.9	7.4	6.0
T4	5.4	8.8	8.3	6.4	8.9	8.8
Mean	6.1	6.4	5.2	7.0	6.7	6.1
SEd	0.8	0.3	0.6	0.7	0.3	0.6
CD(P=0.05)	NS	0.6	1.4	NS	0.6	1.3
CV%	17.6	5.6	16.5	14.4	5.4	13.6

Table 22. Effect of fodder trees on the growth parameters of fodder grasses (Average of five cuttings)

Treat ments	Height of the grass(cm)				Number of tillers				Yield t ha^{-1}			
	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean
T1	150.2	149.9	71.9	124.0	16.8	15.5	9.1	13.8	119.1	131.4	46.1	98.9
T2	167.2	155.2	84.7	135.7	17.8	15.8	9.3	14.3	128.1	131.1	47.9	104.1
T3	163.9	150.9	80.2	131.7	16.8	16.0	8.9	13.9	125.4	124.7	46.9	99.0
T4	164.5	147.1	77.8	129.8	14.8	15.3	8.9	13.0	115.8	132.5	46.6	98.2
T5	98.1	134.0	54.7	95.6	10.5	9.2	5.9	8.5	120.3	124.6	43.7	96.2
Mean	148.8	147.4	73.8	123.2	15.3	14.3	8.4	12.7	121.8	130.0	46.1	99.3
CV=4.13%					CV=8.28%				CV=5.61%			
	SEd	CD(P=0.05)			SEd	CD(P=0.05)			SEd	CD(P=0.05)		
Tree (T)	2.3	4.7			0.5	1.0			2.4	4.9		
Grass(G)	1.8	3.6			0.4	0.8			1.9	3.8		
TG	4.0	8.1			0.9	1.7			Interaction NS			

Table 23. Influence of fodder trees and grasses on the soil NPK status (kg ha^{-1})

Treatments	Initial status of nutrients			Nutrients after one year		
	N	P	K	N	P	K
T1	182.3	14.2	98.3	179.7	13.1	96.5
T2	179.4	16.4	82.6	177.0	14.9	81.3
T3	181.9	15.6	102.3	178.9	15.0	101.6
T4	182.8	15.2	84.9	179.3	14.5	83.5
T5	194.4	15.9	86.3	192.8	14.8	85.4
SEd	7.0	1.2	12.2	6.5	1.2	11.8
CD(P=0.05)	14.2	2.4	24.6	13.2	2.4	23.9
G1	188.1	14.6	90.9	185.0	13.7	89.2
G2	175.8	15.3	95.3	173.0	14.4	94.4
G3	188.7	16.6	86.5	186.6	15.3	85.5
SEd	5.5	0.9	9.4	5.1	0.9	9.2
CD(P=0.05)	11.0	1. 9	19.1	10.2	1.8	18.5
CV(%)	9.1	21.3	32.9	8.7	22.27	32.8

Plate 10. Establishment of fodder tree based *silvipasture* system at Garacharma farm

Silvi-pasture System : Effect of Fertilizer and Cutting on Net Primary Production (herbage production) in Humid Tropical Climate of Andamans

I.Jaisankar, S.K.Verma and V. Damodaran

Coconut based silvipasture system (Plate 11) was established with the fodder grasses like hybrid napier (*Panicum purpurium*), para (*Brachiaria mutica*) and guinea grasses (*Panicum maximum*) under coconut plantation (>25yr old) spacing of the grasses was 50 x 50cm. Coconut trees were planted at 7.5 x 7.5 m distance. These grasses were fertilized with different doses of nitrogen: 20kg ha^{-1}, 40kg ha^{-1} and 60kg ha^{-1} at three locations: under the tree canopy, between the tree canopy and open (without tree). The experiment was laid out in randomized block design with three replications for estimation of the potential of grasses under palm trees. The observations are made on the basis of selected tillers for evaluating seasonal growth rate of fodder

grasses, time and intensity of pruning of fodder grasses to standardize the optimum leaf forage production of the silvipasture system. The seasonal growth rate of the fodder grasses showed more or less same pattern of previous two years result. The result revealed that in all the three grasses the percent cover of leaf was highest in the month of May (Stem Leaf Ratio of Para is 0.39, Guinea is 0.37, and Hybrid Napier is 0.31) and declined with the succeeding months (fig. 3).

This may be due to the luxurious growth of fodder grass with the onset of monsoon. However the least leaf production was observed in the month of April (Stem Leaf Ratio of Para is 5.92, Guinea is 6.23, and Hybrid Napier is 6.98). There is no significant difference in herbage production among the grasses though Para grass recorded numerically higher herbage production (80.9 t ha^{-1}). Among the nitrogen levels, application of 60 kg N ha^{-1} recorded 95.2 t ha^{-1} of herbage production which was significantly higher compared to 40kg N ha^{-1} irrespective of canopy and grasses. Growing of the grasses in open condition led to significantly higher herbage production of 88.6 t ha^{-1} compared to between

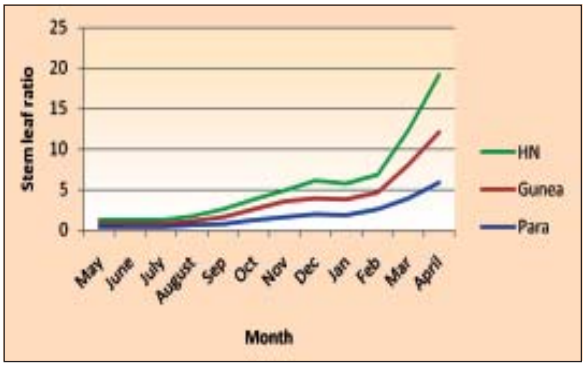


Fig.3. Stem / leaf cover ratio in different grasses under coconut trees

canopy (79.9 t ha^{-1}) and under canopy (69.6 t ha^{-1}). It is found that application of 40kg N ha^{-1} was sufficient to produce maximum herbage of 105.0 t ha^{-1} under open condition while under canopy and between canopy applications of 60 kg N ha^{-1} recorded significantly higher herbage production. This might be due to utilization of the nutrients by the trees and grasses. Among the grasses guinea grass performed better under canopy where as para grass performed much better between canopy (Table 24). This might be due to the availability of low light under the canopy (28000 candles) which favored the luxurious growth of guinea grass since it is shade tolerant and performs well under the diffused light.

Plate 11. Established Silvipasture system at Sippighat Farm

Table 24. Herbage production (t ha^{-1}) under coconut tree canopies

Grasses	Under canopy					Between canopy					Open condition					Grand mean
	Nitrogen (kg ha^{-1})					Nitrogen (kg ha^{-1})					Nitrogen (kg ha^{-1})					
	20	40	60	Control	Mean	20	40	60	Control	Mean	20	40	60	Control	Mean	
Hybrid napier	62.2	70.6	85.6	49.1	66.9	69.5	74.5	103.8	49.9	74.4	104.7	108.4	107.5	63.8	96.1	79.1
Para grass	73.4	74. 7	78.5	56.5	70. 8	84.5	97.5	103.9	54.2	85.1	99.1	101.9	95.1	50.8	86.7	80.9
Guinea grass	68.4	70.4	91.5	54.2	71.1	74. 9	88.5	95.9	62.8	80.5	81.2	104.9	95.1	50.8	83.0	78.2
Mean	68.0	71.9	85.2	53.3	69.6	76.3	86.8	101.2	55.6	79.9	95.0	105.0	99.3	55.2	88.6	79.4
CV%=8.05																

	SEd	CD(P=0.05)
Grass(g)	1.5	NS
Fertilizer(f)	1.8	3.5
Situation(s)	1.5	3.0
fs	3.0	6.1
gs	2.6	5.2
gfs	5.3	10.5

Under canopy lux=28000 candles; between canopy lux= 37000 candles; control condition lux= 49000 candles;
P and K = 80 and 120kg a^{-1}

National Network Project on Underutilized Fruits

D.R. Singh and R. Sudha

Minor fruits germplasm block was established at Garacharma farm of Central Agricultural Research Institute, Port Blair with Mangosteen (6 nos.), Durian (6 nos.), Rambutan (10 nos.), Avocado (10 nos.), Longan (6 nos.), Sweet Tamarind (20 nos.), Litchi (8 nos.), West Indian Cherry (8 nos.) and Custard Apple (9 nos.) for evaluating the growth of the minor fruit trees at field condition. Ten underutilized fruits were analysed for their antioxidant compounds such as total polyphenols, anthocyanins, carotenoids and tannins content. All fruit species were harvested at ripe and unripe stages and stored at -20^{0}C before analysis. Fruit was thawed at room temperature and pulp was used for analysis.

The total polyphenols content was determined by the Folin–Ciocalteu method and expressed as mg Gallic acid /100g. *Malphigia glabra* had the highest polyphenolic content (355.74 ± 4.29) followed by *Mangifera andamanica* (311.19 ± 2.88), *Morinda citrifolia* L. (290.40 ± 3.94), *Syzygium aquem* (285.80 ± 2.50), *Anona squamosa* L.(229.10 ± 1.34), *Averrhoa carambola* (176.25 ± 2.88), *Averrhoa billimbi* L.(164.92 ± 1.41) , *Dilenia indica* (152.91 ± 1.77), *Anona muricata* L.(147.71 ± 1.49) , *Ficus racemosa* L.(133.46 ± 2.24). The total anthocyanin content of the food was estimated by the pH-differential method using two buffer systems – potassium chloride buffer, pH 1.0 (0.025 M) and sodium acetate buffer, pH 4.5 (0.4 M) and expressed as mg C3G / 100g. *Malphigia glabra* had the highest anthocyanin content (91.31 ± 2.64) followed by *Mangifera andamanica* (91.14 ± 1.92), *Morinda citrifolia* L. (84.45 ± 1.53), *Syzygium aquem* (75.93 ± 2.51), *Anona squamosa* L. (62.19 ± 1.80), *Averrhoa carambola* (56.95 ± 2.41), *Averrhoa billimbi* L. (47.36 ± 1.27), *Dilenia indica* (41.67 ± 2.96), *Anona muricata* L. (37.40 ± 2.16) and *Ficus racemosa* L. (36.43 ± 2.82). Carotenoid estimation was done by Sukran *et al.*, (1997) and expressed as µg / ml. *Malphigia glabra* had the highest anthocyanin content (109.16 ± 2.28) followed by *Mangifera andamanica* (84.21 ± 1.39), *Morinda citrifolia* L. (75.46 ± 0.90), *Syzygium aquem* (71.17 ± 2.26), *Anona squamosa* L. (58.62 ± 1.06), *Averrhoa carambola* (49.68 ± 1.36), *Averrhoa billimbi* L.(47.04 ± 2.38) , *Dilenia indica* (42.88 ± 3.58), *Anona muricata* L. (33.65 ± 2.07) and *Ficus racemosa* L. (36.34 ± 3.14). The total tannin content was estimated by to the modified method of (AOAC, 1970). *Malpigia glabra* had the highest anthocyanin content (24.39 ± 1.81) followed by *Mangifera andamanica* (22.68 ± 0.98), *Morinda citrifolia* L. (21.69 ± 2.15), *Syzygium aquem* (18.55 ± 1.09), *Anona squamosa* L. (18.02 ±1.74), *Averrhoa carambola* (9.54 ± 0.74), *Averrhoa billimbi* L. (3.09 ± 1.37), *Dilenia indica* (3.86 ± 0.87), *Anona muricata* L. (3.67 ± 1.25) and *Ficus racemosa* L.(2.69 ± 1.27).

It is the first time that polyphenolic, anthocyanin, carotenoid and tannin contents of *Mangifera andamanica, Anona squamosa, Averrhoa carambola, Averrhoa billimbi* L., and *Dilenia indica* have been estimated. In comparison with some other studies we can point out that polyphenolic contents of *Malpigia glabra, Morinda citrifolia* L., *Syzygium aquem, Anona muricata* L, and *Ficus racemosa* L. is higher.

Technological Innovations for Commercial Exploitation of *Morinda citrifolia* as a Livelihood for Island Farmers (NMPB)

D.R. Singh, R.C. Srivastava, Jai Sunder, Subhash Chand, Krishna Kumar, Ajanta Birah and Shrawan Singh

Standardization of plant geometry

Three different treatments viz. removal of all branches except 3 pairs of branches from lower end (T_1), removal of all branches except 4 pairs of branches from lower end (T_2) while treatment T_3 is removal of all branches except 5 pairs of branches from same were designed. T_3 gave good results in most of the parameters i.e., height of plant, no. of primary, secondary and tertiary branches, length of Internodes on primary and tertiary branches, no. of internodes on secondary and tertiary branches and leaf area meter. The growth in control plant was also found good in respect of plant height and leaf area meter. In terms of fruit size T_2 gave good results compare to all others in fruit girth on primary branches and both fruit length and girth on secondary branches. Maximum yield was found in treatment T_2 (2.66 Kg/ quarter) and also good in T_3 (3.15 Kg/quarter).

Standardization of plant canopy architecture

An experiment was laid out to standardize the plant canopy architecture viz. alternate removal of branches (T_1); alternate removal of branches + removal of main stem tip (T_2); removal of main stem tip only (T_3); removal of main stem tip + cutting of 50% of each leaf (T_4); removal of main stem tip + cutting of tip of each branch ($T_{5);}$ one consequence cutting (T_6). The result revealed that in terms of average number of fruits (14.25 and 11) and average quarterly yield (2.04 kg and 1.69 kg) per plant were higher in T_1 and T_2 compared to others. T_2 was found best treatment in terms of plant spread, fruit size on primary and secondary branches and number of tertiary branches with higher number of internodes. T_1 also gave very good result for average total fruit numbers, fruits on primary and number of secondary branches and fruit size. Till about 2 years of plantation T_1 and T_2 are performing better in terms of number of fruits and yield.

Influence of spacing on growth and yield of *Morinda citrifolia*

After two years of transplanting the observation revealed that, spacing has influence on the growth and production parameters of *Morinda citrifolia.* The initial observation indicated that the 3 x 3m spacing supporting good growth and production qualities followed by 4 x 4m as compared to 2 x 2m, 1.5 x 1.5m and 1 x 1m spacing. The fruit yield was calculated to be 18.8 kg per annum in 3x3m spacing followed by 9.1, 8.9, 7.3 and 3.6 kg per plant per annum in 4x4, 2x2, 1.5x1.5 and 1x1 m spacing, respectively. The average fruit weight and fruit number per plant also showed similar trend.

Evaluation of bush type accessions of *Morinda citrifolia*

Studies revealed that after 1 year 10 month of planting accession TRA-1 recorded higher average plant height (263.5 cm) with stem diameter (6.88 cm) than TRA – 2 with average plant height (247.25 cm) and stem diameter (5.93 cm). The maximum height of the plant in TRA-1 was 301 cm and the lowest 200 cm. The highest basal stem girth was 28.6 cm and the lowest was 18.54 cm in TRA-1. The maximum height of the plant in TRA-2 was 260 cm and the lowest 235 cm. Highest basal stem girth was 19.78 cm and the lowest was 16.96 cm in TRA-2. Fruit yield was also recorded higher in TRA-1 than TRA-2. Hence, it may be concluded that at the age of 1 year 10 months TRA 1 was superior to TRA 2 in both growth and yield parameters.

Evaluation of *Morinda citrifolia* as intercrop under arecanut and coconut plantations

The observation revealed that, in intercropping with arecanut, plant attained an average height of 131 cm with 3.52 cm basal diameter in about 1 year 7 months of planting. The average number of auxiliary leaves was 9.71, number of primary branches 14.3, number of leaves in primary branch 142, number of internodes in primary branch was 6.95 with a length of 3.22 cm. The average number of fruits per primary branch was found to be 1.6. Average number of secondary branch was found to be 5.57 with 35.52 leaves. Number of internode was 4.19 with a length of 3.07 cm. The average number of fruits per secondary branch was found to be 1.42. Under coconut plantation, there was no significant effect of different doses of NPK in the production and growth parameters of the Noni plantation within one year after the initiation of the experiment. The observation revealed that the plant attained an average height of 193 cm with 18.9 cm basal girth in 2 years 6 months of planting. Number of auxiliary leaf was 6.92, number of primary branch 8.17, number of leaves in primary branch 84, number of internodes in primary branch were 7.93 with a length of 4.5 cm. The average number of fruits per

primary branch was found to be 1.84. Average number of secondary branch was found to be 1.82 with 8.16 leaves. Number of internodes was 1.71 with a length of 7.15 cm. The average number of fruits per secondary branch was found to be 1.43. The results revealed that Noni can be successfully intercropped in arecanut and coconut plantation.

Estimation of Phenolic and anthocyanin content in different accessions of *Morinda citrifolia*

Eleven accessions of *Morinda citrifolia* fruits have been evaluated for Phenolic and Anthocyanin content. The results showed that, TRA-2 is the best accession having the highest amounts of phenolics (300mg/100gm), while JGH-1 contains higher amount of anthocyanin (91.8mg/100gm).

Diagnosis and management of diseases occurring on *Morinda citrifolia* (Noni) in Andaman & Nicobar Islands

Infected samples (leaves, fruits, stems and roots) were collected from five locations of South Andaman i.e. Mundapahad, Kodiyaghat, Rangachang, Burmanallah, Garacharma Farm and CARI Campus. The pathogens associated with infected Noni plant parts viz., stem, root and leaf samples were collected for the isolation (Plate 15). Disease incidence and severity of different disease were also recorded from July to September, 2009 in all the location surveyed. From the collected samples fungal pathogens were isolated. The fungal isolates were then purified by adopting single hyphal tip method and maintained on PDA slants for further studies. A total of 17 fungal isolates were isolated, purified and maintained. All the 17 fungal isolates were studied for their colony radius, growth pattern (Plate 16) and form, aspersoria, shape, size and colour of spores (Plate 17). Identification was made by comparing the characteristics of fungi following Charlie *et al.*, (2001) and Deacon (1998). Among the 17 isolates 11 were identified as *Colletotrichum gloeosporiodes*, 2 species of *Xylaria*, and each isolates of *Lasiodiplodia theobromae*, *Daldinia eschscholzii*, *Pestalotiopsis theae* and *Geomyces pannorum* based on morphological and cultural characters. To prove Koch's postulates the fungal isolates associated with anthracnose symptoms were tested for their pathogenicity on the leaves of Noni (*Morinda citrifolia*) by adopting pin-prick and celite injury method and inoculated with conidial suspension (10^6 conidia/ml) prepared from 7 day old culture on PDA. The fungal isolate MC_1 showed symptoms on host. The inoculated plants were maintained under greenhouse by providing proper humidity and irrigation.

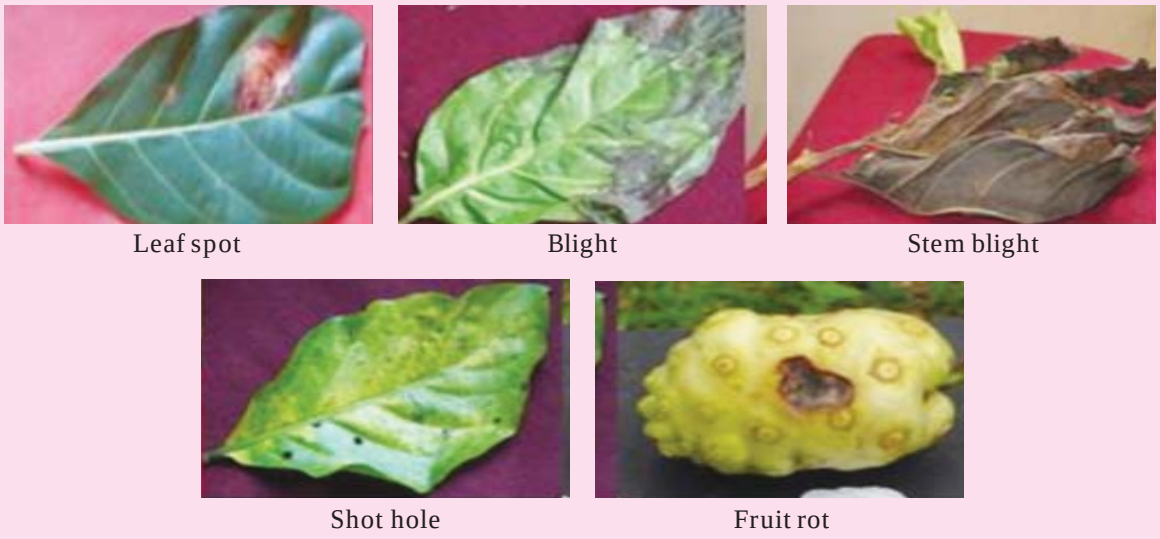


Plate 15. Symptoms associated with *Morinda citrifolia* (Noni)

Plate 16. Cultural variations of pathogens studied

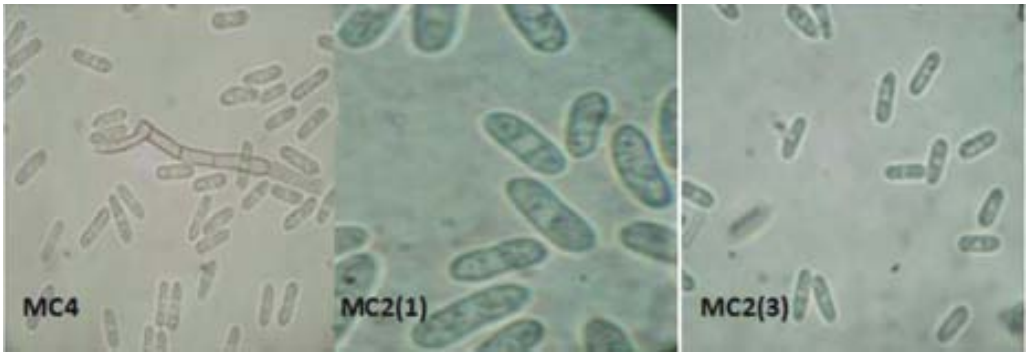


Plate 17. Morphological variations of pathogens

Molecular characterization and diversity analysis

DNA was isolated using SDS method and then amplified with fungal universal primers ITSI and ITS4 (White *et al*., 1990) and obtained PCR products of about 600 bp (Plate 18). Samples were sent for direct sequencing for further identification and diversity analysis through RFLP with *Hinf*-I, which showed distinct variation between the isolates (Plate 19).

A total of 17 fungal pathogens were sequenced for 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA gene, partial sequence. BLAST analysis revealed that nine species of *Colletotrichum gloeosporioides*, 2 species of *Xylaria*, and an each isolates of *Lasiodiplodia theobromae*, *Daldinia eschscholzii*, *Pestalotiopsis theae* and *Geomyces pannorum* .

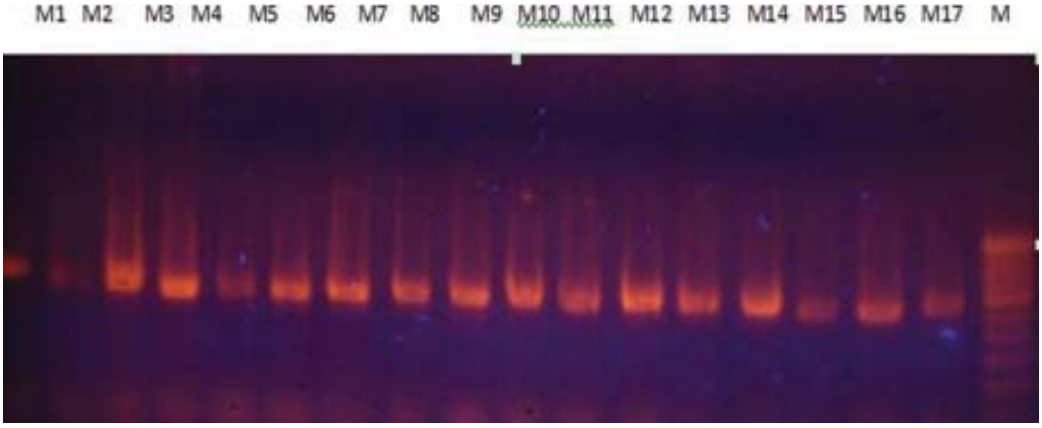


Plate 18. PCR amplification of ITS regions of *Colletotrichum* spp. Lane M1-M17, MC4,MC2(I), MC(I), MC2(3), MC9, MC12(II), MC13, MC14(I), MC14(II), MC15, MC16(I), MC16(II), MC6, MC8, MC2(4), MC17 and MC19 Lane M, 100bp ladder

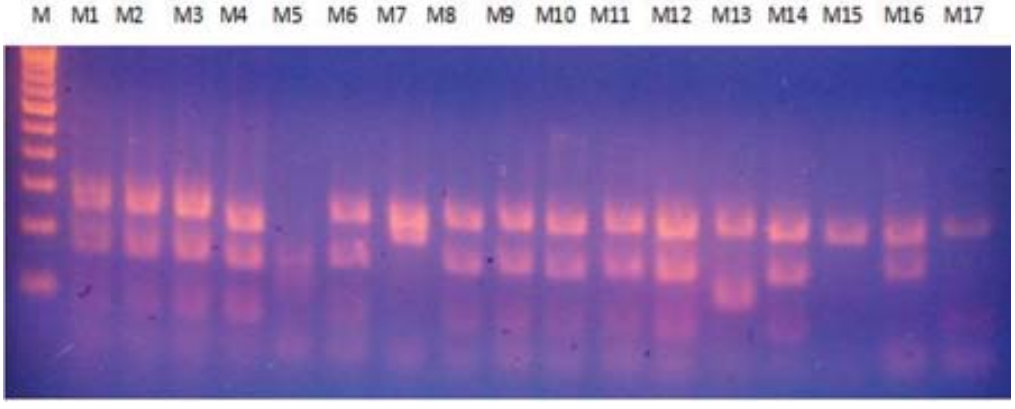


Plate 19. Restriction profile of ITS amplicon with *HinfI* Lane M1-M17. MC4,MC2(I), MC(I), MC2(3), MC9, MC12(II), MC13, MC14(I), MC14(II), MC15, MC16(I), MC16(II), MC6, MC8, MC2(4), MC17 and MC19 Lane M, 100bp ladder.

Effect of Morinda citrifolia extracts against *Ralstonia solanacearum* (bacterial wilt)

The methanol leaf extract, fruit extract and seed extract of *Morinda citrifolia* was tested against *Ralstonia solanacearum* (bacterial wilt) by agar diffusion method. The test micro organisms were seeded into Mueller Hinton agar by spread plate method 10µl (10^6conidia / ml). The zone of inhibition was more in fruit extract compared to others (Plate 20).

Plate 20. Zone of inhibition

Identification of pests of *Morinda citrifolia*

An extensive field survey was carried out to identify the pests of Noni (*M. citrifolia* L.) in different locations of south, middle and north Andaman. Five pests, three types of ants and two types of sucking pests have been reported for the first time. The major pests included three species of ants, black ant, *Camponotus compressus* Fabricius , *Technomyrmex albipes* (Smith), *Anoplolepis gracilipes* (Smith) (Plate 21). Damage by ants to agricultural commodities is usually indirect. Mealybugs and scale insects secrete honeydew, which attracts ants. Among sucking pests, passionvine mealybug, *Planococcus minor* (Maskell) (Pseudococcidae: Hemiptera) and scale insect, Coccus sp. (Coccidae) were also observed as significant pest of *Morinda citrifolia* (Plate 22). There was difference in level of incidence of these insect pests like, ants (10- 40%), mealy bugs (2-5%), scale insects (5-20%), lepidopteran pest (10-30%). Field surveys were conducted in farmer's field as well as research farms and it was found that plants in the natural habitat were more resistant to pests attack than in the research farms.

Growth inhibitory activities of *Morinda citrifolia*

A study was conducted to assess the biological activity of aqueous leaf extract of Noni (*Morinda citrifolia*) against *Spodoptera litura* under laboratory conditions (Plate 23). This study was conducted by using 'leaf dip method'. Leaf extracts of *M. citrifolia* inhibited the growth and development of *S. litura* and affected the larval and pupal survival and adult emergence in a dose-dependent manner. Ninety percent of the larvae of *S. litura* died due to *M. citrifolia* intoxication, hence the larval population could not reach the crucial late instar stage, which is actually responsible for crop damage.

Consequently, the survival of the test insect was reduced (11.89% in 7% concentration), whereas in control it was as high as 76.5%. Larval growth index and total development index of the test insect were drastically reduced 1.10 and 0.28 in *Morinda citrifolia* intoxication (7% concentration) whereas in control it was as high as 5.20 and 2.70 respectively. The leaf extracts of this plant also affected the fecundity and fertility of the test insect adversely as there was no chance of the future generation. The results revealed that *M. citrifolia* possess the insecticidal and juvenomimetic properties against *S. litura,* as total growth and development was reduced which will ultimately affect the future generation of the test insect. The study reveals that aqueous leaf extracts of *Morinda citrifolia* can potentially be used as eco friendly bio-pesticide to control the devastating damage caused by *Spodoptera litura.*

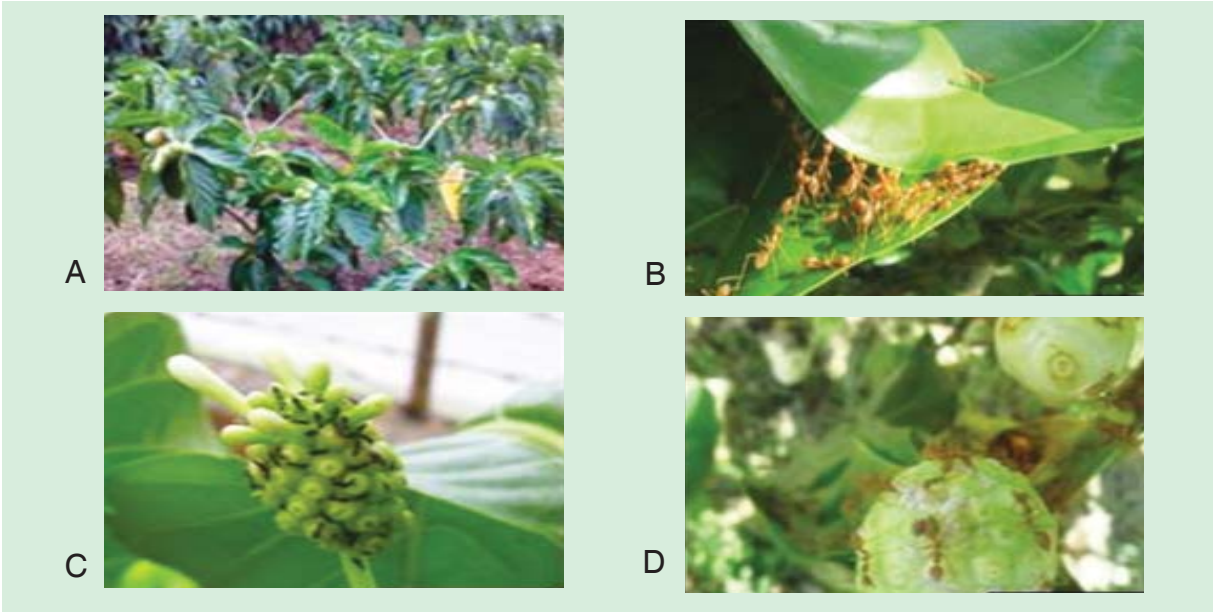


Plate 21 : (a) Noni (*Morinda citrifolia* L.) tree, (b) Yellow crazy ant (*Anoplolepis gracilipes* (Smith), (c) black ant, *Camponotus compressus* Fabricius (d) Passionvine mealybug, *Planococcus minor* (Maskell)

Plate 22 : (a) Scale insects, *Coccus hesperidus* (b) Damage of unidentified lepidopteran pest (c) Adult lepidopteran pest

Plate 23: (a) Larvae of *Spodoptera litura*, (b) Aquous leaf extract of *Morinda citrifolia* (c) Laboratory experiment on *Spodoptera litura* (d) *Spodoptera* larva

Effect of feeding of *Morinda citrifolia* fruit juice on growth and production performance of poultry

The *Morinda citrifolia* ripened fruit was crushed to prepare / extract crude fruit juice. The crude juice was used for feeding poultry. A total of 125 Nicobari fowl (brown, black and white) were used for the experiment. The birds were divided into 5 subgroups with 25 birds in each group. Group I: Morinda supplementation @ 0.5 ml / bird / day; Group II: Morinda supplement @ 0.75 ml / bird / day; Group III: Morinda supplement @ 1.0 ml / bird / day; Group IV: Morinda supplement @ 1.5 ml / bird / day; Control: normal ration only. All the birds were maintained under standard deep litter system of rearing and fed with normal chick ration. Chick starter ration was given till 4th week of age, then grower ration was given till 12th week of age and finally layer ration was given after 13th week onwards. The result revealed that in the male bird attained higher body weight in group IV bird at different week interval till 5th month of age compared to other groups. The overall

results revealed a higher body weight gain in group fed with 1.5 ml of Morinda juice (1830±89.22 g) at the end of 5 month. Followed by control, group II, III and I. In the female bird the higher body weight was recorded in the group I (1366.66±134.15 g) followed by other groups. The effect of Morinda on the birds showed that the body weight increased with the increase in the concentration of Morinda feeding at different week of age. Overall result revealed higher body weight in the birds given Morinda 1.5 ml per bird per day. The FCR at 2nd month was best in the control group compared to other group. At the end of 3rd month the best FCR was observed in the group IV. The age at sexual maturity was earlier in group II (171 days) followed by control (180 days), group I (185 days) and group III (192 days). The weight at sexual maturity of male was highest in group IV followed by control, group II, III and I respectively. The body weight of female was higher in group I, followed by control, group II, group IV and group III respectively. No significant effect on mortality pattern was observed however, in the Morinda fed group the mortality was less than the control group. The egg production performance for the first six week of production was better in group III followed by II, I and control. The result showed that the feeding of Morinda juice influenced the egg production in the birds. The average initial egg weight was 32.5 g, 34.4 g, 30 g and 37.5 g in the group I, II, III and control respectively. The average egg weight at 3rd week of production was better in group III (40 g) compared to other group of eggs.

Studies on carcass quality parameters of Nicobari fowl fed with different concentration of *Morinda citrifolia* fruit

A study was undertaken to assess the carcass quality of Nicobari fowl (White, Brown, and Black) fed with different concentration of *Morinda citrifolia* fruit juice. The results revealed that the Morinda juice has influence in the carcass quality and percentage of carcass weight. Among the different birds Black Nicoabri performed better with higher body weight gain and carcass quality compared to white and brown Nicoabri fowl.

Studies on humoral and cell mediated immune response in the Nicoabri fowl fed with different concentration of *Morinda citrifolia* fruit juice

Study was conducted to assess the immune enhancer (Plate 24) effect of crude juice extracted from fruit of *Morinda citrifolia* in poultry. The birds were divided into five groups and fed with Morinda citrifolia fruit juice @ 0.5ml, 0.75 ml, 1.0 ml, 1.5 ml per bird per day daily while group V was kept as control. The birds were maintained under deep litter system & throughout the experiment no medication and additional supplements were fed except the normal basal ration. To assess the humoral immune response, the haem agglutination test (HAT) was conducted with GRBC in the

experimental birds. The humoral immune response in the group I, II and III was less compared to the control birds at 1 week PI, however at the end of 2nd week group IV birds showed higher titer than the other group of birds. The antibody titer was obtained till the end of 3rd week. Higher T cell response was observed in the group II (2.8±0.02), followed by III (2.28±0.38), IV (1.64±0.21), control (1.37±0.18) and group I (1.27±0.17). Compared to the humoral immune response, the CMI was found better which indicated that the *Morinda citrifolia* induces the CMI better than the humoral immune response.

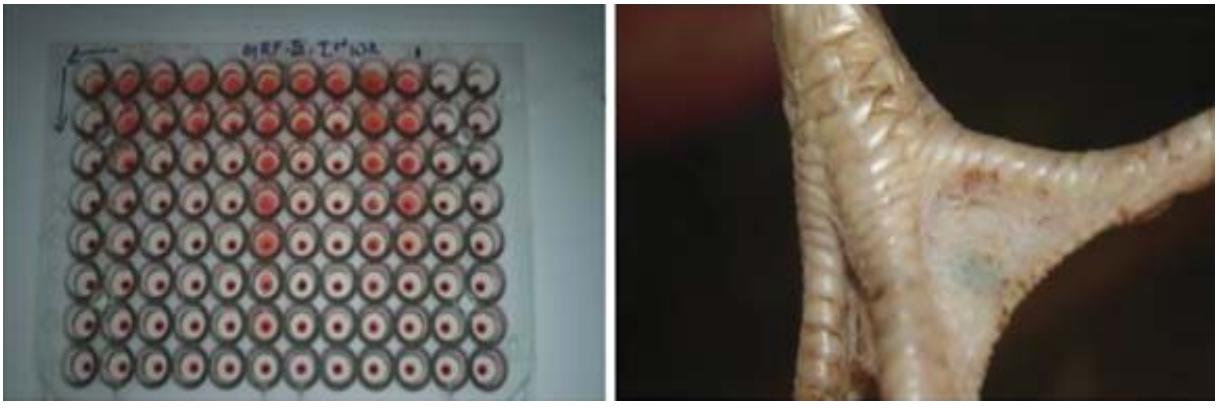


Plate 24. Haem-agglutination and CMI tests

Study on the microbial load and pH of *Morinda citrifolia* fruit in different days of storage at room temperature

Morinda citrifolia fruit were stored at room temperature for 30 days to study the change in pH, microbial load and physical appearance of fruit. The fruits were examined regularly at an interval of 5 days for 30 days period. The microbial count (both bacterial and fungal count) of matured and ripe fruits increased with increasing days of storage (Plate 25). The bacterial and fungal count reached peak at 25 days of storage in matured and ripe fruits. The bacterial load varied between 1.29 $x10^3$ to 19.01 $x10^3$ in the matured fruit. However, the bacterial count was recorded less in ripe fruit with bacterial count ranging from 2.3$x10^3$ to 16.6$x10^3$ bacteria per gram of fruit which might be due to lower pH of the ripe fruits compared to matured fruits. The pH in the matured fruit at 20 and 25 days was 4.5 while in the ripe fruit it was 3.5. In both stages i.e. ripe and mature the pH varied from 3 to 4.5. The physical parameters of the fruit remained almost unchanged till the 10th day of storage in case of mature fruits while with the ripe fruits the physical parameters did not show much difference till the 5th day of storage. Thus, it was revealed that the fruits were in good physical condition and were with less microbial load within 10 days of harvest. The bacterial count in mature fruits with full stalk and shoulder stalk were observed to

increase with increase in storage period. Significantly, the fungal count was nil in aforesaid days in fruits with full stalk and shoulder stalk. The pH in the fruit with full stalk varied from 3.55 to 4.65, while in case of fruit with shoulder stalk similar pattern was observed however the pH was slightly less than the fruit with full stalk. The total bacterial count was less in fruit with shoulder stalk compared to the full stalk fruit.

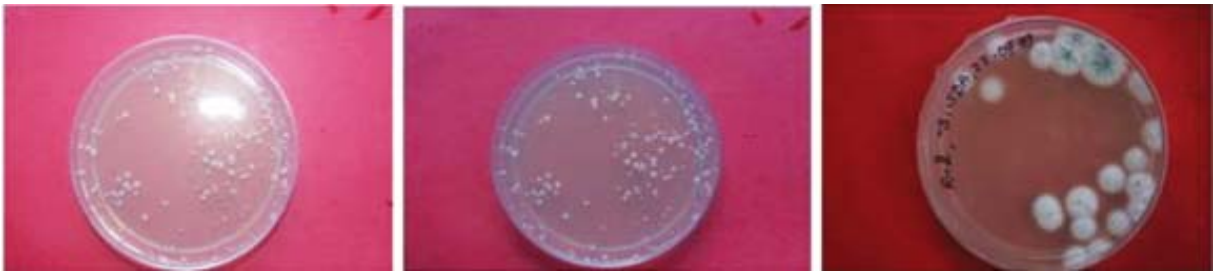


Plate 25. Colonial morphology of different bacterial and fungal growth

Collection, Conservation, Characterization and Identification of Superior Clones of *Morinda Citrifolia* (WNRF)

D.R. Singh and R.C. Srivastava

Rectification of the claim of *Morinda trimera in Andaman and Nicobar Islands*

The samples collected from different parts of the islands have been studied intensively and its reconfirmation revealed that the so far reported *Morinda trimera* in these Islands may be a variety of *Morinda citrifolia* i.e. small variety of *Morinda citrifolia*. Hence, the claim of presence of *Morinda trimera* in Andaman and Nicobar Islands has been rectified and so far no plant or tree of *Morinda trimera* has been seen or reported in Andaman and Nicobar Islands.

Nutritional profile of different accessions of *Morinda citrifolia* (Noni) fruits

The study was conducted to investigate nutritional profile of *Morinda citrifolia* (Noni) fruits collected from different accessions of Andaman and Nicobar Islands. The ascorbic acid, protein, total soluble solids, crude fibre, fat, and free sugar were investigated in the studied accessions of Noni fruits. Ascorbic acid contents were highest in the AHD-1 (127 mg/100g) while lowest in ABH-1 (90 mg/100g) accessions. Among the presently investigated accessions MEM-1 (5.5%) has been identified as rich source of crude protein. Although the TSS value found to be highest in ABH-1 (9.8ºBrix) and the lowest value was found in the fruits of MAN-1 (7.3ºBrix). While the MEM-1 and ABH-1 (9.970.4% and 9.870.4%) contains highest concentration of crude fibre and AHD-1, JGH-1 had the lowest levels (8.340% and 8.564%). Although the maximum concentration of fat was determined in the

fruits of MAN-1 (0.24) accessions, the lowest concentration was found in the fruits of ABH-1 (0.11) accessions. Free sugars were found maximum in ABH-1 (12.98 g/l) and lowest in JGH-1(11.73 g/l).

Evaluation of growth parameter of grafted plants

A total of 14 uniform grafted plants were selected to study the growth parameters. The grafted plants were planted in the field on 06.07.2009 for evaluation of different growth and production parameters. It was found that age of primary branch initiation after planting averaged about 140 days and first flowering after planting was observed on 129 days which took further two days for fruit setting. The average days taken for maturity (Green mature) from date of flowering was found to be 92 days in the grafted plants.


Division of Field Crops

Improving the Quality and Productivity of Rice Based Cropping System

T.V.R.S. Sharma, P.K. Singh, N. Ravisankar and Krishna Kumar

Germplasm introduction/collection

Four hundred seventy five genotypes of six crops viz. rice, green gram, black gram, maize, cowpea and sesame were collected/procured from different parts of India and other countries during 2009-10 (Table 1).

Rice trials

National trials (DRR)

Five All India Coordinated Varietal Improvement Trials of Rice (IVT 1, AVT 2, NASASN 1 and Hybrid 1) were conducted during *Kharif* season in rainfed low land conditions. Under these trials 98 improved lines were evaluated for yield and its attributing characters.

Table 1. Germplasm collected/procured during 2009-10

Sl. No.	Crops	No. of genotypes	Source
1.	Rice	375	IRRI, Philippines, DRR, Hyderabad, CRRI, Cuttack, Andhra Pradesh, Tamil Nadu and A & N Islands
2.	Green gram	15	Indian Institute of Pulse Research, Kanpur, UP and A & N Islands
3.	Black gram	10	Indian Institute of Pulse Research, Kanpur, UP and A & N Islands
4.	Maize	11	Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttara Khand
5.	Cowpea	04	Collected from different parts of A & N Islands
6.	Sesame	60	All India Coordinated Research Project on Sesame and Niger, JNKV, Jabalpur, MP
Total		475	

International trials (IRRI)

Three international rice trials received from IRRI were conducted during *Kharif* season. Under these trials total 183 improved lines were evaluated for yield and its attributing characters.

Evaluation of early and medium early lowland rice lines

One hundred eighty three early and medium early lowland rice lines were evaluated in the randomised block design with three replications in two trials. The crop was transplanted in 3.5 m^2 plots at the spacing of 20x10 cm with fertilizers (NPK) @ 90:60:40 kg/ha. Out of these best performing 14 lines were selected for further evaluation and improvement (Table 2). The top performing cultivars were KARJAT-3 (6.66 t/ha) followed by IR-78555-3-2-2-2 (5.69 t/ha) and IR-78581-12-3-2-2 (5.40 t/ha).

Table 2. Performance of early and medium early lowland rice lines

Lines	Days to flowering	Plant height (cm)	No. of tillers/ Plant	Grains/ panicle	Panicle length (cm)	1000 seed weight (g)	Harvest index	Yield t/ha
IR 78029-34-1-3-1	92.67	112.07	7.58	71.77	24.67	19.07	33.24	4.53
IR 78555-3-2-2-2	**94.00**	**116.67**	**9.60**	**67.47**	**24.67**	**21.31**	**37.91**	**5.69**
IR 64	86.67	106.33	7.92	49.97	25.67	22.39	34.99	4.40
UPR 1201-1-20-1	94.67	108.00	5.96	55.00	22.80	25.00	32.32	4.05
IR 69716-87-1-3-1-3	94.00	103.20	8.44	53.33	24.60	19.68	38.66	5.02
KARJAT-3	**92.67**	**101.13**	**7.29**	**70.70**	**25.40**	**20.05**	**41.36**	**6.66**
IR 20	94.67	109.00	8.17	80.47	23.67	19.81	27.63	5.24
IR 80411-B-28-4	86.67	109.00	7.65	60.97	21.93	23.38	34.34	4.07
NC492	96.00	122.40	7.33	31.77	26.53	23.43	18.61	4.20
IR 78581-12-3-2-2	**98.33**	**113.60**	**8.92**	**48.80**	**24.80**	**24.24**	**31.99**	**5.40**
IR 78585-64-2-4-3	97.67	109.00	8.53	35.83	24.93	27.96	32.42	4.67
IR 32809-26-3-3	94.67	105.53	7.34	54.07	24.20	23.23	42.27	5.05
IR 79216-8-2-3-1	95.67	108.20	9.15	51.43	25.07	23.35	36.52	4.97
IR 73546-20-2-2-2-2	96.33	115.87	7.15	84.87	24.53	18.37	26.93	4.31
CARI Dhan-2 (check)	82.00	111.93	6.01	51.80	24.60	25.17	31.51	3.19
Mean	**93.11**	**110.13**	**7.80**	**57.88**	**24.54**	**22.43**	**33.38**	**4.76**
C.D.	**3.00**	**8.36**	**1.91**	**22.66**	**1.50**	**3.94**	**6.39**	**1.37**
SE(m)	**1.03**	**2.87**	**0.66**	**7.78**	**0.51**	**1.35**	**2.20**	**0.47**
C.V.	**1.92**	**4.51**	**14.59**	**23.29**	**3.63**	**10.46**	**11.39**	**17.05**

Evaluation of soil stress tolerance lines of rice

Ninety nine salt tolerant rice lines were evaluated in the randomised block design with three replications in different three trials with standard spacing 20 x 10 cm and fertilizer dose (90:60:40). The soil EC was between 4-5 dSm^{-1} and pH 8.0. Best performing 13 lines were selected for further evaluation and improvement (Table 3). The maximum yield was recorded 4.34 t/ha for two lines IR-759418-7B-21-3, IR 7646-B-B-10-1-1-1 along with check variety CSR 28.

Varietal evaluation of rice hybrids under rainfed low land condition

Five rice hybrids were evaluated under rainfed conditions in replication trials. The highest yield were recorded for SPH-168 (5.30 t/ha) (Table 4) followed by Suman (5.16 t/ha) and check variety CARI Dhan-5 (5.05 t/ha) (Plate 1).

Table 3. Performance of rice lines in saline effected soils

Lines	DF	PH (cm)	DM	No. of tillers/ Plant	Panicle length (cm)	Yield t/ha
IR 71897-3R-1-1-2	95.00	94.50	137.00	10.00	22.70	4.17
IR 59418-7B-21-3	**80.00**	**79.98**	**136.00**	**7.85**	**21.50**	**4.34**
IR 68144-2B-2-2-3-2	75.00	67.90	131.00	12.90	19.30	3.27
IR 72593-B-13-3-3-1	82.50	89.90	135.00	9.40	21.65	4.09
IR 72593-B-3-2-3-3	82.50	87.30	136.00	9.60	22.30	3.67
IR 71895-3R-60-3-1	81.00	73.90	133.00	8.60	21.10	3.34
IR 7646-B-B-10-1-1-1	**80.00**	**99.10**	**135.50**	**13.60**	**21.75**	**4.34**
IR 63731-1-1-3-3-2	85.00	80.50	134.50	11.10	19.90	3.80
IR 72579-B-2R-1-3-2	80.00	84.70	134.50	11.95	21.40	4.13
IR 77674-3B-8-2-2-14-2-AJY 3	85.00	86.20	130.00	7.70	22.40	3.00
CSR-90IR-2	77.50	103.30	132.00	8.60	23.80	4.00
IR 4527-2B-2-2B-1-1	82.50	92.30	135.50	10.45	22.90	3.63
IR 55179-3B-11-3	92.50	91.40	140.00	8.50	21.50	4.00
CSR 28 (check)	**82.50**	**101.20**	**136.00**	**9.00**	**23.60**	**4.34**
Mean	**82.93**	**88.01**	**134.71**	**9.95**	**21.84**	**3.86**
C.D.	**5.31**	**9.46**	**2.70**	**4.06**	**2.24**	**1.64**
SE(m)	**1.72**	**3.06**	**0.87**	**1.31**	**0.73**	**0.53**

Table 4. Performance of rice hybrids under rainfed low land conditions

Hybrids	Days to 50% flowering	Plant height (cm)	Days to maturity	Panicle length (cm)	No. of tillers/m²	Yield (t/ha)
Parvati	97.00	113.33	136.00	25.47	237.67	4.79
Shivani	101.33	116.07	136.00	23.87	160.67	4.50
Annapurna	90.33	115.27	135.33	27.20	204.33	4.75
SPH-168	**91.67**	**113.67**	**138.00**	**27.33**	**215.00**	**5.30**
Suman	102.33	99.07	136.67	22.60	269.67	5.16
CARI Dhan 5	105.00	115.25	145.00	23.00	240.00	5.05
Mean	**97.94**	**112.11**	**138.00**	**24.91**	**214.56**	**4.93**
SE(m)	**1.25**	**2.59**	**0.84**	**0.65**	**9.73**	**0.26**
CD	**3.98**	**8.25**	**2.69**	**2.07**	**31.04**	**0.84**

Evaluation and improvement of pulses in *rabi* season.

Green gram

Sixteen improved lines of green gram along with local check were evaluated during dry season (January to March) in a replicated trial (Table 5). Observations were recorded for yield and its attributing characters. The maximum yield were recorded for ANM-11 (1.83 t/ha) followed by ANM-5 (1.66 t/ha) and ANM-8 (1.63 t/ha) (Plate 2 a & b).

Plate1. Best performing rice hybrid SPH 168

Table 5. Performance of green gram cultivars

Lines	Days to flowering	Plant height (cm)	No. of branches /plant	Days to maturity	No. of pods/ plant	Pod length (cm)	Yield (t/ha)
ANM1	37	35.80	1.90	60	88.50	8.82	1.08
ANM3	37	31.60	1.20	60	62.00	7.84	1.22
ANM5	**39**	**38.30**	**2.20**	**60**	**68.00**	**7.84**	**1.66**
ANM6	35	35.60	2.00	60	82.50	8.76	1.42
ANM8	**31**	**40.90**	**1.60**	**53**	**65.00**	**8.41**	**1.63**
ANM9	37	35.80	1.70	60	62.50	9.33	1.43
ANM10	32	36.30	1.30	56	77.50	7.28	1.01
ANM11	**39**	**50.60**	**1.00**	**59**	**62.50**	**9.83**	**1.83**
ANM12	40	51.90	2.70	59	71.00	7.73	1.44
RM9-121	32	32.50	1.50	56	46.50	8.25	1.06

RM9-122	31	33.00	1.00	53	52.00	8.79	1.32
RM9-123	35	48.80	1.20	59	64.00	7.53	1.24
RM9-126	31	36.30	1.00	53	55.50	7.20	0.95
RM9-128	33	39.20	1.90	56	74.00	7.54	1.31
RM9-134	37	37.00	1.80	59	82.50	7.05	1.52
RM9-136	31	35.70	1.00	53	58.00	7.59	0.95
Local Check	31	38.60	1.90	53	80.00	7.75	1.39
Mean	**34**	**38.70**	**1.58**	**57**	**67.76**	**8.09**	**1.35**
C.D.	**2.95**	**15.47**	**1.64**	**3.54**	**28.38**	**0.45**	**0.58**
SE(m)	**0.98**	**5.12**	**0.54**	**1.17**	**9.38**	**0.15**	**0.19**
C.V.	**4.02**	**18.69**	**48.33**	**2.91**	**19.59**	**2.61**	**20.11**


Plate 2. (a) Varietal evaluation of Green gram and (b) best performing line ANM-5

Black gram

Fifteen improved lines of black gram were evaluated with local check (Table 6). Crop was sown in the month of January and observations were recorded for yield and attributing characters. Variety IPU-94-1, IPU-02-43 AND TU-40 were found most promising with average yield of 1.89, 1.72 and 1.66 t/ha respectively.

Breeder Seed production

Breeder seed production was undertaken for different varieties of rice, sesame and green gram. Total 109 kg breeder seed of rice (101kg), sesame (3 kg) and green gram (5 kg) were produced (Plate 3 a & b).


Plate 3. (a) Varietal evaluation of black gram and (b) best performing line IPU-94-1

Table 6. Performance of black gram cultivars

Lines	Days to flowering	Plant height (cm)	No. of branches /plant	Days to maturity	No. of pods/plant	Pod length (cm)	Yield (t/ha)
RU-175	43	32.60	1.90	77	18.20	4.25	1.27
RU-9-177	52	49.25	1.70	77	6.90	5.17	0.67
RU-9-178	43	39.10	3.20	77	14.40	4.72	1.16
RU-9-179	46	28.04	2.90	77	21.10	4.37	1.50
RU-9-182	40	37.35	2.00	77	10.90	4.78	0.61
RU-9-183	47	45.20	3.40	77	27.10	4.81	1.50
TU-40	**41**	**43.50**	**3.50**	**80**	**28.70**	**4.78**	**1.72**
TU-17-14	43	37.58	2.50	80	21.30	4.92	1.26
CBG-703	48	44.05	2.60	80	17.50	5.09	1.24
CBG-647	41	45.10	3.20	76	42.90	5.29	1.04
IPU-02-43	**43**	**31.98**	**3.65**	**75**	**26.70**	**4.57**	**1.66**
IPU-94-1	**43**	**33.80**	**3.00**	**75**	**21.30**	**4.55**	**1.89**
NDU-1	48	33.86	3.00	75	32.20	4.32	1.21
Pant-31	42	26.90	2.80	75	16.00	4.79	1.04
Shecher-3	43	27.10	1.40	75	12.50	4.56	0.79
Local check	45	43.58	3.40	75	11.70	4.97	0.79
Mean	**44**	**37.44**	**2.76**	**77**	**20.59**	**4.75**	**1.21**
C.D.	**3.47**	**23.26**	**2.24**	**0.76**	**23.78**	**0.53**	**0.43**
SE(m)	**1.14**	**7.65**	**0.74**	**0.25**	**7.82**	**0.17**	**0.37**
C.V.	**3.67**	**28.89**	**37.68**	**0.46**	**53.71**	**5.19**	**43.26**

Genetic Improvement of Long Duration Rice for Andaman and Nicobar Islands

P.K. Singh, T.V.R.S. Sharma, Krishna Kumar and Ajanta Birah

Collection and evaluation of long duration rice germplasm

Seventy four long duration rice cultivars/ improved lines were collected from coastal regions of India and A & N Islands and evaluated under transplanted condition. Best performing 14 genotypes were selected for further evaluation and improvement (Table7). The highest yield were recorded for Jagbandhu (4.49 t/ha) followed by MTU-2067 (4.39 t/ha) and MTU-1075 (4.32 t/ha) (Plate 4 a& b).

Evaluation of rice lines for disease and insect pests resistance

Three hundred and seventy five lines of rice were screened for major diseases (sheath blight, bacterial leaf blight, and brown spot) and insects (gundhi bug, stem borer, leaf folder and brown plant hopper) under Bay Islands conditions. Twenty nine lines were found tolerant to insects and diseases (Table 8).

Table 7. Performance rainfed long duration rice cultivars

Lines	DF	PH (cm)	Tillers /Plant	Grains/ panicle	Panicle length (cm)	GL (cm)	GW (cm)	L:W index %	Harvest t/ha	yield
TU-2067	**127.67**	**99.93**	**7.28**	**114.67**	**24.47**	**8.38**	**1.94**	**2.10**	**39.61**	**9**
MTU-1061	133.33	111.13	6.61	95.53	22.80	8.32	2.04	2.12	19.65	4.07
MTU-1075	**127.33**	**103.67**	**5.15**	**206.40**	**23.07**	**8.24**	**1.92**	**2.64**	**22.24**	**4.32**
Savitri	130.67	103.13	7.46	120.60	23.20	7.61	2.13	2.06	32.35	3.07
Ramchand	127.33	130.13	6.97	87.07	23.33	9.18	2.17	4.32	26.11	3.56
Jagbandhu	**126.67**	**140.13**	**4.87**	**112.13**	**27.33**	**7.97**	**2.13**	**4.08**	**29.32**	**4.49**
Pratikshya	115.67	113.80	5.49	138.27	25.47	8.42	1.98	4.29	25.64	3.40
Jaganath	121.33	99.60	9.08	122.13	22.00	7.66	1.94	3.57	29.47	3.77
Mahanadi	121.33	117.60	8.02	129.27	22.80	8.07	2.15	4.22	19.73	3.98
Upahar	127.00	142.53	5.98	61.00	23.87	8.73	2.01	3.74	16.18	4.10
Kanchan	132.67	139.60	6.01	170.73	25.47	7.90	1.89	4.26	27.63	4.03
Prachi	127.67	110.13	8.05	140.53	24.80	8.37	2.10	3.94	37.49	3.98
Swarna(3)	128.00	117.87	4.94	107.00	22.93	8.03	2.12	3.75	27.33	3.80
Utpala	125.33	140.93	6.40	121.40	26.07	8.97	2.64	4.34	30.54	3.47
CARI Dhan-5	115.00	129.40	7.94	154.93	25.07	8.23	2.06	4.17	31.86	4.00
Mean	**125.80**	**119.97**	**6.68**	**125.44**	**24.18**	**8.27**	**2.08**	**3.57**	**27.68**	**3.90**
CD	**3.51**	**9.71**	**2.29**	**22.10**	**1.81**	**0.44**	**0.25**	**0.26**	**9.99**	**0.45**
SE (m)	**1.71**	**4.71**	**1.11**	**10.74**	**0.88**	**0.21**	**0.12**	**0.13**	**5.07**	**6.42**
CV	**1.66**	**4.81**	**20.41**	**10.48**	**4.46**	**3.15**	**7.12**	**4.34**	**7.74**	**16.11**

Plate 4. (a) Varietal evaluation of long duration rice and (b) best performing line Jagbandhu

Table 8. Lines tolerant to disease and insect pests

Varieties	Diseases				Insects			
	Brown Spot	BLB	BL	Sh B	Gundhi Bug	Stem borer	Leaf folder	BPH
BPT-5204	1	-	-	-	1	1	1	-
MTU2067	-	-	-	1	-	-	-	-
BPT-1768	1	-	-	-	-	-	1	-
T-90	1	-	-	-	-	-	1	-
MTU1061	-	-	-	-	1	-	1	-
Savitri	-	-	-	1	1	1	1	-
Versha	-	-	-	-	-	-	1	-
Utkal Prabha	-	-	-	-	1	1	1	-
PLA1100	-	-	-	-	1	1	1	-
CRI1014	-	1	-	1	-	1	1	-
Moti	-	-	-	-	1	1	1	-
Hanseswari	-	-	-	-	-	1	1	-
Urbashi	-	-	-	-	1	1	1	-
Monica	-	-	-	-	1	1	1	-
Dharitri	-	1	-	-	1	1	1	-
Panidhan	-	-	-	-	-	1	1	-
Shemapuri	-	1	-	-	-	1	1	-
MTU4870	-	1	-	-	1	1	1	-
Pratibha	-	1	-	-	-	1	1	-
Tulshi	-	1	-	1	1	-	1	-
Shrirag	-	1	-	-	-	1	1	-
CB-07-105	-	1	-	1	1	1	1	-
CB-05-022	-	1	-	-	1	1	1	-
Vedagiri	-	1	-	-	-	1	1	-
Tikamma	-	1	-	-	-	1	1	-
BPT-2270	-	1	-	-	-	1	1	-
Jagbandhu	-	1	-	-	1	1	1	-
Indravati	-	1	-	-	1	1	1	-
Rolagullu kull	-	1	-	-	-	1	1	-

Yield loss due to Gundhi bug incidence in different maturity group rice cultivars

An experiment was conducted to study the yield loss due to Gundhi bug incidence in 103 lines of rice of different maturity groups under rainfed low land condition. The maximum Gundhi bug incidence was recorded in late maturing lines followed by medium duration, but it was very low in very early, early and medium early lines (Fig 1). The data reveals that there was 44-49% yield reduction in medium and late duration lines as compared to early and medium early. Therefore, present findings suggest that early and medium early duration varieties could maximize the rice yield.

Very early rice line (ANR-1) ready for AICRIP trials

A very early line ANR-1 suitable for early transplanting under rainfed condition of coastal areas has been developed by selection from IRRI germplasm. It is short stature 90-100 cm, effective tiller per plant 7 to 8, panicle length 25 cm and matures in 90-100 days. Grains are medium bold and gives 4.0 to 4.5 t/ha yield. It is tolerant to sheath blight, leaf folder, brown spot, BLB and lodging (Plate 5).

Plate 5. Field view of rice line ANR- 1

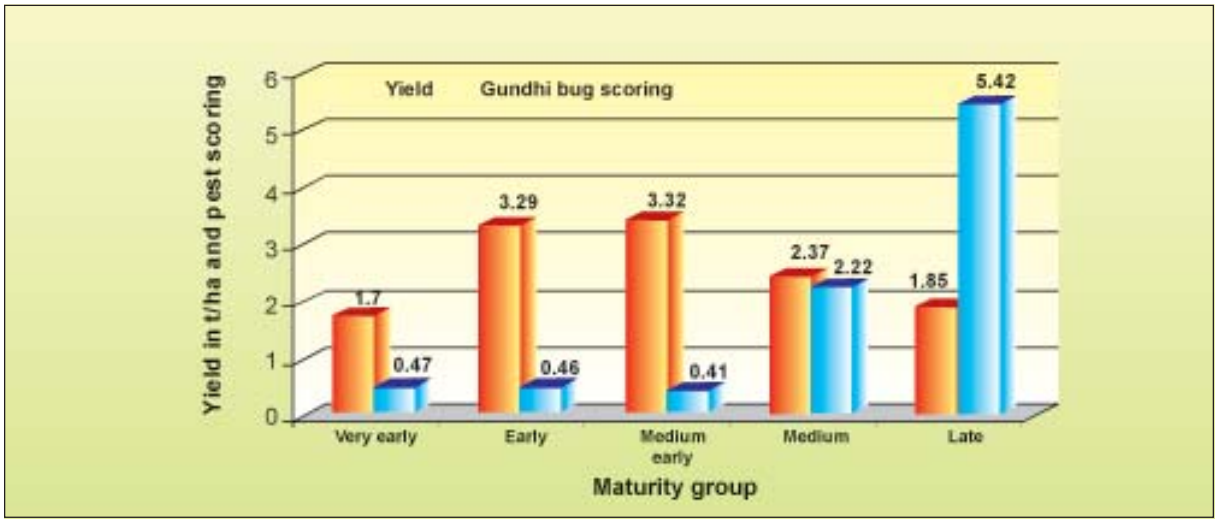


Fig.1. Yield loss due to Gundhi bug incidence in different maturity group rice cultivars

Rice Varieties Release by CARI

T.V.R.S. Sharma, Asit B. Mandal, R.C. Srivastava and P.K. Singh

Institute released five rice varieties through State Seed Sub Committee for Andaman and Nicober Islands. Out of these, two varieties were specially developed for coastal salinity conditions and other three for normal soils. The saline tolerant lines were developed through somoclonal variation, created from cultivar Pokkali of Kerala. Other three were selections from INGER trials of IRRI and their testing for decade. All these selections are tolerant to sheath blight, BLB, leaf spot, stem borer and lodging which are common biotic and abiotic stress of the Islands (Table 9 &Plate 6 a - d).

Bacterial wilt resistant brinjal variety (CARI Brinjal 1)

A bacterial wilt resistant line 'CARI Brinjal 1' developed by CARI have been sent to Brinjal Bacterial Wilt IET Trials under All India Coordinated Research Project-Vegetable 2009 (Table 10 and Plate 7 a, b).

Table 9. Important Characters of Released Rice Varieties

Name	Parentage	Days of maturity	Plant height (cm)	Panicle length (cm)	Yield (t/ha.)
C.A.R.I Dhan-1	Selection from IRRI germplasm	120	114	24	4.5
C.A.R.I Dhan-2	Selection from IRRI germplasm	121	120	25	5 to 5.5
C.A.R.I Dhan-3	Selection from IRRI germplasm	120	115	25	5.1 to 5.5
C.A.R.I Dhan-4*	Somoclonal selection from Pokkali	123	120	25	3.1 to 3.3
C.A.R.I Dhan-5*	Somoclonal selection from Pokkali	150	123	24	4.4 to 4.7

Plate 6. (a) CARI Dhan-1, (b) CARI Dhan-2,

(c) CARI Dhan-3 and (d) CARI Dhan-5

Table 10. Ancillary observations of bacterial wilt resistant brinjal line 'CARI Brinjal 1'

Variety	Plant height (cm)	Days to first flowering	Fruits /plant	Average fruit weight(g)	Yield t/ha	Fruit colour	Fruit shape	Score Bacterial wilt	Fruit and shoot borer
CARI Brinjal 1	75	70	5-7	170	20-25	Green	Oblong	1	3

Plate 7 a. Bacterial wilt resistant line CARI Brinjal 1

Plate 7 b. Field visit by Project Coordinator AICRP Vegetable

Molecular Characterization of Economically Important Flora and Microbes of Andaman and Nicobar Islands

Israr Ahmad, TVRS Sharma, Krishna Kumar, S. Bhagat and D.R. Singh

Molecular characterization of important underutilized wild fruit crops (*Syzygium claviflorum*) of A & N Islands

Twenty one different samples of wild *Jamun* were collected from Andaman and Nicobar Islands and two samples were collected from mainland (Table 11). DNA was isolated from fresh young leaves by CTAB method. PCR amplification has been done with 20 RAPD (Table 12) and 30 ISSR primers (Table.13). PCR products were resolved on 1% agarose gel (Plate 8 & 9). The 0/1 matrix was used to calculate similarity as Jaccard coefficient

using SIMQUAL subroutine in similarity routine. The resultant similarity matrix was employed to construct dendrogram UPGMA to infer genetic relationship. The dendrogram could differentiate all the samples of wild jamun at 67 % similarity with RAPD primers and 44 % similarity with ISSR primers. Dendrogram could be divided into five major clusters (Fig 2). Cluster one contains samples WJ 1, WJ 2, WJ 3, WJ 4, WJ 5, WJ 8, WJ 9, WJ 10 and WJ 11 at 87 % similarity. Cluster two contains samples WJ 7, WJ 12, WJ 13 and WJ 14 at 83 % similarity. Cluster three contains samples WJ 16, WJ 17, WJ 18, WJ 19, WJ 20 and WJ 21 at 81 % similarity. Cluster four contains samples WJ 22 and WJ 23 at 73 % similarity. Cluster five contains samples WJ 6 and WJ 15 at 67 % similarity. Dendrogram could be divided into five clusters (Fig. 3). Cluster one contains samples of WJ 1, WJ 4, WJ 11 and WJ 14 at 81 % similarity. Cluster two contains samples WJ 2, WJ 3, WJ 5, WJ 6, WJ 7, WJ 8, WJ 9 and WJ 10 at 78 % similarity. Cluster three contains samples of WJ 16, WJ 12 and WJ 13 at 76 % similarity. Cluster four contains samples of WJ 21, WJ 18, WJ 17 and WJ 19 at 70 % similarity. Cluster five contains samples of WJ 15, WJ 20, WJ 22 and WJ 23 at 44 % similarity.

Molecular characterization of Plant Growth promoting *Bacillus* sp.

Soil sample were collected from rhizosphere soil of banana grown at Bloomsdale farm of CARI. Bacteria were isolated from soil sample by serial dilution. Based on the morphological and biochemical characterization for plant growth promotion 23 isolates were grown in nutrient broth at 25° C for 24 hours and total genomic DNA was extracted. Primers PA (5'AGAGTTTGATCCTGGCTCAG3') and PH

Table 11. Wild Jamun samples collected from A & N Islands and Bangalore

Sample code	Location	Sample code	Location
WJ 1	Gandhi park	WJ 13	Chauldari farm
WJ 2	Police line	WJ 14	Havelock
WJ 3	VKV School	WJ 15	Car Nicobar
WJ 4	Dollygunj	WJ 16	Bambooflat
WJ 5	Chauldari basti	WJ 17	Mount harriet
WJ 6	Portmoot	WJ 18	Chidiyatapu
WJ 7	CARI Mandir	WJ 19	Wandoor
WJ 8	Ferrargunj	WJ 20	Manpur
WJ 9	CARI field	WJ 21	Maccapahad
WJ 10	CARI Lab	WJ 22	GKVK, Bangalore
WJ 11	Carbinscove	WJ 23	National Park, Bangalore
WJ 12	Tusnabad		

Table 12. RAPD Primers used for DNA amplification

Primer	Sequence (5-3)	% GC
OPA2	TGCCGAGCTG	70
OPA4	AATCGGGCTG	60
OPA5	AGGGGTCTTG	60
OPA7	GAAACGGGTG	60
OPA9	GGGTAACGCC	70
OPE1	CCCAAGGTCC	70
OPE2	GGTGCGGGAA	70
OPF 1	ACGGATCCTG	60
OPF2	GAGGATCCCT	60
OPF3	CCTGATCACC	60
OPF5	CCGAATTCCC	60
OPX3	TGGCGCAGTG	70

Table 13. ISSR Primer used for DNA amplification

ISSR Primer No.	Sequence (5'-3')	Tm °C
7	AGAGAGAGAGAGAGAGT	48.9
8	AGAGAGAGAGAGAGAGC	51.3
9	AGAGAGAGAGAGAGAGG	51.3
10	GAGAGAGAGAGAGAGAT	49.8
11	GAGAGAGAGAGAGAGAC	51.3
12	GAGAGAGAGAGAGAGAA	48.9
13	CTCTCTCTCTCTCTCTT	48.9
18	CACACACACACACACAG	51.3
20	GTGTGTGTGTGTGTGTC	51.3
22	TCTCTCTCTCTCTCTCA	48.9
23	TCTCTCTCTCTCTCTCC	51.3
24	TCTCTCTCTCTCTCTCG	51.3
25	ACACACACACACACACT	49.8
28	TGTGTGTGTGTGTGTGA	49.8

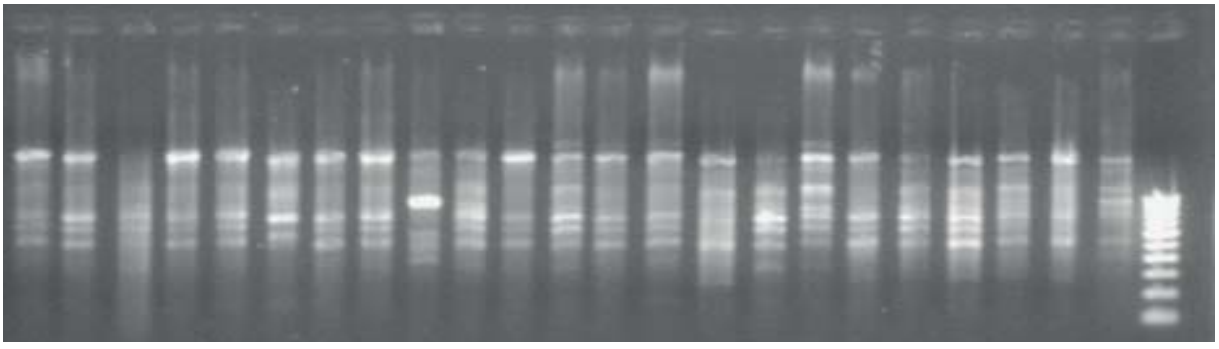


Plate 8. PCR profile of wild jamun using RAPD Primer OPA 5

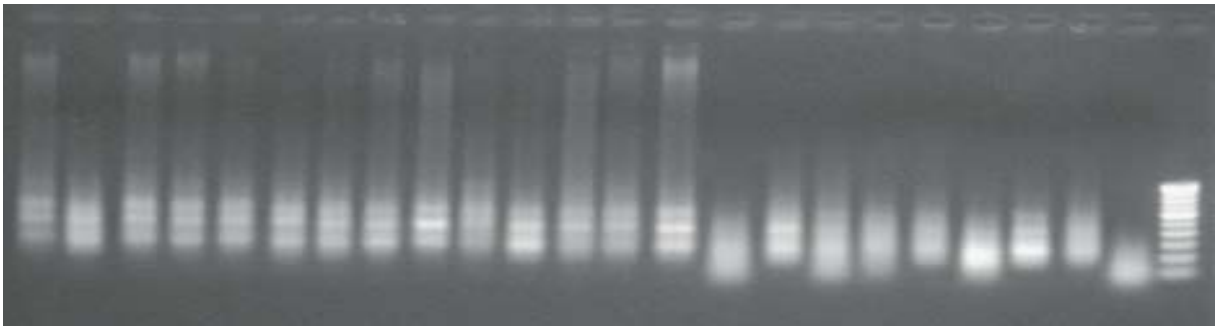


Plate 9. PCR profile of wild jamun using ISSR Primer 13

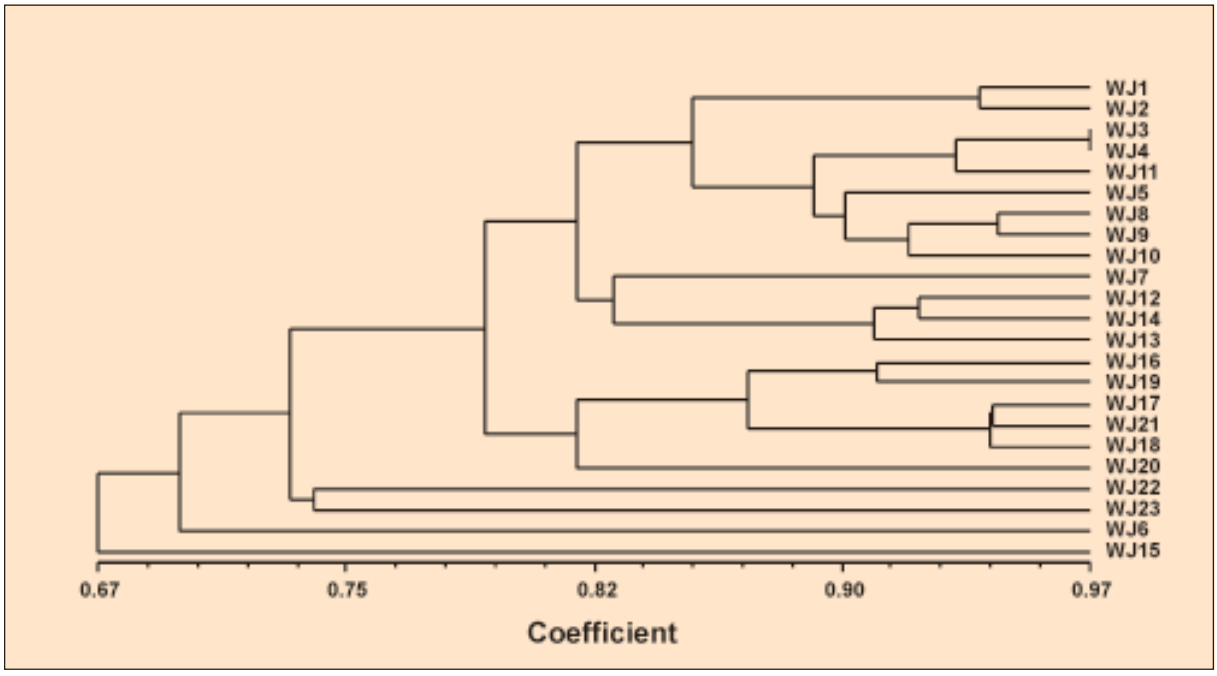


Fig. 2. Dendrogram constructed for 23 samples of wild jamun by RAPD primers

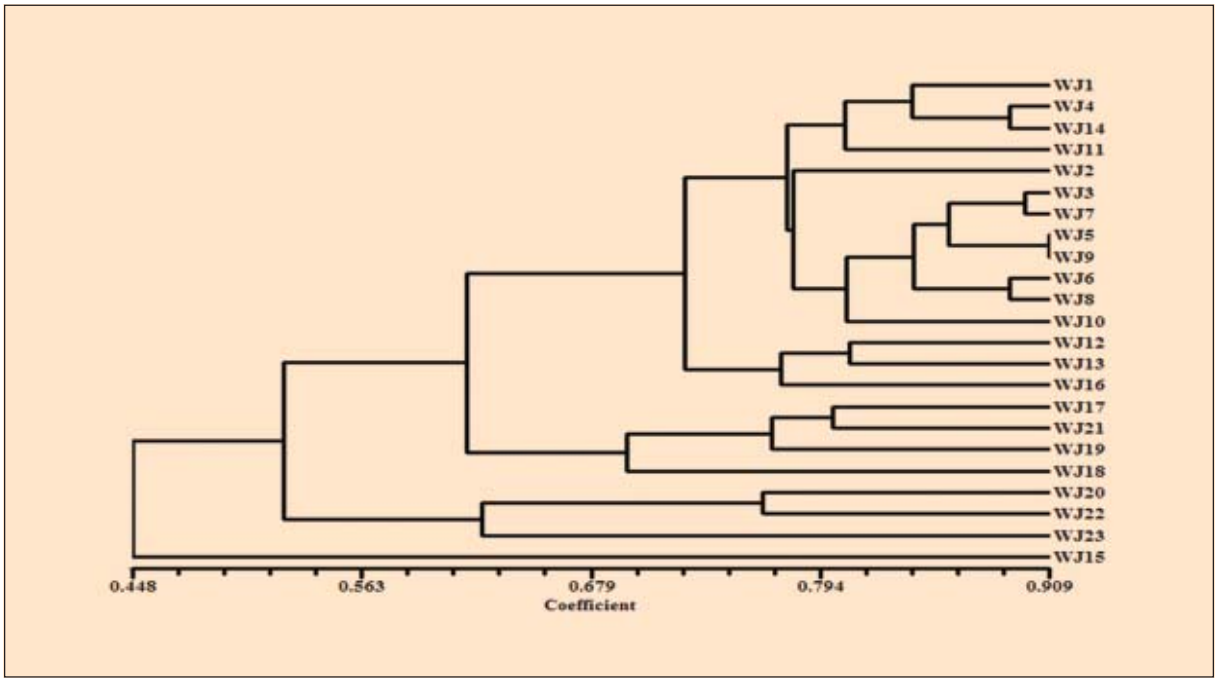
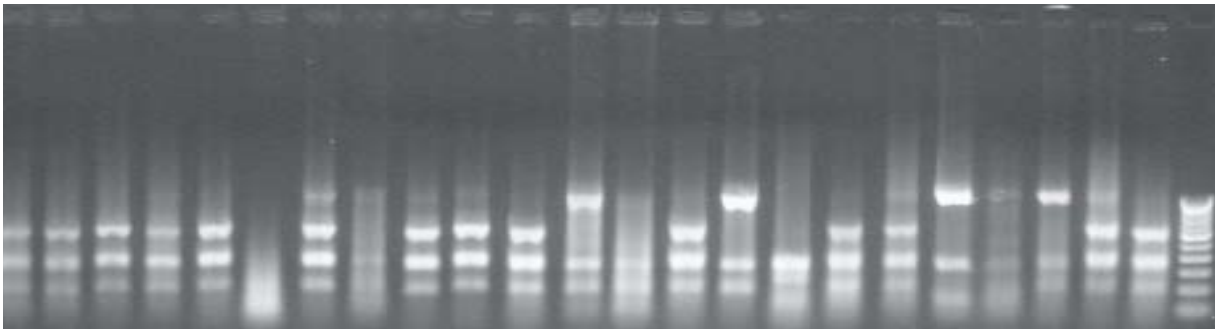


Fig. 3. Dendrogram constructed for 23 samples of wild jamun by ISSR primers

(5'AAGGAGGTGATCCAGCCGCA3') were used to amplify a fragment of 16s rRNA gene. 1.5 kb PCR amplified product from all the 23 isolates were subjected to restriction digestion by 7 different restriction endonuclease (RE) (*Msp I, Hae-III, Hinf-1, EcoR1, Hind-III, Taq-I, Sau-3A*) and resolved on 1% agarose gel (Plate 10). All the genotypes were scored for presence and absence of the RFLP bands and the data were entered into a binary matrix as discrete variables. The 0/1 matrix was used to calculate similarity as Jaccard coefficient. The resultant similarity matrix was employed to construct dendrogram using UPGMA to infer genetic relationship. Dendrogram showed that at 18 % similarity all the isolates are randomly distributed (Fig. 4). Dendrogram can be clearly divided into four different clusters. Cluster one contains isolates B 1, B 3, B 4, B 5 and B 7 at 43 % similarity. Cluster two contains isolates B 2, B 8, B 9, B 19, B 20, and B 22 at 34 % similarity. Cluster three contains isolates of B 10, B 11, B 15 at 48 % similarity. Cluster four contains isolates B 12, B 13, B 14, B 6, and B 16 at 18 % similarity. Sequensing and BLAST analysis of 16s rDNA sequences revealed the presence of three species of *Baciillus* (*B. pumilus, B. megaterium, B. subtilis*) and one species of *Panibacillus.*



Palte 10. Restriction pattern of 16srDNA after digestion with Msp-I. M is marker DNA.

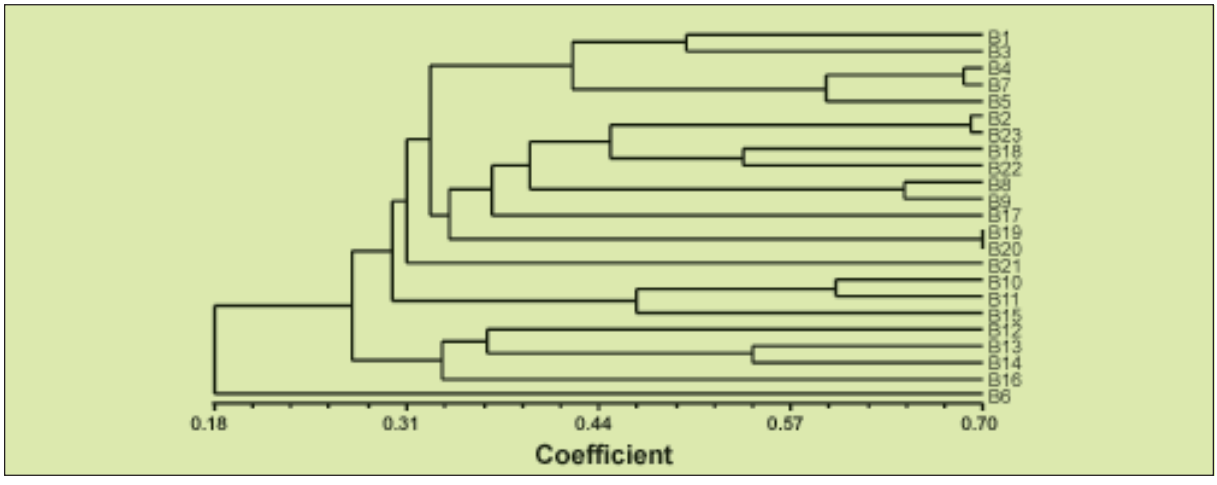


Fig. 4. Dendrogram constructed for 23 bacterial isolates based on the PCR-RFLP profiles of 16srDNA regions.

Molecular characterization of plant growth promoting *Pseudomonas* sp.

Bacteria were isolated from rhizosphere soil of rice rhizosphere collected from Bloomsdales farm of CARI. Based on the morphological and biochemical characterization for plant growth promotion, 20 isolates were grown in nutrient broth at 25° C for 24 hours and total genomic DNA was extracted. Primers PA (5'AGAGTTTGATCCTGGCTCAG3') and PH (5'AAGGAGGTGATCCAGCCGCA3') were used to amplify a fragment of 16s rRNA gene. 1.5 kb PCR product from all the 20 isolates were subjected to restriction digestion by 4 different restriction endonuclease (*Msp I, Hae-III,, EcoR1 and Hind-III*) and resolved over 1 % agarose gel (Plate 11). All the genotypes were scored for presence and absence of the RFLP bands and data were entered into a binary matrix as discrete variables. The 0/1 matrix was used to calculate similarity as Jaccard coefficient. The resultant similarity matrix was employed to construct dendrogram using UPGMA to infer genetic relationship. Dendrogram (Fig. 5) showed that at 59 % similarity all the isolates are randomly distributed and could be divided into 5 different clusters. The dendrogram could be divided into five different clusters with similarity ranging from 59 % to 82 %. Cluster one contains isolates HMI 1, HMI 18, HMI 20, HMI 22, HMI 25 and HMI 26 at 67 % similarity. Cluster two contains isolates HMI 10, HMI 13, HMI 24 and HMI 27 at 70 % similarity. Cluster three contains isolates HMI 2, HMI 4, HMI 5, HMI 6, HMI 14, and HMI 16 at 66.5 % similarity. Cluster four contain single isolate of HMI 19. Cluster five contains isolates HMI 7, HMI 17 and HMI 21 at 66.5 % similarity. 16s rDNA sequensing and BLAST result showed that most of these isolates were from *Pseudomonas putida, Pseudomonas strutzi* and *Pseudomonas montelli.*

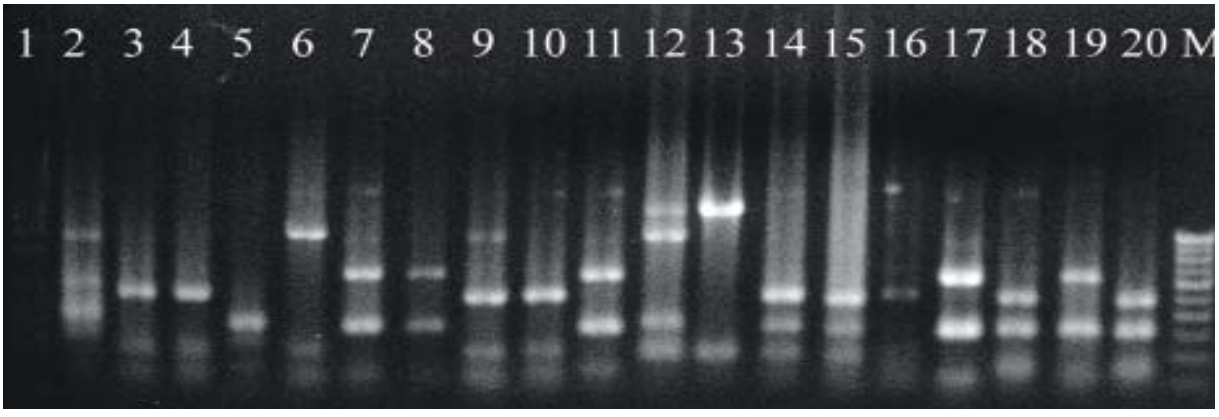


Plate 11. Restriction pattern of 16srDNA after digestion with Hinf-I. M is marker DNA

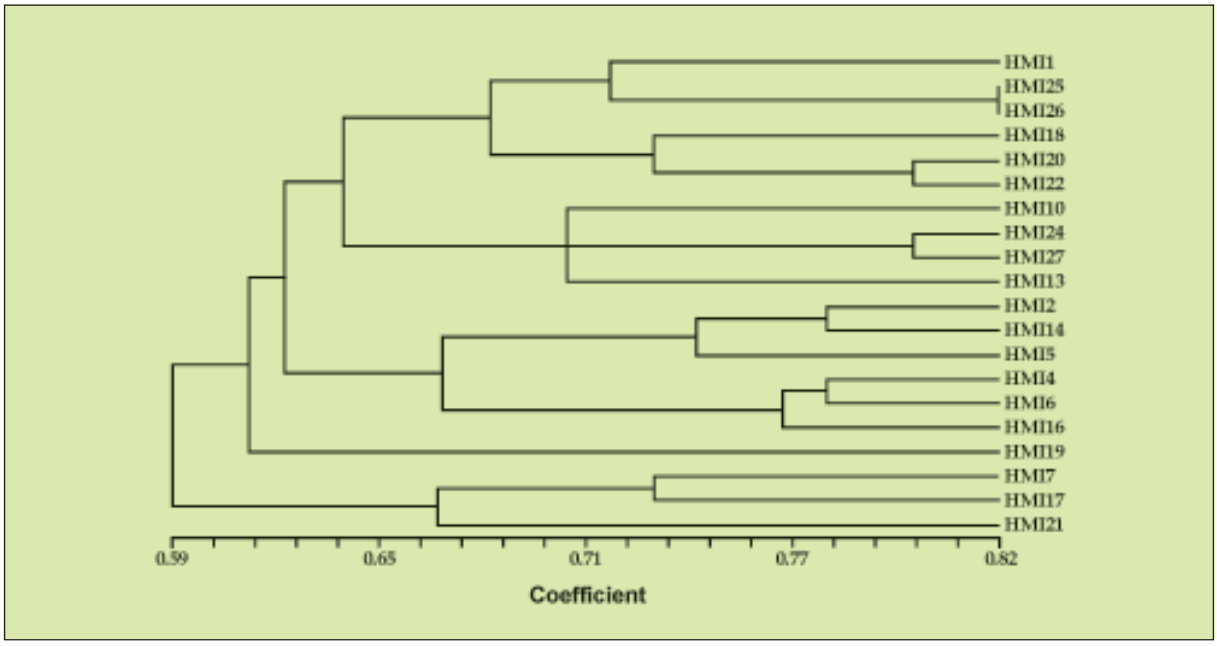


Fig. 5. Dendrogram constructed for 20 bacterial isolates based on the PCR-RFLP profiles of 16s rDNA regions

Molecular characterization of *Trichoderma* sp.

Fifteen isolates of *Trichoderma* available in culture collection were assessed for diversity by PCR-RFLP. *Trichoderma* isolates were grown in Potato Dextrose Broth (PDB) for 5 days and total genomic DNA was extracted by SDS method. Primer ITS1 (5'-TCCGTAGGTGAACCTGCGG-3') and ITS4 (5'- TCCTCCGCTTATTGATATGC -3') were used to amplify a fragment of rRNA gene. 600 bp PCR amplified fragment from all the 15 isolates were subjected to restriction digestion by 3 different restriction endonuclease (RE) (*Eco* R1, *Hinf II* and *Hae III*,) These digestion mixture were resolved over 1 % Agarose gel (Plate 12.). All the genotypes were scored for presence and absence of the RFLP bands and the data were entered into a binary matrix as discrete variables. The 0/1 matrix was used to calculate similarity as Jaccard coefficient. The resultant similarity matrix was employed to construct dendrogram using UPGMA to infer genetic relationship. Dendrogram showed that at 14 % similarity all the *Trichoderma* isolates are randomly distributed (Fig. 6.). Dendrogram can be clearly divided into three different clusters. Cluster one contains isolates F1, F2, F3, F4, F5 and B6 at 34 % similarity. Cluster two contains isolates F7, F8, F9, F10, and F11 at 32 % similarity. Cluster three contains isolates of F12, F13, F14 and F15 at 35 % similarity. Sequensing and BLAST result showed that most of these isolates were from Hypocrea *lixii*, *Trichoderma ovalisporum*, *Trichoderma viride* and *Trichoderma harzianum*.

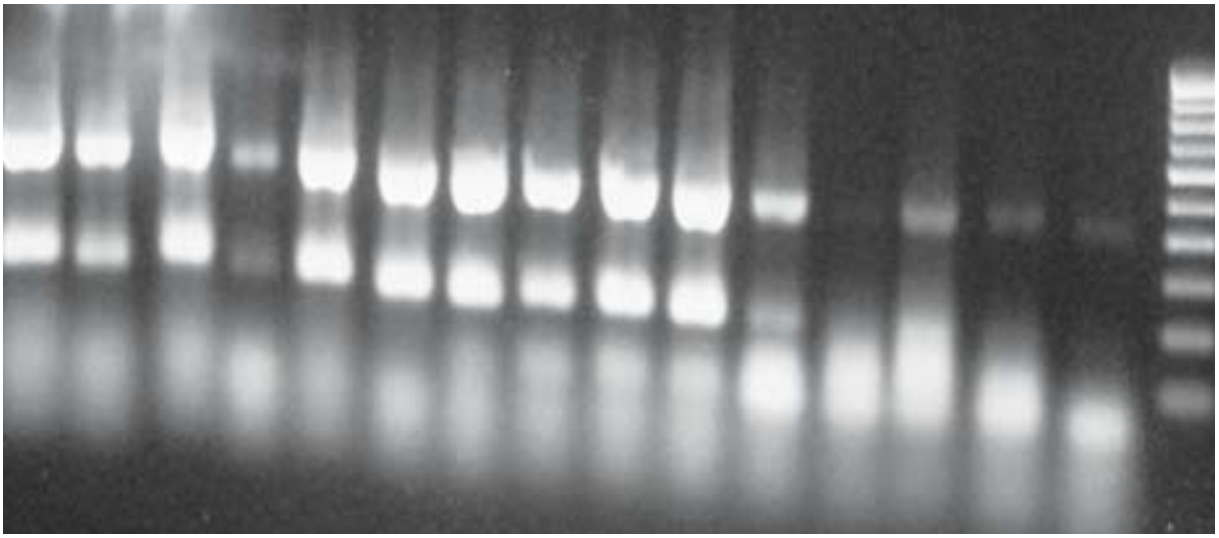


Plate 12. Restriction pattern of rDNA after digestion with Hae-III.

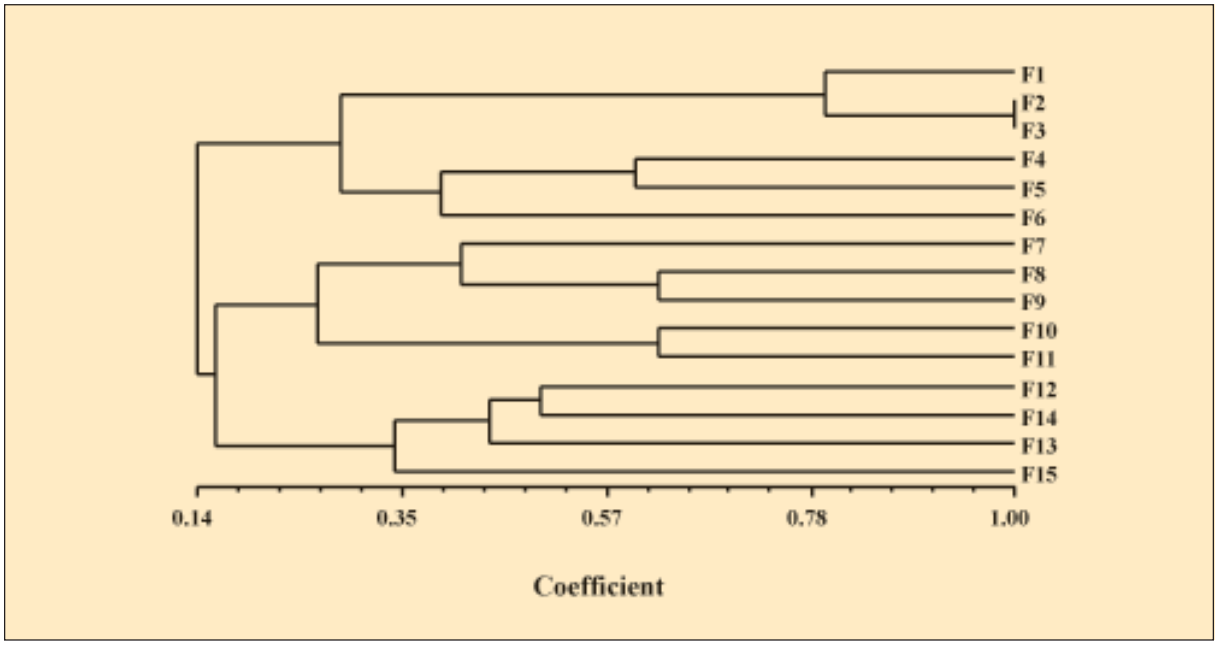


Fig. 6. Dendrogram constructed for 15 isolates of Trichoderma based on PCR-RFLP.

Assessment of crop losses and epidemiology of major vegetable diseases of South Andaman

Krishna Kumar and M. Balakrishnan

Field trials were conducted at Garacharma Farm to study the role of weather variables on development of tomato and chilli diseases. The trials were conducted in randomized block design with three replications. Sowing was done at fifteen days interval starting from 25th January, 10th February, 25th February and 10th March. Weather parameters were recorded from Automatic Weather Station of CARI for Maximum and minimum temperatures, minimum and maximum relative humidity (RH), rainfall and number of rainy days. Correlation and Multiple regression analysis were done to determine the role of weather variables with disease. The data of weather parameters and wilt incidence was analyzed by multiple regression formulate equation. Regression Co-efficient value (R^2) of Max RH was positive and found significant in case of tomato wilt at Feb 10th and Mar 10th planted crops of both varieties (S-22 & Pusa Ruby) of tomato as well as chilly (K2). In the case of chilly leaf curl- 3 factors viz., Max and Min. tem & Rainy day (RD) was significant at Jan. 25th, Feb. 25th & Mar. 10th. In Feb. 25th & Mar. 10th the regression co-efficient value of Max temp. & RD for Mar. 10th in the case of Jan. 25th Min. temp. was found significant.

Integrated Disease and Pest Management of Black Pepper in Andaman and Nicobar Islands

Someshwar Bhagat, Ajanta Birah, Krishna Kumar, M. Sankaran and Israr Ahmad

Evaluation of *Trichoderma* spp. against *P. capsici* and *C. capsici*

Fourteen isolates of *Trichoderma* isolates were evaluated against *P. capsici* and *C. capsici* causing foot rot and anthracnose disease in Black Pepper by dual culture test and production of non-volatile antibiotics. The results revealed that all isolates of *Trichoderma* significantly inhibited the radial mycelial growth of both pathogens as compared to control. Highest percent inhibition of *P. capsici* was recorded with Tv-CARI-27 (60.7%) followed by Th-CARI-37, Tv-CARI-21, Tv-CARI-32 and the isolate Th-CARI-31 was least effective with only 46.3% growth inhibition. Similarly, Highest percent inhibition of *C. capsici* was noted with Tv-CARI-27 followed by Th-CARI-37, Th-CARI-31, Tv-CARI-31, Tv-CARI-28, Tv-CARI-32 and the isolates Tv-CARI-21 and Th-CARI-35 were recorded with lowest percent inhibition (53.1%) of *C. capsici*.

The scanning results indicated that the pathogens viz., *P. capsici* and *C. capsici* were significantly inhibited by all *Trichoderma* isolates by production of non-volatile

inhibitors at 5 and 10% concentrations. Among the antagonists, Tv-CARI-26 was most effective in suppression of mycelial growth of *P. capsici* followed by Tv-CARI-27, Tv-CARI-28, Th-CARI-40 and Th-CARI-33 was noted with lowest percent inhibition. In case of *C. capsici*, highest (63.1 and 73.8 %) growth inhibition was recorded with Tv-CARI-33 by production of non-volatile inhibitors at 5 and 10 % concentrations. The other promising isolates were Th-CARI-37, Th-CARI-31, Tv-CARI-27, Th-CARI-40 and Tv-CARI-31 in their ability to suppress the mycelial growth of *C. capsici*.

Evaluation of fungicides against *P. capsici* and *C. capsici*

For evaluation of fungicides against *P. capsici* and *C. capsici*, poison food technique was used. Nine fungicides, viz., Saaf, Copper oxychloride, Mancozeb, and Krilaxyl Gold were evaluated at five different concentrations as per their rate of application. The concentrations of 10 ppm, 15 ppm, 20 ppm, 25 ppm and 30 ppm (Bavistin and Saaf), 50 ppm, 75 ppm, 100 ppm125 ppm and 150 ppm (Mancozeb and Krilaxyl Gold) was added into the melted PDA medium just before plating into the petri plate. Mycelial plug (5 mm) of both pathogen was inoculated in the centre of fungitoxicated PDA medium, incubated for 7 days at 28 ± 1ºC. All fungicides significantly inhibited both pathogens except Bavistin which was not effective against *P. capsici*. Among the fungicides Bavistin, Saaf and Krilaxyl Gold were more effective against *C. capsici* than *P. capsici* whereas Mancozeb and COC were more effective in percent inhibition of *P. capsici* with lowest LC_{50} value. Furthermore, the mixture of Metalaxyl + Mancozeb (Krilaxyl), Carbendazim + Mancozeb (Saaf) and COC were found more effective in suppression of growth of both pathogen *C. capsici* and *P. capsici* than the Carbendazim (Bavistin) and Mancozeb alone. So, these fungicides can be suitably included in integrated disease management modules for effective management of both foot rot and anthracnose diseases in Black pepper.

Evaluation of botanicals against *C. capsici* and *P. capsici*

Three botanicals namely, Neem oil, Nranj oil and extract of Burma dhania were evaluated against *C. capsici* and *P. capsici*. The three different concentrations, i.e. 1%, 2% and 3% were used for Neem and Kranj oil and aqueous extracts of extract of Burma dhania (methanol extract). For achieving required concentration of botanicals, required volume of liquid was added to melted PDA medium just before plating into the petri plate. The result revealed that all botanicals have the ability to suppress the test pathogens (Fig.7). The percent inhibition of pathogens was increased with increase in their concentrations. The *P. capsici* was more inhibited than *C. capsici* regardless of botanicals tested. Highest percent inhibition of *P capsici* and *C. capsici* was recorded with neem oil at 3% followed by Kranj oil and extracts of *Burma dhania*. The methanol extract of *Burma dhania* was also found

effective in suppression both pathogens. These three botanical can be used for effective disease management of *C. capsici* and *P. capsici* in Black Pepper but its efficacy needs to be validated under *in vivo* and field condition they may loose their efficacy in the presence of rainfall and sunshine.

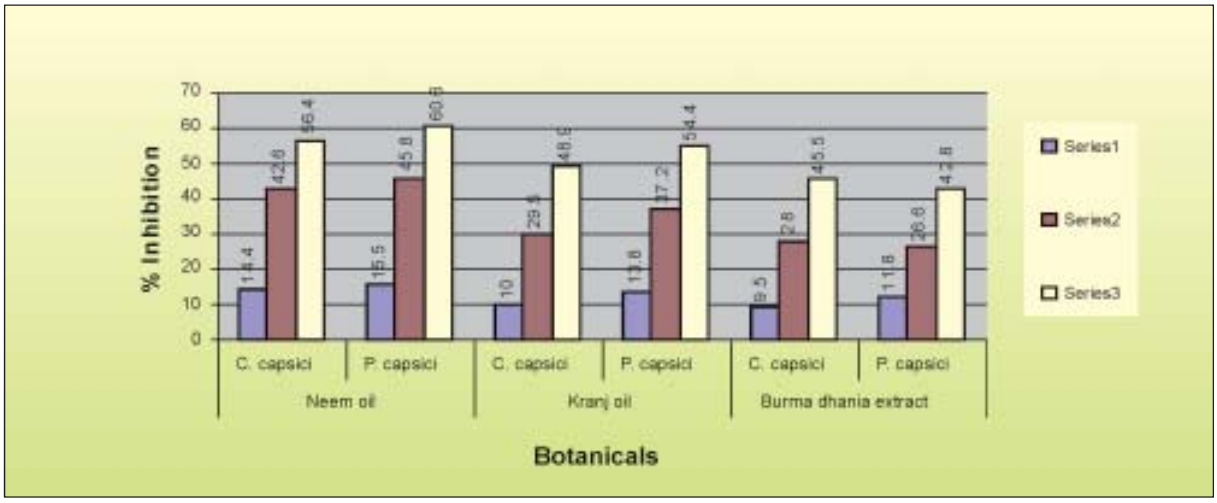


Fig. 7. Effect of botanicals against *C. capsici* and *P. capsici.*

Series 1 - 1%, series 2 - 2% and series 3 - 3% in case of neem and Kranj oil; Series 1 - Methanol extract, series 2 - Ethanol extract and series 3 - Aqous extract in case of Burma dhania extract.

Compatibility of *Trichoderma* spp. with some fungicides

The mechanism of actions of biocontrol fungi and fungicides are different and both are used for disease management. So, if these are compatible with each other they can be applied simultaneously based on their suitability. Compatibility of biocontrol agent, *Trichoderma* spp. with some fungicides were evaluated to develop an integrated disease management module. Four fungicides, viz., Blitox, Moximate, Krilaxyl Gold and Mancozeb which are most commonly used for the control of diseases caused by *Phytophthora* spp. For all fungicides, 50 ppm, 100 ppm and 200 ppm concentrations were added to the melted PDA medium just before plating into the Petri plate. The mycelial plug of all isolates of *Trichoderma* were centrally inoculated and incubated for 7 days at 28 ± 1° C. The radial mycelial growth of test antagonists was measured and percentage inhibition of *Trichoderma* isolates by the respective fungicides was calculated by following formula:

$$I = \frac{C - T}{C} \times 100$$

Where, I = Per cent inhibition of growth

C = Mycelial growth in control plate

T = Mycelial growth in test plate

The results presented in table 14 revealed that all isolates of *Trichoderma* were compatible at lower concentration i.e.50 ppm

and approximately 50 % inhibition of *Trichoderma* isolates by Blitox were recoded at highest concentration (200 ppm). The isolates Th-CARI-37, Tv-CARI-32 and Th-CARI-27 were most compatible with no growth inhibition at 50 ppm concentration. These thee isolates of *Trichoderma* were also most compatible to Moximate with approx. 3.0% growth inhibition at 50 ppm (Table 15), however maximum growth inhibition of antagonists was recorded with Th-CARI-40 (59.3%).

It is evident from the table 16 that all *Trichoderma* isolates were compatible at lower concentrations with very less percent inhibition. Among the isolates, Th-CARI-37, Tv-CARI-32 and Th-CARI-27 consistently performed well against Krilaxyl Gold with very less percent inhibition, whereas the isolate Th-CARI-34 was inhibited upto 60.0% at 200 ppm.

Mancozeb was found compatible with all isolates of *Trichoderma* with maximum growth at lowest concentrations and the isolates Th-CARI-37 and Tv-CARI-32 were found

Table 14. Compatibility of *Trichoderma* spp. with Blitox

Isolates	200 ppm		100 ppm		50 ppm	
	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition
Th-CARI-34	40.0	55.6	62.0	31.1	77.4	14.0
Th-CARI-31	44.0	51.1	66.0	26.7	82.0	8.9
Th-CARI-37	55.0	38.9	76.6	14.9	90.0	0.0
Th-CARI-33	41.5	53.9	62.8	30.2	78.6	12.7
Tv-CARI-21	43.5	51.7	64.0	28.9	79.1	12.1
Tv-CARI-33	45.5	49.4	67.0	25.6	83.3	7.4
Tv-CARI-27	57.0	36.7	79.0	12.2	88.5	0.0
Tv-CARI-28	48.8	45.8	68.0	24.4	84.0	6.7
Tv-CARI-26	38.2	57.6	60.5	32.8	75.8	15.8
Th-CARI-35	40.2	55.3	64.0	28.9	79.2	12.0
Th-CARI-40	36.6	59.3	59.0	34.4	73.2	18.7
Tv-CARI-31	41.6	53.8	65.4	27.3	80.0	11.1
Th-CARI-39	37.7	58.1	59.9	33.4	77.0	14.4
Tv-CARI-32	58.2	35.3	85.0	5.6	90.0	0.0
Control	90.0	-	90.0	-	90.0	-
SEm	0.7642	-	0.5983	-	0.8221	-
CD (0.05)	1.5426	-	1.2077	-	1.6594	-

*Means of 3 replications

Table 15. Compatibility of *Trichoderma* spp. with Moximate

Isolates	200 ppm		100 ppm		50 ppm	
	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition
Th-CARI-34	47.0	47.8	67.7	24.8	78.0	13.3
Th-CARI-31	55.0	38.9	65.0	27.8	75.0	16.7
Th-CARI-37	56.0	37.8	75.0	16.7	87.0	3.3
Th-CARI-33	49.0	45.6	70.0	22.2	82.0	8.9
Tv-CARI-21	44.0	51.1	64.0	28.9	75.0	16.7
Tv-CARI-33	43.0	52.2	62.8	30.2	73.0	18.9
Tv-CARI-27	55.0	38.9	75.6	16.0	86.6	3.8
Tv-CARI-28	42.0	53.3	63.0	30.0	74.0	17.8
Tv-CARI-26	40.0	55.6	61.5	31.7	72.0	20.0
Th-CARI-35	45.0	50.0	68.0	24.4	77.5	13.9
Th-CARI-40	47.0	47.8	70.0	22.2	81.0	10.0
Tv-CARI-31	40.0	55.6	64.4	28.4	75.0	16.7
Th-CARI-39	38.0	57.6	60.0	33.3	71.0	21.1
Tv-CARI-32	54.0	40.0	76.0	15.6	87.0	3.3
Control	90.0	-	90.0	-	90.0	-
SEm	0.8165	-	0.8190		0.7824	-
CD (0.05)	1.6481	-	1.6532		1.5793	-

*Means of 3 replications

Table 16. Compatibility of *Trichoderma* spp. with Krilaxyl Gold

Isolates	200 ppm		100 ppm		50 ppm	
	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition	Radial mycelial growth (mm)*	% Inhibition
Th-CARI-34	36.0	60.0	64.4	28.4	75.0	16.7
Th-CARI-31	38.0	57.8	57.0	36.7	78.0	13.3
Th-CARI-37	50.0	44.4	75.2	16.4	86.0	4.4
Th-CARI-33	38.0	57.8	58.0	35.6	70.4	21.8
Tv-CARI-21	49.0	45.6	71.0	21.1	83.0	7.8
Tv-CARI-33	47.0	47.8	66.0	26.7	78.0	13.3
Tv-CARI-27	50.0	44.4	74.0	17.8	86.5	3.9
Tv-CARI-28	45.0	50.0	64.4	28.4	73.0	18.9
Tv-CARI-26	42.2	53.1	61.0	32.2	72.0	20.0
Th-CARI-35	41.0	54.4	59.0	34.4	70.0	22.2
Th-CARI-40	38.0	57.8	58.2	35.3	67.8	24.7
Tv-CARI-31	40.0	55.6	60.5	32.8	72.0	20.0
Th-CARI-39	39.0	56.7	58.0	35.6	68.0	24.4
Tv-CARI-32	52.0	42.2	76.0	15.6	86.0	4.4
Control	90.0	-	90.0	-	90.0	-
SEm	0.8499	-	0.8002	-	0.7964	-
CD (0.05)	1.7156	-	1.6152	-	1.6076	-

*Means of 3 replications

100.0% growth at 50 ppm concentration (Table 17). The isolates Th-CARI-37 and Tv-CARI-32 were recorded with most compatible with Mancozeb whereas the isolate Th-CARI-35 was noted with least compatible with 55.6% growth inhibition. The other isolates of *Trichoderma* were found with intermediate effect. Thus these four fungicides are very much suited to integrate with biocontrol fungus *Trichoderma* spp. for the management of foot rot and anthracnose disease in Black Pepper.

Table 17. Compatibility of *Trichoderma* spp. with Mancozeb

Isolates	200 ppm		100 ppm		50 ppm	
	Radial mycelial growth (mm)	% Inhibition	Radial mycelial growth (mm)	% Inhibition	Radial mycelial growth (mm)	% Inhibition
Th-CARI-34	52.0	42.2	74.4	17.3	84.0	6.7
Th-CARI-31	52.2	42.0	70.0	22.2	80.0	11.1
Th-CARI-37	58.6	34.9	83.5	7.2	90.0	0.0
Th-CARI-33	51.2	43.1	73.0	18.9	82.0	8.9
Tv-CARI-21	54.0	40.0	74.4	17.3	83.0	7.8
Tv-CARI-33	47.7	47.0	67.0	25.6	78.0	13.3
Tv-CARI-27	47.0	47.8	66.2	26.4	76.0	15.6
Tv-CARI-28	45.0	50.0	65.0	27.8	75.0	16.7
Tv-CARI-26	43.0	52.2	64.6	28.2	75.0	16.7
Th-CARI-35	40.0	55.6	59.2	34.2	70.0	22.2
Th-CARI-40	46.0	48.9	70.0	22.2	80.0	11.1
Tv-CARI-31	48.0	46.7	75.0	16.7	84.0	6.7
Th-CARI-39	52.0	42.2	71.0	21.1	82.0	8.9
Tv-CARI-32	59.0	34.4	84.4	6.2	90.0	0.0
Control	90.0	-	90.0	-	90.0	-
SEm	0.8487	-	0.8641	-	0.8165	-
CD (0.05)	1.7132	-	1.7442	-	1.6481	-

*Means of 3 replications

Green house evaluation of *Trichoderma* spp against Foot rot of Black Pepper

The efficacy of Trichoderma isolates were evaluated against foot rot of Black Pepper under green house condition. The ten best isolates of Trichoderma were mass multiplied in PDB medium for 15 days, grinded and mixed under cyclomixer and mixed with talc powder in 1:2 ratio so that final concentration of Trichoderma propagules ascertained at 10^{10} cfu/g of powder. The formulated product was mixed well rotten farm yard manure and neem cake (1:100:10) and incubated for 21 days under shade and assured moisture at near to field capacity. Thus the Trichoderma enriched FYM was obtained and mixed with the potting mixture where black pepper cuttings supposed to planted. The cuttings of Black Pepper were dipped into the suspension of Trichoderma

(10^{10} cfu / g) for 1 hr and planted into the earthen pot. The moisture holding capacity of soil was maintained at nearly field capacity by adding irrigation water as per requirement. The inoculum load (10^4cfu / ml) of *P. capsici* was added to the soil mixture just before planting of Black Pepper cuttings. The appearance of foot rot disease was observed and recorded at 15 days intervals upto 90 days. The percent reduction in disease (foot rot) due to *Trichoderma* application was calculated by subtracting the disease incidence (treated pot) from control pot and divided by disease incidence in control pot and expressed as percent.

All isolates of *Trichoderma* significantly reduced the disease incidence in Black Pepper seedlings as compare to control. But the isolate Th-CARI-33 was most effective with 63.9% reduction in disease incidence, followed by Tv-CARI-32, Tv-CARI-14, Tv-CARI-16 and the isolate Th-CARI-27 was noted with least reduction in disease incidence of foot rot (42.6%). Thus the native biocontrol agent, *Trichoderma* spp. can suitably used for successful management of foot rot disease in the Bay Islands and they can also be integrated with different IDM modules for the management of diseases in Black Pepper.

Green house evaluation of fungicides against Foot rot of Black Pepper

Three fungicides, Copper oxychloride (soil drenching + foliar spray), Mancozeb (soil drenching + foliar spray), Metalaxyl R (foliar spray) and Bordeux mixture (soil drenching + foliar spray) were evaluated against foot rot of Black Pepper under green house condition. The soil drenching and spray of Bordeux mixture at 15 days interval was found very effective in suppression of foot rot of Black pepper with 96.0% reduction in disease incidence, followed by Copper oxychloride (88.8%), Mancozeb (75.6%) and least control of foot rot was recorded with Metalaxyl R (72.5%).

IPM module for Pollu Beetle

Pollu Beetle is a major pest of Black pepper causing considerable loss in berry yield. Presence of numerous small holes on the surface of the tender leaves is a characteristic early symptom of the occurrence of the pest population in the plantation. Female beetles lay eggs on tender berries. The eggs hatch in 3-8 days into minute creamy-white grubs. The grubs bore into the berries and feed on the internal contents and make them hollow. Infested berries turn pale yellow initially and later, black, and crumble when pressed by hand. The feeding activity of beetles results in the formation of black sunken patches on the tender shoots and spikes and small irregular circular holes on the surface of the tender leaves. With the onset of monsoon showers, they resume their normal feeding and breeding activities. The pest infestation is higher in the plantation during September-October and is very severe in shaded areas of the plantation (Table 18).

Table 18. Details of IMP module for Pollu Beetle

Modules	Integrated pest management practice
Biointensive module	Pruning of branches of the treesNeem cake application @ 250g / vine Foliar spray of 0.5 per cent neem formulation (Neembaan) from July onwards at 21 days interval
Integrated module	Pruning of branches of the treesNeem cake application @ 250g / vine Alternate foliar spray of 0.5 per cent neem formulation (Neembaan) and 0.5 per cent Quinalphos from July onwards at 21 days interval
Farmers practice	Foliar spray of 0.2 per cent Cypermethrin or Deltamethrin
Check	Control

*Mix sticker @0.5ml / lt during the foliar spray

Table 19. Evaluation of pest management modules against Pollu beetle *Longitarsusnigripennis* M.

Modules	Picking wise berry damage (%)				Yield	% increase in
	1st	2nd	3rd	Mean	(kg/ha)	yield over control
T1(Biointensive)	9.67	7.33	8.76	8.58	385.50	80.70
	(18.05)	(15.68)	(17.16)	(16.95)		
T2(Integrated)	5.12	2.40	1.89	3.13	687.56	222.29
	(13.05)	(8.91)	(7.71)	(10.14)		
T3 (Farmer Practice)	14.56	13.45	16.33	14.78	275.67	29.22
	(22.38)	(21.47)	(23.81)	(22.55)		
T4(Check)	16.72	14.54	17.33	16.19	213.33	—
	(24.12)	(22.38)	(24.58)	(23.66)		
SEm	**0.60**	**0.20**	**0.39**	**0.50**	**4.35**	
CD (P=0.05)	**1.36**	**0.46**	**0.89**	**1.15**	**9.84**	
CV(%)	**7.50**	**3.10**	**5.03**	**6.75**	**1.58**	

Figures in parentheses are *arcsin* transformed values

The results presented in (Table 19) revealed that all the treatments have significantly reduced berry damage in 1st to 3rd picking of berries of Black Pepper as compare to untreated check. However, lowest percent berry damage was recorded in T_2 treatment (3.13%) followed by T_1 (8.58%) and T_3 (14.78%) The maximum increase in yield (222.29%) was also noted with integrated module (T_2), followed by bio-intensive (80.70%) and farmer practice (29.22%). The integration of Neem cake as soil application and alternate foliar spray of Neembaan and Quinalphos is helpful in reducing breeding efficiency as well as direct killing of adult beetle in the foliar region and thereby population of pollu beetle reduced below economic threshold level.

Development of IDM modules for Tomato

Someshwar Bhagat and Krishna Kumar

This project aimed to develop integrated disease management modules for tomato under Island ecosystem of Bay Islands.

Module-I: Combination of bioagents, neem cake and neem seed oil

The basic idea behind the IDM module I, is the exploitation of some promising biocontrol agents which have already been proved to control many soil borne diseases directly and indirect control of foliar diseases by their growth promoting activities, rhizosphere colonization and induced resistance in host plants. The inclusion of neem cake in this module as soil application was due to its antimicrobial activities and supports the growth and development of bio-control agents when it is applied along with well rotten FYM. The details of treatment schedules are as follows (Table 20).

Table 20. Treatment schedules

T_1	Seed treatment with Tv-CARI-3 @10 g / Kg of seed
T_2	Seed treatment with Th-CARI-5 @10 g / Kg of seed
T_3	Seed treatment with Tv-CARI-5 @10 g / Kg of seed
T_4	Seed treatment with Psf-CARI-1@10 g / Kg of seed
T_5	T_1 + Seedling dip with Tv-CARI-3 @10 g / L of water + Soil application of Tv-CARI-3 enriched FYM and neem cake (1:100:10 ratio)@ 5.0 Kg / m^2
T_6	T_2 + Seedling dip with Th-CARI-5 @10 g / L of + Soil application of Th-CARI-5 enriched FYM and neem cake (1:100:10 ratio)@ 5.0 Kg / m^2
T_7	T_3 + Seedling dip with Tv-CARI-5 @10 g / L of water + Soil application of Tv-CARI-5 enriched FYM and neem cake (1:100:10 ratio)@ 5.0 Kg / m^2
T_8	T_4 + Seedling dip with Psf-CARI-1 @10 g / L of water + Soil application of Psf-CARI-1 enriched FYM and neem cake (1:100:10 ratio)@ 5.0 Kg / m^2
T_9	T_5 + Two sprays of neem oil (2%)
T_{10}	T_6 + Two sprays of neem oil (2%)
T_{11}	T_7 + Two sprays of neem oil (2%)
T_{12}	T_8 + Two sprays of neem oil (2%)
T_{13}	Control

The results presented in Table 21 revealed that all the treatments have significantly reduced percent reduction of disease incidences in tomato as compared to untreated control. But T_{10} treatment was most effective in reduction of disease incidences in tomato except bacterial wilt followed by $T_{11,}$ $T_{12,}$ T_{11} and T_9. Treatment T_{10} was also recorded with highest yield (275.5 Q / ha) and T_3 was least effective in percent reduction of disease incidence of all diseases and lowest yield (165 Q / ha).The results suggested that

the combination of seed treatment + seedling dip + soil application of biocontrol agents were more effective than seed or seedling or soil treatment alone with respect to their ability to reduce the disease incidence. So, these biocontrol agents can suitably incorporated into any IDM modules for the management of disease complex of tomato.

Table 21. Evaluation of bioagents and neem products against disease complex of tomato

Treatments	% Reduction of disease incidence				Yield	% increase
	Bacterial wilt	Leaf curl	Basal stem rot	Fusarial wilt	(q/ha)	in yield
T_1	16.4 f	21.9 f	15.8 e	24.2 e	195.0 g	30.0
T_2	22.5 e	25.1 d	19.8 d	29.2 d	200.0 e	33.3
T_3	14.6 f	19.9 f	13.4 ef	22.0 f	192.0 h	28.0
T_4	20.0 e	20.5 f	14.0 ef	22.5 f	189.0 i	26.0
T_5	48.1 c	22.5 e	54.2 b	65.2 b	202.5 f	35.0
T_6	55.5 b	26.0 d	59.6 a	75.0 a	213.9 d	42.6
T_7	45.2 d	20.3 f	52.0 bc	63.4 bc	206.5 e	37.7
T_8	58.0 a	20.8 f	50.0 c	65.0 b	200.0 f	33.3
T_9	46.0 d	51.0 b	52.9 bc	64.0 b	220.0 c	46.7
T_{10}	56.0 b	58.5 a	60.8 a	75.8 a	227.5 a	51.7
T_{11}	55.0 b	54.5 b	55.0 b	66.0 b	221.8 b	47.9
T_{12}	58.2 a	50.0 c	51.0 c	61.7 c	216.0 b	44.0
T_{13}	0.0	0.0	0.0	0.0	150.0j	-

The letter indicating same letter was significantly not differed as per DMRT test (0.05%)

Module-II: Integration of biocontrol agents and fungicides

Use of chemical pesticides is the most common practice for the management of plant diseases. But indiscriminate use of chemical pesticides are not only causing pollution to the soil and water ecosystem but also leading to development of resistance among various pathogens against chemical pesticides. The rationale behind the IDM module-II is to challenge the plant pathogens with relatively low dose of test fungicides, which weaken the strength of pathogen and subsequent application of biocontrol agents will facilitate rapid colonization these bioagents in the rhizosphere region of roots and thereby direct killing of pathogens by lysis or competition for nutrient and space (Table 22).

It is evident from Table 23 that Carbendazim and Krilaxyl Gold were not effective against both bacterial wilt and leaf curl of tomato. But all three fungicides were very effective against basal stem rot and fusarial wilt. The integration of bioagents with these fungicides improved their efficacy in percent reduction of disease incidences and corresponding increased yield in tomato. T_7

Table 22. Treatment schedules

T_1	:	Seed treatment + Seedling dip + Soil drenching with Copper oxychloride @ 2 g/Kg of seed and 2 g/L of water
T_2	:	Seed treatment + Seedling dip + Soil drenching with Carbendazim @ 2 g/Kg of seed and 2 g/L of water
T_3	:	Seed treatment + Seedling dip + Soil drenching with Krilaxyl @2 g/Kg of seed and 2 g/L of water
T_4	:	Seed treatment + Seedling dip with Th-CARI-5 @10 g/L of water for half an hour + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/m^2)
T_5	:	Seed treatment + Seedling dip with Tv-CARI-3 @10 g/L of water for half an hour + Soil application of Tv-CARI-3 along with FYM and neem cake (5.0 Kg/m^2)
T_6	:	Seed treatment + Seedling dip with Psf-1 @10 g/L of water for half an hour + Soil application of Psf-CARI-1 along with FYM and neem cake (5.0 Kg/m^2)
T_7	:	Seed treatment + Seedling dip with COC + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_8	:	Seed treatment + Seedling dip with COC + Soil application of Tv-CARI-3 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_9	:	Seed treatment + Seedling dip with COC + Soil application of Psf-CARI-1 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{10}	:	Seed treatment + Seedling dip with Carbendazim + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{11}	:	Seed treatment + Seedling dip with Carbendazim + Soil application of Tv-CARI-3 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{12}	:	Seed treatment + Seedling dip with Carbendazim + Soil application of Psf-CARI-1 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{13}	:	Seed treatment + Seedling dip with Krilaxyl + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{14}	:	Seed treatment + Seedling dip with Krilaxyl + Soil application of Tv-CARI-3 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{15}	:	Seed treatment + Seedling dip with Krilaxyl + Soil application of Psf-CARI-1 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %)
T_{16}	:	Control

treatment i.e. Seed treatment + Seedling dip with COC + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg/m^2) + Two sprays of neem oil (2 %), was recorded with highest percent reduction in incidence of all diseases (86.0% bacterial wilt, 56.2% leaf curl, 76.4% basal stem rot and 74.8% fusarial wilt) and increase in yield (106.7%) followed by T_1, T_9, T_8, T_{13}, T_4 and the treatment T_2 was recorded least effective

in percent reduction in disease index and yield increase (35.3%). Thus it seems that integration of biocontrol agents with suitable fungicides at relatively low concentrations can become best option as compare to either of biocontrol agent or fungicides alone.

Table 23. Integrated effects of biocontrol agents and fungicides against disease complex of tomato

Treatments	% Reduction of disease incidence				Yield (q/ha)	% increase in yield
	Bacterial wilt	Leaf curl	Basal stem rot	Fusarial wilt		
T_1	84.9b	0.0	75.3ab	73.6b	256.0a	70.7
T_2	0.0	0.0	72.5bc	68.4cd	203.0h	35.3
T_3	0.0	0.0	76.0a	76.0a	214.0g	42.7
T_4	55.6de	55.4a	65.6f	60.0g	210.0 b	40.0
T_5	41.6e	52.1b	60.0g	56.8h	220.0f	46.7
T_6	63.4c	48.5	58.2gh	53.0i	224.0f	49.3
T_7	86.0ab	56.2a	76.4a	74.8b	263.0a	75.3
T_8	84.0b	52.6b	73.2b	65.0e	248.0b	65.3
T_9	87.5a	49.0c	62.9de	62.0f	254.0ab	69.3
T_{10}	57.0d	56.0a	76.0a	70.0c	233.0c	55.3
T_{11}	42.2e	53.0b	74.1b	62.3f	226.6e	51.1
T_{12}	65.0c	49.3c	60.0d	60.5g	221.0d	47.3
T_{13}	57.8d	55.5a	77.0a	70.1c	236.6b	57.7
T_{14}	43.0e	52.7b	74.0b	64.0e	232.2d	54.8
T_{15}	65.0c	48.6c	63.2d	60.5g	229.5d	53.0
T_{16}	0.0	0.0	0.0	0.0	150.0i	0.0

Module- III: Combination of cultural practices, biocontrol agents and fungicides

The rationale behind the integrated approach of disease management in tomato is that either use of cultural practices, biocontrol agents and fungicides alone is not effective in suppression of disease complexes of tomato. So, integration of these three components seems to be more effective in management of diseases in tomato because each component expected to have synergistic effect in disease management process. The integration of cultural practices, botanical and biocontrol agents not only helpful in suppression of disease complexes in tomato but also reduce the requirement of chemical pesticides (Table 24).

It is evident from the Fig. 8 that all the treatments significantly reduced the incidence of disease complex in tomato as compare to control. But the combination of biocontrol agents, fungicide and botanicals in different method of delivery system was proved superior when the seedlings were transplanted directly in the main field without disturbing the root system as compared to uprooting of seedlings and subsequent transplantation in the main field.

The treatment T_2 was most effective in percent reduction of disease incidence and corresponding yield increase of tomato, followed by T_3, T_4 and T_1. The results also suggested that crop rotation with non host crop and intercropping with Burma Dhania with tomato resulted into improved disease control and yield of tomato.

Table 24. Treatment schedules for tomato

T_1	Seedlings raised in nursery beds and transplanted in main field + Th-CARI-5 + Psf-CARI-1 + Copper oxychloride + Mixture of FYM and neem cake + Neem oil
T_2	Seedlings raised in plastic cup and direct transplanting + Th-CARI-5 + Psf-CARI-1 + Copper oxychloride + Mixture of FYM and neem cake + Neem oil
T_3	Crop rotation with sorghum + Th-CARI-5 + Psf-CARI-1 + Copper oxychloride + Mixture of FYM and neem cake + Neem oil
T_4	Intercropping with Burma Dhania + Th-CARI-5 + Psf-CARI-1 + Copper oxychloride + Mixture of FYM and neem cake + Neem oil
T_5	Control (seedlings raised in nursery bed and transplanted in main field)

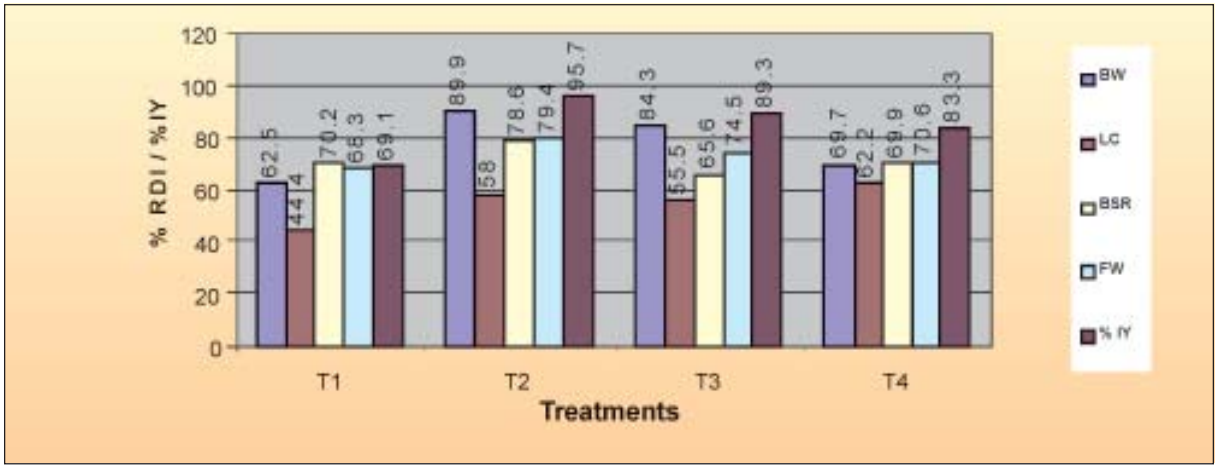


Fig. 8. Integrated effect of cultural practices, biocontrol agents and fungicide against disease complex of tomato

OFT trial on disease management of Tomato

The on farm trial on disease management of tomato by integration biocontrol agents, botanicals and fungicides were carried out in five farmer's field of South Andaman with in an area of 100 m^2 each (Table 25). The plant protection measures in tomato and other vegetables used by respective farmers was noted and analyzed. The best three treatments with lowest disease incidences of tomato were chosen for on farm trial in five farmer's field. The data on disease incidence of bacterial wilt, leaf curl, and basal stem rot and fusarial wilt was recorded 7 days after transplanting and repeated at 15 days intervals. The percent reduction in disease incidence of each disease was calculated by the formula:

$$\%RDI = \frac{\text{(Disease incidence in control plot) - (Disease incidence in treated plot)}}{\text{(Disease incidence in control plot)}}$$

The treatment schedules of best three treatments are as follows:

The results presented in Fig. 9 revealed that all treatments have significantly reduced the disease incidence of all diseases studied as compared to farmers practice. But T_1 was found most effective in percent reduction in disease incidences of bacterial wilt, leaf curl, basal stem rot and fusarial wilt of tomato in all five farmer's field followed by T_2, T_3 and T_4 (Farmer practice) was least effective with lowest %RDI and increase in yield. The present result indicated that though there was lower % RDI of all diseases in farmer's field and increase in yield as compared to our experimental result but there was significant higher % RDI and increase in yield of tomato as compared to farmer practice.

Table 25. Treatment schedules

T_1	Seed treatment + Seedling dip with COC + Soil application of Th-CARI-5 along with FYM and neem cake (5.0 Kg / m^2) + Two sprays of neem oil (2 %)
T_2	Seed treatment + Seedling dip with COC + Soil application of Tv-CARI-3 along with FYM and neem cake (5.0 Kg / m^2) + Two sprays of neem oil (2 %)
T_3	Seed treatment + Seedling dip with COC + Soil application of Psf-CARI-1 along with FYM and neem cake (5.0 Kg / m^2) + Two sprays of neem oil (2 %)
T_4	Farmers practice
T_5	Control

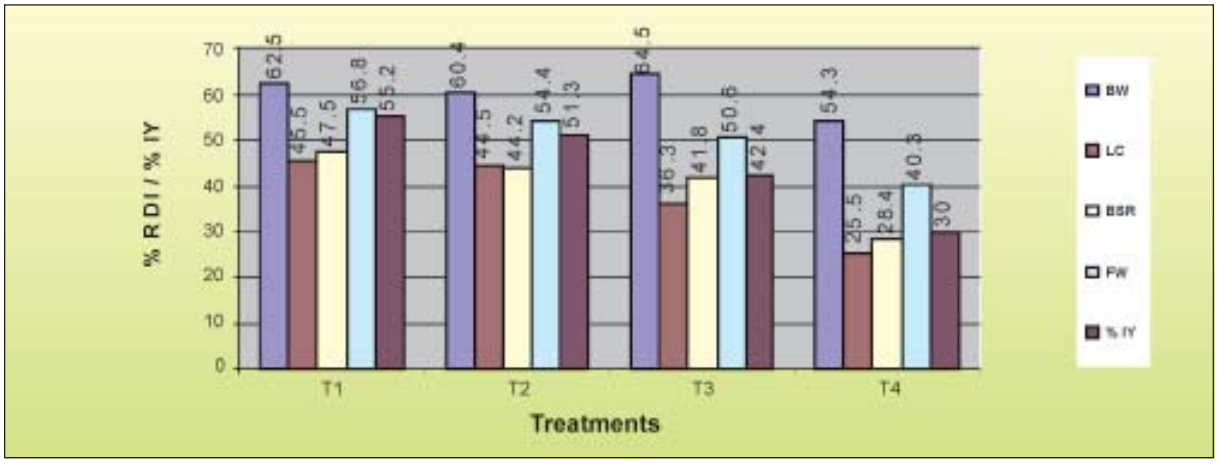


Fig. 9 Integrated disease management of Tomato

Development of Ecofriendly IPM Modules for Okra and Cucurbits in Andaman

Ajanta Birah, Shrawan Singh, Subhash Chand, Krishna Kumar and Someshwar Bhagat

In these Islands, tropical and humid climate offers congenial environment for spread and multiplication of insect-pests of varied origin. Keeping this in view of alarming pest problems, the present study has been planned to develop the eco-friendly sustainable vegetable IPM modules in Andaman to combat against notorious pests.

A. Laboratory evaluation of plant extracts

The melon fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) is a major pest of cucurbitaceous vegetables. It prefers to infest young, green, soft-skinned fruits. This pest inserts the eggs 2 to 4 mm deep in the fruit tissues, and the maggots feed inside the fruit. Pupation occurs in the soil at 0.5 to 15 cm below the soil surface. It has been reported to cause 15-85% loss in cucurbitaceous vegetables. *In-vitro* study was conducted to evaluate aqueous extracts of different plants for their repellency action against fruit fly. Out of tested plant species, *Syzygium aromaticum, Amomum aculeatum* and *Morinda citrifolia* were found effective against fruit fly in which mortality ranged from 5.77 to 71.76, 4.13 to 80.45 and 13.22 to 70.23% and LC_{50} was recorded 8.83, 10.67 and 10.85%, respectively. Whereas, ***Annona squamosa,*** *Pongamia glabra* and *Gliricidia* spp had showed lower mortality range between 12.80 to 73.84, 3.13 to 57.03 and 5.53 to 62.11% and LC_{50} was 15.99, 21.61 and 31.97%, respectively (Table 26, Fig. 10, Plate 13).

B. Field evaluation of pest management modules

Okra (*Abelmoschus esculentus* Moench) commonly called as bhendi or ladies

Table 26. Regression equation and LC_{50} values of aqueous plant extracts against fruit fly, *Bactrocera dorsalis*

SL. No.	Plant extracts	Heterogeneity		Regression equation	LC_{50} value(%)	Fiducial limits
		df	x^2			
1.	*Syzygium aromaticum*	6	2.197	y=3.562 +1.519x	8.834	6.43- 12.13
2.	*Amomum aculeatum*	6	0.824	y=1.845 +3.068x	10.670	9.22 - 12.34
3.	*Morinda citrifolia*	6	1.958	y=2.886 +2.041x	10.850	8.62 - 13.64
4.	***Annona squamosa***	6	2.782	y=2.200 +2.325x	15.999	13.19 -19.39
5.	*Pongamia glabra*	6	0.503	y=1.013 +2.987x	21.610	17.85 -26.15
6.	*Gliricidia* spp.	6	2.939	y=0.058 +3.283x	31.978	27.48 - 37.2

df: degree of freedom, $\div^2$: chi square, LC_{50} : median lethal concentration

finger has special status in Island in providing nutrition among the varied vegetables. The yield and quality of okra is hampered severely due to outbreak of various insect pests. Shoot and fruit borer, *Earias vittella* is ubiquitous and major obstacle for okra production in these islands. Keeping in view, the present study was undertaken to evaluate different pest management modules against okra shoot and fruit borer in field conditions. Field trials were conducted on okra (cv-*Arka Anamika*) to evaluate pest management modules. The trial was laid in Randomized Block Design with four treatments (modules) replicated four times including control. All the agronomic practices were followed for raising the crop in this location. The details of all the treatments (modules) are presented in table 27. The incidence of fruit borer was calculated on the basis of weight of damaged fruits. Data recorded on the incidence of jassid population and okra shoot and fruit borer and fruit yield were presented in tables 28-29 and Plate 14.

Table 27. Details of different integrated pest management practices adopted for the okra field trial

Name of Module	Details of treatment
M_1– Biointensive	Neem cake application @ 250 kg / ha at the time of sowingSowing of maize at the borders as barrier crop for conservation of natural enemiesWeekly clipping of infested shoot & fruit Erection of pheromone trap @ 100traps / ha for mass trappingFoliar spray of neem formulation (Neembaan) @ 30ml / lt at 45 DASFoliar spray of aqueous leaf extracts of cloves (*Syzygium aromaticum*) @ 250g / lt at 60 DASFoliar spray of Karanj oil @ 30 ml / lt at 75 DAS
M_2- Integrated	Seed treatment with imidacloprid @ 5 g / kg seed a day before sowing Sowing of maize at the borders as barrier crop for conservation of natural enemiesWeekly clipping of infested shoot & fruit Erection of pheromone trap @ 100traps / ha for mass trappingFoliar spray of neem formulation (Neembaan) @ 30 ml / lt at 45 DASFoliar spray of Spinosad 45 SC @0.5ml / lt at 60 DASFoliar spray of Karanj oil @ 30 ml / lt at 75 DAS
M_3- Farmers practice	Foliar spray of endosulfan @ 2 ml / lt at 45 DASFoliar spray of cypermethrin @ 1.5 ml / lt at 60 DASFoliar spray of deltamethrin @ 1.5 ml / lt at 75 DAS
M_4 - control	Control

DAS : Days after sowing
* Sticker mixed @0.5ml / lt during the foliar spray of insecticidals and botanical formulations

Table 28. Evaluation of pest management modules against Jassid population in okra

Modules	Average number of Jassid nymph and adult whitefly per leaf														Fruit yield (q/ha)	% increase in yield over control
	25DAS		35DAS		45DAS		55DAS		65DAS		75DAS		Pooled over periods			
	J	W	J	W	J	W	J	W	J	W	J	W	J	W		
M_1	1.02	3.33	4.33	4.35	5.52	4.33	6.91	7.93	2.85	11.70	4.98	5.37	4.27	6.17	97.12	33.96
M_2	1.51	2.35	3.19	4.25	4.10	2.55	3.30	7.04	3.33	11.31	4.50	7.22	3.32	5.79	119.69	65.08
M_3	2.31	3.75	4.31	4.57	7.55	4.77	5.65	8.38	6.16	13.00	5.85	8.20	5.31	7.11	90.77	25.20
M_4	2.50	4.88	7.79	9.77	8.65	7.77	13.33	13.50	13.92	14.63	14.54	13.77	10.12	10.72	72.50	—
SEm	**0.06**	**0.03**	**0.08**	**0.05**	**0.38**	**0.06**	**0.06**	**0.14**	**0.01**	**0.32**	**0.12**	**0.05**	**0.05**	**0.05**	**1.17**	
CD (P=0.05)	**0.15**	**0.08**	**0.20**	**0.13**	**0.85**	**0.15**	**0.14**	**0.31**	**0.03**	**0.74**	**0.27**	**0.12**	**0.13**	**0.12**	**2.65**	
CV (%)	**5.13**	**1.48**	**2.59**	**1.43**	**8.33**	**1.96**	**1.27**	**2.15**	**0.37**	**3.68**	**2.28**	**0.89**	**1.42**	**1.05**	**1.75**	

DAS : Days after sowing, J : Jassid, W : whitefly

Table 29. Evaluation of pest management modules against shoot and fruit borer and yield of okra

Modules	Picking wise fruit damage (%)									Fruit yield (q/ha)	% increase in yield over control
	1st	2nd	3rd	4th	5th	6th	7th	8th	Mean		
M_1	1.13	9.20	9.33	9.25	9.93	4.53	6.33	5.25	6.87	97.12	33.96
	(6.02)	(17.66)	(17.76)	(17.66)	(18.34)	(12.25)	(14.54)	(13.18)	(15.12)		
M_2	2.10	5.65	6.57	4.95	2.33	10.11	9.25	4.13	5.64	119.69	65.08
	(8.33)	(13.69)	(14.77)	(12.79)	(8.72)	(18.53)	(17.66)	(11.68)	(13.69)		
M_3	2.33	6.95	11.85	5.93	10.73	11.14	3.99	5.53	7.31	90.77	25.20
	(8.72)	(15.23)	(20.09)	(14.06)	(19.09)	(19.46)	(11.39)	(13.56)	(15.68)		
M_4	10.93	14.54	13.25	16.25	21.33	21.59	17.59	19.32	16.85	72.50	—
	(19.28)	(22.38)	(21.30)	(23.73)	(27.49)	(27.63)	(24.73)	(26.06)	(24.2)		
SEd	0.42	0.09	0.33	0.79	0.95	1.29	0.15	0.11	0.06	1.17	
CD (P=0.05)	0.96	0.20	0.75	1.80	2.15	2.92	0.34	0.25	0.14	2.65	
CV(%)	5.62	0.75	2.54	6.61	7.30	9.62	1.24	1.00	0.52	1.75	

Figures in parentheses are arcsin transformed values

(i) Incidence of sucking pests

The data presented in table 4 revealed that there was a significant lower jassid population in all the modules as compared to control (M_4) (10.12 jassids/leaf) in periodical observations (Plate 9). The pooled data revealed that integrated module (M_2) and bio-intensive module (M_1) recorded significantly lower jassid population (3.32 jassids/leaf, 4.27 jassids/leaf) than farmers practices (M_3) (5.31 jassids/leaf). The data revealed that there was a significant lower whitefly population in all the modules as compared to control (M_4) (10.72 whitefly/leaf) in periodical observations. The data on pooled over periods revealed that integrated module (M_2) recorded significantly lower whitefly population (5.79 whitefly/leaf) as compared to bio-intensive module (M_1) (6.17 whitefly/leaf) and farmers practices (M_3) (7.11 whitefly/leaf).

(ii) Incidence of borer pests

It is revealed from the data that the fruit damage by borer was significantly lower in all the modules as compared to control at each picking as well as in pooled analysis. There was significant increase in the total yield of okra fruits due to protection of crop with different management modules. The data pooled over picking indicated that integrated module (M_2) recorded significant lower fruit damage than other modules. The maximum fruit yield (119.69q/ha) was realized in M_2 followed by bio-intensive module M_1 (97.12q/ha). The yield in untreated control plots was recorded 72.50q/ha. Thereby percent increase over control was 65.08% and 33.96% in M_2 and M_1 modules, respectively. No phytotoxic effect due to any treatment could be noticed during the entire crop season.

The results revealed that different types of management practices have significantly reduced jassid, whitefly population and shoot and fruit borer damage than untreated control in okra. Integrated module (M_3) which included seed treatment with imidacloprid @ 5 g/kg seed a day before sowing + sowing of maize at the borders as barrier crop + weekly clipping of infested shoots and fruits + erection of pheromone trap @ 100traps/ha for mass trapping + foliar spray of neem formulation (Neembaan) @ 30 ml/lt, spinosad 45 SC @ 0.5ml/lt and karanj oil @ 30 ml/lt at 45, 60 and 75 days after sowing, respectively. In this module, less incidence of shoot and fruit borer (5.63%) and more fruit yield (119.69q/ha) was recorded as compared to untreated control (16.85% incidence of shoot and fruit borer and fruit yield 72.50q/ha). The integrated management emphasizes the importance of both chemical and botanical pesticides for pest suppression in agricultural systems. Such compounds can be used in the pest management strategy to achieve the desired control. By incorporating these management practices, application of synthetic insecticides can be reduced to a minimum possible level. Such an approach poses a lower risk to people, wildlife and the environment while simultaneously protecting economic interests among farmers.

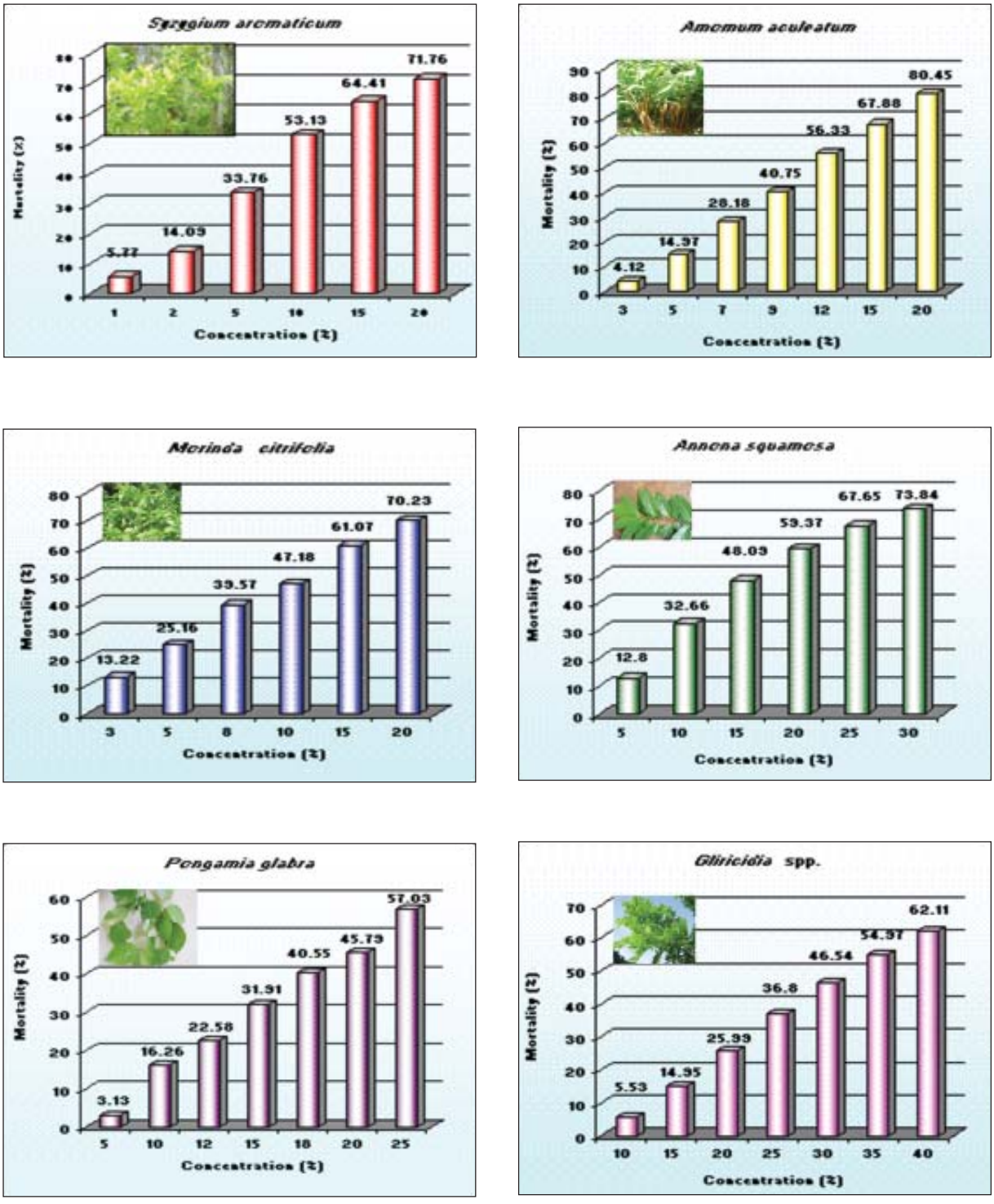


Fig.9. *In-vitro* evaluation of aqueous plant extracts on fruit fly *Bactrocera cucurbitae*

(a)

(b)

(c)

(d)

Plate 13. *In-vitro* evaluation of plant extracts, (a) fruit flies, *Bactrocera cucurbitae* in rearing cage, (b) aqueous plant extracts, (c) fruit flies in treatments, (d) fruit flies in untreated control

(a)

(b)

(c)

(d)

(e)

(f)

Plate 14. Field view of evaluation of pest management modules, (a-c) field view in different stages, (d) jassid population on field, (e) larva of okra shoot and fruit borer, (f) pupa of shoot and fruit borer.

Standardization of Production and Protection Technology of Tropical Mushrooms

Krishna Kumar, Someshwar Bhagat and Ajanta Birah

Sorghum grain, wheat grain, rice grain (Chaffy), rice grain, paddy straw, dry banana leaf, dry arecanut leaf and dry coconut husk were evaluated *in vitro* to select best substrate for spawn production. The results of pooled data of the experiment showed that all the substrate steamed for different timings (20, 30, 45 min) had considerable mycelial growth. Substrates steamed for 20 min showed highest mycelial growth at 13th day in sorghum grain (12.0 cm) followed by rice grain (chaffy) (9.0 cm), banana and arecanut leaf (8.5 cm), wheat grain (8.3 cm), paddy straw and rice grain (8.0 cm) and least growth was observed in dry coconut husk (7.7 cm) (Table 30).

Mycelial growth in 30 min steamed substrates was low as compared to 20 min steaming. Under 30 minutes of substrate steaming mycelial growth was higher in banana leaf (11.0 cm) followed by sorghum (10.0 cm) and in rest of the cases it was less than 10.0 cm in all treatments though it had lower growth rate in 20 min steaming. It might be due to increase in steaming timings of substrate as it would have gained lot of moisture resulted in low mycelial growth. In case of 45 min steaming similar trend of mycelial growth was also observed in sorghum grain (11.2 cm) at 13th day of spawn run followed by wheat grain (11.1 cm) and in rest of the treatments it was less than 10 cm mycelial growth.

Spawn prepared by steaming at three timings were also tested for their quality and breakability as color and compactness has major criteria for quality spawn production. Table 31 and Plate 15 revealed that sorghum grain and paddy straw had the efficiency to colonize the mycelia and devoid of the pigments. In all the steaming timings sorghum grain and paddy straw, banana leaf and arecanut leaf was best whereas it had best quality of spawn.

Table 30. Effect of steaming of sustarte on growth of *Pleurotus florida*

Treatments	Mycelial growth (cm)		
	20 minute	30 minute	45 minute
Sorghum grain	12.7	10.0	11.2
Wheat grain	8.3	8.5	11.1
Rice grain	8	8	8.1
Rice grain (Chaffy)	9	5	7.6
Paddy straw	8	8.5	8.7
Dry banana leaf	8.5	11	7.5
Dry arecanut leaf	8.5	8.5	8.5
Dry coconut husk	7.7	9	8.5
Mean	8.8	8.6	8.9
SEm	1.88	0.68	0.88
CD (P=0.05)	1.88	1.44	1.88

Table 31. Summary of spawn quality assessment of *Pleurotus florida* prepared after steaming 20, 30, and 45 min steaming on different locally available substrate

Treatments	Colour of spawn	Pigmentation	Colonization	Grading of spawn
Sorghum grain	White	No pigmentation	****	N
Wheat grain	Creamy white	Yellow	***	N
Rice grain	Light yellowish white	Yellow	***	ES
Rice grain Chaffy)	White	Yellow	***	ES
Paddy straw	White	No pigmentation	****	ES
Dry banana leaf	Brownish	No pigmentation	***	ES
Dry arecanut leaf	Brownish	No pigmentation	***	ES
Dry coconut husk	Dirty white	No pigmentation	**	ES

* Poor, ** Medium *** Good, **** Excellent

N: Normal mycelial growth, ES: Easy segregation, VES: Very Easy segregation

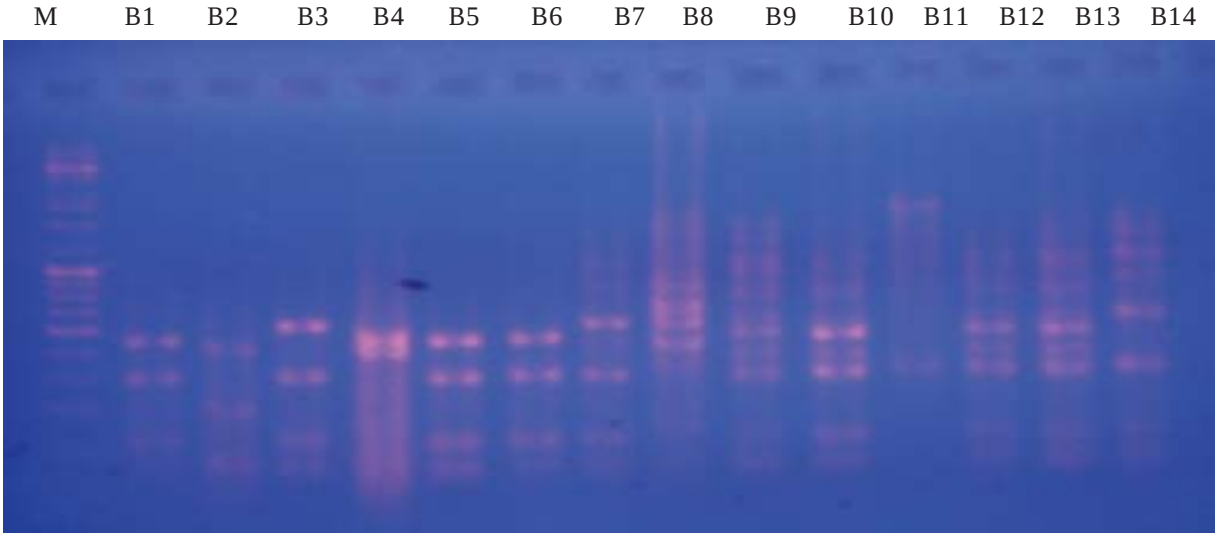
Plate 15. A-H. Mycelial growth of *P. florida* on different substrates. A - Sorghum grain, B - Wheat grain,C- Rice grain,D - Rice grain (Chaffy),E - Paddy straw, F - Dry banana leaf,G - Dry arecanut leaf and H - Dry coconut husk

Exploration of Plant Pathogenic and Antagonistic Microbial Resources Associated with Vegetable and Spice crops of Andaman and Nicobar Islands

Krishna Kumar and Someshwar Bhagat

Eighty bacterial isolates from Neil and Havelock Islands were studied for their antagonistic and Plant Growth Promoting (PGP) properties, among 15% and 43.7% isolates showed antagonism against *Sclerotium rolfsii* and *C. capsici* and 42.5% and 74.4% of the isolates showed ability to produce siderophore and phosphate solubilization respectively, 21.2% isolates were able to produce more than 15 µg/ml IAA. Potential antagonistic and PGP isolates were further identified based on carbohydrate utilization pattern using Microbial Identification System (BIOLOG). Identified as *Bacillus subtilis* (6), *B. pumilus* (5), *B. megaterium* (3), *B. cereus* (3), *B. lichiniformis* (1), *Staphylococcus* spp (3), *Enterobacter cloacae* (2), *Pseudomonas* spp (2) and *Alcaligenes faecalis* (1). Restriction enzymes *Msp*I (Plate 16) and *Hae*III revealed distinct molecular diversity among various isolates (Fig 11). *Bam H*I, *Eco R*I and *Pst* I did not show any diversity among the isolates. A total of 206 isolates from South Andaman Island were characterized for their hydrolytic enzymes, plant growth promoting properties and antagonism. It was found to be positive for protease (67.5%), cellulase (56.8%), siderophore (31.5%), IAA production (27.7%), PO_4 solubilization (18.4%) HCN production (4.0%) and potential antagonistic activity against list of pathogens like *Macrophomina* sp (2.9%), *Rhizoctonia solani*

(15.1%), *S. rolfsii* (4.9%) and *Pythium aphanidermatum* (2.9%) respectively (Plate 17). Twelve isolates of *Trichoderma* from rhizosphere soils of spice crops were characterized for their morphological, antagonistic and molecular studies. Sequencing of all twelve isolates revealed that four species *viz*., *T. erinaceum, T. ovalisporum, T. asperellum* and *T. brevicompactum* are the first report from India (Plate 18, 18a). Forty-two isolates of *Trichoderma* spp isolated from South Andaman villages were screened for their antagonistic activity against *Macrophomina* sp, *Rhizoctonia solani, S. rolfsii* and *Pythium aphanidermatum* respectively. *In vitro* screening of rhizosphere *Trichoderma* spp against *S. rolfsii, Macrophomina* sp, *P. aphanidermatum* and *R. solani* showed that overall the results showed that the proportion of isolates with antagonistic activities was highest for the *S. rolfsii* followed by *R. solani, Macrophomina* sp and *P. aphanidermatum* respectively (Plate 19). Twenty-one *Colletotrichum* spp isolated from leaf and fruits were characterized for cultural morphological, molecular and sequencing. Results showed that cultural and morphological variation occurred in all isolates but sequencing revealed most of the isolates were *Colletotrichum gloeosporioides*. ITS-RFLP studies also showed minor variations among the isolates. A total of 43 sequences were submitted to NCBI which includes 12 *Trichoderma* spp (GQ426033-44), 13 *Colletotrichum* spp (GU222366-78) and 18 bacterial sequences (GU250810-27). In the reported period a total of 21 bacterial and fungal microorganisms were submitted to NBAIM and initiated work on the isolation and characterization of microbial populations in the Mud volcano and other extreme environments (Plate 20).



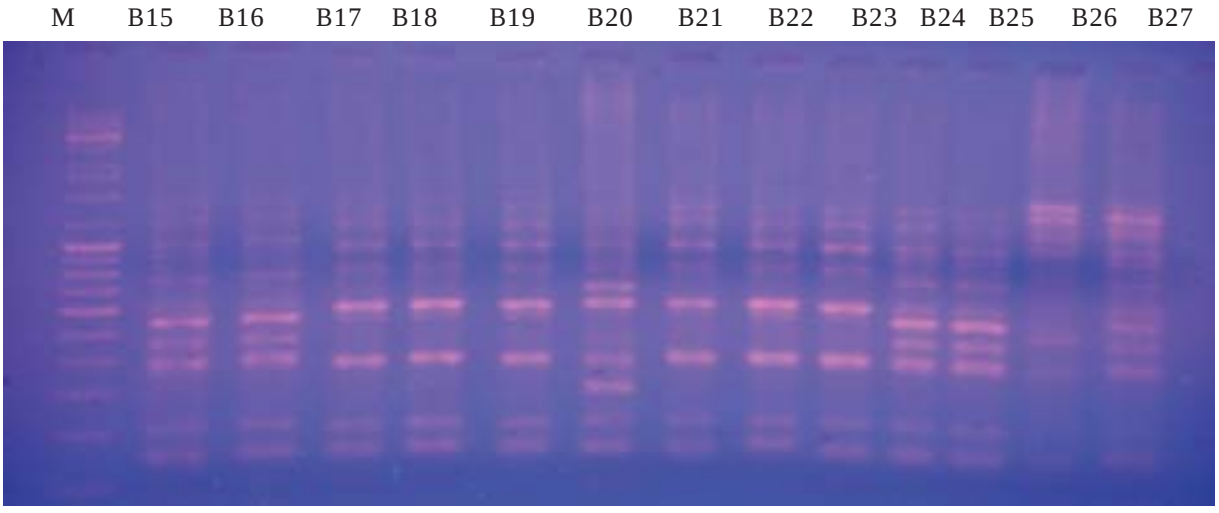


Plate 16. Restriction profile of 16S rDNA amplicon with MspI Lane B1-B27. PfL9, PfS2, C21, C22, C19, PfR1, BB18, PfR8, BS1, PfR5, C20, PfR2, BL5, BG3, BL6, PfS1, BS2, BR5, BL7, PfG1, BR4, BL4, BL1, BR4, BL4, BL1, BR7, BG6, PfL7 and BB14 Lane M, 100bp ladder

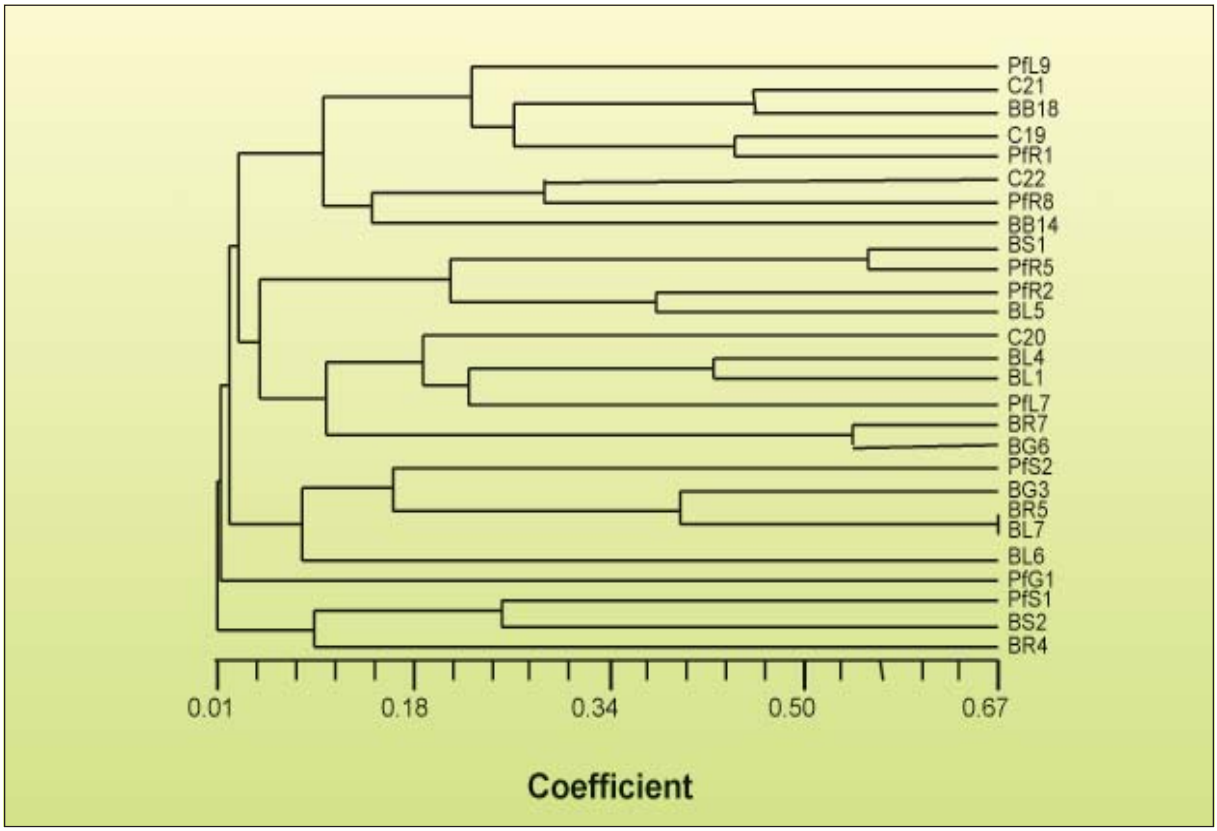


Fig. 11. Dendrogram showing the similarity co-efficient of potential isolates based ARDRA analysis using HaeIII and MspI restriction Enzymes

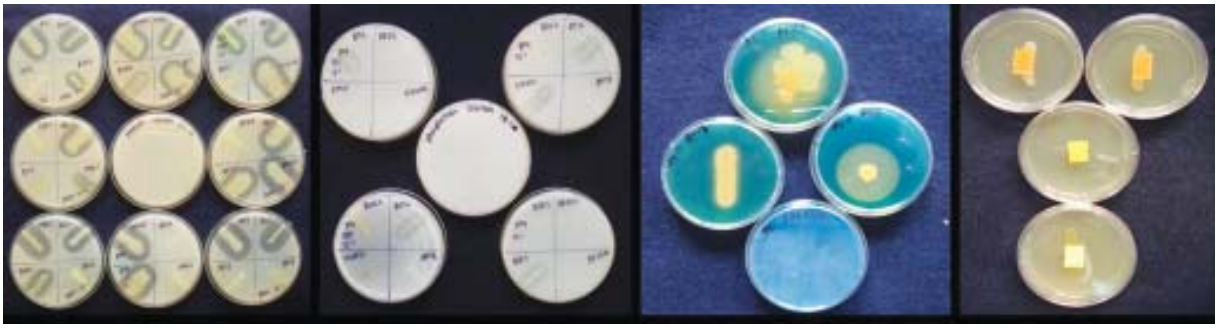


Plate 17. a. Protease b. PO4 solubilization c. Siderophore d. HCN production

Plate 17. e. IAA production f. *Macrophomina spp* g. *P. aphanidermatum* h. *S. rolfsii*
Antagonistic activity shown by rhizosphere bacteria

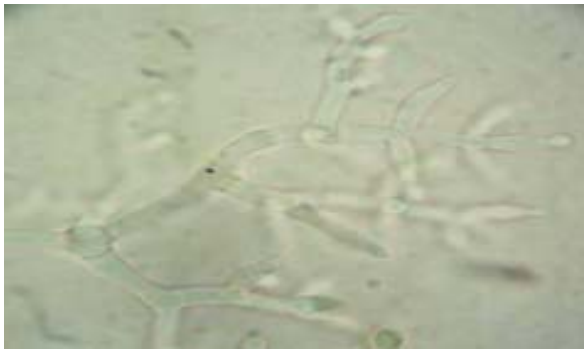
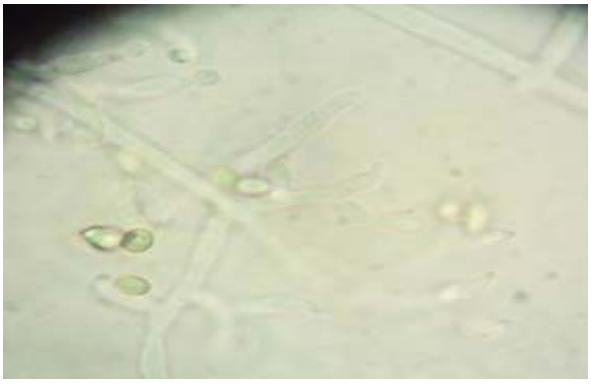


Plate 18. T. ovalisporum T. erinaceum



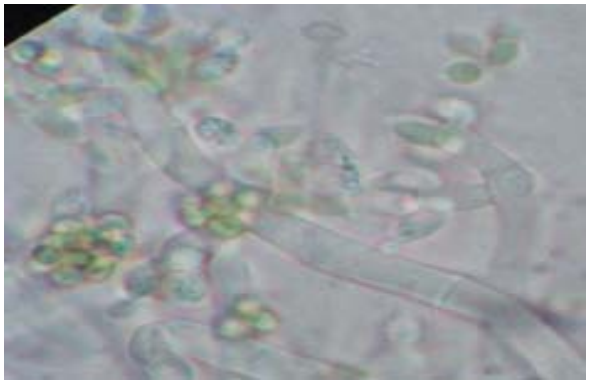
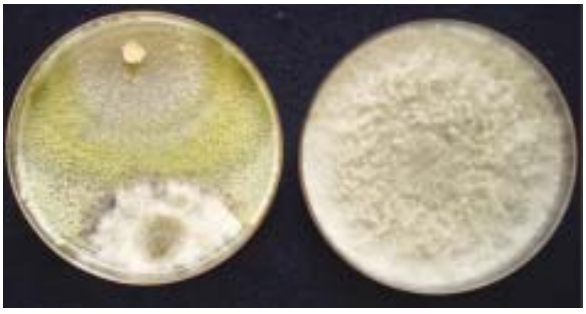
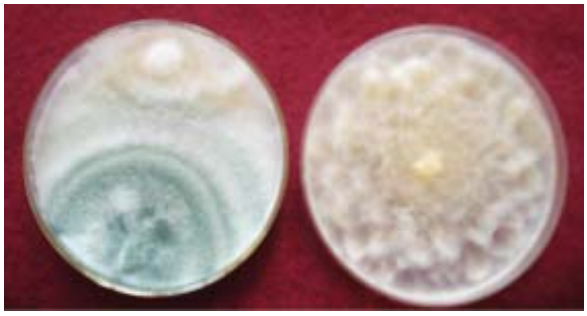


Plate 18 a T. asperellum T. brevicompactum



Macrophomina sp



P. aphanidermatum

R. solani

S. rolfsii

Plate 19. Antagonistic activity of Trichoderma isolates

Plate 20. Mud volcal Antagonistic activity by Mud volcano isolates

All India Network Project on Rodent Control

Ajanta Birah

Rodents are largest group of mammals in Andaman Islands represented by 15 species, although detailed information about these is lacking. The impact of rodents is significant in terms of agriculture through crop and commodity loss and in public health.

Surveillance and population ecology of Rodent pests

Survey and surveillance activities were undertaken with an objective to understand species composition and damage potential in different locations. Surveys for rodent activity were conducted in different locations namely Manglutan, Minniebay, Meethakhari, Calicut, Gupta Para, Baramanala, Wandoor and Telrabad of South Andaman district. The data collected from South Andaman district indicated that 8 to 26 percent of coconut palms are infested with rodents (Plate 21). Looking at the economic angle, such infestation rate directly affects the economic returns for the farmers. Typically rat damage to coconuts consists of a single hole of approximately 65 x 40 mm usually found near the nut's point of attachment. As rats are unable to penetrate mature or nearly mature coconuts, damage takes place in the palm crown. The rat after gnawing the husk consumes the inner contents including the soft-shell of the nut. After gnawing the husk, they consume the inner contents. The damaged nut may fall on the ground in 2-6 days or even up to 15-20 days of rodent attack.

Damage in term of percent damaged fruit in case of vegetables *viz*. brinjal and tomato was recorded. The survey data revealed the predominance of *Rattus* species followed by squirrel in South Andaman region. In case of brinjal, the damage per cent ranged from 5.76 to 46.59, whereas it was 8.26 to 33.89% in tomato, respectively. Rodents damages oil palm at seedling, flowering and immature and mature fruit stages. A study conducted in Little Andaman indicated rodent activity on all palms frequenting from adjoining forest area or from the nests made on the fronds. The total area under oil palm plantation is 1593ha. An extensive survey in two different locations of Little Andaman was carried out to assess the rodent infestation in oil palm cropping system. The palms infestation ranged from 40 to 50 percent indicating the intensity of their problem.

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

(i)

Plate 21. Economic loss caused by rodents

(a) Coconut damaged by rodents,
(b) Breeding sites of rodents,
(c) Rodent pest situation in oil palm plantations of Little Andaman
(d) Breeding nests of rodents on oil palm,
(e) Oil palm damaged by rodents,
(f) Tomato damaged by rodents,
(g) Brinjal damage,
(h) Rat in cage,
(i) Preserved specimen of rat.

Division of Animal Science

Improvement of Nicobari Fowl for Meat and Egg

A. Kundu, Arun Kumar De, Jai Sunder, M.S. Kundu, S. Jeyakumar and S.K.Verma

Comparative performance evaluation of Black, White and Brown varieties of Nicobari fowl

With an aim to improve the Nicobari fowls by crossing with other exotic breeds / strains such as Vanaraja birds, the selection of three varieties of Nicobari fowls (Brown, Black and White) were initiated. One hundred and sixty five number of Nicobari fowl chicks were reared just after hatching under deep litter system and their growth performance at different weeks (at 4th, 8th and 12th week of age) were recorded. The body weight of Black varieties Nicobari fowl was observed significantly ($p<0.05$) higher at 4th, 8th and 12th week of age than the other two varieties viz. Brown and White (Table 1). Male and female of White and Brown Nicobari fowl differed significantly ($p<0.05$) at 4th, 8th and 12th week of age. The male and female of Black Nicobari fowl differed significantly ($p<0.01$) at 12th week of age only.

Table 1. The body weight of the preselected population of Nicobari fowls

Type	4th week body weight		8th week body weight		12th week body weight	
	Male	Female	Male	Female	Male	Female
Black	181.29±7.26 (n=40)	170.56±6.26^{a} (n=40)	434.75±13.96^{a} (n=38)	419.88±11.26^{a} (n=39)	882.5±25.55^{a} (n=38)	790.50±20.80^{a} (n=38)
White	167.29±11.06 (n=22)	132.28±5.84^{b} (n=31)	402.75±14.2^{ab} (n=21)	348.44±8.13^{b} (n=31)	789.31±24.9^{ab} (n=21)	639.67±14.55^{b} (n=31)
Brown	148.33±10.36 (n=17)	112.08±11.62^{b} (n=15)	371.88±17.65^{b} (n=16)	297.64±18.08^{c} (n=15)	782.06±29.03^{b} (n=16)	585.00±28.93^{b} (n=15)

**Values having different superscripts in the same column differ significantly ($p<0.05$)*

Differences in body weight between male and female were highest in Brown followed by White followed by Black Nicobari fowl in all the weeks of measurement (Table 2). The difference may be due to the genetic variation of the different strains.

Table 2. Differences in body weight between male and female in different weeks

Type of strains	Differences in body weight (g) between male and female		
	4th week	8th week	12th week
Black	10.73	14.87	92
White	35.01	54.31	149.64
Brown	36.25	74.24	197.06

Plate1. Preselected
Black Nicobari

Plate 2. Preselected
White Nicobari fowl

Plate3.Preselected
Brown Nicobari fowl

Selection of Nicobari fowl

Selection of Nicobari fowl was done on the basis of 12th week body weight. Out of 159 numbers of birds, 85 birds were selected. The numbers of selected varieties were 39 for Black, 30 for White and 16 for Brown. The reproductive performances of the selected varieties (female) of Black, White and Brown Nicobari fowl have been given in plate 4, 5 and 6.

Plate 4. Selected Black Nicobari
ASM- 22 weeks
50 days egg production
18/bird

Plate 5. Selected White Nicobari
ASM- 21 weeks
50 days egg production
25/bird

Plate 6. Selected Brown
Nicobari
ASM- 22 weeks
50 days egg production
22/bird

Performance evaluation of Vanaraja poultry birds

With an aim to utilize the Vanaraja chicks for crossing with Nicobari fowls and production of improved varieties/strains, one hundred Vanaraja chicks of 1 week old were procured from Department of Animal Husbandry and Veterinary services, Port Blair. The Vanaraja chicks were reared under deep litter system providing standard

Plate 7. Flock of Vanaraja Birds

managemental conditions. The body weight (g) of Vanaraja birds at 6th and 10th week of age were recorded as 431.53 and 924.35 respectively. The preliminary study showed more mortality in Vanaraja (15%) than Nicobari fowl (6%).

Improvement, Evaluation and Propagation of Indigenous Nicobari Fowl and Ducks and Dissemination of Technology in Tsunami Affected Area

A.Kundu, T.Sujatha, S. Jeyakumar and Jai Sunder

Development and Comparative evaluation of performance of various synthetic crosses of Nicobari fowl

To improve growth rate, survivability and further improvement in egg production, the various crosses of Nicobari fowl were produced and evaluated under intensive management condition. The results are given in table 3. Subjective scoring index on the basis of 6 point scale of various performance traits of the crosses revealed that Black Nicobari X Black Rock cross score highest (47) followed by Black Rock x Black Nicobari (39), Black Rock X White Nicobari (34), White Nicobari X Black rock (30), ILI80 X Brown Nicobari (23) and Brown Nicobari X ILI80 (19).

The growth performance of pure and crossbred ducklings

Eight different genotypes of day old ducklings of Andaman local- Chara-Chembelli (CC) (mixed population), Khaki Campbell(KC),Pekin (P) and its various crosses viz PxP, PxCC, PxKC, KCxKC, KCxCC, CCxCC, CCxP, and CCxKC., were produced from the existing parent stocks of CC, KC and P . Their growth performance was evaluated.

The Subjective scoring index on the basis of 8 point scale of various growth performance traits (growth rate, feed utilization, survivability, performance index and production number) of the crosses revealed that PxCC scored highest (43) followed by KCXCC (37), PxKC (36), CCxP (34) and CCxKC (22). The pure PXP, KCXKC and CCXCC scored 52, 37 and 19 respectively. Hence the cross of Pekin and Chara-Chembelli crossbred did better than all other crosses other than pure Pekin and may be used as meat purpose duck.

Table 3. Performance of various crosses of Nicobari fowl

Traits	Brown Nicobari X ILI80	ILI80 X Brown Nicobari	Black Rock x Black Nicobari	Black Nicobari X Black Rock	Black Rock X White Nicobari	White Nicobari X Black rock	Remarks
Hatch wt	32.48±1.23^{c}	32.43±1.12^{c}	38.38±1.47^{a}	36.86±.10^{a}	36.1±1.00^{ab}	33.24±1.18^{bc}	CD (0.01) = 4.34, CD (0.05) = 3.31, CV=15.67
B.Wt at 8 week	229.52±12.59	231.23±10.07	235.05±16.71	249.1±7.69	241±8.63	233.35±10.60	NS,CV 22.92
B.Wt at 20th wk	690.5±26.41^{c}	691.17±34.82^{c}	982.11±23.57^{a}	886.31±29.19^{ab}	788.56±38.33^{bc}	707.87±45.53^{c}	CD(0.01)=130.62 CD 0.05) = 98.70, CV=17.24
WASM (g)	1148±25.33^{bc}	1193.19±32.84^{b}	1741.27±65.11^{a}	1589.58±87.75^{a}	1208.38±44.33^{b}	1018.33±37.91^{c}	CD(0.01)=204.78, CD (0.05) = 154.43,CV = 14.44
ASM (days)	187±2^{a}	170±4^{b}	161±2^{c}	155±2^{c}	172±3^{b}	160±3^{c}	CD(0.01)=9.455 CD (0.05) = 7.11 CV=5.63
Annual Egg production (nos.)	196±5^{b}	226±6^{a}	176±6^{d}	180±4^{cd}	190±4^{bc}	192±4^{bc}	CD(0.01)=18.43 CD (0.05) =13.91 CV=5.63
Average egg weight(g)	47.4±1.21^{c}	49.1±0.51^{c}	52.5±0.97^{ab}	53.1±0.83^{a}	50±0.86^{bc}	48.2±1.00	CD (0.01) 3.434, CD(0.05) = 2.596, CV=9.92
Total mortality % (0-72Wks)	6	9	8	4	5	6	
FCR (kg feed / dozen egg)	2.67	2.74	2.52	2.31	2.59	2.5	

Productivity Enhancement of Pigs Under Island Ecosystem

M.S. Kundu, A. Kundu, Jai Sunder, S. Jeyakumar and S.K. Verma

Comparison of reproductive performances under different types of feeding management

The reproductive performances were compared under different types of feeding management system. A total numbers of 16 gilts of 5 months old were divided in to 3 groups. There were 5 gilts in first two groups whereas in third group the number of gilts was six. The compositions of ration were rice bran and colocasia leaves as a sole feed (Control). In treatment 1 (T1) 50 percent of the control diet were replaced by the broken rice / broken wheat. In treatment 2(T2) ration was made up of maize, wheat, and coconut cake and rice bran. The experiment was continued till all the gilts farrowed and subsequent weaning of the new born. The mean value of different reproductive parameters and various litter traits of different categories of feeing system presented in table 4.

The age at puberty, age at first conception and age at first furrowing was found significantly better in T2 compared to T1 and control group. This may be due to the better availability of the nutrient from the maize based diet. The protein and energy ratio also plays important role for better assimilation of the nutrient. Moreover the colocasia based diets contain the oxalate which may prevent the assimilation of the nutrient specially the calcium.

Table 4. Reproductive traits of Large white Yorkshire breeds of pigs under different types of feeding

Parameters	Control	T1	T2
Age at puberty (days)	299.6 ± 6.11^{c}	260.00 ± 4.76^{b}	221.67 ± 3.99^{a}
Age at first conception (days)	340.2 ± 7.42^{c}	292.40 ± 6.60^{b}	245.50 ± 3.94^{a}
Age at first farrowing (days)	452.4 ± 7.57^{c}	404.80 ± 7.80^{b}	357.00 ± 4.07^{a}
Litter size at birth (nos)	5.6 ± 0.68^{NS}	6.00 ± 0.71^{NS}	6.17 ± 0.48^{NS}
Total litter weight at birth (kg)	5.32 ± 0.74^{NS}	5.90 ± 0.72^{NS}	7.26 ± 0.87^{NS}
Individual litter weight at birth (Kg)	0.96 ± 0.09^{NS}	1.00 ± 0.09^{NS}	1.18 ± 0.12^{NS}
Litter size at weaning (nos)	3.80 ± 0.58^{NS}	5.20 ± 0.58^{NS}	5.17 ± 0.48^{NS}
Litter weight at weaning (Kg)	23.04 ± 3.99^{NS}	28.85 ± 1.41^{NS}	30.46 ± 1.98^{NS}
Individual litter weight at weaning (Kg)	6.01 ± 0.19^{NS}	5.79 ± 0.62^{NS}	6.11 ± 0.60^{NS}
Weaning percentage	67.33 ± 3.36^{NS}	84.33 ± 6.74^{NS}	84.7 ± 5.51^{NS}
Values (in the same row) with different superscripts differ significantly ($p<0.01$).			

Ultrasonographic characterization of Back fat and loin eye muscle depth in Large White Yorkshire pigs

Measurement of subcutaneous adipose tissue is used in decision making during pig production for optimal growth, for longevity in gilts and for quality control and carcass classification. The aim of the present study was to standardize the technique of ultrasonograhic evaluation of back fat thickness and to assess its status in growing and adult pig. A total of six adult and ten grower pigs were monitored for Sonographic observation revealed that there were 2 to 3 fat layers in swine. The edge of the outer aspect of outer fat layer and skin is difficult to separate. Differentiation here is based on the tissue structure, which for skin, is more uniform than outer layer. The middle layer is composed of uniform hypoechoic tissue, producing few internal reflections. It has a sharp boundary with the overlying outer and the underlying inner fat layer. This layer contains a series of internal hyperechoic linear structures together with hypoechoic tissue. Being hyperechoic it contrasts well with middle fat layer and also with the hypoechoic muscle fibers beneath. Its linear striations result in sharp edges, L3 is thus readily differentiated from adjacent tissues. Loin muscle showed hypoechoic with hyperechoic intramuscular fat (marbling) with sharp boundry of hyperechoic rib bones. Ultrasonographic evaluation of back fat thickness (mean) found to be 19.00 and 33.17 mm in young and adult pigs respectively. Young pig showed less back fat thickness and layers and loin eye muscle depth than adult pig. The growing pigs were under the process of fat deposition and adult breeding pig showed distinctive fat layers and larger eye muscle depth indicating static process in fat deposition. It is suggested that this method found to be useful in characterizing the fat and muscle of indigenous and exotic pigs. Real-time ultrasound data might be useful in blocking / selecting pigs prior to allocation to experimental treatment in growth trials, and serial measures appear promising as a technique for monitoring composition of growth in the desi / indigenous, crossbred and pure breed pig under various nutritional and management conditions.

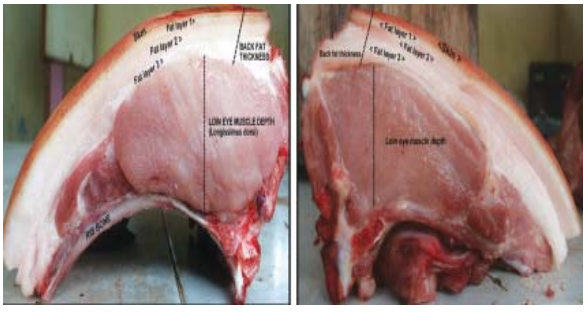


Plate 8. Illustration of area to be traced for measurement of Back fat thickness and loin eye area (longissimus dorsi) muscle

Plate 9. Ultrasonogram showing different layers of back fat and depth of of area to be traced for measurement of Back fat thickness and loin eye area (longissimus dorsi)

Study of the Feasibility and Convergence on Subsistence Pig Rearing to Commercial Pig Farming Inclusive of its Process

M. S. Kundu, A. Kundu, S.Jeyakumar, Subhash Chand, S.K. Zamir Ahmed and P.Balakrishan

Study of the nutritional status of the pigs at Carnicobar

Four feed materials (*i.e* Pandanus, Coconut, Bread fruit and Nicobari Aloo) mostly used to feed the pigs were collected from Nicobar and their proximate principles were estimated (Table 5). The nutrient requirement and availability was calculated based on the available data (Table 6). It was noticed that these feed materials are able to supply the 90% of the energy requirement for the pregnant sows but the nursing sows could not able to meet its energy requirement from these feeds and it is only 42 percent of their energy needs. The protein requirement seems to be very poor. Calculated values of protein requirement and supply show that there are severe shortage of protein requirements and are in the range of 16-35% of the requirement.

Plate 10. Nursing sow with severe PEM

Table 5. Proximate principles of feed materials

Type of feed	Moisture	Ash	Silica
Pandanus	70.98 ± 0.46	1.96 ± 0.06	1.06 ± 0.35
Coconut	34.99 ± 0.86	1.98 ± 0.05	0.31 ± 0.12
Nicobari Aloo	31.01± 0.85	3.95 ± 0.27	0.21 ± 0.03
Bread Fruits	33.79 ± 0.98	2.98 ± 0.27	0.31 ± 0.06

Table 6. Nutrient requirement and their availability

Types of Animal	Requirement			Available		
	DM (Kg)	Protein (g)	Energy (K Cal)	DM (Kg)	Protein (g)	Energy (K Cal)
Grower (20-35Kg)	1.7	272	5610	2.2	80(29%)	4500 (80.21%)
Adult (Male) 110-180 Kg	2.5	350	8250	3.3	100 (28.57%)	6000 (72%)
Pregnant Sow (110-160Kg)	2	280	6600	2.8	100(35%)	6000 (90.90%)
Nursing Sow (140-200Kg)	5	750	16,500	6	120(16%)	7000(42%)

The nursing sows are the worst affected. The sows are suffering from severe Protein Energy Malnutrition (PEM) Sows do not come to next heat till the litters are sucking and normally it is around 3 months.

Study of the breeding behaviour of sows

Normally the sows farrow in the jungle. At least 15 days prior to expected farrrowing sow prepare its nest for farrowing. There the sows farrow and remain for quite some time. Then they come to the owner's house for feed. The feed materials available to the nursing sows are deficient both in terms of protein and energy. During this time the body reserve is used for production of milk to feed the piglets. Ultimately the sows suffer from severe PEM resulting in delay to post farrowing heat leading to increasing the farrowing intervals. The productivity of the sows decreased substantially.

Creation of awareness among the change agents

Pig farming is an integral part of the Nicobari society. Herd size of the pigs is an indication of richness of a person in the society. Still the pig farming in the Nicobari society is in the primitive stage. It is very difficult to introduce the new ideas for rearing pigs in the Nicobari society. After lot of persuasions and interaction with the youth a few youth were willing to interact with the team of

Plate 11. Imparting training in interactive mode to the change agents at Car Nicobar

scientist of CARI to get the ideas about scientific pig rearing. Accordingly a training programme on "Scientific Pig rearing & conservation of indigenous pig germplasm" was organized at Car Nicobar. All together 11 change agents participated in the training programme. They were given the ideas on the importance of balance nutrition, care and management of piglets and selection of boar among the existing stock.

Study on the selection procedure of boar at Car Nicobar

Normally they do not follow the norms to select the boar for breeding purpose. Vigorous and active male pigs are castrated for better meat purpose. Breeding boars are maintained without proper selection. Lack of knowledge often leads to negative selection. More over the healthy and more vigorous piglets are castrated to make them docile and to keep the pigs nearer to the house.

Evaluation of Therapeutic and Immunomodulatory Properties of *Morinda Citrifolia* in Poultry

Jai Sunder, D.R. Singh and A. Kundu

The *in-vitro* antibacterial activity of *Morinda citrifolia* extracts was tested against two different isolates of *Ralstonia solanacearum*, causative agent of bacterial wilt in solanaceous plants. The effect of feeding of *Morinda citrifolia* in the milk quality and mastitis was assessed in the dairy cows.

Antibacterial activity of *Morinda citrifolia* against *Ralstonia solanacearum*

The *Morinda citrifolia* leaf and fruits were collected, dried and grounded. The dried samples were mixed with solvents viz. chloroform and acetone and kept at room temperature for 2-3 days with stirring in between. The samples were filtered through Whatman filter paper no. 43 and the extracts were used as crude extract and kept at -20^{0}C for further use.

The antibacterial activity of the extracts was assayed by using disc diffusion method. Standard disc of 6 mm diameter were prepared and sterilized for disc diffusion assay. Two different bacterial isolates of *Ralstonia solanacearum* collected from the Division of Field Crops were used for the antibacterial assay. About 20 ìl of 10^{-3} dilutions of bacterial cultures were poured over the Nutrient Agar plate surface. Then the filter paper discs soaked with different extracts were placed on the surface of the agar and allowed to dry. Standard antibiotics discs (octadisc, Himedia) were used as positive control while the solvents were used as negative control. The plates were incubated at room temperature for overnight and the zone of inhibition was recorded with the Himedia antibiotic scale.

Antibiotic sensitivity profile of *Ralstonia sp.*

The results of the antibiotic sensitivity test revealed that 41.17% of the antibiotics produced absolute resistant against RSN 6 and RSN 12 isolates. The average zone of inhibition of 13.06±3.04 mm and 12.59±2.93 mm were produced against RSN 6 and RSN 12 isolates respectively (Table 7). The maximum zone of inhibition of 33 mm was produced against both the isolate. Almost similar type of inhibitory activity was obtained with respect to 17 standard broad spectrum antibiotics (Plate 12).The best zone of inhibition was obtained with ciprofloxacin (33 mm).

Table 7. Zone of inhibition against antibiotics

Sl.No.	Antibiotics	Concentration (µg)	Zone of inhibition (mm)	
			RSN6	RSN12
1	Ampicillin	10 µg	0	0
2	Cephalothin	30 µg	0	0
3	Chloramphenicol	30 µg	17	19
4	Ciprofloxacin	10 µg	33	29
5	Clindamycin	2 µg	0	0
6	Colistin	10 µg	0	0
7	Co-trimazole	25 µg	25	18
8	Erythromycin	15 µg	23	22
9	Gentamycin	10 µg	24	22
10	Gentamycin	10 µg	21	19
11	Nitrofurantonin	300 µg	10	0
12	Ofloxacin	1 µg	30	32
13	Oxacillin	1 µg	0	0
14	Penicillin-G	10 units	0	11
15	Streptomycin	10 µg	12	12
16	Tetracyclin	30 µg	27	30
17	Vancomycin	30 µg	0	0
	Average		**13.06±3.04**	**12.59±2.93**

Plate 12. Zone of inhibition of RSN6 and RSN 12 isolates against different antibiotics

Antibacterial activity of leaf extract

The leaf acetone extract produced 24 mm zone of inhibition against RSN 6 and 23 mm against RSN 12 isolate. An average of 23.5 mm zone of inhibition was obtained against both the Ralstonia which is much better than most of the antibiotics. The leaf chloroform extracts produced 26 and 22 mm zone of inhibition against RSN6 and RSN 12 isolate. The average zone of inhibition was more in the chloroform extracts than the acetone extracts; however, no significant difference was obtained with both the extracts. Both the extracts showed more activity against the RSN 6 isolate compared to the RSN 12 isolate.

Antibacterial activity of fruit extracts

The fruit acetone extract produced 14 mm zone of inhibition against RSN 6 and 19 mm against RSN 12 isolate. An average of 16.5 mm zone of inhibition was obtained against both the Ralstonia. The fruit chloroform extracts produced 15 and 17 mm zone of inhibition against RSN 6 and RSN 12 isolate. The average zone of inhibition was more in the acetone extract than the chloroform extract. However, no significant difference was observed with both the extracts. Both the extracts showed more activity against the RSN 12 isolate compared to the RSN 6 isolate (Fig. 1).

Comparison of antibacterial activity of solvent extracts with Antibiotics

The antibacterial activity of the leaf and fruit extracts of *Morinda citrifolia* was 58.82% more than the antibiotics against the RSN 6 isolate

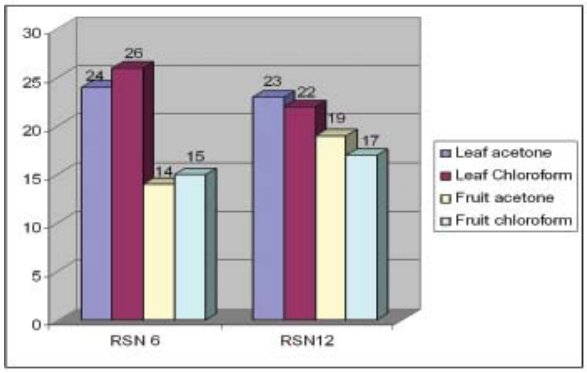


Fig. 1. Antibacterial activity of solvent extracts against RSN6 & RSN 12

of *Ralstonia solanacearum*. (Table 8). Only 7 antibiotics produced more inhibitory activity than the morinda fruit and leaf extracts. The best inhibitory activity was produced in descending order by leaf chloroform (28 mm), leaf acetone (24 mm), fruit chloroform (15 mm) and fruit acetone (14mm) respectively against RSN 6 isolate. The difference of average inhibitory activity against the standard antibiotics was more in leaf chloroform (12.94 mm), followed by leaf acetone (6.82 mm), fruit chloroform (1.94 mm) and fruit acetone (0.94 mm) against RSN 6 isolate.

The inhibitory activity of the fruit and leaf extracts against RSN 12 showed that 70.59 % of antibiotics showed less inhibitory activity than the fruit and leaf extracts of the *Morinda citrifolia* (Table 9). Only 5 antibiotics produced more inhibitory activity than the fruit and leaf extracts. The difference of inhibitory activity against the standard antibiotics was more in leaf acetone (10.41 mm) followed by leaf chloroform (9.41mm) fruit acetone (6.41 mm) and fruit chloroform (4.41 mm) against RSN 12 isolate.

Table 8. Difference of zone of inhibition with the standard antibiotics

Antibiotics	RSN 6				
	Leaf acetone	Fruit acetone	Fruit Chloroform	Leaf chloroform	Average
Ampicillin	24	14	15	26	19.75
Cephalothin	24	14	15	26	19.75
Chloramphenicol	7	-3	-2	9	2.75
Ciprofloxacin	-9	-19	-18	-7	-13.25
Clindamycin	24	14	15	26	19.75
Colistin	24	14	15	26	19.75
Co-trimazole	-1	-11	-10	1	-5.25
Erythromycin	2	-9	-8	3	-3
Gentamycin	0	-10	-9	2	-4.25
Gentamycin	3	-7	-6	5	-1.25
Nitrofurantonin	14	4	5	16	9.75
Ofloxacin	-6	-16	-15	-4	-10.25
Oxacillin	0	14	15	26	13.75
Penicillin-G	0	14	15	26	13.75
Streptomycin	12	2	3	14	7.75
Tetracyclin	-2	-13	-12	-1	-7
Vancomycin	0	14	15	26	13.75
Average	**6.82**	**0.94**	**1.94**	**12.94**	
% Inhibition more than the extract	**76.47**	**52.94**	**52.94**	**82.35**	

Overall, the best inhibitory activity was produced by leaf chloroform and the least activity was produced by fruit chloroform (Fig. 2). The inhibitory activity was more in RSN 12 compared to RSN 6. The result revealed that both the extracts have produced inhibitory activity against the *Ralstonia spp* and the same could be used to extract antibacterial activity against the *Ralstonia spp*. The potential of the *Morinda citrifolia* extracts was found much better than most of the antibiotics and the same may be useful against the *Ralstonia solanacearum*.

Effect of Feeding of *Morinda citrifolia* Juice to cattle

Morinda citrifolia fruit juice was fed to dairy cow @ 100 ml orally daily. A total of 8 adult dairy cows were selected to feed the morinda juice. The effect on daily milk yield, milk pH,

Table 9: Difference of zone of inhibition with the standard antibiotics

Antibiotics	RSN 12				
	Leaf acetone	Fruit acetone	Fruit Chloroform	Leaf chloroform	Average
Ampicillin	23	19	17	22	20.25
Cephalothin	23	19	17	22	20.25
Chloramphenicol	4	0	-2	3	1.25
Ciprofloxacin	-6	-10	-12	-7	-8.75
Clindamycin	23	19	17	22	20.25
Colistin	23	19	17	22	20.25
Co-trimazole	5	1	-1	4	2.25
Erythromycin	1	-3	-5	0	-1.75
Gentamycin	1	-3	-5	0	-1.75
Gentamycin	4	0	-2	3	1.25
Nitrofurantonin	23	19	17	22	20.25
Ofloxacin	-9	-13	-15	-10	-11.75
Oxacillin	23	19	17	22	20.25
Penicillin-G	12	8	6	11	9.25
Streptomycin	11	7	5	10	8.25
Tetracyclin	-7	-11	-13	-8	-9.75
Vancomycin	23	19	17	22	20.25
Average	**10.41**	**6.41**	**4.41**	**9.41**	
% Inhibition more than the extract	**82.35**	**70.59**	**52.94**	**82.35**	

conductivity, bacterial load, protein concentration and effect on treatment of mastitis was observed over a period of 3 months. The animals were fed with morinda juice for 1 month and data of two months post feeding were collected and analyzed. The conductivity decreased from 5.5 mho to less than 5.0 mho. The total bacterial count in the mastitis milk was also decreased from $5.13x10^8$ to $3.54x10^8$ bacteria. The microbial

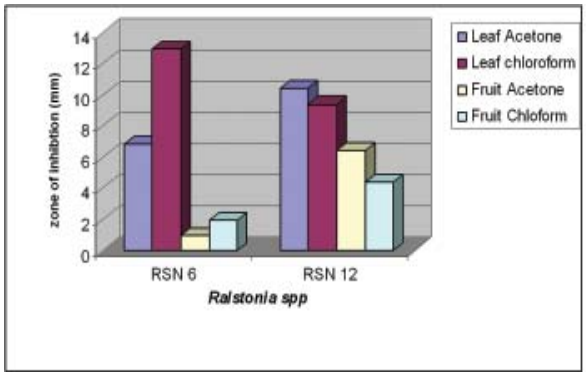


Fig. 2. Antibacterial activity against RSN 6 & RSN 12

load in the mastitis affected right teat was found more than the other teat. The microbial load in the right teat was 4.19 x 10^8 (Fig. 3).

The protein concentration in the normal cow's milk varied from 21 to 33 µg/ml. In the mastitis affected cow's milk the concentration varied from 31.5 to 54 µg/ml. The morinda feeding decreased the protein concentration in the mastitis milk from 40.83 µg/ml to 20.41 µg/ml in 3 weeks period (Fig. 4).

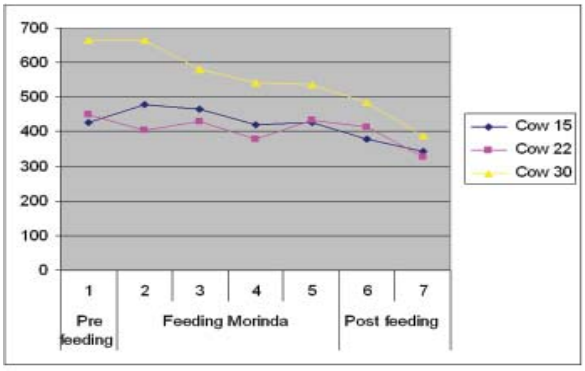


Fig. 3. Microbial load in the mastitis milk

The incidence of mastitis was confirmed by the change in pH towards higher side and increase in the conductivity and +ve result

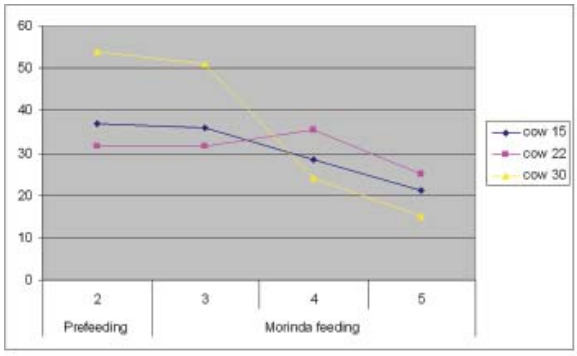


Fig. 4. Protein concentration (µg/ml) in the mastitis milk

with the CMT. Out of the 11 cows, 3 animals showed variation in the pH, +ve to CMT and change in conductivity. The pattern of the mastitis in the different teat of the cow suggested that the incidence was high in the right rear teat compared to other teat. The pH varied from 6.7-7.5 in the right rear teat. The feeding of morinda juice to all the mastitis affected cow showed that the pH of the milk decreased from 7.0 to 6.6 in all the animals. Among the normal cow no change was observed in the pH of cow's milk with respect to different teat of the cow.

Potential of *Morinda citrifolia* Fruit as Feed for Livestock and Poultry

Jai Sunder, D.R. Singh, S.K. Verma, A.Kundu and R. C. Srivastava

Feeding of *Morinda citrifolia* fruit as feed to Japanese quail

An experiment was conducted to study the feeding of *Morinda citrifolia* fruit as a feed for Japanese quail. Three different rations of quail was prepared by replacing 20% concentrate feed with *Morinda citrifolia* dried fruit granules, 20% with dried azolla granules and 20% with Morinda fruit and azolla combinedly. The feed were fed to three different groups of Japanese quail while one group was kept as control. The observations viz. body weight, mortality and feed conversion were recorded and FCR was calculated. The FCR at the end of first week

of age was lowest in the birds fed with combination of Morinda and azolla feed (Table 10). At 2nd week of age the best FCR was observed in the group fed with morinda. However at 3rd and 4th week of age the FCR was best in the control group compared to the other group of birds. The body weight at first week was highest in the birds fed with combination of Morinda and azolla feed (Table 11). At 2nd and 3rd week highest body weight was observed in the birds fed with morinda feed. However, at the end of 4th week highest body weight was observed in the control birds compared to other birds. The body weight at the end of 5th week was highest in the morinda fed group. Best FCR was obtained in the birds of morinda group. The mortality was high in all the groups during the first four days of age, however, no mortality was observed after the 2nd week in all the groups.

Table 10. Body weight at different week interval (g)

Week	Control	Morinda (20% replacement)	Azolla (20% replacement)	Morinda +azolla (20% replacement)
1	15±2.03	19.875±2.68	23.2±1.74	*23.25±1.25*
2	31.33±3.85	38.16±4.51	33±3.21	*32.75±2.69*
3	48.4±4.79	57.2±6.76	45.6±3.31	*41.33±3.08*
4	76.8±6.46	71.6±10.16	66.4±5.07	*61.16±2.88*
5	*106.8±6.65*	*109.4±7.22*	*97.2±6.34*	*97.33±3.04*

Table 11. Feed conversion ratio at different week interval

Week	Control	Morinda (20% replacement)	Azolla (20% replacement)	Morinda +azolla (20% replacement)
1	6.13	5.42	4.94	4.23
2	4.25	3.67	6.67	7.54
3	4.19	5.26	7.27	10.53
4	4.47	7.73	4.86	6.05
5	4.62	3.98	4.48	4.88
Average	4.73	4.38	5.64	6.19

Characterization of Livestock Production Sub System and Assessment of Critical Nutritional Gap in Bay Islands

S.K. Verma, M.S. Kundu, Subhash Chand, Jai Sunder, I. Jaisankar and Abhay Singh

A total of 35 farm families consisting of 20 from North and 15 from South Andaman region were surveyed for characterization of livestock production sub-system and assessment of critical nutritional gap in Bay Islands. During sample survey, it was found that most of the farmers were having small to medium land holdings. Average land holding was in the range of 0.13 to 2.26 ha^{-1} family in respect of paddy field and 0.5 to 1.0 ha^{-1} family for plantation crops. Most of the farmers were operating mixed farming system comprising of crops, livestock, plantation and horticultural crops. In North Andaman, most of the farmers had paddy land and they were engaged in vegetable cultivation along with plantation crops. Livestock compositions are mostly cattle, goat and every house hold reared ducks. However in South Andaman area rearing of chicken is more prevalent rather than ducks.

Dry Matter requirement of the cows are mostly met through open grazing during dry season and in wet season were from the green grass. After harvesting of paddy the dry matter requirement is met with the paddy straw. Only the lactating animals are supplied with the concentrate feed. However due to lack of proper knowledge the concentrate mixture normally observed deficient with so many nutrients mostly micro nutrients. In this way the ration of the cows were observed deficient with micro nutrients as well as protein leading to low productivity of the animals.

Feasibility Evaluation of Growing Fodder During Pre Paddy and Post Paddy Period under Rainfed Conditions

S.K. Verma, R.C. Srivastava, T. Subramani and B.K. Nanda

Farmers of Andaman and Nicobar group of Islands face severe shortage of green and dry fodder for their livestock round the year as very little area is under cultivable fodder. Due to this fact the productivity of the animals are very poor. Cultivable area is very limited. Therefore the options left are either to utilize the existing cultivable land judiciously to produce fodder during that period when no crop is there in fields or to utilize the land under coconut and arecanut gardens and nearer to fish ponds. Hybrid napier cuttings and rooted slips were transplanted on the bank of fish pond. The fodder grass has been established well and producing biomass even during dry period. Besides this, Hybrid

napier fodder was transplanted on the ridges and terrace risers of vegetable block. The grass has been established well and due to thick grass canopy, the risers were stabilized very soon and the soil erosion was checked. To utilize the space available between two Morinda plants Hybrid napier and guinea grass were transplanted as Morinda intercrop. Hybrid napier gave an yield of 110 q/ha while guinea grass produced 78.4 q/ha (Table 12).

As the cultivable land is meager therefore concept of growing pre paddy and post paddy fodder was exercised. A trial was conducted to study the feasibility of growing coix as post paddy fodder crop. The crop was sown on 16th February 2009 and harvested on 19th May 2009 (92 days). Coix produced 40.26 q/ ha and 77.05 q/ha biomass in high land and low land respectively. As the low land had more moisture therefore the production was more in low land as compared to high land. In another trial coix sown in the field on 16th November 2009 produced a biomass of 70 q/ha.

Possibility of growing fodder crops as pre paddy fodder was also explored. Four crops were sown on 28th April 2009 at Bloomsdale Farm in five replications and harvested on 04th July 2009 after 67 DAS. Coix produced maximum biomass (85 q/ ha) followed by Ricebean (83.2 q/ha), Cowpea (73.9 q/ha), Maize (44.3 q/ha). It is concluded that fodder crops may be taken as pre and post paddy crops successfully to augment the fodder supply to the livestock.

Table 12. Economics of post paddy fodder cultivation

Crops	Seed required (kg/ha)	Price of seed (Rs. 26/kg)	Yield (t/ ha)	Paddy straw eq yield (t/ha)	Paddy straw eq price @ Rs. 5.25 per kg	Profit (Rs./ha)
Coix (High land)	15	390	4.03	1.34	7046	6656
Coix (Low land)	15	390	7.71	2.57	13482	13092

Enhancement and Sustainable Dairy Cattle and Buffalo Production in Bay Islands

S. Jeyakumar, A. Kundu, M.S. Kundu, Jai Sunder, T. Sujatha, S.K. Verma, Subhash Chand, M. Balakrishnan and R.C. Srivastava

Productive and reproductive performance of dairy cows

Lactation performance (April 09-March10) of cows showed that mean no. of cows on lactation per month was 9.5±1.03. Mean monthly production of milk, monthly production of milk per cow and wet average (average daily milk yield of a cow) in lit. was 1355.35±139.20, 305.79±82.94 and 4.79±1.95 respectively (fig 5). Peak yield of adult (multiparous cows) was significantly ($p<0.01$) higher (8.05±0.76) than heifers (primiparous) (5.38±0.37). However there was no significant difference observed on days to reach peak yield between multi and primiparous cows. However the overall performance of the herd was improved than previous years. Birth weights (kg) of male and female calves were 24.58 ± 2.9 and 20.23 ± 1.2 respectively. Age at first calving was 3.82±0.2 years in crossbred heifers.

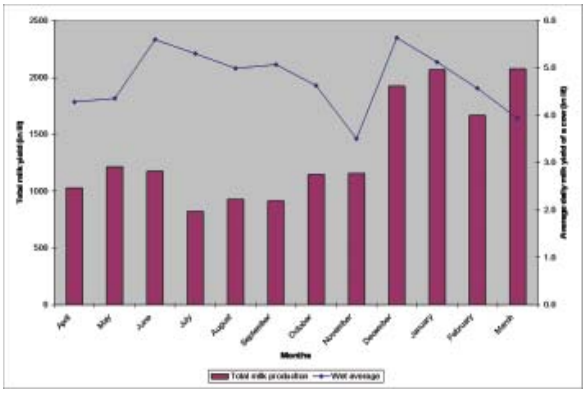


Fig 5. Total milk production and wet average of crossbred cows

Sonometric characteristics of crossbred bovine teat

Udder health and teat parameters are important for application of machine milking operation, hygienic milk production and for taking preventive measures against mastitis. Our previous study showed that ultrasonography is considered as a valuable non-invasive research tool to study the physiopathology of the bovine udder and teat. In the present study the 56 teats of fourteen lactating cross bred cows (n=14) were examined by brightness mode (B-mode) ultrasonography. A real time B mode portable ultrasound scanner [SA-600V (Medison Co.Ltd, Korea)] fitted with a 7.5 MHz linear array triple frequency transducer was used for scanning. The sonographic image of interest was fixed

Plate 13. Sonometry of cow's teat

by using the freeze mode and characteristics and measurements were recorded. In lactating cows, the teat sinus, teat cistern and gland cistern were imaged by water bath method. Ultrasonographic examination using water bath method allowed clear visualization and measurement (sonometry) of teat anatomical characteristics viz. connective tissue thickness at sphincter muscle, teat canal length, diameter, teat end, mid and base width, teat wall thickness, teat cistern width and length (Table 13). Hence, the present findings suggest that the water bath based ultrasonography proves to be a valuable diagnostic methodology and provides an accurate features and estimation of bovine teat characteristics.

Table 13. Sonometric characteristics (overall mean±se) of teats of crossbred cows

Teat parameters (in mm)	Right Fore (n=14)	Left Fore (n=14)	Right Hind (n=14)	Left Hind (n=14)
Teat length	45.00 ± 2.3	44.71 ± 2.3	44.71 ± 2.4	42.57 ± 1.9
Connective tissue thickness	9.33 ± 0.3	8.14 ± 0.6	8.64 ± 0.4	9.00 ± 0.6
Teat canal length	11.17 ± 0.4	10.71 ± 0.5	11.21 ± 0.5	10.14 ± 0.4
Teat canal width	2.00 ± 0.0	2.00 ± 0.0	2.07 ± 0.1	1.93 ± 0.1
Teat cistern length	39.33 ± 1.3	37.57 ± 2.3	34.57 ± 2.3	35.57 ± 2.5
Teat cistern width	11.67 ± 1.2	12.57 ± 0.9	11.93 ± 0.8	10.36 ± 1.0
Teat wall thickness	6.50 ± 0.2	6.66 ± 0.2	6.66 ± 0.2	6.75 ± 0.3
Teat base (top) width	27.50 ± 1.0	29.21 ± 1.1	27.70 ± 1.3	29.57 ± 1.1
Teat mid width	23.50 ± 0.9	25.14 ± 1.0	23.79 ± 0.9	25.21 ± 1.0
Teat end width	17.00 ± 1.3	16.21 ± 0.8	15.64 ± 0.8	15.71 ± 0.8

Gut micro flora and its antibiotic sensitivity pattern in calves

A total of 23 faecal samples were collected from calves (4 months old) and screened for isolation and identification of the bacterial flora. A total of 29 bacterial isolates have been isolated and identified and the all bacteria belong to Gram –ve type. *E.coli* and the *Enterobacter spp.* were the most common isolates of the faecal microflora. The new bacteria identified from the faecal swab were *Cedecea* spp and *Pantoea* spp. The antibiotic resistant ability against the five common antibiotics revealed that all the antibiotics were effective against the bacterial isolates. The bacteria showed absolute sensitivity to gentamicn, ciprofloxacin and penicillin G. However the field isolates showed higher resistant pattern against commonly available antibiotic which could be due to prolonged or indiscriminate usage.

Distribution of crossbred cattle germplasm to the farmers towards augmentation of dairy production in the islands

For the first time by the institute and under this project, Division of Animal Science, CARI has distributed **17 crossbred dairy cattle** to the farmers of these islands through the **National Cooperative Union of India** (NCUI), Ministry of Agriculture, Govt. of India. This is a significant achievement of CARI towards boosting islands dairy industry.

Plate 14. Distribution of crossbred germplasm

Animal and agricultural waste management through Vermicompost technology

The availability of nutrients in the islands at farmers' field is a major constraint to the enhancement of productivity. To evaluate feasibility of meeting nutrient requirement of institute farms from vegetative waste and animal waste, a pilot project has been initiated to convert all the dung and agricultural wastes produced in the institute in vermicompost. With this in aim, a vermicompost unit has been established. It helps in both way- cleaning of the campuses in one way and on the other hand a valuable vermicompost product is produced.

The unit comprises of three tanks with a proposed handling of 9900 kg of bio residues, 7200 kg dung and 900 kg of glyricidia and with annual expected production of 96 T. This eco-friendly system will be efficient in handling the animals and agricultural waste and would yield huge quantity of organic fertilizer to the crops of CARI farms. In addition to utilization of bio waste the unwanted bushes / weeds available in the experimental plots, farm area, and institute campus are cleared regularly to maintain cleanliness and improve the yield of crops.

Plate 15. Clearing of bushes / weeds and collection of plantation waste


Plate 16. Transport of bushes / weeds and plantation waste from farm premises


Plate 17. Chaffing of bushes / weeds and plantation waste for quick composting


Plate 18. Collection system of animal waste (dung) and farmyard manure for composting


Plate 19. Vermicompost unit, pit and vermicomposting in progress

Productivity Enhancement of Goats in Bay Islands

S. Jeyakumar, Jai Sunder, M.S. Kundu, A.Kundu, S. K. Verma, M. Balakrishnan, Subhash Chand, S.K. Zamir Ahmed and R. C. Srivastava

Productive and reproductive performance of goats

A total number of 15 kidding were recorded during the period of study. Composition of birth (Fig. 6) revealed that the usual number of kids born at one time varied from single to twins, of which percentage of singles (53.33) were more frequent than twins (46.66).The overall birth weight of kids born as single and twins was 1.48±0.14 and 1.60±0.14 respectively. Mean birth weight of male and female kid was 1.63±0.14 and 1.46±0.15 respectively. However, there was no significant difference observed between male and female kids. Dam weight at birth was 25.41±0.78 kg.

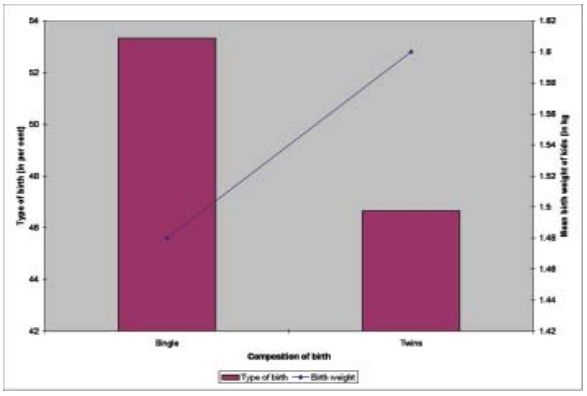


Fig. 6. Composition of birth and birth weight of kids

Carcass yield characteristics of 4 male and 8 female goats were studied. The carcass yield was significantly ($p<0.01$) higher in males (50.13±1.18) than females (41.36±0.98). However no significant difference was observed on head, leg, skin, pluck, blood, liver, spleen, stomach and intestine of male and female carcass.

Goat meat production and marketing channels in islands

The goat meat production and consumption pattern varies with the island and the ethnic group. The number of goats slaughtered in a year was 11, 000 (2004 – 05) and the average yield of meat per goat was 11.52 kg. The average yield of goat meat was higher in Andaman than the national average (9.28 kg). Studies on marketing system and channels revealed that there is existence of 6 channels in meat goat production to consumption in the islands (Fig. 7).

Plate 20. Goat meat market in Port Blair

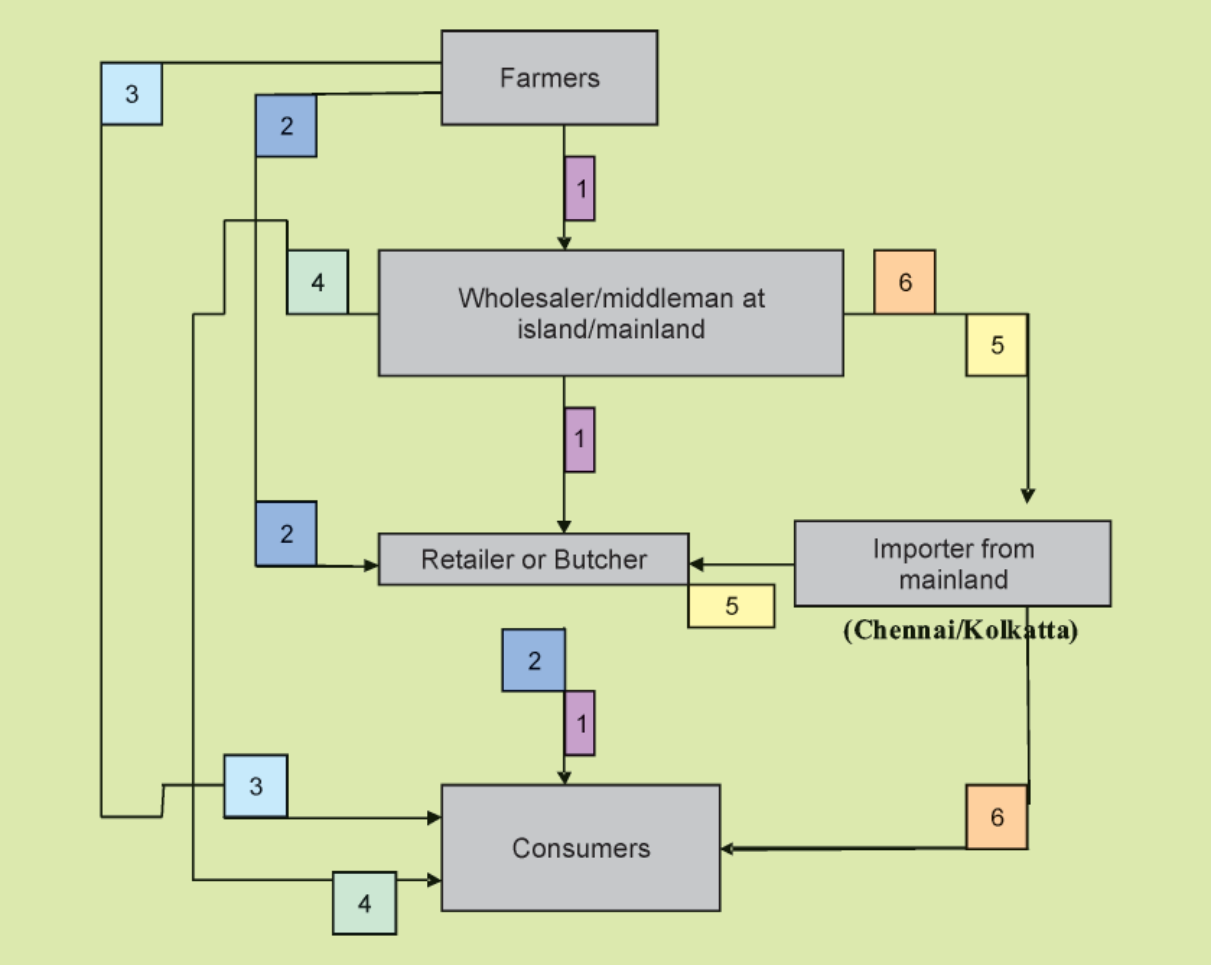


Fig. 7. Marketing channels of goat meat production to consumers

Identification of gut microbes and its antibiotic sensitivity pattern in kids

Out of 17 goat kid faecal samples a total of 19 bacteria have been isolated. The majority of the organisms were gram positive (94.73 %) than gram negative (5.26%). Majority of the isolates were E.coli (16) and Salmonella spp. (3). The resistance pattern of the isolates showed that majority of the isolates is sensitive to antibiotics.

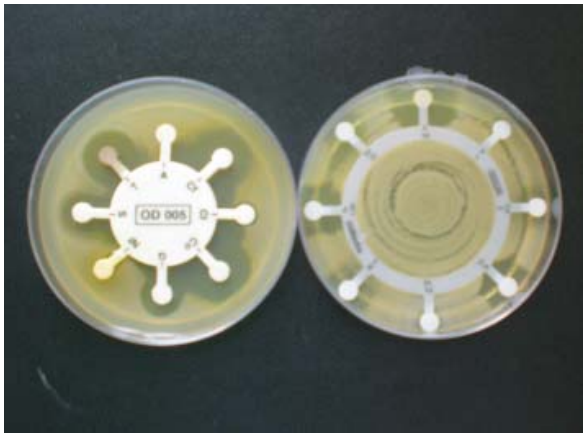


Plate 24. Antibiotic sensitivity pattern

Conservation and Phenotypic and Molecular Characterization of Indigenous Goats of Andaman and Nicobar Islands

S. Jeyakumar, Jai Sunder, A. Kundu and V. Thiagarajan

Genotype number and frequency

Genotyping of each locus was carried out after scoring the alleles from the gel. A total of 50 genotypes were observed across the 15 loci. The number of genotype varied between (MAF70; SRCRSP3) 1 and 6 (SRCRSP15). The observed number of alleles (No), effective number of alleles (Ne), observed heterozygosity (Ho), expected heterozygosity (He) and F-statistics (F_{IS}) value are given in table 14 & 15. The effective number of alleles (Ne) varied from 2 to 6.98 in Teressa goat and 2 to 4.31 in local goats.

F-Statistics

F_{IS}, F_{IT} and F_{IT} values were calculated and heterozygosity deficiency at each locus using FSTAT software (Wier and Cockerham, 1984). All the values of FIS obtained for the Teressa and Andaman local goats were negative which is suggestive of no inbreeding within the populations and the animals were outbred.

Table 14. Measures of genetic variation across microsatellite loci in Teressa goat

Loci	Size range	Teressa Goat		
		No (Ne)	Ho(He)	FIS
SRCRJSP5	110-139	4.0(3.44)	1.0(0.72)	-0.398
MAF70	132-182	2.0(2.00)	1.0(0.51)	-1
SRCRSP23	145-177	2.0(2.00)	1.0(0.51)	-1
OarFCB48	64-86	2.0(2.00)	1.0(0.51)	-1
INRA023	116-136	3.0(2.60)	1.0(0.63)	-0.61
SRCRSP9	120-130	3.0(2.60)	1.0(0.61)	-0.67
OarAE54	102-136	4.0(3.52)	1.0(0.73)	-0.379
INRA063	107-141	2.0(2.00)	1.0(0.51)	-1
SRCRSP7	180-300	2.0(2.00)	1.0(0.51)	-1
SRCRSP15	176-397	5.0(4.67)	0.75(0.80)	0.064
ETH10	220-357	5.0(4.41)	1.0(0.79)	-0.277
INRABERN185	396-790	6.0(5.17)	0.79(0.82)	0.04
BM6444	108-255	5.0(4.95)	0.96(0.79)	-0.225
P19(DYA)	211-290	4.0(3.63)	1.0(0.74)	-0.363
TCRVB6	191-509	8.0(6.98)	1.0(0.87)	-0.149

Table 15. Measures of genetic variation across microsatellite loci in Andaman Local goats

Loci	Size range	Andaman Local Goat		
		No (Ne)	Ho(He)	FIS
SRCRJSP5	254-643	2.0 (2.00)	1.0 (0.51)	-1
MAF70	132-182	2.0 (2.00)	1.0 (0.51)	-1
SRCRSP23	101-165	2.0 (2.00)	1.0 (0.51)	-1
OarFCB48	210-291	4.0 (3.81)	1.0 (0.75)	-0.342
INRA023	178-310	3.0 (2.67)	1.0 (0.64)	-0.59
SRCRSP9	144-656	5.0 (4.31)	1.0 (0.78)	-0.286
OarAE54	80-131	2.0 (1.98)	0.9 (0.50)	-0.806
INRA063	176-278	3.0 (2.72)	0.92 (0.65)	-0.438
SRCRSP7	102-186	4.0 (3.81)	1.0 (0.75)	-0.342
SRCRSP15	132-173	3.0 (2.66)	1.0 (0.63)	-0.592
ETH10	107-128	2.0 (2.00)	1.0 (0.51)	-1
INRABERN185	142-191	3.0 (2.63)	1.0 (0.64)	-0.591
BM6444	118-183	3.0 (2.67)	1.0 (0.64)	-0.59
P19(DYA)	145-243	4.0 (3.81)	1.0 (0.75)	-0.342
TCRVB6	269-398	2.0 (2.00)	1.0 (0.51)	-1

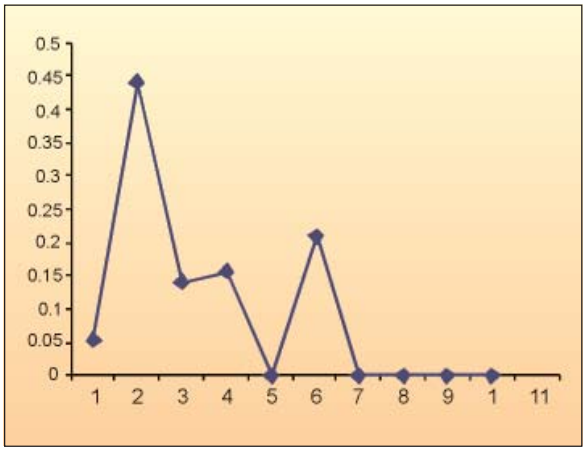
No = Observed number of alleles, Ne = Effective number of alleles, Ho = Observed heterozygosity, He = Expected heterozygosity, F_{IS} = F-Statistics value

Bottleneck analysis

Populations that have experienced a recent reduction in their effective population size exhibit a corrective reduction of the allele numbers and heterozygosity (He) at polymorphic loci. But the allele numbers is reduced faster than the heterozygosity. Thus, in a recently bottlenecked population, the observed heterozygosity is higher than the expected equilibrium heterozygosity, which is computed from the observed number of alleles, under assumption of a constant population size.

The data were subjected to statistical analysis to test for heterozygosity excess. Three tests viz. Sign-rank test, standardized differences test and Wilcoxon test utilized in each of the three models of mutations, IAM, SMM and TPM revealed a significant heterozygosity excess for both goat populations rejecting the null hypothesis of mutation drift equilibrium. The mode-shift test indicated the genetic bottleneck in Teressa and Andaman Local goats, which is depicted in Fig. 8 and 9.

A total of 50 genotypes were observed across the 15 loci. The number of genotype varied



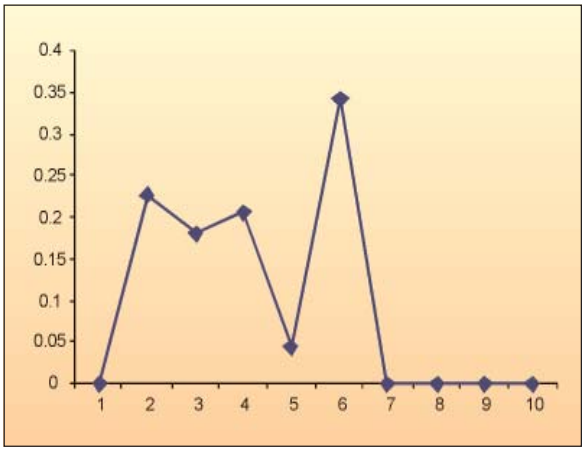


Fig. 8. Mode shift graph of Teressa goat Fig. 9. Mode shift graph of Andaman Local goat

between (MAF70; SRCRSP3) 1 and 6 (SRCRSP15). The Observed number of alleles (No), effective number of alleles (Ne), observed heterozygosity (Ho) Expected heterozygosity (He) and F-statistics (F_{IS}) were analyzed. The effective number of alleles (Ne) varied from 2 to 6.98 in Teressa goat and 2 to 4.31 in local goats. All the values of FIS obtained for the Teressa and Andaman local goats were negative which is suggestive of no inbreeding within the populations and the animals were outbred. The mode-shift test indicated the genetic bottleneck in Teressa and Andaman Local goats and needs greater attention towards *in situ/ex situ* conservation. It is concluded that the Andaman Local Goat and Teressa goats are considered as an indigenous goat breed / germplasm belonging to this island territory. The information elucidated through the present study would be useful for the formulation of effective conservation strategies for sustainable maintenance and identification of quantitative trait loci for marker-assisted selection.

Molecular Characterization of Indigenous Pigs of Bay Island by Microsatellite Markers

Arun Kumar De, M.S.Kundu, S. Jeyakumar, Jai Sunder, A. Kundu and S.K. Verma

Standardization of protocol of PCR (Polymerase Chain Reaction) for amplification of genomic DNA using microsatellite primers of pig

Blood samples were collected from pigs maintained in our institute farm as well as from native pigs of farmer's field. Blood samples were also collected from pigs of a newly identified breed in these islands. The breed is mostly available at Baratang and Mayabander area of Andaman & Nicobar Islands. Phenotypically they have unique characters with long shiny backwardly curved bristles and long tail for both males and females. The adult weight is about 65 Kg

Plate 22. Newly identified pigs

for male and 60 Kg for female. They are much more docile and lazy than western pigs. The age at first farrowing is about 300 days with litter size about 7-8. They are maintaining a good health with low plane of nutrition. DNA was isolated by standard procedure of phenol/ chloroform method. PCR protocol was standardized for four set of FAO recommended microsatellite primers. Each 25 µl reaction consisted of DNA (100 ng), primers (50 ng each), dNTPS (50 mM each), 2.5 µl of 10 X buffer and Taq DNA polymerage (0.75 unit) (Table 16).

Table 16. Set of FAO recommended microsatellite primers standardized for PCR protocol

Primer sequence	Annealing temp.(^{0}C)
Foreward- ATAGACATTATGTCCGTTGCTGAG Reverse- GAACTTTCACATCCCTAAGGTCGT	62
Foreward- TCCTTCCCTCCTGGTAACTA Reverse- GCACTTCCTGATTCTGGGTA	58
Foreward- AGTGGTCTCTCTCCCTCTGCT Reverse- CCTTCAACCTTTGAGCAAGAAC	62
Foreward- CCAAGACTGCCTTGTAGGTGAATA Reverse- GCTATCAAGTATTGTACCATTAGG	58

Division of Fisheries Science

Cage Culture of Commercially Important Marine and Brackishwater Fishes in Protected Bays & Creeks of Andaman

S. Dam Roy, P. Krishnan, Kamal Sarma, Grinson George, S. Murugesan and Benny Varghese

Andaman and Nicobar islands situated in Bay of Bengal have numerous bays, creeks, lagoons and islets with varying depths and different substrate which are suitable for cage culture. This project was conceived with an objective of designing cages suitable for protected bays and evaluating the feasibility of culture of groupers in Andaman.

Four cages of 5x4x3m each were fabricated using wooden frames and made afloat using 24 empty barrels (Plate 1). Two anchors of 50kg were used to anchor them at Minnie Bay. The net webbing procured from CIFA, Bubaneshwar were fit in the mainframe and tied to the vertical supports.

Plate 1. A view of the cages

Grouper belonging to Cephalopholis sp. (C. argus, C. minieta, C. boenex and C. milliaris) and Epinephelus sp (E. merra, E. fasciatus and E. longispitis) were caught from North Bay & Chunnapatta offshore area. 210 fishes of 162.1 ±26.95 mm length and 62.11±32.18 g weight were stocked in two cages each measuring 5x4x2m. They were fed everyday with low value fishes like Sardinella sp. at 5% of body weight. The net webbings of the cages were scrubbed at fortnightly intervals to maintain water flow. The growth was recorded after 4 months and a 67% increase in weight was observed with about 90% survival. In the creek area, high turbidity and intense fouling were the major issues which necessitated frequent cleaning of the net webbing and the frames.

Plate 2. Sampling work underway in the cages

The water quality parameters of the cages were monitored regularly and it was found that dissolved oxygen (4.0-5.0 ppm), salinity (30-34 ppt), pH (7.8-8.1) and alkalinity (120-135ppm) were within the acceptable limits for fish culture.

After the first sampling (Plate 2), the net cages were damaged by the crabs resulting in inadvertent loss of the fishes. The cages were subsequently shifted further away from the shore where the depth below the cage during the lowest low tide was 4 m. About 150 fishes belong to the same species were collected afresh and stocked in the cage. The average initial length and weight of the fishes were 201.7±27.57 mm and 90.06±41.40 g respectively. The fishes were fed with chicken offal and trash fish @ 5% of body weight. Sampling was conducted at quarterly intervals. The fishes recorded a growth of 34.04% in three months with 98% survival. The culture lasted for a period of six months and the fishes reached 268.43±33.56 mm in length and 161.36±52.64g in weight, registering a growth of 79.17% with 96.81% survival. These successive culture experiments suggested that the cannibalism in the groupers can be checked by resorting to proper feeding and the fishes can be successfully cultured in cages in the protected bays and creeks in Andaman.

Production of Commercially Important Cat Fishes: Clarias Batrachus (Indian Magur) and Heteropneustes Fossilis (Singhi) in Andaman and Nicobar Islands

C.S. Chaturvedi, S. Dam Roy, Kamal Sarma, Grinson George and Benny Varghese

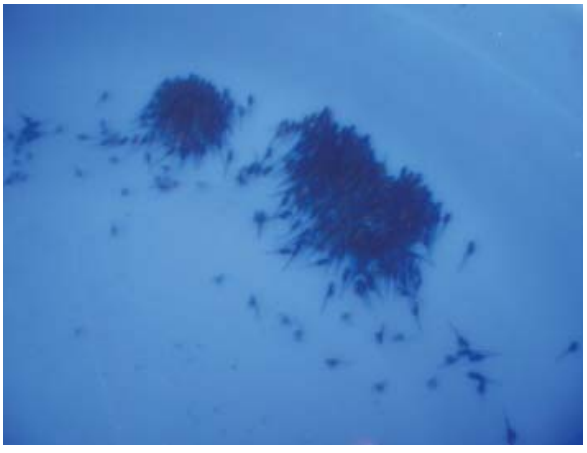
The Indian Magur, Clarias batrachus is highly priced, delicious, nutritious and a preferred fish for consumption throughout the country. It breeds once in a year in stagnant waters during monsoon. Secondary sexual characters are generally more prominent during breeding season. Interestingly magur are found in the paddy

fields and freshwater ponds of Andamans. Some of the airbreathing fishes like magur, singhi and climbing perches were introduced by the migrants of A&N Islands. The objective of the project was to standardize the breeding technique of air-breathing fishes like Clarias batrachus and Heteropneustes fossilis in the island condition. Initially the brood fishes were collected from the local market and villages.

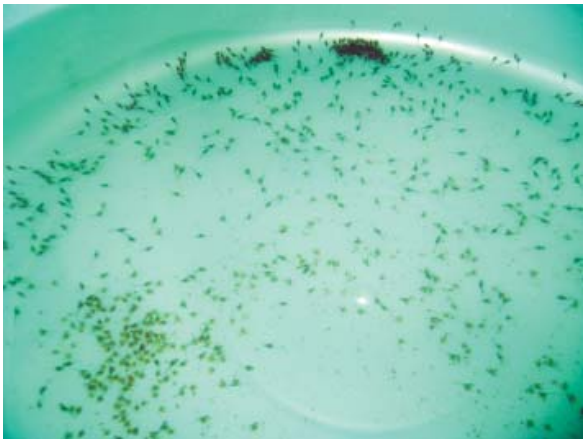
Broodstock of C. batrachus & H. fossilis were reared in outdoor cemented tanks (8x3x1m) wherein black soil base of 7.5-10.0 cm thickness was provided. The brooders were fed with boiled egg and also fish meal and prawn powder in a ratio of 1:1 @ 5 % of their body weight. The condition of brood fishes was examined periodically. During the year, 24 sets were selected for hypophysation technique and 90% of the fishes bred successfully. A total of 10,432 cat fish spawns were produced and reared in indoor hatchery system developed in the institute for this purpose. The magur spawn were reared for 12-15 days in indoor hatchery system. The spawn were stocked in the indoor hatchery at a density of 2000-3000 / m^2. The depth of water in rearing tanks was maintained as 6-8 inches. The catfish spawn were fed from the 5th day onwards with mixed feed having 30% protein, after the absorption of yolk sac. During rearing period, proper shelter was provided for the magur fry. Fry were fed *ad libitum*.

The cat fish larval development unit consisted of a spawn rearing unit (circular tank of 1m diameter) and a fry rearing unit (3x1x1 m). The spawn rearing unit is based on a flow-through system, consisting of 20 troughs (30 cm dia and 8 cm height), arranged in two rows and interlinked to each other. The full system is mounted on a platform and connected to aeration and a water source during operation. Using this unit, a survival of 60% was obtained under controlled conditions. There was an instance of natural breeding of C. batrachus in

Removal of testis, magur



Magur hatchlings



Fertilized eggs of magur

Fingerlings of magur

Supply of magur fingerlings

Naturally bred magur fry

Plate 3. Activities in the Catfish hatchery

controlled condition where the male was not sacrificed. However, refinement of the magur breeding is underway. The fingerlings were transferred to the grow-out tank (8x3x1 m) and fed with mixed feed @ 5%. About 4,000 seeds were distributed to private fish farmers at the rate of Re. 1 per seed. The larval stages and fingerlings of magur are shown in Plate 3.

Apart from breeding, a polyculture experiment was attempted with four species viz., catla, rohu, and magur in cemented pond (8x3x1m) under semi intensive management. The fingerlings were stocked @ 5/m^2. The fishes were fed with rice bran and mustard oil cake (1:1) @ 3% of their body weight. The average size of catla, rohu and magur were 142mm, 112mm and 130 mm respectively while the weight was 31g, 12.4g and 20g respectively. The culture is under progress.

Temporal and Spatial Variability of Water Quality Parameters and Mineral Profile of Waters of Andaman and their Impact on Shellfishes and Finfishes

Kamal Sarma, S. Dam Roy, Grinson George, C. S. Chaturvedi, Benny Varghese and S. Murugesan

Objective of the project is to study the variability of water quality parameters in Andaman waters and implication of variability on organism level. Analysis of water quality parameters were done from six different sites viz. Chatam, Phoenix jetty, brackishwater potential site of Sippighat, mangrove site of Sippighat, coral reef site at Wandoor and North Wandoor of the south Andaman. Different important water quality parameters like water temperature, primary productivity, dissolved oxygen, pH, carbon dioxide, salinity, alkalinity, phosphate and nitrate were estimated from April 2009 to Feb. 2010. In Phoenix jetty low DO level and high alkalinity, nitrate and phosphate levels were observed. This might be due to the discharge of sewage in that area. Gross productivity, net primary productivity and respiration requirement were 372.5 - 401.3, 160.67 -176.3 and 15.07 -15.3 mg C/m^3/h respectively.

To generate data on effect of pollution on the aquatic organisms, a comparative study was

Table 1. Variations in the water quality parameters from two different ecosystems

No.	Parameters	January 2010		February 2010		March 2010	
		North Wandoor (unpolluted)	Phoenix Jetty (polluted)	North Wandoor (unpolluted)	Phoenix Jetty (polluted)	North Wandoor (unpolluted)	Phoenix Jetty polluted)
1.	Temperature (0C)	29	31.066	31	30.85	31	31.5
2.	DO (mg/ L)	4.8	2.08	5.2	2.4	4.4	3.2
3.	DO%	79.1	73.79	83.8	78.05	75.7	77.04
4.	pH	8.4	8.436	8.35	8.388	8.35	8.48
5.	Salinity (g/ L)	33.71	31.235	32.99	31.45	33.35	31.915
6.	Turbidity (NTU)	20.4	21.52	18.2	21.4	20.8	24.37
7.	Alkalinity (mg/ L)	116	145	108	142	130	142
8.	CO2 (mg/ L)	nil	4.0	nil	nil	nil	nil
9.	Nitrite (mg/L)	0.0060	0.0138	0.0075	0.0127	0.0063	0.0115
10.	Nitrate (mg/L)	0.17	1.00	0.42	0.58	0.33	0.67
11.	Phosphate (mg/L)	0.03	0.20	0.06	0.07	0.03	0.05

conducted on oysters present in polluted (Phoenix jetty) and unpolluted water bodies (North Wandoor). Average length, weight, meat yield of the oyster sample collected from North Wandoor sample were relatively higher compared to Phoenix jetty sample. Glycogen and ascorbic acid concentration was higher in North Wandoor sample compared to Phoenix jetty (Table 1). There was no significant difference in the parameters recorded in three dry months starting from Jan. to Mar. 2010. To record the enzymatic activity acetylcholine esterase and alkaline phosphate enzyme activity, two important enzymatic biomarkers for environmental studies were estimated between two places. It was observed that both the enzymes were relatively less active in oysters collected from Phoenix jetty sample compared to the North Wandoor sample. However there were not many variations observed in proximate composition of oysters between two different places (Table 2).

Table 2. Biological biochemical parameters of *Crassostrea rivularis* collected from two different ecosystems

Parameters	North Wandoor	Phoenix jetty
Biological parameters		
Length (cm)	11.757±0.31	7.213 ±0.28
Weight (g	205.16 ±12.91	62.8452 ±3.03
Min. & Maximum Length (cm)	9.5 - 13.3	5.88 -9.1
Min. & Maximum weight (g)	113.89 - 331.48	42.101- 92.715
Average meat yield	9.846±1.11	3.85±0.30
Shell yield (%)	95.612±1.04	94.065±1.04
Meat yield (%)	4.388±1.04	5.935±1.55
Proximate composition		
Moisture (%)	80.25±1.25	77.81±1.92
Fat (%) [1*]	15.38±0.56	13.53±0.57
Protein (%)[1*]	57.73±0.39	58.41±1.55
Ash (%)[1*]	11.72 ± 0.68	10.69 ± 0.35
Biochemical parameters		
Ascorbic acid in liver[2*]	159.44 ±16.84	92.56 ±10.01
Glycogen content in liver[3*]	0.51±0.02	0.14±0.01
Acetylcholine esterase activity in gill[4*]	0.023±0.003	0.019± 0.002
Alkaline Phosphatase activity in gill[5*]	25.609 ±2.86	13.827 ±2.041

[1*] on dry weight basis

[2*] µg ascorbic acid / g of wet tissue

[3*] mg glycogen / g of wet tissue

[4*] µ moles of acetyl choline hydrolyzed / mg protein / minute at 37^{0}C

[5*] n moles of paranitrophenol released / mg protein / minute at 37^{0}C

Distribution, Abundance and Stock Assessment of Groupers and Snappers of Andaman Waters

S. Dam Roy, Kamal Sarma, Grinson George and P. Krishnan

Groupers, belonging to the family Serranidae, are chiefly marine fishes of tropical and warm areas while some are found in fresh and brackishwater areas also. The subfamilies that are included in Family Serranidae are *Epinephelinae* and *Anthinae*. They include the

Table 3. Region wise landing of Groupers and Snappers

Region	Places studied	Groupers	Snappers	Period
		Aethaloperca rogaa	*Aprion virescens*	Jun 09-
		Cephalopholis argus	*Lutjanus argentimaculatus*	Feb 10
South Andaman	Junglighat, Chatham, Dugnabad, Panighat, Guptapara, Wandoor, Neil Island, Havelock Baratang , Hut Bay	*C. miniata* *C. sonnerati* *Epinephelus malabaricus* *E. tauvina* *E. caeruleopunctatus* *E. bleekeri* *E. aerolatus* *E. fuscoguttatus* *E. flavocaeruleus* *E. fasciatus* *E. areolatus* *E. merra*	*L.bohar* *L. gibbus* *L. lunulatus* *L. malabaricus* *L. erythropterus* *L. deccusatus* *L. russelli* *L. madras* *L. fulviflamma* *Variola louti*	
Middle Andaman	Kadamtala , Rangat, Betapur (RRO)	*Cephalopholis miniata* *Epinephelus malabaricus* *E. tauvina* *E. aerolatus* *E. fasciatus*	*Lutjanus gibbus* *L. bohar* *L. argentimaculatus* *L. fulvus*	May-Jun 09
North Andaman	Mayabunder, Panighat, Kalighat, Durgapur,	*Cephalopholis miniata* *C. argus* *C. sonnerati* *Epinephelus tauvina* *E. malabaricus* *E. caeruleopunctatus* *E. fuscoguttatus*	*Lutjanus bohar* *L. argentimaculatus* *L. malabaricus* *L. gibbus* *L. deccusatus* *L. fulvus*	Nov-Dec 09
Nicobar group Islands	Car Nicobar, Kamorta, Katchal, Terressa, Campbell Bay,	*Epinephelus tauvina* *E. malabaricus* *E. aerolatus* *E. fuscoguttatus* *E. fasciatus* *Aethaloperca rogaa*	*Lutjanus bohar* *L. gibbusL. fulvus* *L. malabaricus*	June – July 09

worlds' most important food fishes and some are strikingly beautiful and coloured. They are carnivores in feeding habit and are oviparous and protogynus. Snappers are also important food fishes in our region, which are noted for the species diversity rather than the abundance. Snappers are found in the shallow inshore waters, inhabiting in the rocky and coral reef areas, where they are usually caught on hand-lines and traps. The common genera under this group are *Aprion, Gymnocaesio, Aphareus, Lipochellus, Pristipomoides, Symphysanodon, Caesio, Glabrilutjanus, Macolor, Pinjalo, Lutjannus, Paracaesio, Apsilus*. The common groupers and snappers landed in A&N islands are shown in Plate 4.

A survey was carried out on various landing centers situated at North, Middle and South Andaman and the Nicobar group of Islands to study the availability of grouper and snappers at various landing centers. The occurrence of different groupers and snappers in the daily catch of the fishermen

Table 4. Morphometric data of commercially important species of Grouper and Snappers in A&N Islands

Name of the species	Length (cm)*	Weight (kg)*
Cephalopholis miniata	49.91 ± 2.57	1.64 ± 0.20
C. argus	43.87 ±3.70	1.32 ± 0.25
Epinephelus fasciatus	51.66 ± 2.46	1.32 ± 0.07
E. caeruleopunctatus	36.72 ± 0.37	1.29 ± 0.05
E. fuscoguttatus	80.65 ± 1.17	5.56 ± 0.17
E. merra	54.06 ± 1.86	1.98 ± 0.11
E. malabaricus	54.44 ± 0.71	2.17 ± 0.06
E. tauvina	38.51 ± 2.52	1.61 ± 0.37
E. bleekeri	40.82 ± 3.00	1.22 ± 0.23
Lutjanus erythropterus	36.35 ± 0.12	1.23 ± 0.01
L. deccusatus	25.58 ± 0.80	0.32 ± 0.04
L. gibbus	35.50 ± 1.56	0.96 ± 0.05
L. lunulatus	37.45 ± 0.71	1.14 ± 0.05
L. madras	51.79 ± 0.60	1.43 ± 0.04
L. quinquelineatus	23.77 ± 0.56	0.23 ± 0.01
L. bohar	43.60 ± 0.84	0.98 ± 0.05
Variola louti	74.00 ± 3.12	4.62 ± 0.53

* *Mean ± Standard Error*

were recorded (Table 3). The craft and gear used for catching these important varieties varied from place to place but gill net and hook & line were found to the predominant gears used for catching these fishes. The average length and weight of the commercially important groupers and snappers landed in the Islands are summarized in Table 4. A comprehensive study on the food and feeding habit of the fishes and their distribution in relation to the productivity of the waters is underway.

Epinephelus macrospilos (Bleeker)

Cephalopholis sonnerati (Valenciennes)

Epinephelus flavocaeruleus (Lacepede)

Epinephelus areolatus (Forsskal)

Lutjanus argentimaculatus (Forsskal)

Lutjanus gibbus (Forsskal)

Lutjanus fulvus (Schneider)

Lutjanus bohar (Forsskal)

Plate 4. Groupers and Snappers landed in A&N Islands

Broodstock Development and Breeding of Damsel Fishes

Grinson George, S. Dam Roy, C.S. Chaturvedi, Kamal Sarma, S. Murugesan and Benny Varghese

Andaman waters are rich in marine ornamental fish resources. Damsel fishes are the priced ornamental fishes, living in association with sea anemone in the coral reef areas. This project has been taken up with the initial objectives to survey the damsel fish resources. Line Intercept Transect (LIT) method was adopted for successful estimation of ornamental fish resources of the islands. In the present study, the substratum preference and distribution of anemone fishes were estimated from 10 transects at three selected sites (disturbed, semi disturbed and undisturbed) in the North Bay island. Out of the whole substratum more than 52% was constituted by corals (Fig. 1). Among the fauna, total of 80.9% was constituted by fishes with anemone fishes representing about 7.5%. Anemones constituted about 3.2% of the fauna in the study area (Fig.2). The ratio between the anemone fishes and anemone was almost similar in all transects. However, availability of anemone (7.9%) and anemone fishes (15.6%) were much higher in undisturbed areas compared to semi-disturbed and disturbed area.

Development of ornamental brood stock for breeding purpose is a major objective of this project. *Amphiprion alkallopsis, A. ephippium* and *Premnas biaculeatus* are collected from wild and maintained in the hatchery for development of suitable breeding pair by simulating natural conditions. After maintaining the fishes for a month *P. biaculeatus* responded positively and 5

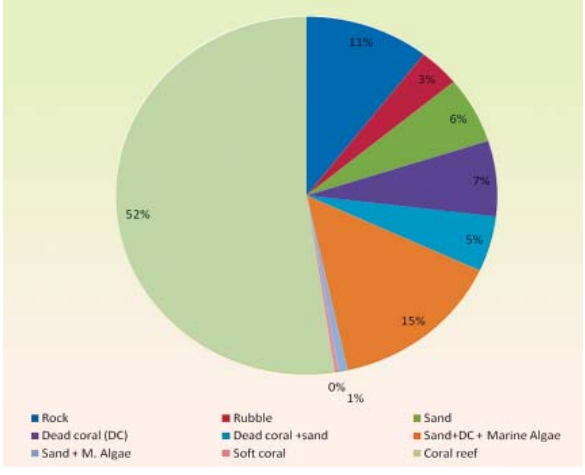


Fig. 1. Percentage distribution of different substratum recorded during the transect survey

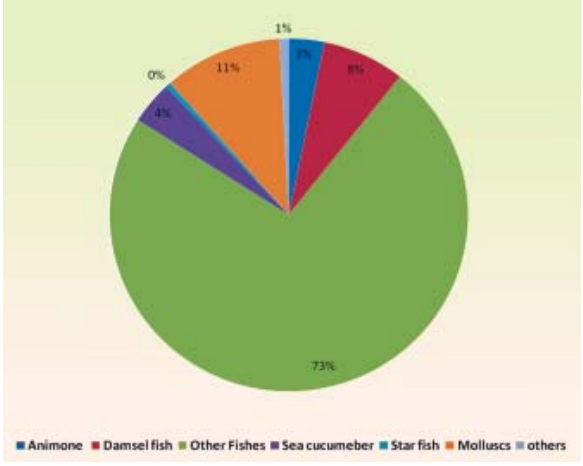


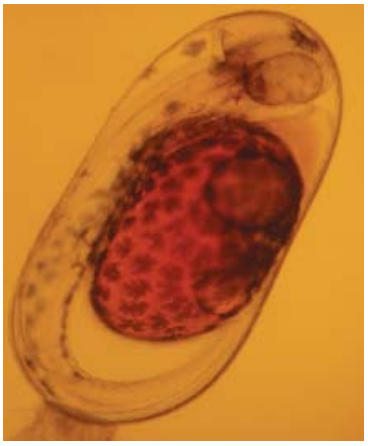
Fig. 2. Distribution of anemone fishes and other living organisms recorded during the transect survey from different locations off North Bay

breeding pairs were formed. Out of these pairs one pair spawned in the 5th month. The eggs of *P. biaculeatus* are adhesive in nature, capsule shaped and yolk mass occupying three fourth of the egg. Both the parents were engaged in egg tending activities and males were more pronounced from 5th day onwards. Average size of the egg was 1.705±0.02 mm. The first cell division was observed within 40-60 min after fertilization. Subsequently the cell division was going on rapidly and eggs hatched out in 6½ days (152-159hr) after fertilization. Details of embryonic development from egg to hatchling were recorded and photographed. The larvae (3.724 ±0.05 cm) after hatching were active swimmers and started feeding on rotifers after yolk absorption (12-24 hr). Continuous illumination was provided to the larvae. Some of the important development stages are given in Plate 5.

Just after spawning showing parental care

4 cell stage

Gastrulation (24hr)



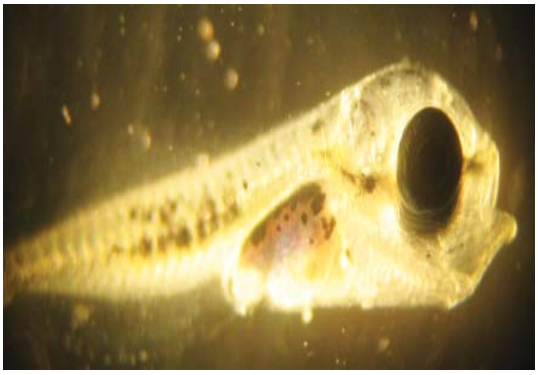
vertebrate column, eye, pericardial cavity clearly distinctive (48hr)

Blood circulation started (72hr)

Rudimentary gut cavity and Pectoral fin visible (96 hr)

Body twisting movement was more (120 hr). Gut cavity & gill arches were clearly visible

Eggs more or less opaque. Twisting movement became more vigorous (152hr)



After yolk absorption. Melanophore intensity increased (12 hr after hatching)

Plate 5. Development stages of *Premnas biaculeatus*

Characterization of the Role of Associated Bacteria in the Bioactivity of Marine Sponges from Andaman

P. Krishnan, S. Dam Roy, Kamal Sarma, S. Murugesan and Jai Sundar

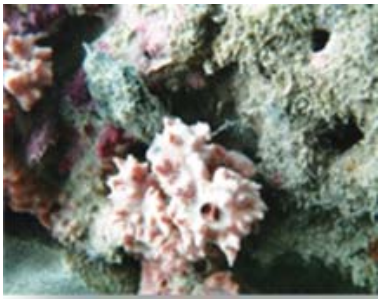
Marine sponges were being exploited for a range of commercial products from cushion to inner pad of the helmets till the discovery and wide use of synthetic sponges in 1950s. However, apart from this physical application, of late they are globally realized as candidate organisms for exploration under drug from sea projects. About 8000 sponge species have been described globally against the estimated 15,000 species. In India, so far only 486 species of sponges have been identified, of which about 15% are from Andaman. Considering the paucity of studies on the sponge biodiversity in Andaman and their significance in nutrient cycling, maintaining reef health and as potential producers of future drugs, the present investigation was initiated to document the marine sponge resources in the coastal waters of North Bay and Pongi Baalu in South Andaman. The sponges were identified taking assistance from Zoological Survey of India, Port Blair (Plate 6).

The antimicrobial activity of the host vis-à-vis the associated bacteria was characterized for *Ircinia* sp, a marine sponge collected from North Bay. The total heterotrophic bacterial count associated with *Ircinia* sp was found to be 5.8×10^6 cfu cm^{-2}. About 70 bacterial strains belonging to three different morphotypes were isolated and were assigned to *Vibrio* sp., *Aeromonas* sp., *Bacillus* sp., *Corynebacterium* sp., *Pseudomonas* sp., *Streptococcus* sp., *Enterococcus* sp., *Neisseria* sp., *Veillonella* sp., *Citrobacter* sp. and *Klebsiella* sp., based on their morphological, physiological and biochemical properties. The bacteria which were specifically

Diacarnu sp

Crella cyathophora

Chalinula nematifera



Stylissa carteri

Monanchora arbuscula

Cliona sp

Ircinia strobilina

Liosina paradoxa

Ecionemia acervus

Carteriospongia foliascens

Plakortis sp

Oceanapia sagittaria

Plate 6. Sponges collected from North Bay and Pongi Baalu

associated with the sponge were obtained by excluding the isolates with similar characteristics and also those present in surrounding water samples. 28 such isolates were found which were subsequently screened for their antimicrobial activity against selected pathogens *viz.*, *Aeromonas hydrophila* (AH), *Bacillus subtilis* (BS), *Enterococcus durans* (ED), *Streptococcus lentus* (SL), *Klebsiella pneumoniae* (KP) and *Rolstonia solanacearum* (RS) using disc diffusion assay. The results of primary screening based on their ability to resist host metabolites suggested that these isolates were not free-living and essentially associated with the sponges. The antibacterial activity of the sponge extract was also measured similarly.

Of the selected sponge surface associated bacterial isolates, 26 (92.86%) were found to have the antibacterial activity or in other words produce antibiotics. The antimicrobial activity of the sponge-associated bacterial isolates was more pronounced against gram positive bacteria (41.54%) than gram negative bacteria (12.82%). Of the total bacterial isolates tested, 66.67% were found to have antimicrobial properties ranging from broad spectrum to species specific. There was significant ($P<0.05$) difference in the nature of inhibitory activity of the antibiotics produced by different bacterial isolates. While 24 isolates (92.31%) bacterial isolates obtained from *Ircinia* sp. showed significant inhibitory activity against *Enterococcus durans*, none of the isolates was effective against *Streptococcus thermophilus*, *Klebsiella pneumonia* and *Ralstonia solanacearum*. The results of the antibacterial activity of the sponge extract and isolates obtained from *Ircinia* sp. are depicted in Fig. 3. One of the isolates, I12 which was identified as *Lysinibacillus fusiformis* based on DNA sequence homology of 16S rDNA gene, inhibited *Aeromonas hydrophila* with about 120% of the efficiency of erythromycin.

Four sponges collected from Pongibaalu *viz.*, *Crella cyathophora*, *Oceanapia sagittaria*, *Plakortis sp.* and *Monanchora* sp. are being

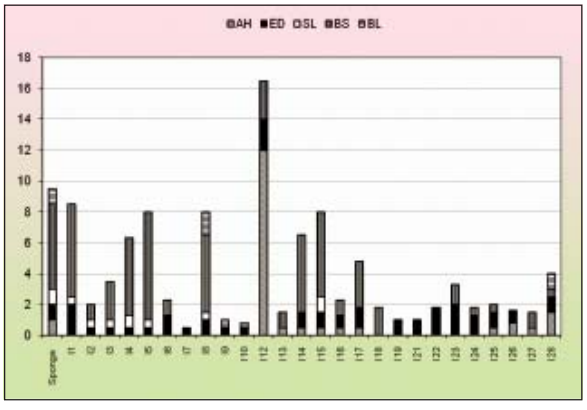


Fig. 3. Inhibitory efficiency of the extracts from Ircinia sp and its associated bacteria

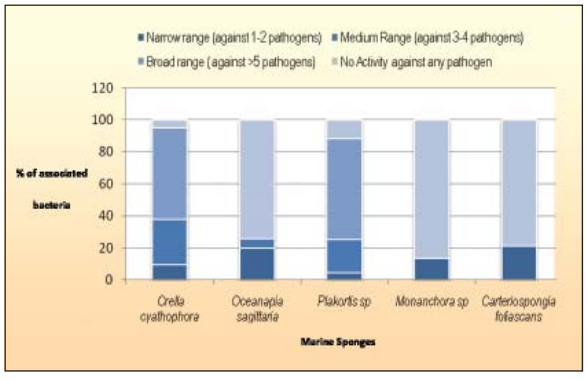


Fig. 4. Percentage the bacteria associated with selected marine sponges showing various levels of inhibitory efficiency

studied. Altogether over 200 sponge associated bacteria have been purified from them, which were assigned to *Neisseria villonella, Micrococcus* sp., *Staphylococcus* sp., *Clostridium* sp., *Corynebacterium* sp., *Bacillus* sp., *Pseudomonas* sp., *Enterobacteria* sp., *Lactobacillus* sp., *Vibrio* sp., *Aeromonas salmonicida, Mycobacterium smagmatis, Sterptococcus pneumonia* and *Streptococcus mitis* based on their morphological, physiological and biochemical properties. A preliminary qualitative dual culture assay revealed that in case of *Oceanapia sagittaria* and *Monanchora* sp, the antimicrobial activity was primarily due to the host metabolites. In *Crella cyathophora* and *Plakortis* sp., over 75% of the associated bacteria exhibited significant ($P<0.05$) antimicrobial activity against the selected pathogens (Fig. 4). The quantitative analysis of the antimicrobial property of these sponge associated bacteria is underway.

Assessment of threats due to Climate Change in Nicobar Group of Islands and Development of Adaptation Strategies

P. Krishnan, S. Dam Roy, S.K. Ambast, A. Velmurugan, S. Jeyakumar, Subhash Chand and S.K. Zamir Ahmed

The Nicobar group of islands face environmental and socio-economic pressures exacerbated by global climate change. Recent scientific evidences indicate that climate change will increase the frequency and intensity of extreme events in the decades to come. The present project is conceived with the objective of identifying the vulnerable sectors and structures in Nicobar Group of Islands due to Climate Change and to suggest the location-specific adaptation strategies to minimize the impact of Climate Change.

Secondary data from the A&N Administration were obtained with respect to the meteorological parameters, demographic particulars and productivity in the agricultural sector. Extensive field surveys were conducted at Car Nicobar, the headquarters of the Nicobar District and series of consultations were held with different stakeholders. Shuttle Radar Topography Mission (SRTM) maps of Nicobar group of islands (30m) were obtained from the online resources and digital elevation maps (DEM) were prepared using ArcGIS software (Plate 7). Soil samples collected from different locations across the islands were analysed following standard protocols and the data overlaid on the GIS platform to get the soil map of the islands. Land-use maps were prepared based on the standard criteria laid by National Remote Sensing Agency (NRSA) using IRS-P6 (LISS III). Adaptive capacity of the islands - the potential of the system to adjust to actual or expect climate stress or to cope up with the consequences- is being worked out based on

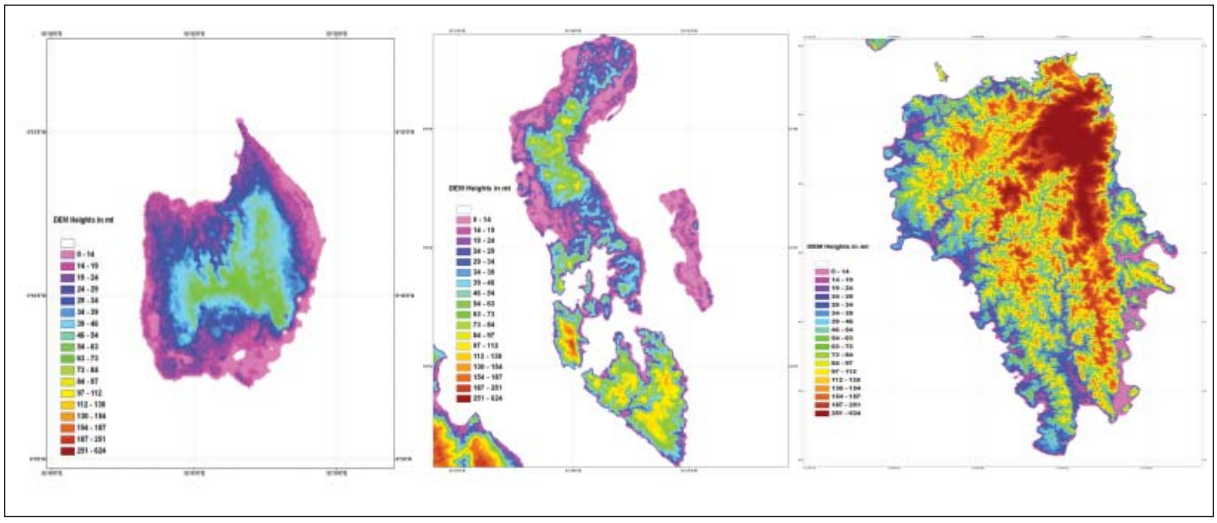


Plate 7. Digital Elevation Maps of Selected Islands in Nicobar District
(Courtesy: ISRO Regional Remote Sensing Centre - Central, Nagpur)

various socio-economic attributes, biophysical factors, infrastructural facilities and technological abilities using the methods of Tata Energy Research Institute (TERI) as a template.

There are 22 islands in the Nicobar district of which 12 are inhabited having a total area of about 1976 km^2. The DEM of the district indicate that among the Nicobar Islands, Trinket and Chowra have over 15% of the total land area with an elevation less than 10m above mean sea level (MSL) and are thus significantly vulnerable to sea level rise associated with global climate change (Fig.5). It was observed that about 70% and 93% of the total land area in Car Nicobar and Great Nicobar have an elevation >20m above MSL respectively. The DEM data taken together with the population density of different islands (Fig. 6) in the Nicobar district showed that Chowra is the most densely populated island which has a vast expanse of its land area with low elevation above MSL.

A critical review of the agricultural production data revealed that the major crop in the Nicobar group of islands were plantation crops followed by root crops and fruits (Fig. 7).Though Nicobar district accounted for over 60% of the total area of the union territory under plantation crops, its contribution to total production of plantation crops is just 32%, which corroborates the wide gulf between the production and potential. The islands depend on external sources entirely for their requirements of cereals, pulses and oilseeds. An analysis of the temporal data of the fish landings from the region showed that the district's contribution to the total UTs fish production has been insignificant (1.82±0.12%) (Fig. 8). The scenario of the livestock population except that of nicobari

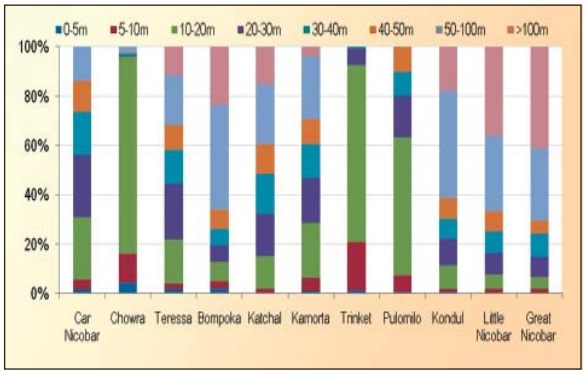


Fig. 5. Areas with different elevation as determined from the DEMs prepared from SRTM data of inhabited islands in Nicobar District

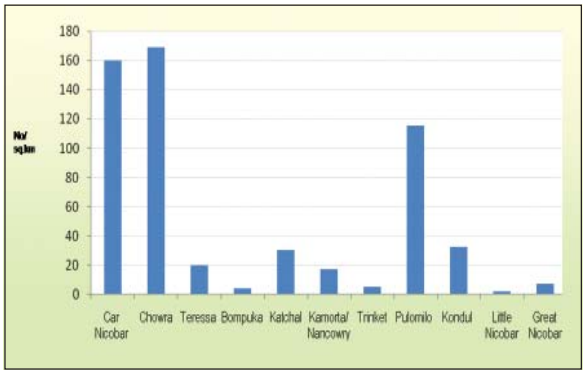


Fig. 6. Population density of inhabited islands in Nicobar District

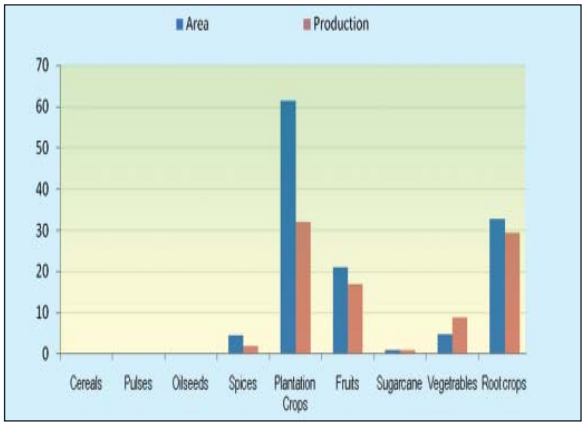


Fig. 7. Percentage contribution of Nicobar Islands to the Total area and production of various crops of A&N Islands

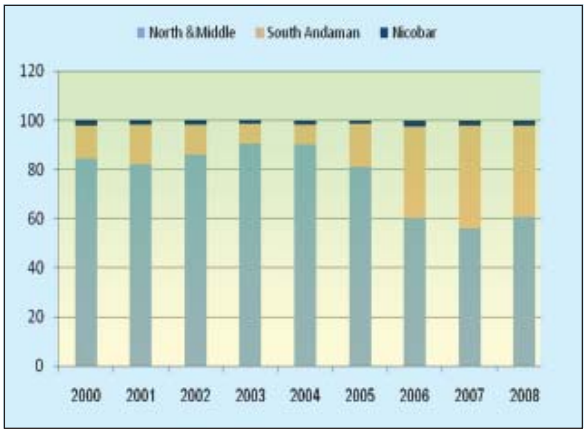


Fig. 8. Fish landings from different districts of A&N Islands as percentage of total fish landings

pigs, was no different from the other allied sectors.

The typical feature of the pattern of coconut plantations in Car Nicobar warranted specific corrections to be incorporated in the preparation of land-use map. About 60% of the island is under dense forest mixed with plantation crops while there are dense plantation crops in 23% of the island area (Fig.9). The soil map of the island (Plate 8) showed that a vast expanse of area has fine sandy loam. Since coconut is the most important crop in the island, the island was classified based on the soil quality and depth with respect to the extent of suitability for coconut cultivation. It was found that as per the standard criteria, about 2% of the area was highly suitable for coconut cultivation, 56% moderately suitable and 35% marginally suitable (Fig.10).

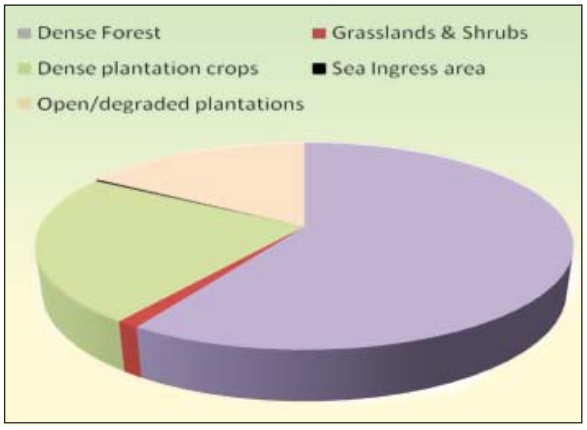


Fig. 9. Land cover / land-use pattern in Car Nicobar

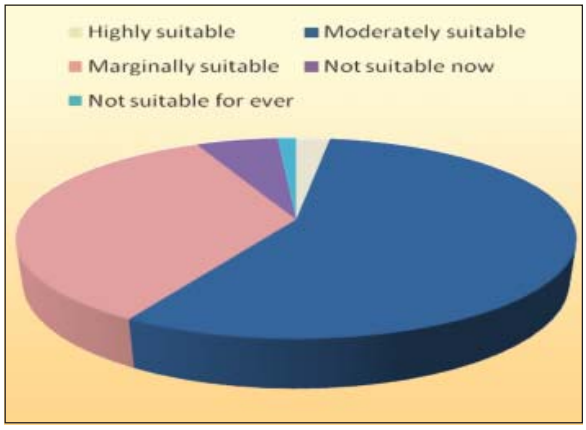


Fig. 10. Soil suitability for coconut cultivation in Car Nicobar

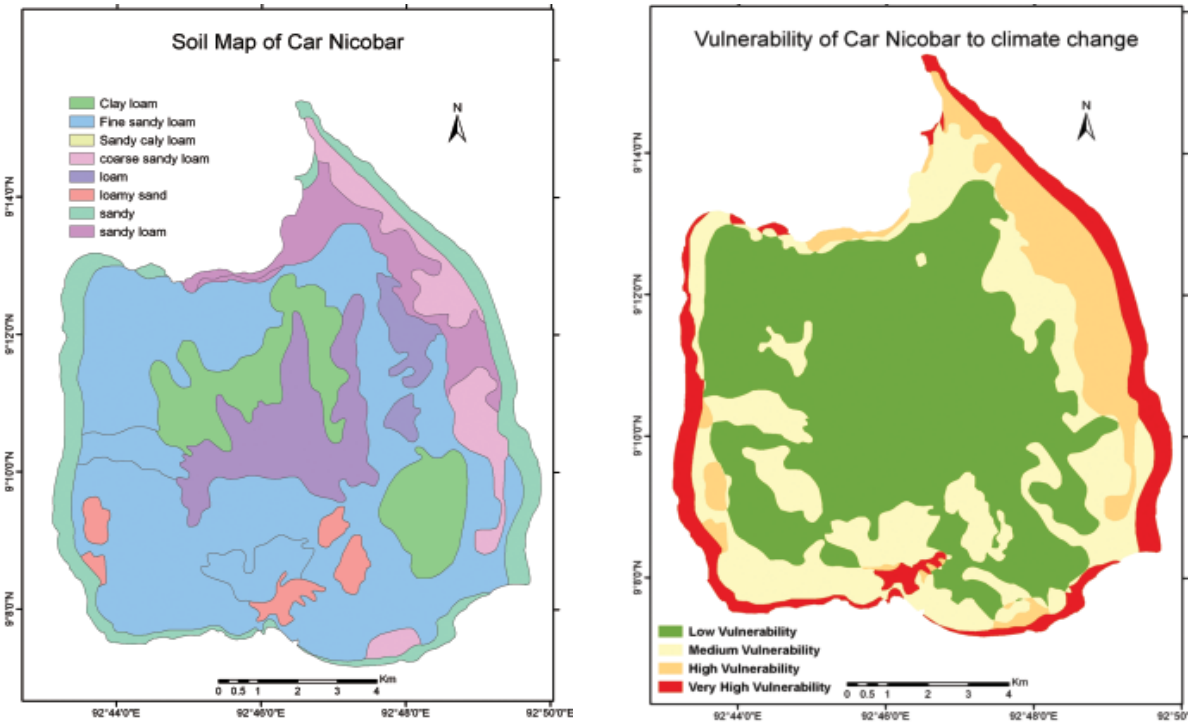


Plate 8. Digital Maps of soil resources and vulnerability to climate change for Car Nicobar

The agricultural vulnerability map of Car Nicobar was prepared based on multiple parameters *viz.*, elevation above MSL, estimated sea level rise of 0.3-0.5m, soil quality / depth and land-use pattern. It is observed that about 20% of the area in Car Nicobar has high to very high vulnerability to climate change as predicted globally. Construction of soil resource, land use, and vulnerability maps and determination of the adaptive capacity for all the inhabited islands in Nicobar District are underway.

Costal Zone Studies

S. Dam Roy, Grinson George and P. Krishnan

Corals and mangroves form the two important coastal ecosystems which have an indirect livelihood relation with the fishers and farmers in the Islands. Extensive field surveys of these ecosystems were conducted across the Islands in this project. The extent of reef cover, different components of substrate, live coral percentage and the dominant species were recorded periodically from the selected sites for comparing with the spectral signatures in satellite images. Hydrographical parameters were also monitored regularly and correlated with the ecological changes in the reef environment.

Studies on Coral Reefs

Two Marine Protected Areas (MPAs) in Andaman and few reefs in Nicobar group of Islands were surveyed extensively. The MPAs were a) Mahathma Gandhi Marine National Park Wandoor which included Jolly Buoy Island, Tarmugli Island and Boat Island; b) Rani Jhansi Marine National Park which included Havelock Island, Dolphin jetty, Elephant Beach, and Radha Nagar beach. In Nicobar Islands, sites around Car Nicobar were surveyed.

In the MGMNP reef, *Porites sp., Acropora sp., Echinophora sp.* account for more than 60% of the corals (Fig.11). The other species include *Stylophora sp., Astreopora sp., Pavona sp., Leptoseries sp.,Gardineroseris sp.,Coeloseris sp., Fungia sp., Ctenactis sp., Cycloseries sp., Herpolitha sp., Galaxea sp., Pectinia sp., Lobophyllia sp., Symphyllia sp., Merulina sp., Leptoria sp., Oulophyllia sp., Montastrea sp., Diplostrea sp., Leptostrea sp., Cyphastrea sp., Euphyllia sp., Turbinaria sp.*

In the RJMNP reef, *Porites sp., Acropora sp., Favites sp.* account for more than 75% of the corals (Fig.12). The other species include *Seriatopora sp., Stylophora sp., Astreopora sp., Psammocora sp., Pavona sp., Leptoseries sp., Gardineroseris sp., Coeloseris sp., Pachyseris sp., Fungia sp., Ctenactis sp., Herpolitha sp.,*

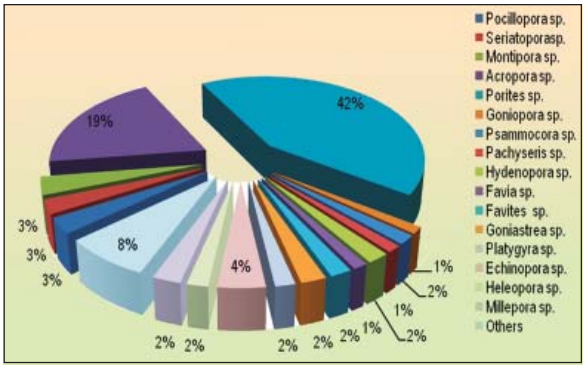


Fig.11. Percent cover of Mahatma Gandhi Marine National Park, Wandoor

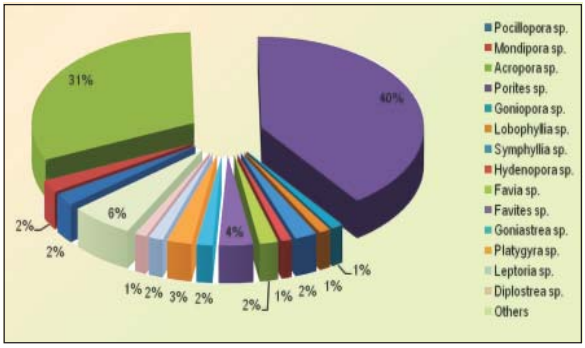


Fig.12. Percent cover of corals in Rani Jhansi Marine National Park, Havelock

Galaxea sp., Pectinia sp., Merulina sp., Plerogyra sp., Oulophyllia sp., Montastrea sp., Leptostrea sp., Cyphastrea sp., Echinopora sp., Euphyllia sp., Turbinarea sp., Helleopora sp., Millepora sp.

Studies on Mangrove biodiversity

The mangroves were studied in different sites of Andaman and Nicobar Islands by quadrant survey. The major survey sites included Carbyn's Cove, Minnie Bay, Shoal Bay, Sipighat, Sipighat Junction, Dhanikari, Chouldari, Luha barrick, Wandoor, Beedna bad, Barmanalla, Chidiatappu, Havelock, Neil Island and Baratang in South Andaman; Kadamtala, Porlobjig creek, Yerrata, Rangat Bay and Betapur–RRO in Middle Andaman; Mayabunder, Dhanapur, Karmatang, Austin Creek, Kalighat Creek, Ariel Bay, Durgapur and Basataka in North Andaman; Hut Bay, Harbinder Bay, Butler Bay and Dugong creek in Little Andaman; Car Nicobar, Kamorta, Katchal, Terressa, Magar Nallah, Donghi Nallah and Gandhi Nagar in Nicobar Group of Islands.

According to the earlier report the diversity of mangrove in Andaman and Nicobar Islands was 34 true mangrove species belonging to 17 genera, 10 orders and 13 families (though without comprehensive distribution account, description of vegetative characters and *in situ* photographs). Among them, 28 species under 15 genera have been identified during our study period. *Rhizophora* sp., *Bruguuiera gymnorrhiza* and *Ceriops tagal* are the predominant mangrove species in the islands (Fig. 13).It is noted that the *Acrosticum* sp. and *Flegellaria* sp. are commonly found in the mangrove areas with significant distribution.

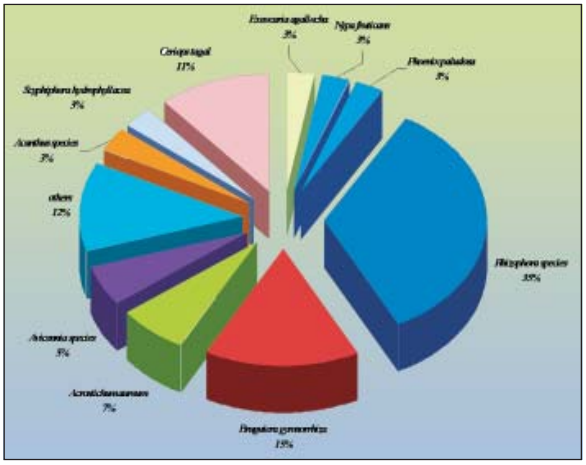


Fig.13. Percentage distribution of different Mangroves species of A&N Islands

Potential Fishing Zone Validation in Andaman Sea

Grinson George, S. Dam Roy and Kamal Sarma

Surface chlorophyll and Sea Surface Temperature (SST) is quite often correlated with the availability of fish, especially the pelagic resources. Many pelagic species are known to concentrate at current boundaries particularly in areas with sharp horizontal temperature gradients. Chlorophyll and SST images show common gradients due to inverse correlation between these two parameters and hence considered as the most important tools

in depicting Potential Fishing Zones (PFZ). The SeaWiFS Ocean colour and SST of Indian Ocean and model output of mixed layer depth / wind speed are given in Plate 9&10 respectively.

PFZ disseminations are usually intimated through fax and email by INCOIS (Plate 11). Validation was preformed for each PFZ advisory and inferences were drawn after the validations. The team could improve the understanding of Andaman Sea for the sustainable development of marine fishery resources and thereby improving the livelihood of coastal people. The issues related to PFZ data utilization in the Islands included the remoteness of predicted zones from the traditional fishing grounds and inaccessibility due to current patterns.

Electronic Display Boards were installed successfully at Junglighat, Rangat and Hut bay in collaboration with INCOIS and the directorate of fisheries. This improves in the faster dissemination of PFZ advisories generated at INCOIS. The EDBs provide ocean state forecasts, wind speed, tsunami warning and related information for the advantage of fishermen.

A critical analysis of the fish landings at the PFZ area and non-PFZ area revealed that PFZ data-guided fishing increases fish landings up to three folds (Table 5).

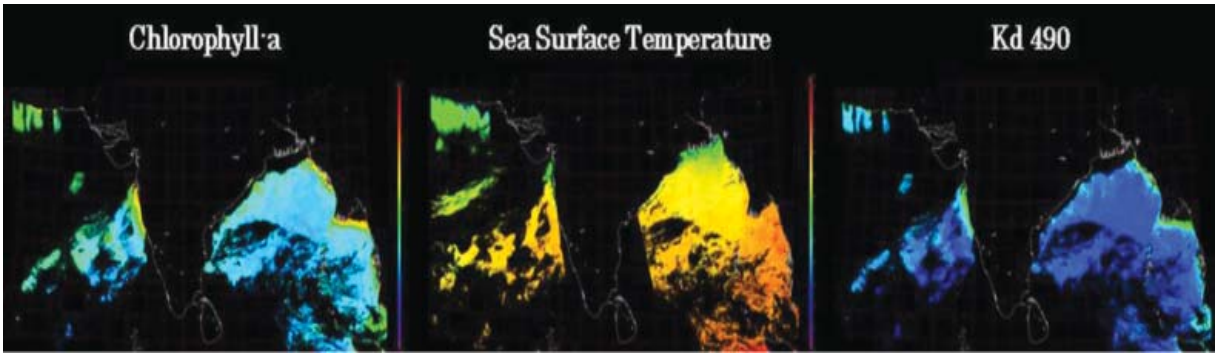


Plate 9. Sea WiFS Ocean Colour and SST of the Indian Ocean Region used for PFZ forecast

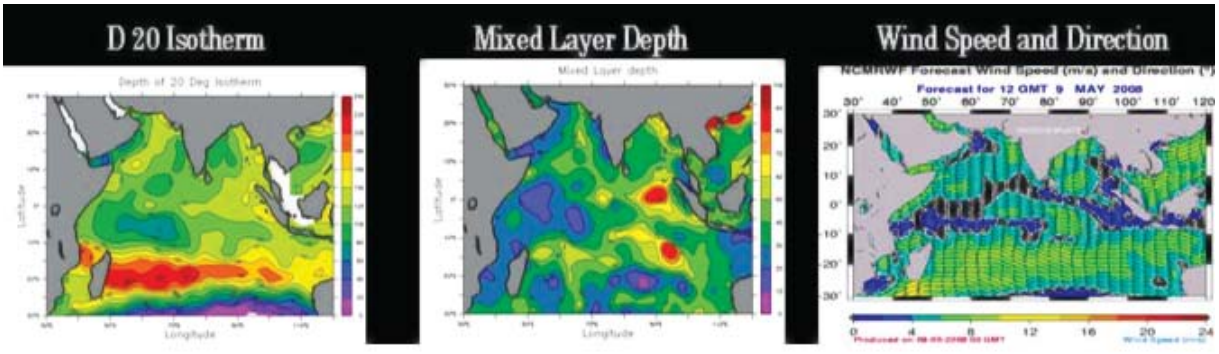


Plate 10. Model output of mixed layer depth, wind speed and direction for PFZ prediction

Table 5. Summary of results on the interventions under PFZ project

No.	Lat-Long. of Prediction of PFZ	Name of the Place	Avg. catch (kg)		Craft & Gear used	Major catches
			PFZ area	Non-PFZ area		
1	7 06 29.21 N 93 29 58.81 E	Kabra Pt	150	100	Gill net, Hook & line	Mullet, Chanos sp., Jack fish, *Sardinella sp, Rasterelliger sp, Carangoides sp, Epinephelus sp, Tuna sp, Siganus sp., Scarus sp.,*
2.	7 06 29.21 N 93 29 58.81 E	Kabra Pt	200	150	Gill net, Hook & line	*Sweetlips, Goat fish, Leiognothus splendeus, flat fish, Sea bass, Lethrinus sp., Hilsha ilisha, Anodontostoma sp., elabps, megaleps, shark, snappers, Ray fish, hemirampus, eel, Lutjanus sp. Sphyraena sp.* etc.
3	13 17 47.71 N 93 10 17.07 E	Mayabunder	100	50	Gill net, hook & line	*Sardinella sp., Rasterelliger sp,*Mullet, *Carangoides sp, Siganus sp.,*Lutjanus sp., *Epinephelus sp,* Shark
4	13 20 23.82 N 93 09 22.36 E	Diglipur	75	30	Gill net Hook & line	*Liza sp., Rastrelliger sp., Sardinella sp., Anodontostoma sp., Carangoides sp., Decapterus sp., Gerres sp., Toxotes jaculatrix, Epinepheleus tauvina, Epinepheleus malabaricus, Epinepheleus caeruleopunctatus, Alectis indicus, Trachyurus sp., Lutjanus sp.,* and *Atule mate*
5	13 27 09.73 N 93 10 56.15 E	Landfall light House	150	40	Gill net and Hook & Line	*Sardinella sp., Rasterelliger sp, Epinepheleus sp.,* Groupers, Snappers, *Carangoid sp*

ANDAMAN ISLANDS
अन्दामान द्वीप
Satellite Data shows likely availability of Fish Stock till December 07, 2009
उपग्रह आकड़ों से December 07, 2009 तक की संभावित मत्स्य भंडार की उपलब्धि।

From the Coast of कि समुद्र तट से	Direction दिशा में	Angle in Degrees कोण (डिग्री में)	Distance in Kilometres दूरी (किलो मीटर में)		Depth In Metres गहराई (मीटर में)		Latitude / Longitude रेखांश / अक्षांश
			From कहाँ से	To कहाँ तक	From कहाँ से	To कहाँ तक	
Landfall Lt H लेन्डफॉल लाईट हाऊस	--	--	--	--	-	--	--
Narcondam नारोन्डैम	--	--	--	--	-	--	--
Diglipur दीग्लीपुर	--	--	--	--	-	--	--
Mayabubunder मायाबुन्दर	--	--	--	--	-	--	--
Elphinstone Hr Lt H एल्फीन्सटोन हेड़ लाईट हाऊस	--	--	--	--	-	--	--
Barren बारेन	--	--	--	--	-	--	--
Neill Island नील आईलेन्ड	--	--	--	--	-	--	--
Port Blair North Pt पोर्ट ब्लेयर उत्तर पी टी	--	--	--	--	-	--	--
Mt Haughton माउन्ट हाउघटोन	--	--	--	--	-	--	--
Rutland Lt H रुटलेन्ड एल टी एच	NW	293	93	98	-	--	11 41 35.87 N 91 48 38.08 E
Cinque Lt H चिन्कुए लाईट हाऊस	--	--	--	--	-	--	--

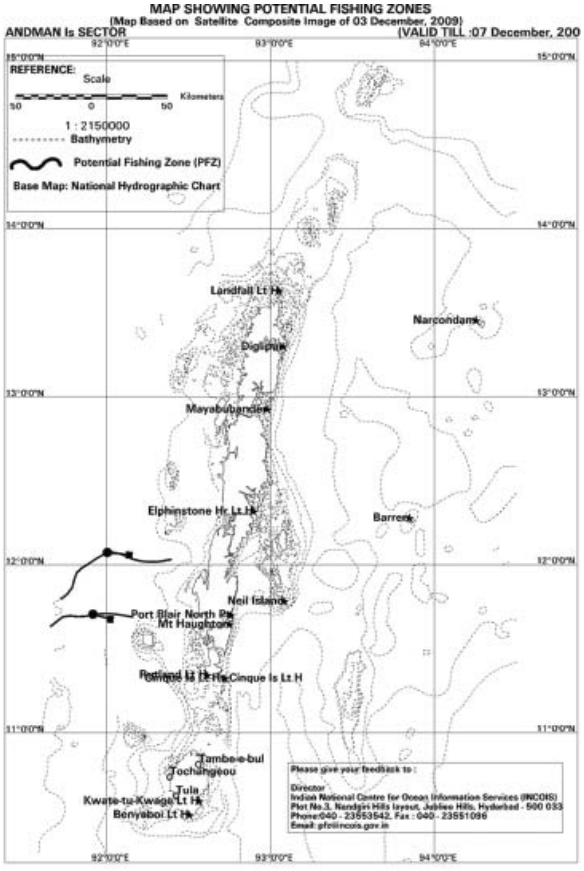


Plate 11. A sample of PFZ advisory as disseminated and PFZ map of Andaman by INCOIS

Development of Mangrove Based Agro Aqua Farming for Restoration of Mangrove Ecosystem and Livelihood Through Community Farming in Andaman Islands

S. Dam Roy, Alok Saxena, P. Krishnan and Grinson George

Project Co-ordinator: R.C. Srivastava

Andaman and Nicobar Islands are jotted with a number of creeks fringed with lush-green mangroves. The mangroves act as nursery ground for a wide range of aquatic flora and fauna in the interface of terrestrial and marine ecosystem and thus ensuring food security. They are of great importance to the islands as natural sea defence. The project was conceived in order to explore the possibility of using the mangrove ecosystem as a livelihood option for the residents of the coastal fisherman. The proposal also helps in the protection of the mangrove forests which otherwise are exploited for other agricultural purpose.

A survey was conducted on the different mangrove stands in South Andaman with respect to the species distribution and soil and water quality in order to determine the suitability of site for establishing a tide-fed pond adjacent to mangroves. It was found that in the survey sites *viz.*, Manjeri and Wandoor, the dominant specie were *Bruguiera gymnorhiza, Rhizophora apiculata* and *Acanthus illicifolis.* Considering the issues in taking up civil works in areas adjacent to mangroves and the parallel activities of the development departments in the selected areas, a demonstration farm was developed adjacent to the creek in Sippighat within the Brackishwater Farm complex of CARI. The model has two ponds with provision for water exchange according to tide level and a mangrove nursery bordering the ponds. Two ponds measuring 15x20m in size and the creek side were strengthened with boulders.

A make-shift nursery has been established in the farm area (Plate 12). About 600 mangrove wildlings of *Bruguiera gymnorrhiza, Rhizophora apiculata, Acanthus ilicifolius* collected from the nearby Sippighat, Guptapara and Manjery forest areas, and 100 *Rhizophora* saplings obtained from the forest department were planted at 30cm distance covering the whole make-shift nursery area. The pond preparation has been completed and tiger shrimp seeds would be stocked in the ensuing period.

A pilot study was conducted in two areas in South Andaman *viz.*, Sippighat and Wandoor, to study the socio-economic status of the local populace inhabiting adjacent to the mangroves. Altogether 26 families in Sippghat and 31 families in Wandoor were covered in the study. Most of the inhabitants in Sippighat were found to be engaged in private business or jobs while a majority of the people living adjacent to the mangroves in Wandoor were engaged in fishing related activities. The study revealed that the mangrove has an intrinsic role to play in the livelihood of these people as a source for fire wood, timber, etc and also as potential fishing grounds. The awareness on the importance of the mangroves among the

Plate 12. Mangrove make-shift nursery established under the project

people was reasonably good with majority of them recognizing the importance of mangroves as for natural defense, flood control, scenic beauty, etc.

As a part of the project, awareness camps have been conducted for the school children and teachers in collaboration with CP Ramaswamy Environment Foundadation, Chennai, in order to sensitize the local inhabitants on the importance of sustainable utilization of the mangroves. Training programmes have been conducted for the benefit of the farmers in the areas of brackishwater aquaculture and value added fish production.

Social Science Section

An Economic Analysis of Floriculture and Vegetables Potential in Andaman and Nicobar Islands

Subhash Chand, D.R. Singh, R.C. Srivastava and Sharwan Singh

The data on prices of different vegetables, market channels involved, market margins were collected from Port Blair, Bathu Basti and Golghar markets from producers, sellers and consumers. Analysis of price behavior of vegetables in A&N Islands was carried out during 2009-10. The prices of vegetables showed volatile behaviour and they were directly affected with the mainland market prices. There was big gap between producer's price and consumer's price in these islands in the vegetable market. Mainly three market channels producer to consumer, Producer to Retailer to consumer and Producer to whole seller to retailer to consumer were identified in these islands. The analysis of distribution of vegetable areas in different Islands revealed that main production hubs are Diglipur and Rangat Islands. The total area is about 3800 ha. under vegetables in different islands i.e. Diglipur (1468.08 ha) followed by Rangat (1000 ha) and South Andaman (700 ha).

Inter Islands price variations for vegetables:

The data on vegetables' price variations were collected from Port Blair, Diglipur and Niel Island markets. As is evident from the table 1, at Port Blair market, prices of vegetable were higher as compared to Diglipur and Niel Islands due to the fact that Port Blair being urban area with high population concentration is the consumption centre where as Diglipur and Niel islands are the production centres having poor market infrastructure. In case of Potato and Onion, it was reverse because these vegetables are mainly imported from mainland and Port Blair being the importing centre, receive these vegetables first and incur less transportation cost.

Table 1. Inter Islands price variations for vegetables

Name of vegetables	Market price at different Islands (Rs/kg)		
	Port Blair	Diglipur	Neil
Tomato	15- 40	10-50	5-45
Okra	10-25	8-20	7-15
Brinjal	10-30	8-20	8-15
Cauliflower	30-60	15-70	25-65
Cabbage	25-40	15-50	20-45
Potato	15-30	20-40	20-35
Onion	20-40	25-50	25-45

The prices of almost all vegetables in Port Blair market start falling in December month and remain low up to March which again starts rising. This all depends upon local availability.

Vegetables price variation in Port Blair and Mainland

It is evident from table 2 that there was a big difference in the prices of different vegetables paid by the consumer in Port Blair and main lands. The price for all the vegetables in Port Blair market was higher as compared to Chennai, Kolkata and Delhi market. These islands mainly depend on the supply of vegetables from Kolkata and Chennai. The prices of vegetables were much lower in these markets than Port Blair. It was found that in Port Blair market prices were high in the range of 43 to 127 percent for brinjal, 25 to 233 percent for capsicum, 389 percent for cauliflower and 567 to 700 percent higher in the case of cabbage. Similar trend was notice in the case of onion, tomato and potato also. Thus, to reduce the consumer price for vegetables, the vegetables have to be cultivated locally. Therefore, introduction of improved varieties, protected cultivation and improvement in market infrastructure may help overcome the problem.

Table 2. Comparison of Vegetables price variation in Port Blair and Main Lands

Vegetable	Price variation of vegetables (Rs.)			
	Port Blair	Chennai	Kolkata	Delhi
Tomato	15- 40	05-11.7	06-14	4.5-11.5
Brinjal	10-25	07-11	04-15	04-14
Onion	15-30	03-13	05-16	04-08
Potato	15-30	07-11	06-16	04-12
Capsicum	25-100	20-30	20-35	25-40
Cauliflower	30-60	07-14	6.5-15.5	03-12.5
Cabbage	20-40	03-05	04-06	04-06

Identifying Livelihood Options and Training Needs Compatible to Self Help Groups to Fructify these Options

S.K. Zamir Ahmed, Subhash Chand, M. Balakrishnan and R.C. Srivastava

The scenario of credit linkage of SHGs in North & Middle Andaman (having men & women and mixed group) & Nicobar District (women group only) accounts for 26 and11.59 percent respectively which is very less as compared to the South Andaman

District (36.0%) .The saving & credit linkage relationship of the selected six leading self help group promoting agencies (SHGPA) revealed that National Cooperative Union of India had the maximum credit linkage i.e. 50.81 percent followed by Yuva Sakthi (38.94%), Unnati (33.75%), CARE India (33.16%), SURABI (22.33%) and ACANI (21.65%) respectively. A total of 50 samples were randomly selected from these six leading SHGPA working at Diglipur, Rangat, Mayabunder & Campbell which revealed that maximum of the respondents in the groups were young but not enterprising, had middle level of education and practiced non agriculture occupation i.e. petty income generating activities (IGP) mainly due to lack of proper information on the profitable livelihood options in agriculture & allied fields. They could earn an annual income to the range of Rs. 20,000 to Rs. 50,000. The strength of members of the groups was 10.48 which was apt for better coordination and group dynamism. They were having low level of economic motivation, scientific orientation and medium level of risk orientation and innovativeness. Further the average loan amount with the credit linked SHGs were in the tune of 0.36 to 0.95 lakhs which was although enough to start any self employment enterprise in agriculture & allied fields but not enough to sustain the business (Table 3).

Table 3. Average loan per credit linked SHG

Agency	Saving Mobilized (in Lac Rs)	Bank Loan (in Lac Rs)	Average Loan / SHG (in Lac Rs)
CARE INDIA	125.68	46.13	0.36
ACANI	91.02	41.79	0.45
NCUI	281.01	267.27	0.95
YUVASAKTHI	83.55	48.86	0.58
SURABI	17.48	9.42	0.53
UNNATI	7.22	4.24	0.59

Goat farming was the choice of the maximum group members as it was very lucrative with assured market but the problems faced was non-availability of desired number of kids per unit to start the business in a profitable manner (Table 4).

Table 4. Training needs & alternative livelihood options identified

Training	Preference Ranking
Goat Farming	I
Vegetable cultivation	II
Floriculture	III
Poultry Farming	IV
Piggery	V
Mushroom cultivation	VI

Establishment of Out Reach Centre at Diglipur, North & Middle Andaman District

R. C. Srivastava & S. K. Zamir Ahmed

Under the Farmers Technology Transfer Fund (FTTF) of NABARD, CARI established an Out Reach Centre (ORC) for a period 4 years from July, 2009 at Keralapuram village of Diglipur in North & Middle Andaman District, with an objective to serve the farmers of the area leading to integrated agricultural and socio economic development of the villagers and the cluster of the villages as a whole. For the period based on the PRA, need based technological backstopping in the mode of training, technological demonstration and extension activities were planned and executed.

Training

Seven trainings for the stakeholders were conducted in agricultural and allied fields wherein 237 farmers got trained and 686 trainee days were utilized. Beside one each of Kisan Gosthi and Technological back stopping in agricultural and allied field were conducted the wherein a total of 145 beneficiaries representing from nine villages participated and benefited.

Technological Demonstration

During the *rabi* season twenty seven technological demonstrations in farmers field with seven crops namely Green Gram var. K851 (03), Black Gram var. Tel Kalai local (09), Cauliflower var. White Marble(03) and Kimaya(01), Cabbage var. BC76 (02), Chilli var. Flame Hot (02), Tomato var. Lakshmi NP 5005 (03), Okra var. US-7136 (02) and Potato var. Kufri Jyothi & Kufri Surya (01) were taken up in Keralapuram, Subhash Gram, Sita Nagar, R. K, Gram, V.S. Pally, Rabindra Pally, Khudirampur and Desh Bandhu Gram of Diglipur Panchayat . The area of demonstration ranged from 0.01 To 0.40 ha covering a total area of 4.45 ha. The performance of the interventions along with

its maximum, minimum and percentage increase of yield over the local check (even after the receipt of 224.08 mm of rainfall (4 rainy days) in the month of January 2010 i.e the harvest period of most of the crop) is manifested in the Table 5.

Table 5. Performance of Technological Demonstration (*Rabi* Crops) in Farmer's Field

Crops	Variety	Area of Demonstration (in ha.)	Demonstration (Nos)	Yield (q/ha)			Local check / Yield (q/ha.)		% increase in yield
				Min.	Max.	Mean	Variety	Yield	
Chilli	Flame hot	0.042	02	87.5	112.5	100	Fair bomb	85.51	16.94
Cabbage	BC 76	0.15	02	437.5	462.5	450	Blue bandies	420.00	7.14
Cauliflower	White Marble	0.105	03	362.5	462.5	400	Karuna	320.00	19.07
	Kimaya	0.042	01	393.75	-	394	Karuna	360.00	9.4
Okra	US-7136	0.05	02	50.00	62.5	56	Arun	42.00	33.3
Tomato	Lakshmi	0.14	03	125.00	156.25	140	Karan	110.00	27.27
	NP 5005								
Green gram	K851	0.3	03	5.31	6.9	5.93	Local	4.25	41.17
Black gram	Tel Kalai	3.6	09	6.25	15.62	11	Jhad Kalai	08.00	39.52
	local								
Potato	K. Surya	0.01	01	-	-	81.25	Local	20.00	306.2
	K. Jyoti	0.01	01	-	-	18.75	Local	8.00	134.37
Total		**4.45**	**27**						

Extension Activities

Exposure visit

For the first time a group of thirty six farmers i.e. 31 male and 5 females from 10 different villages of Diglipur under the aegis of ORC, attended Kisan Mela on the theme " Livestock and Poultry Farming for Decent Livelihood" from 8th to 11th February, 2010 at CARI, Port Blair. During the period they attended Kisan Gosti, Kullah Manch , Farmers quiz and training at KVK. Knowledge through video films on Integrated Farming System, Poultry Farming, Broad Bed and Furrow System, Goat Farming, Pig Farming and others were also imparted. The farmers got address their field problems addressed and were happy by the quick response by the team of scientists. Few farmers also shared their experiences during the session.

Field Visit(s) by the Scientist /Experts

Fifty six (56) visits were made to farmers field to monitor the incidence of disease in pulses, germination of potato , performance of tomato, chilli , cauliflower and selection of farmers, youth for imparting knowledge and skill level training.

Farmers visit to ORC

One hundred and sixty eight (168) farmers visited ORC with the purpose to read the technical bulletin, to get knowledge on PoP on pulses and other crops, discussed on pest and disease management in brinjal, ongoing training programmes from R.K. Gram , V.S. Pally, Subhash Gram, Khudirampur, Aerial Bay, Sita Nagar and Keralapuram villages.

A Telephonic Advisory Service was started on 6th February 2010

During the reporting period up to 31st Mach, seven farmers approached the Scientists of host institute over phone on the problems faced on the crop viz., banana, ginger, pulses, brinjal, cucumber and coconut from three villages.

Development of Artificial Neural Networks (ANN) Based Forecasting Model for Studying Varieties Diversity, Yield snd Production in Prominent Rice Cultivars of Bay Islands

M.Balakrishnan, N.Ravisankar, Subhash Chand, R.C.Srivastava, S.K Zamir Ahmed, Krishna Kumar and T.V.R.S. Sharma

The aim of this study is to investigate the important factors that influence rice production, especially the different treatments and different method, and also to understand the potential of ANN in forecasting task of rice yield The observations of different treatments such as rice varietals spectrum in the different islands, weather parameters, yield components, soil parameters and pest and disease index for the period of 31 years from 1971 have been collected from the basic records of experimental field of Central Agricultural Research Institute and developmental departments, Port Blair. In order to assess the dependability, weather and crop data from basic records were subjected to co efficient of variation analyses. Field data related to rice production were subjected to construct

training set and testing set for ANN learning process. The architecture of the ANN chosen for study consists of three layers viz., an input layer, a hidden layer, and an output layer involving a multi- layer feed forward network with a single hidden layer. The activation function used both in hidden layers and the output layer is a nonlinear function, where as the input layer, no activation function is used since no computation is involved in the input layer. Information flows form one layer to other layer layer in feed forward manner. The weights of the various connections in the neural network are initially chosen randomly. Then the weighted sum of the inputs is calculated for each processing neuron.

ANN's of each model were trained and tested. Each ANN was trained until the Mean Square Error (MSE) decreases and reaches 0.01 or the number of iteration exceeds 10,000 when the training session stops. The MSE is the summation of the square of the difference between the desired and actual outputs of the network for the entire training pattern. Then the testing set will be presented to the trained ANN in order to determine the accuracy of the forecast.

N.B: MSE = ½ Σ (E (p)-X (p))^2

Where 'E (p)' is the desired output and 'X (p)' is the actual outputs.

The forecast outputs trace the actual production very well for all levels of rice yields in those years used in the experiment. It can be concluded that the ANN has high potential for the application of Rice yield forecast. The training set and testing set are created according to inputs of ANN model. Training set such as rice varietals spectrum in the different islands, weather parameters (month wise, Week wise and year wise), yield components, soil parameters and pest and disease index and yield which was selected according to structure of model. It was observed that data set for the experiment contains wide variation of rice yield, which will help in evaluation of potential of the ANN in forecasting rice yield.

Preliminary ANN model for phase I comprising one variety (C14-8) of South Andaman is presented in Fig. 1 (Weather parameters with yield which using weekly, Monthly and Yearwise weather) which indicates the predicted yield coming much closer to actual values wather with monthwise,weather. However, the estimated ANN model needs to be tested with more data sets.

On the basis of the ANN model, results of the experiment, it is observed by chi-square

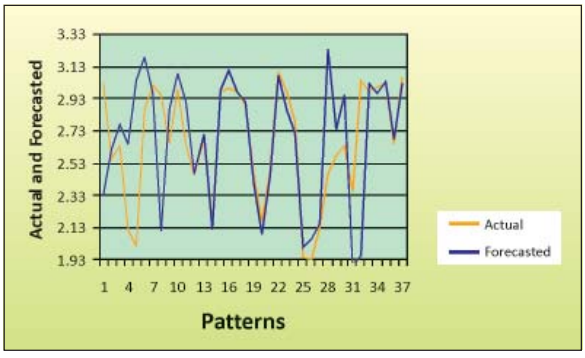


Fig. 1. ANN model for prediction of rice yield for C14-8(Actual and Forecast)

($\div^2$) test that there is interdependency between the actual and expected yield. Since the computed values of $\div^2$=0.99 is less than the table value of $\div^2$ 21.666, for 9 degrees of freedom at 1 per cent level of significance there is no significant difference between the actual yield and expected yield.

Development of Database on Fodder Resources and Waste Land in Bay Islands

M. Balakrishnan, S.K.Verma, S.Jeyakumar, N. Ravisankar, A.Kundu, Subhash Chand, S. K. Zamir Ahmed and R. C. Srivastava

The Andaman and Nicobar Islands comprise chain of more islands in addition to a number of islets and rock outcrops in the Bay of Bengal. Perishable commodities, such as vegetables fruits and animal products (milk, meat and egg) have to be procured from mainland India and are always in short supply. In the livestock sector, the major constraints are less population, poor germplasm and poor productivity due to shortage of feed and fodder resources. The dairy animals especially the local cows and buffaloes yield on an average 1.5 and 2.0 l/ day of milk, respectively. The reasons for this low productivity are 'desi' or non-descript breeds; local climatic factors conducive for disease and parasites and above all there is lack of assured round the year availability of fodder in ample quantities. However there are about 112 species of fodders have been documented in A & N Islands. Before chalking out the possible strategies and plans, information on current status of local grasslands and pastures; local natural resources including vegetation, soil, land and climate; inherent constraints of geographical remoteness, geological past, socio-economic setup, weather elements all must be born in mind. The present attempt is to summarize all such related information at one place, so as to facilitate planning processes. Based on the empirical observations on the performance of various types of exotic and indigenous fodder resources, under local rainfed conditions over last many years, a comprehensive fodder information resources database has been designed and developed. The details regarding various aspects of fodder resources regarding their family, habitats, crop, rainfall period, distribution area, climate and scientific names management practices etc. were collected and documented. This database design is user friendly and provides all the information about fodder resources for the end user viz. research, academic, development and administrative departments. Primary and secondary data about the fodder resources of Andaman and Nicobar group of Islands were collected through survey under various projects (Fig. 2 - 8).

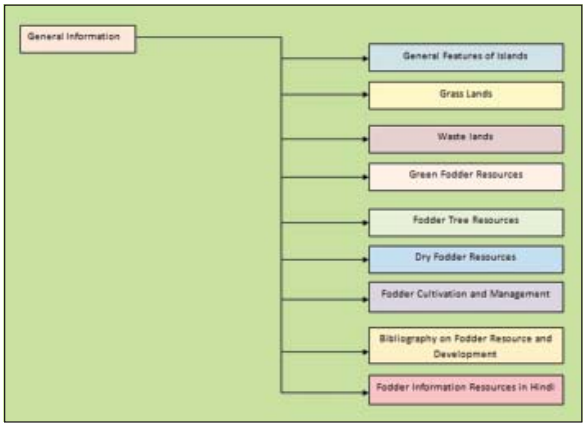


Fig 2. General Information about A & N Islands

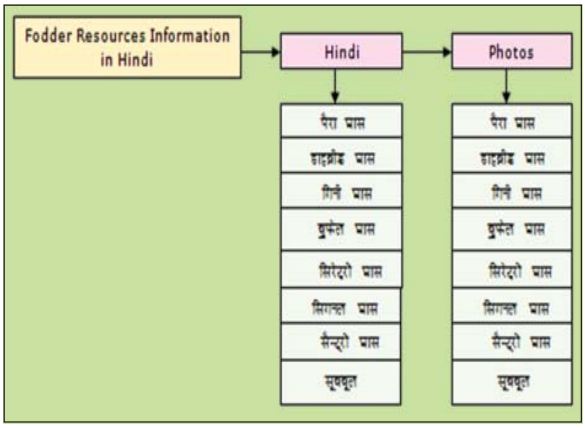


Fig 5. Hindi informations

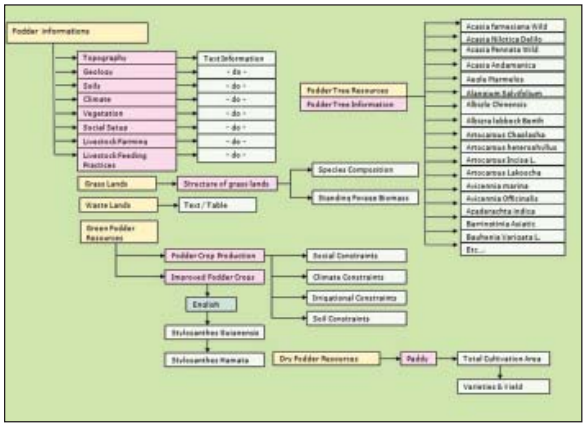


Fig-3. Database design

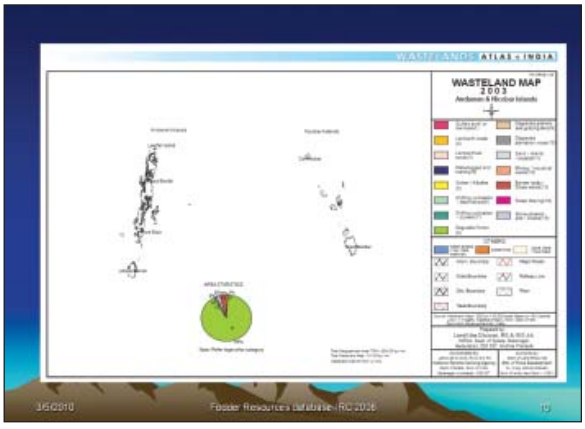


Fig 6. Waste land of Andaman & Nicobar Islands

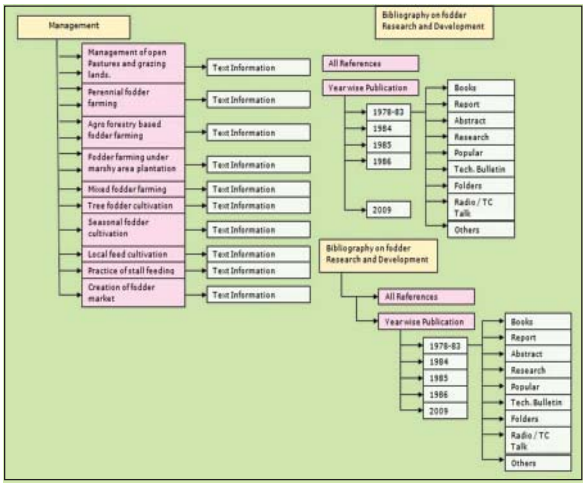


Fig 4. Management practices

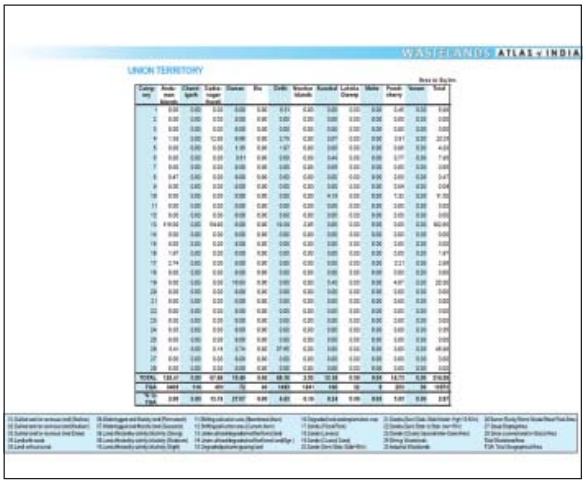


Fig 7. Waste land information

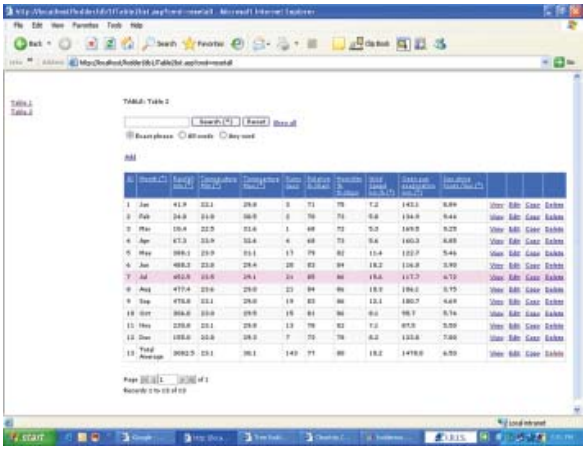


Fig: 8. Database of fodder resources

The database aimed at developing the website fodder Resources of Andaman and Nicobar Islands which would provide its users good quality and ample information regarding the fodder resources of these islands. The database was designed in MySQL at the blackened and the interface was created using adobe dream weaver in HTML. The webpage interface was interactive and was designed keeping general public in mind for easy access of their desired data. The database was very rich and up-to-date with information from latest Island wise statistical census and other data from CARl and development department.

The collected data has been entered in definite format. Tables & templates were created using MS access and HTML respectively.

Development of database and layout

The database development was aimed at developing the website - FIRBI - Fodder Information Resources of Bay Islands. The website will prove to be a databank of fodder resources of these islands and will contain information like general information, family, habitats, crop, rainfall period, distribution area, climate, scientific names and management practices. The FIRBI website will provide the administrator to create users with permissions to access the data of their respective area of work. The website is targeted to a wide range of user which includes department of Animal Husbandry and Veterinary Services, policy makers, Scientists and public (Fig. 9 & 10).

Fig: 9. Main Page of the fodder resources

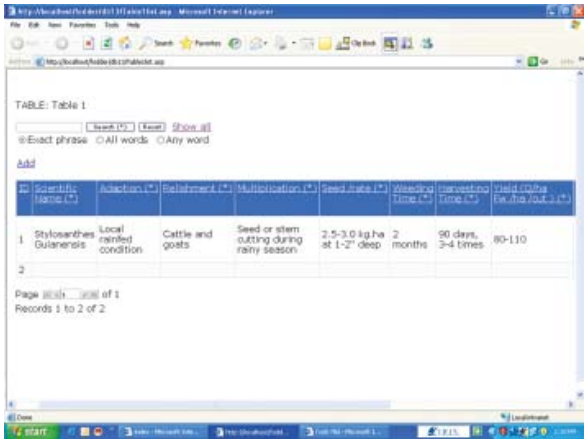


Fig:10 . Database of fodder resources (English)

Database developed for fodder Resources of A & N Islands has the main page which comprises links to general information, statistics of A &N Islands and fodder resources (Fig. 11).

The fodder database is rich in information. It comprises of general information about A & N Islands, fields for fodders. Once logged on, the user will get access to the entire database regarding different fodder resources in these islands. The database page provides general information, fodder resource information research and publication. The fodder resource information page is divided into seven categories namely general feature of the islands, status of grassing lands, fodder tree, constraints to fodder, managements, references and improved fodder crops. Each of these categories comprises of links to fodder belonging within each category which will take the user to the well furnished database which has been developed PHP programming.

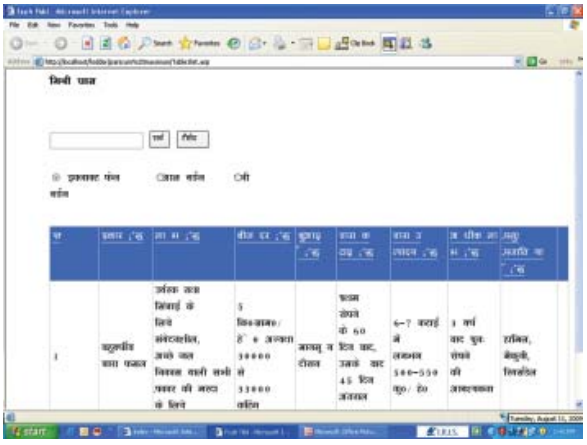


Fig:11. Database of fodder resources (Hindi)

It is needless to state that fodder resources play an essential role in agricultural economy. The future improvement and development of fodder for agriculture is dependent upon the availability of genetic variation, which is its principal resource. When compared to Indian mainland, very limited variety of fodder is found in these islands. We need to conserve and simultaneously exploit this potential resource in a sustained manner to meet out the Islands demand. This database design is user friendly and provides all the information about fodder resources for the end user viz. research, academic, development and administrative departments. This database can be updated on a regular basis, so that it would provide current status about the fodder resources.

Establishment of Sub- Distributed Information Centre (DBT)

M. Balakrishnan

The main mission of the Bioinformatics Centre, CARI is to create the awareness about bioinformatics and its applications to the islanders and develop databases on Biodiversity of Andaman & Nicobar Islands, which would provide information to taxonomists, ecologists, biodiversity management specialists, policy makers, planners & related entrepreneurs to store, manage, and exchange electronically published scientific information in standard

format. It also serves as an active site for bioinformatics research and development in the remote union territory of Andaman and Nicobar Islands. The following activities have been carried out during the year.

- Developed Software/Tools on :
  - BioSAT : Biological Sequence Analysis Tools
  - PathoSys: Plant Disease resist information systems.
  - RNA Secondary Structure Prediction Tool
- Database on Algae resources and Coral reef Fish has been developed.
- In silico protein modeling of translational elongation factor 1-Alpha of *phytophthora palmivora* and docking studies by Benzimidazoles compound model has been developed.
- Docking Studies of 5 Zanamivir analogues over the enzyme neuramindase from H1N1 avaian Influenza virus in the Treatment of Avian Flu.
- Updated and maintained the existing databases of bioinformatics centre.
- Developed website for Bioinformatics Centre which is updated regularly
- CARI Website has been developed/ updated with the help of Dream weaver and ASP.Net
- Guided students for project works in the discipline of M.Sc (Bioinformatics), M.Sc (Biotechnology) and B.E./B. Tech.

Krishi Vigyan Kendra

Training

Fifty one training programmes for the benefit of practicing farmers, rural youths and extension functionaries were conducted wherein 1078 beneficiaries (683 Male and 395 Female) in agriculture and allied disciplines got benefited. 13 numbers of Front Line Demonstration (FLD) in agriculture and allied disciplines covering paddy, maize, black gram, green gram, ground nut, sweet potato, duck, turkey, pig, composite fish culture, integrated fish farming, brackish water shrimp culture and cat fish culture were conducted. 5 numbers of On Farm Trial (OFT) at farmers field were conducted to assess and refine the selected technology on agriculture and allied fields. Integrated farming system both in fresh water and brackish water has been introduced under cost effective farming system for decent livelihood. Different extension tools like exhibition, field days, farmers visit, TV shows, campaign, diagnostic visit, Scientist farmers interaction, radio talks, Kisan Mela were used to popularize the technologies. Summary of training programmes is presented in table 6.

Table 6. Training programmes

Thematic Area	Training	Participants		
		Male	Female	Total
Practicing Farmers/ Farm women				
Crop production	8	116	64	180
Horticulture	7	120	27	147
Livestock Production and Management	6	70	68	138
Agrl. Engineering	6	73	18	91
Fisheries	5	86	43	129
Home Science	2	3	42	45
Rural Youth				
Crop production	3	40	27	67
Horticulture	3	37	29	66
Livestock Production and Management	1	12	7	19
Agrl. Engineering	2	41	1	42
Fisheries	2	42	4	46
Home Science	2	0	50	50
Extension Personnel				
Crop production	2	27	6	33
Livestock Production and Management	1	8	7	15
Fisheries	1	8	2	10
TOTAL	51	683	395	1078

Front Line Demonstrations (FLD)

- On Integrated Nutrient Management for Paddy were conducted in five farmers field of Guptapara, Memyo, Indiranagar, Badmaspahar and Brindavan villages of South Andaman. The results indicate an average yield of 3.88t/ha, which was 25.16 percentage higher over the local variety.
- Demonstration on Paddy variety of MLT-10 was conducted in two farmer's field at Guptapara and Memyo village of South Andaman. Result indicated that maximum of 4.47t/ha was recorded in farmers field with an average yield of 4.26t/ha which was 15.1 % higher than local check.
- FLD on Maize (Shakti) was conducted in five farmer's field at Namunagar, Shoal Bay, Guptapara and Indiranagar. Average yield of 3.72t/ha was recorded which was 18.5 % higher than local check.
- Groundnut variety ICGS 76 was demonstrated in six farmers' field at Calicut village, in 10-12 years old

coconut as well as 1-2 years old coconut plantation. The lowest yield of 1,000 kg/ha was recorded in 10-12 years old, whereas the highest yield of 2,750 kg/ ha was obtained in younger plantation of 1-2 years old.

- FLD on pulses viz. Black gram (ADT 3) and Green gram (CO 6) have been demonstrated in farmers field at Guptapara, Manglutan, Ograbraj, Ferrar Gunj and Shoal bay villages of South Andaman. An average yield of 6.34 q/ ha and 7.40 q/ha was recorded in Black gram and Green gram respectively.
- FLD on Sweet Potato with variety CARI SP-I and CARI, SP-II were taken up in South Andaman villages, i.e. Namunaghar, Chouldari and Memyo. CARI SP-I performed better and gave a yield of 21.01 t/ha followed by CARI SP-II 19.91t/ha over the local check Bidhan jaganath 13.4t/ha.
- Three demonstrations on duck farming were conducted at Guptapara, Wandoor and Chouldari with 60 nos. Khaki Campbell ducks. The ducks recorded higher egg productions of 245 eggs/year over the local check 160 eggs/year.
- One demonstration on Pig farming was conducted at Memyo village with 4 piglets wherein the pigs attained an average body weight of 78 kg/animal over the local check of 68 kg/animal.
- One demonstration on Turkey (broad breasted white) was conducted at Namunaghar village with 20 birds. The birds attained average 7.5 kg/ bird in 20th week of age.
- Five demonstrations on composite fish culture were conducted in five irrigation ponds (0.08 ha each) with stocking ratio of 3:4 : 3 (Catla, Rohu and Mrigal). The average yield was 145 kg over the local check of 88 kg.

On Farm Trials (OFT)

- OFT on Evaluation of high yielding long duration paddy varieties during wet season was conducted in randomized block design with 6 replications. The results revealed that among the four varieties tested. Root dry weight of Ranjit was recorded significant (13.5g/hill), which was on par with Savitri (13.3g/hill). Higher number of productive tillers of 18.9 tillers/hill and 103 no. of filled grains per panicle was registered in Ranjit variet followed by Savitri which recorded 15.1 and 96.4 productive tillers per hill and no. of filled grains per panicle respectively. No significant difference was recorded in test grain weight. Ranjit registered significantly higher grain yield of 4013 kg/ha which was no par with Savitri (3907 kg/ha) followed by Varsha (3574 kg/ha). The lowest grain yield of 2207 kg/ha was recorded in C 14-8.

- An experiment on System of Rice Intensification (C14-8) was conducted during wet season at Ferrar Gunj block. The trial was laid out in randomized Black design with seven replications at Brindaban and Ferrar Gunj villages of South Andaman. Maximum number of 20.7 productive tillers/hill was obtained with SRI method, which was significantly superior than that of 20 x 15 cm. While, significantly the lowest number of 14 productive tillers/hill was observed under farmer's method of planting. Panicle weight (2.86 g), numbers of grains/panicle (98) were registered higher at the spacing of 25 x 25 cm in SRI method. The difference in test grain weight was not significant due to method of planting. Significantly higher grain (2850 kg/ha) and straw yield (7555 kg/ha) was recorded with SRI planting followed by recommended practice of 20 x 15 cm. SRI method of planting led to 13.1 % and 30.7 % higher yield than other method of planting.

- OFT on evaluation of disease resistance high yielding varieties of okra was conducted at farmers field using three varieties namely Pusa Sawani, Arka Anamika and Prabhani Kranti. The Arka Anamika recorded highest yield of 69.8t/ha followed by Prabhani Kranti (62.9 t/ha).

- OFT on evaluation of improved poultry strain under backyard poultry production system with local desi bird, Vanraja, Nicorock and Nishibari was conducted in Chouldari and Namunagarh. The body weight recorded at maturity revealed higher in Vanaraja (2900.00 ± 34.79) followed in Nicorock (1483.83 ± 22.72) and lowest recorded in desi bird (1275.87 ± 24.91). The highest annual egg production recorded was 164.00 ± 0.40 in case of Nishibari birds followed by 141.58 ± 0.28 in Nicorock and the lowest in desi birds 89.75 ± 0.46.

- OFT on evaluation of growth performance of Indian Major Carp was conducted with four technical options viz. Farmers practice (no feeding), organic (lime + cow dung), organic + inorganic (lime + cow dung + SSP) and feed + lime + cow dung + SSP. Highest yield was recorded (347 g) at the age of 90 days in technical option 4 (feed + lime + cow dung + SSP) followed by 258 g in technical option 3 (lime + cow dung + SSP). Lowest yield of 144 g recorded in technical option1 (no feeding).

Extension activities

Extension activities undertaken during the year is presented in table 7.

Table 7. Extension activities

Extension Activities	No.	Farmers			Extension Officials			Total		
		M	F	T	M	F	T	M	F	T
Field Day	06	62	51	113	-	-	-	62	51	113
Kisan Mela	01	-	-	2000	-	-	-	-	-	2000
Kisan Ghosthi	03	185	65	250	-	-	-	185	65	250
Exhibition	03	Many								
Film Show	35	Many								
Method Demonstrations	08	90	70	160	-	-	-	90	70	160
Farmers Seminar	03	40	25	65	-	-	-	40	25	65
Workshop	02	20	12	32	-	-	-	20	12	32
Group meetings	32	48	450	498	-	-	-	48	450	498
Lectures delivered as resource persons	25	250	72	322	-	-	-	250	72	322
Newspaper coverage	15	Published in Daily Telegram, News Paper, Port Blair								
Radio talks	05	Broadcasted in All India Radio, Port Blair								
TV talks	06	Telecasted in Doordarshan, Port Blair								
Extension Literature	11	210	125	335	-	-	-	210	125	335
Advisory Services	32	30	75	105	-	-	-	30	75	105
Scientific visit to farmers field	95	310	152	462	-	-	-	310	152	462
Farmers visit to KVK	63	167	137	304	-	-	-	167	137	304
Diagnostic visits	67	157	95	252	-	-	-	157	95	252
Self Help Group Conveners meetings	34	16	331	347	-	-	-	16	331	347

Radio talk

Sl. No.	Title	Date of Broadcast	Resource person
1.	Kali Mirchee Se Adhik Utpadan Kyse	13th July 2009	L.B. Singh
2.	Bakriyo Ki Pramukh Beemariya Va Prabandhan	18th August, 2009	N.C. Choudhuri
3.	Deepon ke liye machliyon ki upyukt kismain	19th February, 2010	Nagesh Ram

Door Darshan talk

Sl. No.	Title	Date of Broadcast	Resource person
1.	Barish ke mausam mein Amruth ke Bageche kee dekhbal	29th August, 2009	L.B. Singh
2.	Sapota cultivation in Islands	7th September ,2009	L.B. Singh
3.	Intercropping of Fruit Crops	26th February, 2010	L.B. Singh

Linkages & Collaboration with other departments

KVK has developed effective linkage with development departments of A & N Administration and other organization. Table 8 presents a summary of linkage and collaboration.

Table 8. Summary of linkage and collaboration.

Name of organization	Nature of linkage
Department of Agriculture, A & N Administration	Training and supply of seedlings
Department of AH & VS, A & N Administration	Training & inputs distribution
Department of Fisheries, A & N Administration	Training & fingerling distribution
A & N Cooperative Bank,	SHG Promotion & financial assistance
NABARD, Port Blair	Formation of projects, SHGs & farmers club
NRSE, Dept. of Electricity, A & N Administration	Non-Conventional energy resources
Lead Bank	SHG promotion & financial assistance
CIPMC, Port Blair	IPM management
NCUI, Port Blair	Training and field advisory
NGOs (ADRA, ACANI, WBVH)	Training

TECHNOLOGIES ASSESSED AND TRANSFERRED

The technologies generated at the institue were assessed for its performance by the scientists in participatory mode and based on the location, need, preference and feed back it was transferred to the target groups through the ATIC, Krishi Vigyan Kendra and Out Reach Centre of the Institute. The progressive farmers, NGOs and the line department have played a vital role in transmission of the below mentioned technologies among the target groups (both tribal and non-tribal) of the Island eco-system in all three districts of South Andaman, North & Middle Andaman and Nicobar.

Natural Resource Management

- Recharge structure cum well system for providing water during dry period
- Reinforced plastered silpauline lining in tanks for rainwater storage and its recycling
- Seed production of table purpose groundnut in coconut plantations during wet season and package of practices for ICGS 76 variety in rice fallows.
- Four technological interventions i.e. Tank-well system, BBF, IFS and micro-irrigation system.
- Long duration tall varieties i.e. Ranjit, Varshadhan, Savitri and Gayatri for low lying areas.

Field Crops

- Five rice varieties: two (CARI Dhan 4 & 5) for coastal salinity conditions and other three for normal soils (CARI Dhan 1,2 & 3).
- IDM modules of tomato
- Use of non-chemicals measures for the management of vegetable crop pests

Horticulture & Forestry

- Technology for establishment of Hi-Tech Nursery.
- Production technology for indigenous orchids, Anthurium, Marigold and Gladiolus

Animal Science

- Improved Nicobari crosses (Nicorock and Nishibari) for backyard farming.
- Azolla as a feed supplement for Quail and Duck.
- Ultrasonography as a tool to characterize the ovarian follicle in poultry.

Social Science

- Development of Micro business modules of 14 technologies in agriculture & allied fields.

INFORMATION ON OTHER SECTIONS

Library

The institute has a well organized library which plays an important role as centre for literature and information related to the institute's mandate in these islands. It serves and fulfils the need of the scientists of this institute as well as research workers and students from local research and educational institutes. It has the facilities for on and off line information retrieval, networking, automation-computers and other accessories. The library has been enriched with 5444 books, 2518 other publication and 2455 bound volumes in addition to journals by subscription, gratis, on exchange basis and technical books. Extensive collection of resource materials in agriculture and allied fields, special collection of islands related books and publications along with reprographic facility has given it a prime importance in these islands. Internet services via VSAT connection is also available for easy access to these informations.

Planning, Monitoring and Coordination Cell

The Planning, Monitoring & Coordination Cell (PMCC) serves as a vital link between the Institute, Council (ICAR), Government, Semi-Government, NGOs, other R & D organization and A & N Administration in addition to providing information on various research, development, extension and human resource development activities to these agencies. The cell co-ordinated the conduct of the Institute Research Committee meeting (IRC) from 17th to 21st August, 2009 wherein a total of fifty ongoing projects, eleven new projects and one concept note totaling sixty two were presented followed by feed back wherein the house opined that the conduct of IRC in a participatory mode was very helpful as every scientists could get enough time and

opportunity to present their research finding. Further Mini IRC was also conducted on 4th November, 2009 to accommodate new projects of the newly joined scientists.

Beside compilation of institute reports, it also facilitates publishing of research articles, technical bulletins, folders, books, newsletter and proceedings of the workshop, symposium and seminars and coordinates to showcase the achievement of the institute both at island and National level. Presently the cell has a repository of RPFs along with the Annual Report, bulletins, folders, books and other related publication for ready reference to the visiting VIPs from Mainland & Island.

Computer Cell / ARIS Cell

The Agricultural Research Information System (ARIS) envisages providing online interconnectivity between the different Research Institutes, National Centres and State Agricultural Universities.

Activities under taken is mentioned below:

- Institute Website made bilingual.
- Internet and e-mail connectivity to all Scientists / Officers .
- VSAT of 512 Kbps for browsing and downloading information.
- Web page creation, updation and maintenance.
- Computer upkeep, up-gradation and training to Institute personnel.
- Data compilation and statistical analysis.
- Providing visual aids for different programmes.
- Procurement , installation and verifying quality control of personal computer .
- Maintenance of networking, DAMA VSAT.
- Intranet maintenance and updation.
- Providing Individual email ids for all Scientists / officers .
- PERMISNET - Personal Management Information System Network (Monthly and quarterly updating of personal records of all the staff of CARI has been carried out through online).
- Intelligent Reporting System (Quarterly updation of data and uploading regularly).
- Procurement of softwares, cartridges etc.
- Maintenance of all the computers and its accessories.
- Downloading the circulars and other information from ICAR website.

Website Updated

- Institute bilingual website is updated regularly.
- Updating of the CARI website (http://cari.res.in) was done regularly by publishing the latest Institute progress in terms of research, technologies developed, tender notifications, recruitment notifications and other information.
- Intranet of CARI (http://server:8080/carionline) was updated regularly.

Workshop / Training Organized

- One day awareness workshop on "Consortium of eResources in Agriculture –Cera" was held at CARI, on 22nd December, 2009 for the Scientists and Technical Officers, wherein 48 participated.
- One day training on SYSTAT was conducted on 27th July for the Scientists and Technical Officers by Cranes Software International Limited, Bangalore , wherein 18 participated.
- R-governance office automation software training was imparted to the Scientist, Technical and the Administrative staff in batches from 8th October to 26th March.

Sub Distributed Information Centre

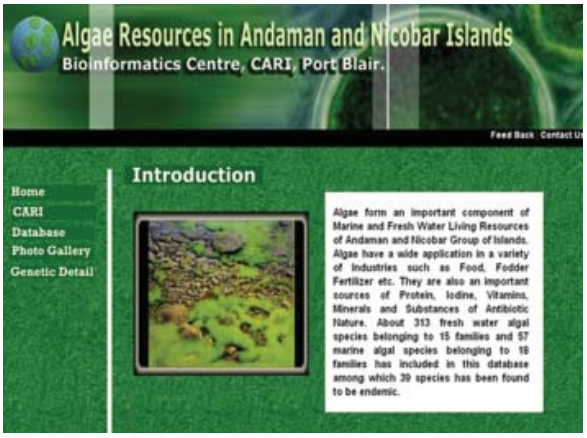
The Bioinformatics Centre, CARI is focused on providing quality consultancy services in the field of website, software development, database maintaining and manpower training. It is contributing as an active site for bioinformatics research and development in these islands. This centre can assist any progressive organization and institute in developing, integrating and maintaining valuable biological data so that it can be accessible in a safe and comfortable manner.

The Centre has actively carried out the following activities viz:

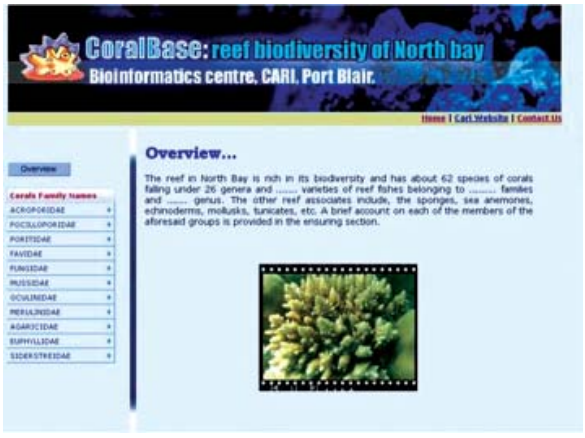
- Development of databases for online and CD ROM on Algae Resources , Coral Reef Resources, Web based BioSAT: Sequence Analysis Tools and Phyto Pathosys , RNA Secondary structure Prediction Softwares .
- Organised 21st Annual BTISnet Coordinators meeting on 3rd & 4th February, at Port Blair.

- Guided M.Sc students for undertaking project works in the discipline of M.Sc (Bioinformatics)
- Developed three Proteins homology modeling from medicinal plants and micro organisms.

Data Base Developed



Algae Resources in A & N Islands



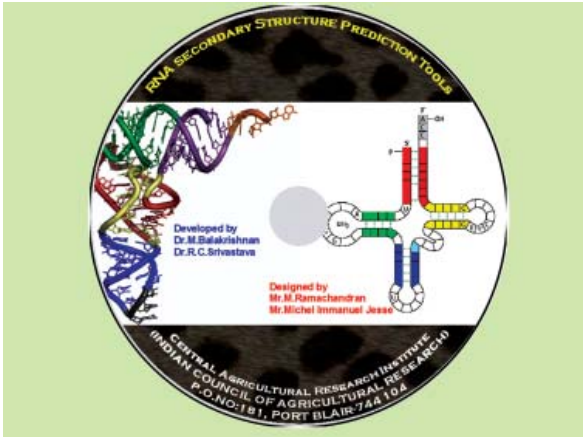
Coral Reef Biodiversity of North Bay Islands

Modelled Proteins Structures in Insilico Approach

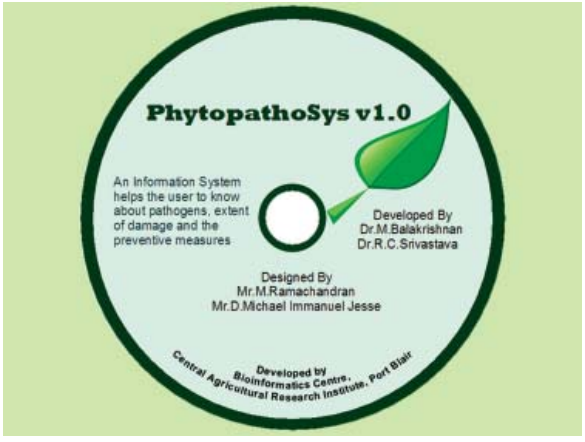
- For Acetylglutamate Kinase Enzyme of *Leptospira interrogans*
- For HIV-I Protease Enzyme
- For TEF-1 Protein of *Phytopthora palmivora*

Software /Tools Developed

BioSAT: Biological Sequence Analysis Tools
Phytopathosys Software



RNA Secondary Structure Prediction Software



Phytopathosys Software

Estate Section

The section also includes workshop and instrumentation centre. It takes up works related to infrastructure development for the institute to support research activities of the Institute. The section also takes up repair and maintenance of residential and non-residential buildings of the Institute. The power supply plays an important role for laboratory research works. A 320 KVA Generator Set is kept as stand by for restoration of power supply during power cuts. The water supply system to residential & non- residential buildings is operated by the staff of the Estate Section. During dry spells, water supply is also made through pumping from wells, ponds, reservoirs to residential, non-residential, experimental blocks, livestock and plantation crops.

Infrastructure Development

An amount of Rs.50.71 lakhs under plan and non-plan has been spent for development of new infrastructures, repair and maintenance of the residential and non- residential building of the institute. The construction of two R.C.C drop spillways across the Nallah, one at Sippighat farm and the other one at Garacharma farm have increased the impounding capacity of the Nallah on the upstream side for providing life saving irrigation to crops during dry spells. A number of R.C.C. wells of different sizes have been constructed at Sippighat Farm for irrigation purpose. A number of dug out ponds have also been developed in addition to extension and deepening of existing pond at Sippighat and Garacharma farm. In addition to the above, few poly houses/ shade net houses, vermiculture tank unit, chaff cutter shed, puval and fodder shed, implement shed etc have been constructed to facilitate smooth conduct of research activities by the scientists. Installation of 5HP pump sets, laying of pipe line and installation of water tanks have been done at different locations of the Garacharma farm area for providing irrigation to experimental plots through drip & sprinkler systems. This year also 20 nos. of stalls for displaying exhibits were constructed including a big Pandal and a stage for the Kisan Mela- 2010. The section also acts as the liaisoning agency for the works executed by CPWD, Port Blair and Electricity Department of A & N Administration

Workshop

Re-scheduling of school trips, arrangement and management of vehicles during XXI All India BTIS Net Co-ordinator meeting, All India group meeting on Rodent Control and Agricultural Ornithology, Kisan Mela and other major events of the Institute was done.

The works related to routine and major repair of Staff car, Jeep and Swaraj Mazda (bus) was also completed in stipulated time. The year saw addition of 2 Jeeps (TATA Sumo & Bolero) in the fleet of institute vehicle.

Instrumentation Cell

Repairs and maintenance of scientific equipments and providing uninterrupted power supply during important meetings and functions of the Institute was done.

The Estate Section has performed all its duties with its full efficiency for the smooth conduct of research works under the able guidance of the Director.

RTI, ITMU, Rajbhasha Implementation Cell (RIRIC)

RIRIC started functioning *w.e.f.* 1st March 2009 at CARI, Port Blair. The matters related with RTI Act, Institute Technology Management Unit and Implementation of Rajbhasha are being dealt by this cell. During the year, nineteen applications received under RTI Act 2005 were addressed. Under ITMU, different technologies developed by the Institute are being compiled to develop a database and to formulate a strategy for their commercialization in near future.

Under the ageis of Rajbhasha Implementation Cell, CARI celebrated Hindi Chetna Month from 14th Sep. to 13th Oct. wherein various programmes were organised like Hindi Tankan Pratiyogita, Hindi Shabdawali Pratiyogita, Hindi Patra Lekhan Pratiyogita, Hindi Nibandh Lekhan Pratiyogita, Hindi Tippan Evam Aalekhan Pratiyogita for Hindi and non Hindi speaking Staff . The special attraction of these celebrations was Hindi Sangoshthi on "Naye Aarthik Paridrashya Me Krishi Evam Krishi Anusandhan Ki Bhumika" on 23rd September 2009. Another special event was Elocution Competition for school children on "Jalvayu Parivartan: Kaaran, Prabhav Evam Nivaran Ke Upaay" on 24th September 2009 wherein six students of three schools participated. The most sparkling event was Grameen Mahilaon Hetu Bhashan Pratiyogita on "Swam Sahayta Samoohon Se Mahilaon Ka Badalta Hua Jeevan Estar" on 30th September 2009 wherein eleven rural women belonging to different Self Help Groups shared their experiences.

As a part of the month long celebration of Hindi Chetna Month, CARI organised a Kavya Gosthi on 6th October, 2009. A total of 15 poets from the Islands recited their compilations including Dr. R.C. Srivastava, Director, CARI on this occasion. The compilations of the poets were also broadcasted by AIR, Port Blair on every

Wednesday for the benefit of the radio listeners of these Islands.

Beside two Hindi workshops were also organised on 12th October & 16th March to enhance the skill of the officials in working knowledge of Hindi and to increase the use of hindi in day to day work.

The Cell also undertakes timely publication of weekly issue of Agro Advisory Bulletin based on weather forecast received from Meteorological department and functions as the nodal agency for widespread use of Hindi language in research, extension and developmental programmes carried out by the Institute.

Post Graduate Students Cell

Post Graduate Students cell has been established to coordinate the dissertation and project work of the students registered in different disciplines from various universities of the mainland. This year a total of 30 students doing master programme in M.Sc. have registered for dissertation work and 13 students have undertaken summer training in different disciplines. The facility for student's accommodation inside the campus has been created by converting four type-I quarter into boys and girls hostel. The students from different disciplines such as Microbiology, Bioinformatics, Biotechnology, Bioinformatics, Marine science etc have registered for dissertation work under the guidance of different scientists. The guidelines for the student's registration have been displayed in the Institute website. The institute is also trying to establish MoU with the other universities like Bidhan Chandra Krishi Viswavidyalaya for the Ph.D. scholars who wants to carry out their research work at this institute.

The details of the students undertaken dissertation work during the year is given below:

Students Guided by Scientists for Dissertation

Name of the Student	Degree/ Course	Duration (Month)	Title of the Project Work/ Thesis	College/ University
Dr. Jai Sunder				
M. Agni Raj Kamal	M.Sc (Biochemistry)	06	Effect of feeding of *M. citrifolia* in quality characteristics of cow's milk	Bharathidasan University
K. Akbar Ali	M.Sc (Microbiology)	03	Isolation, Identification and Characterization of gastro intestinal microflora of cow, poultry and goat of Andaman	Jamal Mohammed College, Bharathidasan University
Dr. S. Jeyakumar				
M. Motilal	B.Tech (Biotechnology)	03	Molecular Characterization of Teressa goat using Microsatellite markers.	Sastra University
Krishna Mohith J	B.Tech (Biotechnology)	03	Molecular Characterization of Teressa goat using Microsatellite markers.	Sastra University
M. Mohammed Niyas	B.Tech (Biotechnology)	03	Molecular Characterization of Teressa goat using Microsatellite markers.	Sastra University
Sreesujatha R. M	M.Sc (Animal Biotechnology)	05	Ultrasonograpnic characterization of ovarian follicular dynamics and studies on follicle apoptosis (atresia) in Japanese Quail (Coturnix coturnix japonica)	Bharathidasan University
Dr. Arun Kumar De				
P. Prakash	M.Sc (Biotechnology)	04	Molecular Characterization of Andaman Local goat using Microsatellite markers.	Bishop Heber College, Bharathidasan University
P. Saravanan	M.Sc (Biotechnology)	03	Molecular Characterization of Teressa goat using Microsatellite markers.	Srimad Andavan College, Bharathidasan University
Dr. D. R Singh				
B. Prabhakaran	M.Sc (Biotechnology)	06	Genetic diversity analysis of Colocasia esculenta collected from different locations of Andaman and Nicobar Islands using RAPD markers.	Kurinji College, Bharathidasan University

N. Palanivel	M.Sc (Biotechnology)	06	Genetic diversity among three varieties of Ocimum sanctum from Andaman Islands using RAPD markers.	Bishop Heber College, Bharathidasan University
Dr. Ajanta Birah				
Ponmani Manimaran	M.Sc (Biotechnology)	04	Effect of plant lectins on growth and development of lepidoteran pests.	Bishop Heber College, Bharathidasan University
Dr.Krishna Kumar				
K. Sathya Raj	M.Sc (Biotechnology)	04	Exploration of genetic and functional diversity of antagonistic and plant growth promoting bacteria isolated from Rhizospheric soil.	St.Joseph College, Bharathidasan University
Ajitha Krishna	M.Sc (Biotechnology)	03	Pathogenic variability, Biochemical and Molecular Characterization of Ralstonia solanacearum causing wilt in Solanaceous crops of Bay Islands.	KSR College, Anna University
P. Uthayaraj	M.Sc (Biotechnology)	06	Physiological and Molecular Characterization of antagonistic Trichoderma spp isolated from Indian Bay Island ecosystem.	Kurinji College, Bharathidasan University
G. Venkadesaperumal	M.Sc (Biotechnology)	06	Functional diversity and community structure of microorganisms in mud volcano and lime cave of Andaman Islands.	Bharathidasan University
Dr. Someshwar Bhagat				
K. Bharathi Kannan	M.Sc (Biotechnology)	05	Characterization of Trichoderma spp from Andaman and Nicobar Islands.	Bharathidasan University
S. Sundravelu	M.Sc Plant (Biotechnology)	05	Evaluation of some fungicides and biocontrol agents against some plant pathogens.	Bharathidasan University
Punitha Tiwari	M.Sc (Biotechnology)	03	Compatibility of *Tricoderma spp.* with some botanicals	Amity University
Sh. Israr Ahmad				
M. Hamida Nasrin	M.Sc (Biotechnology)	05	Assessment of salt tolerant plant growth promoting Rhizobacterial diversity isolated from rice rhizospere	Bharathidasan University

			in South Andaman.	
N. Manjubashini	M.Sc (Biotechnology)	05	DNA fingerprinting of biocontrol isolates of Trichoderma spp isolated from Andaman and Nicobar Islands.	Bharathidasan University
Dr. S. Dam Roy				
M. Thiruchelvan	M.Sc (Marine Biotechnology)	06	Studies on the inhibitory properties of bacteria associated with selected marine sponges from Andaman	Bharathidasan University
S. Prabaharan	M.Sc (Marine Biotechnology)	06	Characterization of anti-bacterial activity of selected marine sponges from Pongibalu, South Andaman	Bharathidasan University
Dr. Kamal Sharma				
A. Anand Kumar	M.Sc (Marine Science)	04	Biochemical parameter and nutritional status of shell fish, Crassostrea rivularis from two different ecosystem of Andaman	Bharathidasan University
S. Ramesh	M.Sc (Marine Science)	04	A preliminary study on abundance of anemone fishes in North Bay and mass culture of live food organism for their larval rearing.	Bharathidasan University
N. Manoj Kumar	M.Sc (Marine Science)	04	Anti microbial properties of *Oceanapia sagetaria*, a marine sponge from Andaman and characterization of its associated bacteria	Bharathidasan University
Dr. Balakrishnan				
S. Sridhar	M.Sc (Bioinformatics)	06	Insilico protein modeling of translational elongation factor 1-alpha of Phytopthora palmivora and docking studies by benzimidazoles compounds.	Bharathidasan University
K. Muthuvel Prasath	M.Sc (Bioinformatics)	06	Dockings studies of 5 zanamivir analogues over the enzyme neuraminidase from H1N1 avian influenza virus in the treatment of avian flu	Bharathidasan University

Students Guided by Scientists for Summer Training

Name of the Student	Degree/ Course	Duration (Month)	College/ University
Dr. P. Krishnan			
Jeeva Priya	M.Sc (Marine Biotechnology)	01	Annamalai University
Reena Singh	M.Sc (Marine Biotechnology)	01	Annamalai University
R. Shanti	M.Sc (Aqua Marine Ecology)	02	Madurai Kamraj University
Dr. S. Dam Roy			
Sunil Kumar Sahu	M.Sc (Marine Biotechnology)	01	Annamalai University
Dr. Krishna Kumar			
Alok Kumar	B. Tech (Biotechnology)	01	NIT, Durgapur, West Bengal
Cyril Kurien	B. Tech (Biotechnology)	01	NIT, Durgapur, West Bengal
Himanshu Palivoal	B. Tech (Biotechnology)	01	NIT, Durgapur, West Bengal
Ravi Pratap Singh	B. Tech (Biotechnology)	01	NIT, Durgapur, West Bengal
Mr. Israr Ahmed			
Jasmine Kalra	M.Sc (Marine Biotechnology)	01	Annamalai University
Yasmin	M.Sc (Marine Biotechnology)	01	Annamalai University
Dr. M. Balakrishnan			
Bibiyana Kumari Dung Dung	M.Sc (Bioinformatics)	01	Karpagam Arts and Science College
Dr. S. Jeyakumar			
S. Gayathri	B.Tech (Biotechnology)	01	Kalasalingam University

AWARDS AND RECOGNITION

Scientist	Award / Recognition	Awarding Agency / Organization Society
Someshwar Bhagat	Best Poster Presentation	5th International Conference on Biopesticides: Stakeholders Perspectives, held at TERI, New Delhi from 26th to 30th April, 2009.
T.V.R.S. Sharma	Lieutenant Governor's Commendation Certificate	In recognition of his contribution in Agriculture Research and Development in Bay Islands on the occasion of Independence Day.
Kanak Lata, Singh, D.R., Srivastava, R.C. and George, Z.	Best Poster Presentation Award	National Symposium on Noni for Empowerment and Prosperity, Chennai from 24th to 25th October, 2009.
Ajanta Birah	Life Fellow	In recognition of her contribution in the promotion of research in Entomology by The Entomological Society of India, IARI, New Delhi on September, 2009.
Singh, D.R., Shrawan Singh and Srivastava, R.C.	Best Poster Presentation Award	National Symposium on Noni for Empowerment and Prosperity, Chennai from 24th to 25th October, 2009.
Singh, D.R., Srivastava, A., Srivastava, A.K. and Srivastava, R.C.	Best Oral Presentation Award	National Symposium on Noni for Empowerment and Prosperity, 24th to 25th October, Chennai.
S. Jeyakumar, A. Kundu, Kuntola Roy, Jai Sunder, M.S. Kundu and R.C.Srivastava.	Best Poster Presentation Award	Indian Society of Animal Reproduction. In the International Symposium Expanding the horizons of Reproductive technologies for augmenting fertility in farm and pet animals in the global scenario, 10th to 12th , December 2009, Veterinary College and Research Institute, Namakkal, T.N.

Shrawan Singh, V.B. Pandey, Singh, D.R., R.C. Srivastava, V. Damodaran and I.Jaisankar	Best Poster Presentation Award	National Seminar on Production System Management in Adverse Conditions for Higher Productivity in A & N Islands from 22nd to 24th December, 2009.
C.S. Chaturvedi & S. Dam Roy	Best Poster Award	National Symposium on National Seminar on Productivity system management in adverse condition for higher productivity in A & N Islands from 22nd to 24th December, 2009.
Natural Resource Management Division	First Prize	For the best stall in the Kisan Mela from 9th to 10th February, 2010.
Arun Kumar De	Best Paper Award	Indian Dairy Association from 17th to 19th February, 2010.
Krishna Kumar	Distinguished Service Award	In recognition of his contribution in Plant Pathology by BIOVED Research Society, Allahabad on 20th February, 2010.
Chaudhary N.C., Singh L.B., Singh, A.K., Damroy S., Srivastava R.C., Chand Subhash, Lata K. and Damodaran V.	Best Poster Presentation Award	In National workshop cum Seminar on Status and Future Strategies of Horticulture Development in A&N Islands, CARI, Port Blair.
D. R. Singh	Outstanding Research Scientist on Noni	World Noni Research Foundation, Chennai, Tamil Nadu.

ON GOING RESEARCH PROJECTS 2009-10

Externally Funded

Project Title	Principal Investigator	Budget (lakhs)	Date of Start/ Completion	
Central Sector Scheme-NHM				
Centrally sponsored scheme for Integrated development of Spices	Mr. I. Jaisankar	5.79	2004	2010
Department of Biotechnology				
Development of Mangrove-based fin / shellfish culture for livelihood restora-tion through employ-ment generation in Andaman Islands	Dr. S. Dam Roy	36.00	2008	2011
Cataloguing and conservation of Marine Sponges of Andaman through DNA Barcoding	Dr. P. Krishnan	33.82	2010	2013
Conservation and phenotypic and molecular characterization of indigenous goat of Andaman and Nicobar Islands	Dr. S.P.Yadav Dr. S.Jeyakumar (w.e.f.March 2009)	34.07	04 / 2006	10 / 2009
Establishment of Sub-Distributed Information Centre	Dr. M.Balakrishnan	80.89	4 / 2005	3 / 2012
NMPB, New Delhi				
Technological innovations for commercial exploitation of *Morinda citrifolia* as livelihood option for island farmers	Dr. D. R. Singh	246.00	2008	2011
MoWR, New Delhi				
Farmers Participatory Action Research Programme	Dr. R.C. Srivastava / Dr. S.K. Ambast	24.00	04 / 2008	06 / 2010
Integrated Agromet Advisory Services	Dr. R.C. Srivastava / Dr. S.K. Ambast	60.00	04 / 2008	03 / 2012
ICAR				
All India Network Project on Rodent Control	Dr. Ajanta Birah	8.31	02 / 2009	03 / 2012

ICAR Mega Seed Project	Dr. Pankaj Kumar Singh	39.72	2007	2011
National Network Project on Underutilized Fruits	Dr. D. R. Singh	18.82	2008	2011
AICRP on Vegetable Crops	Mr. Shrawan Singh	-	2008	Continued
AICRP on Tuber Crops	Mr. Shrawan Singh	-	2008	Continued
Coconut Development Board				
Production of Disease Free Elite Planting Material for Improving the Productivity of Coconut in Bay Islands	Dr Krishna Kumar	18.29	03 / 2010	03 / 2013
Monitoring and surveillance of infestation of pest and disease of coconut in Andaman and Nicobar Islands	Dr. Ajanta Birah	7.01	03 / 2010	3 / 2012
SAC, Ahmedabad				
Coastal Zone Studies	Dr. S. Dam Roy	17.00	2007	2009
Optical Characterization of Coral Reef Diversity	Dr. S. Dam Roy	10.55	2010	2013
NBAIM-ICAR				
Application of microorganisms in Agriculture and allied sectors- Microbial diversity and identification	Dr Krishna Kumar	34.85	10 / 2006	03 / 2012
WNRF, Chennai				
Collection, conservation, characterization and identification of superior clones of *Morinda citrifolia*	Dr. D. R. Singh	9.54	2008	2011
INCOIS, Hyderabad				
Potential Fishing Validation in Andaman Sea	Mr. Grinson George	21.00	2008	2011
NOVOD				
Germplasm collection, evaluation and identification of high yielding genotypes of *Jatropha* and *Karanja* and their multiplication in Bay Islands	Mr. I. Jaisankar	20.00	2008	2011

IIRS, Derhadun				
Assessment of soil C pool of A&N Islands	Dr. S. Ghoshal Chaudhuri / Dr. T.P. Swarnam	0.66	03 / 2009	03 / 2011
A & N Administration				
Development and Efficient Utilization of Water Resources in the Micro Watershed of Hazaribagh Nala	Dr. R.C. Srivastava	69.00	04 / 2010	03 / 2013
DEPARTMENT OF SCIENCE AND TECHNOLOGY(WOMEN SCIENTIST SCHEME)				
Isolation, Identification and Characterization of Marine Actinomycetes from Andaman Coasts	Mrs Sumitha Gopalakrishnan / Dr. Jai Sunder	8.50	11 / 2009	11 / 2012
Enhancement and Sustainable Dairy Farming Through Reproductive Health care	Dr. Kuntola Roy / Dr. S. Jeyakumar	13.68	05 / 2009	05 / 2012
GEF (World Bank), NAIP				
Strategies for sustainable management of degraded land and water for enhancing livelihood in coastal area	Dr. S.K. Ambast	206.06	10 / 2009	09 / 2013
NABARD, Port Blair				
Establishment of Out Reach Centre at Diglipur, North & Middle Andaman District	Dr. R.C. Srivastava / Dr. S.K. Zamir Ahmed	79.696	06 / 2009	03 / 2013
PDFSR, Modipuram (ICAR)				
AICRP on Integrated Farming System	Dr. N. Ravisankar	85.06	03 / 2010	03 / 2012

Institute Funded

Project Title	Principal Investigator
Natural Resource Management	
Development on fresh and brackish water based integrated farming system (IFS) in Bay Islands	Dr. R.C. Srivastava
Planning, augmentation and efficient utilization of water resources in Kaju Nallah watershed	Dr. S.K. Ambast
Studies on effective storage of water in ponds	Dr. R.C. Srivastava
Natural resources degradation and socio-economic impact of leased farming in Andaman	Dr. S. Ghoshal Chaudhuri
Evaluation of soil management techniques in problem soils of South Andaman	Dr. T.P. Swarnam / Dr. S. Ghoshal Chauduri
Effect of vermicompost on nutrient dynamics and yield of vegetable crop Effect of nutrient levels and irrigation on arecanut yield and soil fertility	Dr. A. Velmurugan
Assessing the impact of pesticide use on soil and water resources of intensively vegetable growing areas of Andaman	Dr. T.P. Swarnam
Salt, water and nutrient dynamics in broad bed and furrow system	Dr. S.K. Ambast
Standardization of package of practices for table purpose (HPS) groundnut in Andaman	Dr. N. Ravisankar
Effect of supplemental irrigation on crop yield and water use efficiency in rice based cropping system of A&N Islands	Dr. T. Subramani
Water and nutrient management in capsicum through drip system under protected cultivation	Dr. T. Subramani
Field Crops	
Improving the quality and productivity of rice based cropping system	Dr. T.V.R.S. Sharma
Genetic improvement of long duration rice for Andaman and Nicobar Islands	Dr. P.K. Singh
Molecular characterization of economically important flora and microbes of Andaman and Nicobar Islands.	Mr. Israr Ahmad
Assessment of crop losses and epidemiology of major vegetable diseases of South Andaman.	Dr. Krishna Kumar

Standardization of production and protection technology of tropical mushrooms	Dr. Krishna Kumar
Integrated pest and disease management of Black pepper Development of integrated disease management modules for tomato crop	Dr. Someshwar Bhagat
Development of eco-friendly IPM module for Okra and cucurbits in Andaman	Dr. Ajanta Birah
Horticulture & Forestry	
Standardization of micro-propagation techniques for potential orchids and ferns of A & N Islands Studies on improvement of coconut and arecanut in Andaman and Nicobar Islands Collection, conservation and molecular characterization of early flowering open pollinated mango clones of bay islands	Dr. D. R. Singh
Silvipastural system : Effect of fertilizer and cutting on net primary production (Herbage production) in humid tropical climate of bay islands Standardization of agro technique for organic black pepper cultivation in Andaman and Nicobar Islands Identification, evaluation and development of Silvipastoral system for Bay Island condition Role of Alley cropping system in nutrient conservation (nutrient build up + protection of fine soil particles from erosion), and selection of suitable crop sequence for the cropping system for the Andaman Islands	Mr. I. Jainsakar
Standardization of technologies for protected cultivation of vegetable crops under Andaman & Nicobar conditions Collection, conservation, characterization and documentation of in digenous vegetables of Andaman & Nicobar Islands	Mr. Shrawan Singh
Development of agro techniques for potato in bay islands	Dr. M. Sankaran
Standardization of technology for production of quality flowers under island ecosystem	Ms. R. Sudha

Animal Science	
Improvement, evaluation & propagation of indigenous Nicobari fowl and ducks and dissemination of technology in *T*sunami affected areas. Improvement of Nicobari fowl for meat and egg production	Dr. A.Kundu
Productivity enhancement of pigs under island ecosystem To study the feasibility and convergence on subsistence pig rearing to commercial pig farming inclusive of its process	Dr. M.S.Kundu
Evaluation of therapeutic and immunomodulatory properties of *Morinda citrifolia* in poultry. Potential of *Morinda citrifolia* fruit as feed for livestock and poultry	Dr. Jai Sunder
Characterization of livestock production sub system and assessment of critical nutritional gap in bay Islands.	Dr. S.K.Verma
Evaluation and utilization of azolla as feed supplement for backyard poultry in bay island. Productivity enhancement and sustainable dairy cattle and Buffalo production in bay islands. Productivity enhancement of goats in bay islands	Dr. S.Jeyakumar
Molecular characterization of indigenous pigs of bay island by microsatellite markers	Dr. Arun Kumar De
Fisheries Science	
Cage culture of commercially important marine and brackish-water fishes in protected bays and creeks of Andamans Stock assessment of grouper and snapper	Dr. S. Dam Roy
Breeding and seed production technology of commercially important cat fishes: *Clarius batrachus* (Indian Magur) and *Heteropneustus fossilis* (Singhi) in A & N Islands	Dr. C. S. Chaturvedi
Temporal and spatial variability of water quality parameters and mineral profile of waters of andaman and their impact on shell fishes and fin fishes Evaluation of pond lining for pisciculture in saline acidic soils of Andaman	Dr. Kamal Sarma
Brood stock development and breeding of damsel fishes	Mr. Grinson George

Characterization of the role of associated bacteria in the bioactivity of marine sponges from Andaman Assessment of threats due to climate change in Nicobar group of Islands and development of adaptation strategies	Dr. P. Krishnan
Social Science	
An economic analysis of floriculture and vegetable potential in Andaman and Nicobar Islands Economic valuation of mangroves in Andaman and Nicobar islands Market and export potential analysis of marine fishery resources in Andaman and Nicobar islands	Dr. Subhash Chand
Identifying livelihood options and training needs compatible to self help groups to fructify these options	Dr. S.K. Zamir Ahmed
Development of artificial neural networks (ANN) based forecasting model for studying varieties diversity, yield and production in prominent rice cultivars of bay islands Development of data base on fodder resources and waste land in bay islands	Dr.M.Balakrishnan

PUBLICATION

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Balakrishnan, M. and R.C Srivastava (2010). In Silico Analysis of Different Gene Expressions and Phylogenetic Analysis of Corynebacterium Efficiens. *IUP Journal of Biotechnology,* March, Vol. 4, No. 1, pp: 13-25.

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Folders

Dam Roy, S., Krishnan, P., Kamal Sarma, Murugesan, & S., Kaliamurthy, M. (?). Production of Tiger prawn seeds in a backyard hatchery in Andaman. CARI, Port Blair.

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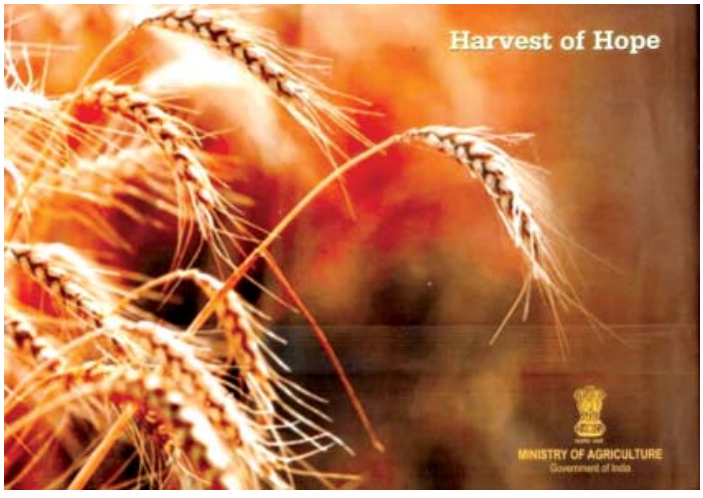
In addition to above 106 Papers were presented in the Conference/ Symposium/ Workshop

Success Stories

Success stories of five farmers technologically supported by CARI has found place among 101 farmers selected from all over country for publication in "Harvest of Hope: Coffee Table Book of 101 Success stories documented by Ministry of Agriculture, released on 26th February 2010 by Hon'ble Minister of Agriculture, Govt. of India



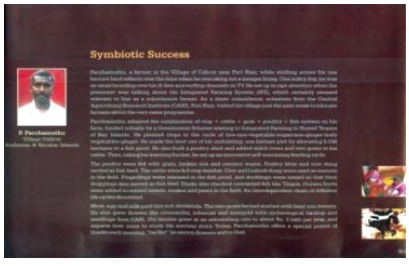
- Sea change, Success story of Land based IFS, Mrs Sabita Singh, Guptapara Village, A & N Islands *In* Harvest of hope: A tribute to the farmers of India, Published by Ministry of Agriculture, Government of India, New Delhi, (Story Number 81).

- Harvesting Happiness, Success story of Water user Association, Mr Kartick Das, Manjery Village, A & N Islands *In* Harvest of hope: A tribute to the farmers of India, Published by Ministry of Agriculture, Government of India, New Delhi, (Story Number 42).

- Integrated Initiative, Success story of IFS farmer Mr A.L. Swaminathan, Calicut Village, A & N Islands *In* Harvest of hope: A tribute to the farmers of India, Published by Ministry of Agriculture, Government of India, New Delhi, (Story Number 14).

- Furrows for Fantastic Future, Success story of BBF farmer Mr M. Muthaiah, Indiranagar Village, A & N Islands *In* Harvest of hope: A tribute to the farmers of India, Published by Ministry of Agriculture, Government of India, New Delhi, (Story Number 49).

- Symbiotic Success, Success story of IFS farmer Mr P. Pacchamuthu, Calicut Village, A & N Islands *In* Harvest of hope: A tribute to the farmers of India, Published by Ministry of Agriculture, Government of India, New Delhi, (Story Number 65).



PEER RECOGNITION TO DIRECTOR, DR. R. C. SRIVASTAVA

Award

- Fellow Member for the year 2007-08 awarded by the Indian Society of Agricultural Engineers on 28th Jan. 2010.
- Selected as Fellow of Institutions of Engineers, Kolkata.

Special Deliberations

- CARI'S mandate, achievement and vision for A & N Islands from 2006 to 2009 on Prasar Bharti, A & N Islands.
- Climate change & its effect on security of Andaman & Nicobar Islands on 4th September 2009 at Seminar on Security and Development of A & N Islands organized by Andaman & Nicobar Command.
- Employment opportunities for decent livelihood and climate change at M.G. College, Mayabunder on 10th September, 2009.
- Effect of Climate Change – Mitigation and Adaptation during Environmental Awareness for teachers jointly organized by CPR Foundation, Chennai and A & N Science & Technology Council, A & N Administration at Diglipur on 10th September, 2009.
- Effect of Climate Change in A & N Islands: A Prelude in the Secretariat of A & N Administration which was chaired by Shri Vivek Rae, Chief Secretary and attended by all Secretaries and HoDs of A & N Islands.
- Dweepon Me Krishi Ki Chunoutiya Va Sambhavnayen on AIR, Port Blair on 01.01.2010.
- Water harvesting technology for hilltop, mid hills, valleys & its management with special reference to island conditions on World Water Day on AIR, Port Blair on 23.03.2010.

Lead Papers presented

- Srivastava, R.C. (2009). Climate change and Security of the A & N Islands. In : Seminar on Security and Development of A & N Islands organized by A & N Command.
- Srivastava, R.C. (2009) Water Resource Development and Management. In : Rainfed Areas in Annual KVK Conference at TNAU, Coimbatore.
- Srivastava, R.C. (2010) Rehabilitation of *T*sunami Affected Farmers through Integrated Agricultural Technological Interventions in Andaman Islands. In : International Workshop on The Indian Ocean *T*sunami : 5 years later – Assessing the Vulnerability and Resilience of *T*sunami affected coastal regions conducted by Inter-University Research Institute Corporation, National Institute for the Humanities from 1st to 3rd March, 2010 at Singapore.

- Srivastava, R.C. (2009). Plant disease management in island ecosystem-options and strategies. In: 5th International Conference of Plant Pathology on Plant Pathology in Globalised era at IARI, New Delhi on 12th Nov. 2009.
- Srivastava, R.C. (2009) Island Agriculture- Potential, Constraints and Threats from Climatic Change. In : Agriculture Science Congress at SKUAST, Srinagar.
- Srivastava, R.C. 2009 Genetic Resources of Horticultural Crops in Andaman & Nicobar Islands. In : Agriculture Science Congress at SKUAST, Srinagar.

Peer Recognition

- Member, UT Coordination Committee, A&N Administration, Port Blair
- Member, Society for Science Centre, A&N Islands, Port Blair
- Member State Level Environment Council, A&N Islands, Port Blair
- Member, Executive committee of SOC, Andaman Nature Club, Port Blair
- Member, State Board for Wildlife, A&N Islands, Port Blair
- Member, Andaman & Nicobar Science and Technology Council, A&N Islands, Port Blair
- Member, State Level Sanction Committee for Rashstriya Krishi Vikas Yojana, A&N Islands
- Member, State Level Advisory Committee for Narrow casting project under the scheme mass media support for agril. extension, A & N Islands
- Member, State Seed Sub-Committee for Agricultural & Horticultural Crops, A & N Islands
- Member, UT Level Monitoring committee to monitor the implementation of programme relating to rehabilitation of Animal Husbandry
- Member, State Level Watershed Development Committee under Watershed development Project for rainfed areas in A&N Islands
- Member, High Value Agriculture Development Agency for the UT of A&N Islands
- Member, Governing Council of Andaman & Nicobar Coconut Mission
- Member, UT level Task Force Committee for A&N Islands
- Member, Agriculture Technology Management Agency Governing Body of A&N Islands

Participation in important meeting, symposium and workshop

- Brainstorming Meeting on Management of Horticultural Crop Genetic Resources held at NBPGR, New Delhi on 21st April, 2009.

- Swadesh Prem Jagriti Sangosthi - 2009 held at Mahmada, Pusa,Bihar from 28th to 31st May, 2009.
- 9th Agricultural Science Congress held at Srinagar from 22nd to 24th June, 2009.
- Chaired, Coordination Committee meeting on Morinda Project at CDRI, Lucknow on 25th June, 2009.
- ICAR Foundation Day Ceremony and Director's conference from 16th to 18th July, 2009 at ICAR, New Delhi.
- Seminar on Security and Development of A&N Islands held at Andaman & Nicobar Islands on 4th & 5th September, 2009.
- Training on Effective Leadership for Good Governance: from 17th-19th September, 2009 at Management Development Institute, Gurgaon.
- AICRP meeting on Tuber Crops held at OUAT, Bhubaneswar from 9th - 10th October, 2009.
- Meeting of Institutions of Engineers held at Kolkata on 21st October, 2009.
- 4th National Conference on KVK held at TNAU, Coimbatore on 7th Nov. 2009.
- Panel discussion on Online Examination System held at ASRB, KAB, New Delhi on 9th Nov. 2009.
- 5th International Conference of Plant Pathology on Plant Pathology in Globalised era at IARI, New Delhi on 12th Nov. 2009.
- National Children's Science Congress Seminar held on 24th Nov. 2009 at Govt. Girls Sr. Secondary School , Port Blair.
- Annual Convention of Indian Society of Agricultural Engineers held at New Delhi on 28th -29th January 2010.
- Horticulture Divisional Meeting with Director General, ICAR on 2nd Feb. 2010.
- Director's Conference on 15th & 16th Feb, 2010 and Interaction meeting with Vice Chancellors and Directors held on 17th Feb. 2010 at ICAR, New Delhi.
- International Workshop on The Indian Ocean *T*sunami : 5 years later – Assessing the Vulnerability and Resilience of *T*sunami affected Coastal Regions conducted by Inter-University Research Institute Corporation, National Institute for the Humanities from 1st to 3rd March, 2010 at Singapore.

Management & Guidance of Research, Development and Extension (RDE)

Research

During the IRC meeting held on 17th to 21st August, 2009 research programs were reviewed in the light of recommendations of RAC. Another meeting of IRC was held on 4th November, 2009 to review the new projects of new scientists and sponsored projects. Guided smooth execution of

ongoing institute projects (50 nos.) and sponsored projects (17 nos.) by making periodic reviews of the projects .

Summary of the institute funded and sponsored projects for the period :

Summary	
a) Number of institute funded research projects continuing	**50**
b) Number of institute funded research projects concluded	**12**
c) Number of new institute funded research projects initiated	**12**
d) Number of externally funded projects continuing	**17**
e) Number of externally funded projects concluded	**NIL**
f) Number of new externally funded projects initiated	**5**

Consultancy Projects

- Impact assessment of post *T*sunami agriculture development programme In Andaman & Nicobar Islands
- Establishment of High-Tech nursery in South Andaman
- Soil and crop mapping of Andaman Islands using remote sensing and geographical information system
- Aforestation and landscaping for soil conservation at Naval Unit, Diglipur
- Preparation of detailed project report on installation of micro irrigation systems in farmers' field under HVADA

Significant achievements

Five sponsored research programs have been initiated viz.

- Water resource development technology demonstration in a mid hill watershed. RKVY, A & N Administration : Rs 64 lakhs
- Production of disease free elite planting material for improving the productivity of coconut in islands. CDB. Budget: Rs. 18.2 Lakhs
- Monitoring and surveillance of infestation of pest and diseases of coconut in A & N islands. CDB. Budget: Rs 17 lakhs
- Isolation, identification and characterization of marine actinmycetes from Andaman coast. DST under Women Scientist Scheme. Budget : Rs. 8.64 lakhs
- Cataloguing & Conservation of Marine Sponges of Andaman through DNA Bar Coding: DBT: Budget: Rs. 35.02 Lakhs

Transfer of Technology

- The Out Reach Centre at Diglipur (North Andaman) funded by NABARD at a cost of Rs 79.80 lakhs started functioning from July, 2010
- Advice to the farmers on weather through **Agro Advisory Bulletin** for both Andaman and Nicobar Group of

islands is being narrowcast by the AIR and DDK, Port Blair on every Tuesday. The bulletin is also faxed to all Rural Knowledge Centres on same day. It is also printed by the local newspapers. A campaign for popularizing it was launched during the Kisan Mela.

- The Agricultural Column launched on 23rd June 2008, in the Echo of India an English daily published simultaneously from Kolkata and Portblair for wider dissemination on technological innovations in agriculture an allied fields to the islands stakeholders is continuing. The newspaper publishes the column on weekly basis.
- KVK, CARI has started publication of monthly Newsletter 'Krishi Sandesh' having agro-advisory for the current month from July, 2009.
- CARI has signed an MoU with Shri Hari Fabricators, Port Blair to fabricate three farm implements (Copra dryer, Cono weeder and Coconut dehusker) designed and developed by CARI on royalty basis. The institute has received a royalty of about Rs. 10000/- in 2009-2010.
- Kisan Mela on the theme Pashupalan and Murgipalan se behtar jivikoparjan was organized on 9th and 10th February, 2010. It was inaugurated by Dr. A.K. Singh, DDG (NRM), ICAR. A total of 20 stalls representing different divisions of CARI, line departments of Administration like Agriculture, Animal Husbandry, Fisheries, IINRG, Ranchi, State Bank of India, NGOs, private entrepreneurs and Self Help Groups were put up showcasing their activities for the benefit of the stakeholders *viz*., farmers, farm women, youths and urban dwellers. The attraction of the Kisan Mela was the conduct of "Kisan Sangoshthi" on 9th and "Khulla Munch" on 10th February wherein farmers in large number interacted with the scientists and got their problem addressed. A record 1035 farmers and 357 students visited the mela. In addition, urban people from Port Blair city and officials from department visited the stalls.
- KVK conducted 60 regular training programs both on and off campus for farmers in addition to conduct of 10 OFT and 10 FLDs each.
- Exposure visit of Bodoland Territorial Council Member & Officer, Kakrajhar, Assam was conducted on 7th to 9th December, 2009
- I along with my scientists visited Campbell Bay, the Southernmost part of archipelago, and discussed with the farmers, NGO and officials of line departments about agriculture activities once the farmers go back to their permanent shelters. A detail plan of action is submitted to A & N Administration.

Development of Research Infrastructure

a) Hatchery shed, air blower room etc. at Marine hill Complex

b) Renovation of five poly houses

c) Renovation of poultry shed, and cattle shed

d) Relaying of another sector of farm at Bloomsdale to facilitate larger experiments

e) Renovation of two orchidarium,

f) One 5 m dia open dug well at Sippighat farm, one dug well at KVK for creating irrigation facilities

g) Construction of implement shed, open threshing floor and covered threshing floor at Bloomsdale farm

h) Process of construction of two Type V, four Type IV, four Type III has been initiated. After vetting of estimate, the first installment has been deposited. Construction of Type IV, and Type III quarters has started.

i) Process of construction of Guest House at Kolkata has been initiated. Ist installment has been deposited.

j) Process of construction of boundary wall at Bloomsdale and Sippighat farm has been initiated. After vetting of estimate, the first installment has been deposited. Construction has started.

k) Drip and sprinkler irrigation system are being installed in all the three farms

l) A 96 tonnes capacity vermicompost unit has been constructed and it has started functioning.

m) Equipment worth Rs. 118 lakhs viz NIR, Gas chromatograph, deep freezer, PCRs, E-governance software, statistical software, etc. were purchased. Besides the HPLC, water purification system, electrophoresis etc. under different sponsored projects were also purchased.

n) Foreign journals worth Rs 19 lakhs and Indian journals worth 2.5 lakhs were subscribed. Books worth 6 lakhs were purchased.

Develop & conduct of customized training programs for stakeholders on various technologies funded by NGOs and State agencies

- Polyhouse construction, water resource development and vegetable cultivation for farmers from 19th to 21st May, 2009
- Organic spices cultivation at Diglipur on 8th & 10th Sept. 2009
- Market-led Extension. MANAGE & CARI, Port Blair, from 4th to 8th December, 2009
- Promotion of agro forestry in backyard system on 29th & 30th October, 2009
- Crop diversification through broad bed and furrow system from 25th to 29th August, 2009

Organizing Workshops/Seminars/ Conferences

- Brain Storming on Natural resource Management in Island Ecosystem on 7th & 8th July, 2009
- One day workshop on Consortium for e-Resources in Agriculture (CeRA), Unit of Simulation and Informatics, IARI, New Delhi on 22nd October, 2009
- National Seminar on Production System Management in Adverse Conditions for Higher Productivity in A & N Islands on 22nd & 23rd December, 2009
- XXI All India BTISNET Coordinators' Meeting on 3rd & 4th February,2010
- Panel Discussion on Development of Human Resources in Agriculture for A & N Islands and Tropical Island Nations: Need, Scope and Prospect on 22nd & 23 rd February, 2010
- All India Group Meeting on Rodent Control & Agricultural Ornithology on 19th - 21st March, 2010

PARTICIPATION OF SCIENTISTS IN CONFERENCES / SEMINARS/ SYMPOSIA / MEETINGS

Scientists	Programme	Venue	Date / Duration
A. Kundu & S.K. Zamir Ahmed	Project launching Workshop on Building Sustainable Livelihood for the Tsunami affected in Great Nicobar	CARI, Port Blair	6th April, 09
Arun Kumar De	86th Foundation Course for Agricultural Research Service	NAARM, Hyderabad	21st April- 18th August, 09
Someshwar Bhagat	5th International Conference on Biopesticides: Stakeholders Perspectives	TERI, New Delhi	26th - 30th April, 09.
S.K. Zamir Ahmed	Swadesh Prem Jagriti Sangosti 09	Mahmada, Pusa, Bihar.	28th - 31st May, 09
Pankaj Kumar Singh Ajanta Birah	44th Rice Research Group Meeting Interaction meet of scientists of entomology	DRR Hyderabad, A.P C ISH, Lucknow, UP	9th – 12th June, 09 10th - 11th June, 09
S. Ghoshal Chaudhuri	Natural resource management using RS and GIS-Decision Makers course	IIRS, Dehradun	16th – 18th June, 09
I. Jaisankar	Summer Course on Non-conventional approaches for crop improvement in horticulture crops	Division of Biotechnology, IIHR, Bangalore	16th June - 6th July, 09.
Israr Ahmad	21 days Summer School on Non-Conventional Approach for crop improvement in Horticulture Crops	IIHR, Bangalore	16th June - 6th July, 09
S.K. Ambast	National Workshop on Remote Sensing and GIS for Decision Support in Agriculture	IASRI, New Delhi	18th June, 09
All Scientists	Brainstorming Session on Natural Resource Management for Island Ecosystem	CARI, Port Blair	7th - 8th July,09
Pankaj Kumar Singh	State Seed Sub Committee Meeting	Secretariat, A&N Admn., Port Blair	13th July 09
M. Balakrishnan	Bioinformatics and its applications in agriculture	Presidency College, Chennai	21st Aug., 09

	National Conference on Information technology and its applications in horticultural Crops	CPRI, Shimla	24th - 25th Aug., 10
Pankaj Kumar Singh	ICAR Seed Project Review Meeting	Pusa, New Delhi	24th -25th Aug., 09
D. R. Singh	Monitoring committee meeting of the NMPB project on Morinda	KAB-II, ICAR	9th Sept., 09
P. Krishnan	Open water diver course	Dive India (P) Ltd, Havelock	17th - 21st Sep., 09
Ajanta Birah	Short duration training programme on rodent pest management	National Institute of Plant Health Management, Hyderabad	17th - 23rd Sep., 09
D. R. Singh	X Group Meeting on AICRP on Tuber Crops	OUAT, Bhubaneswar	9th - 10th Oct., 09
Subhash Chand	Workshop on methodology for impact assessment of agricultural technologies	NCAP, New Delhi	9th - 11th Oct.,09
S. Ghoshal Chaudhuri	Management development programme on priority setting, monitoring and evaluation	IIM, Lucknow	19th - 23rd October, 09
All Scientists	Consortium for e-Resources in Agriculture	CARI, Port Blair	22nd October, 09
A. Kundu	XXVI Annual conference and national symposium of Indian Poultry Science Association .	Indian Poultry Science Association, Mumbai	22nd - 24th Oct., 09
D. R. Singh & Jai Sunder	Noni Search – 2009: The IV National Symposium on Noni for Empowerment and Prosperity.	WNRF, Chennai	24th - 25th Oct., 09
M. Balakrishnan	National Horticulture Biotechnology Seminar	IIHR, Bangalore	28th - 30th Oct. 09.
D. R. Singh	International Conference on Horticulture, ICH-2009.	Dr. Premnath Agriculture Science Foundation, Bangalore	9th - 12th Nov.,09
R.C. Srivastava, Krishna Kumar and Someshwar Bhagat	5th International Conference on Plant Pathology in Globalized Era	IARI, New Delhi	10th -13th Nov., 09.

A. Kundu	IV WORLD Water fowl - conference 2009 organized by Kerala Agricultural University in association with World's poultry science Association-IB	Kerala Agricultural University	11th -13th Nov., 09
Krishna Kumar	Review meeting on microbial diversity and identification of application of micro-organisms in agriculture and allied sectors (AMMAS)	NASC, New Delhi	17th Nov., 09
S.K. Ambast	60th IEC Meeting and 5th Asian Regional Conference of ICID, organized by CBIP	Vigyan Bhawan, New Delhi	9th - 11th Dec., 09
N. Ravisankar	Third annual review meeting on Integrated Agro Met Advisory Services (IAAS)	IIT, Roorkee	10th - 12th Dec., 09
S. Jeyakumar	International Symposium, Expanding the horizons of reproductive technologies for augmenting fertility in farm and pet animals in the global scenario	Namakkal, Tamil Nadu	10th -12th Dec., 09
M.S. Kundu	Diversification of Animal Nutrition Research in the Changing Scenario	Animal Nutrition Society of India and National Institute of Nutrition and Physiology, Bangalore	17th - 19th Dec., 09
A. Velmurugan S. Dam Roy & P. Krishnan	Mechanization in Horticulture National Seminar on Indian Marine Fisheries- Sustainability at Cross Roads	CPCRI, Kasaragod College of Fisheries, Mangalore, Karnataka	18th - 19th Dec., 09 22nd – 23rd Dec., 09
All Scientists	National Seminar on Production System Management in Adverse Conditions for Higher Productivity in A&N Islands.	CARI , Port Blair	22nd – 24th Dec., 09
Jai Sunder & S.K. Verma	CPCSEA Conference	New Delhi	15th Jan., 10,
Shrawan Singh	XVIII Group meeting on AICRP on Vegetable Crops	IIHR, Bangalore	15th -19th, Jan., 10

Krishna Kumar	XXVII Group meeting of AICRP (VC)	IIHR, Bangalore	16th - 19th Jan., 10
S. Dam Roy P. Krishnan	Sensitization Workshop on Innovation in science pursuit for inspired research (INSPIRE)	Pondicherry University, Brookshabad campus, Port Blair	29th Jan., 10
S.Damroy, S.K. Ambast, D. R. Singh, I. Jaisankar & Shrawan Singh	National Workshop on coconut based farming system in A & N Islands	CARI, Port Blair	10th - 12th Feb., 10
Jai Sunder & S.K. Verma	Zonal Technology Management Centre meeting cum workshop	IINRG, Ranchi	19th - 20th Feb., 10
All Scientists	Panel Discussion on Development of Human resources in Agriculture for A & N Islands and Tropical Island Nations: Need Scope and Prospect.	CARI, Port Blair	22nd - 23rd Feb. 10
Krishna Kumar and Ajanta Birah	Monitoring Committee Meeting–NMPB funded Project	CARI, Port Blair	23ed Feb.,10
Kamal Sarma P. Krishnan	Applied Chemistry in Marine Sciences: Current and Future Trends	Pondicherry University, Brookshabad Campus, Port Blair	24th – 25th Feb., 10
S.K. Ambast	Brain Storming Session cum	Agricultural Research	06th - 09th March, 10
S. Dam Roy & P. Krishnan	Workshop on promotion of Tuna fishing and allied activities in A & N Islands	Directorate of Fisheries, A&N Administration	10th March, 10
N. Ravisankar	Launching workshop and Biennial group meeting of AICRP on Integrated Farming Systems	Station, Karmana, Thiruvananthapuram	
M. Balakrishnan	National Workshop for the sensitization of the ARIS In-charge about the uniformity guidelines for ICAR websites	NBPGR, New Delhi	18th March, 10.
M. Balakrishnan	International Seminar cum	Bioinformatics Centre,	20th - 22nd March, 10

	training workshop on Molecular Modeling and Protein-protein interaction and drug design	Allahabad University, Allahabad	
A.Velmurugan	MDP on Prioritization, Monitoring and Evaluation of research projects	IIM, Lucknow	22nd - 26th March, 2010
Subhash Chand	National Workshop on success of growth in Indian agriculture, trend, challenges and progress	NCAP, New Delhi	27th March, 10
S.K. Ambast, Subhash Chand & N. Ravisankar	NAIP project on Strategies for s ustainable management of degraded coastal land and water for enhancing livelihood security of farming community	Regional Research Station, CSSRI Canning Town, Kolkata	28th March, 2010
	Launching workshop of NAIP project Strategies for sustainable management of degraded coastal land and water for enhancing livelihood security of farming communities	CSSRI, Canning town, West Bengal	28th March, 10

Administrative Staff

Administrative Staff	Programme	Venue	Date / Duration
Abhishek Srivastava	Handling of CAT Cases, Legal Matters & Court Cases by ISTM	New Delhi	26th - 28th Aug., 09
	Values in Administration	ISTM, New Delhi.	12th - 14th April, 10
R.N. Majumdar & Karupaiah	Pension & other retirement benefits	DWM, Bhubaneshwar	26th – 27th Oct., 09
Joseph George, M. Krishnan, & P.K. Roy,	New Pension scheme by NSDL	NBSSLUP Regional Station, Kolkata	8th Dec., 09

HUMAN RESOURCE DEVELOPMENT OF STAKEHOLDERS

Title	Period	Participants (No.)	Type of Participants	Venue	Conducted by
Training					
Tuber crops cultivation in Andaman & Nicobar Islands	18th - 24th April,09	20	Farmers	CARI	CARI & NHM
Polyhouse construction , water resources development and vegetable cultivation	19th - 21st May, 09	20	Farmers	CARI	CARI & CEFI-International (NGO)
Operation and maintenance of paddy transplanter	22nd - 24th June, 09	25	Farmers	KVK	KVK & NRM
Improved agro-techniques for Paddy	25th - 27th June,09	30	Farmers	Ferrargunj	KVK & NRM
Mat nursery & soil sample collection	15th – 18th July,09	25	Farmers	Diglipur	ORC CARI & NABARD
Duck-cum-fish farming	29th – 31st July, 09	38	Farmers	Diglipur	ORC CARI & KVK
SRI, cultivation of Noni & Duck-cum fish farming	29th – 31st July,09	50	Farmers & Youth	ORC, Diglipur	ORC CARI & NABARD
Soil and water conservation measures	30th July - 1st August, 09	25	Farmers	KVK	KVK & NRM
Crop diversification through broad bed and furrow system	25th - 29th August, 09	25	Extension Personnel	KVK	NRM & KVK
Package and practice of goat farming	25th -27th August,09	20	Para veterinary staff	CARI	KVK, CARI
Peration and maintenance of power tiller	31st August - 4th September,09	25	Farmers	KVK	KVK & NRM
Organic cultivation of spices	8th - 10th September, 09	32	Farmers	Diglipur	ORC CARI, NHM & NABARD

Organic spice cultivation	8th – 10th Sep., 09	53	Farmers	Diglipur	ORC CARI, NABARD Spices Board
R-Governance and its applications	12th -16th & 20th October, 09	96	All staff of CARI	CARI	CARI
Biopesticide production and its applications	27th – 29th October, 09	25	Farmers / SHGs	ATIC	KVK, CARI
POP of scientific pig farming	7th - 10th December, 09	25	Farmers	CARI	Animal Science Division & KVK
Organic spice cultivation	10th - 11th December, 09	26	Farmers	Hut Bay	CARI & NHM
Plantation based cropping system	22nd - 24th January, 10	24	Farmers	Diglipur	ORC CARI & NABARD
Brackish water farming	24th – 27th February, 10	30	Farmers	Lalpahar	FSD, CARI & KVK
Integrated fish farming	15th – 17th March, 10	10	Farmers	KVK	FSD, CARI & KVK
Freshwater prawn farming	22nd – 24th March, 10	16	Farmers	KVK	FSD, CARI & KVK
Rodent control in crops	22nd -23rd March, 10	25	Farmers	Diglipur	ORC CARI& NABARD
Pig & goat farming	27th- 29th March, 10	30	Farmers	Diglipur	ORC CARI& NABARD
Protected cultivation of high value vegetables	27th- 29th March, 10	30	Farmers	Diglipur	ORC CARI& NABARD
Customized Training					
Poly house construction, water resource development and vegetable cultivation	19th - 21st May, 09	18	Progressive farmers	CARI	CARI & CEFI-International (NGO)
Promotion of agro forestry in backyard	29th - 31st October, 09	30	SHG members	CARI	CARI & ADRA
Market led Extension : Tools to improve agricultural marketing information network	4th - 8th December, 09	20	Junior level officers	CARI	CARI & MANAGE

EXTENSION ACTIVITIES					
A. Organization of Kisan Mela / Workshop/ Meeting Workshop/ Seminar					
National Seminar on production system management in adverse conditions for higher productivity in A& N Islands	22nd - 24th December, 09	Many	Experts, Scientists, Development officers and Farmers	CARI, Port Blair	CARI & HVADA, Dept. of Agriculture, A& N Adm.
National Workshop on coconut based farming system in A & N Islands	10th- 12th February, 10	Many	Experts, Scientists, Development officers and Farmers	HVADA, Port Blair	CARI, ATMA HVADA, , Dept. of Agriculture, A & N Adm. and CDB
XXI All India BTISNet Coordinators meeting	3rd – 4th February, 10	200	Experts, Scientists	CARI, Port Blair	DBT, GoI, New Delhi
All India Group Meeting of Rodent Control & Ag. Ornithology	19th – 20th March, 10	85	Directors / Professors / Scientists	CARI, Port Blair	ICAR, New Delhi
Exhibition					
Kisan Mela on theme : Livestock and poultry farming for decent livelihood	9th-10th February, 10	1392	Farmers , PRI's, SHG's & Students	CARI, Port Blair	CARI

Other Extension activities

Radio Talks		
Title	**Date of Broadcast**	**Expert**
Seed replacement rate and its importance	03.04.2009	N. Ravisankar
Nursery techniques for paddy	03.06.2009	N. Ravisankar
Integrated nutrient and weed management for paddy	28.07.2009	N. Ravisankar
Harvesting and ratoon practices for paddy	28.10.2009	N. Ravisankar
After care and field management for pulses and table purpose groundnut	18.02.2010	N. Ravisankar
Dhan ke pramukh keet va unka prabandhan	20.07.2009	Ajanta Birah
Dweepon main varsh bhar anannas ugayen	06. 04.2009	V.B. Pandey
Hare dhaniye ki kast	03.08.2009	V.B. Pandey
Dweepon main kharbuj ki kheti ki sambhavanayen	08.01.2010	V.B. Pandey
Sabjiyon ki Javik kheti Sarankshit keti - kuchh sujhav	18.04.2009 24.12.2009	Shrawan Singh Shrawan Singh
Battako ki pramukh beeemariya	21.07.2009	A.Kundu
Murgi palan me chhatni ka mahatva	22.12.2009	A.Kundu
Vermicomposting – ek acha Laghu vyavsay	27.07.2009	S.K. Zamir Ahmed
Scientific storage of grain	17.12.2009	S.K. Zamir Ahmed
Dhan ki kheti me machali palan	30.07.2009	C. S. Chathurvedi
Sarankshit kheti	26.08.2009	D. R. Singh
Garbhavati bakariyo ka prabandhan	03.09.2009	S.Jeyakumar
Bakri palan se adhik labh kaise	25.02.2010	S.Jeyakumar
Krishi utpadan bridhi me biotakneek	19.09.2009	Israr Ahmad
Fasal suraksha me bio takneek	12.02.2010	Israr Ahmad
Kele ke bimariyan avam unke roktham	19.12.2009	Someshwar Bhagat
Swachchh dugdha utpadan – kuch sujhav	31.12.2009	S.K.Verma
Rangeen machaliya ke palan se arthik pragati	05.01.2010	C. S. Chathurvedi
Murgiyon mei IBD	07.01.2010	Jai Sunder
Aarthik samridhi ke liya dairy - kuch sujhav	07.01.2010	M.S.Kundu
Machali palan talabo ka nirman – kuch sujhav	11.01.2010	Kamal Sarma
Andaman aur Nicobar dweep samuho main krishi hetu Jal prabandhan	18.02.2010	S.K.Ambast

Doordarshan Interview		
Title	**Date of Broadcast**	**Expert**
Dhan ke beejo ka rakh -rakhaw	24.09.2008	Krishna Kumar
Phaslo me beej upchar ka mahtava	23.04.2009	Krishna Kumar
CARI dwara vikshit dhan kee unnat kishme	24.09. 2009	Pankaj Kumar Singh
Sabjion ke pramukh keet va unka prabandhan	26.11. 2009	Ajanta Birah
Methodology of seed treatment of crop seeds	23.04.2009	Someshwar Bhagat
Cat fish breeding & seed production	07.08. 2009	C. S. Chathurvedi
Main diseases in poultry during rainy seasons	24.07.2009	A.Kundu
Feeding of pigs and its management in island farming system	24.07.2009	M.S Kundu
Integrated nutrient and weed management for paddy	28.07.2009	V. Damodaran
Nursery raising techniques in coconut	03.12.2009	V. Damodaran
Cultural practices for summer season vegetables in A&N Islands	18.02.2010	V. Damodaran
Dweepan keliye dhan ki unnat kisme	09.04.2009	N. Ravisankar
Dhan ki fasal ki dhekbhal	06.08.2009	N. Ravisankar
Contingency plan for managing crops during dry spell	28.08.2009	N. Ravisankar
BBF padhti se sabzi va machali utpadan	11.01.2010	N. Ravisankar
Achche utpadan ke liye mrida prabandhan	24.08.2009	S.K.Ambast
Krishi utpadan badhane ke upay	09.01.2010	S.K.Ambast

ROUND UP OF INSTITUTE ACTIVITIES

S. N.	Events	Date
1.	RAC meeting	9th to 10th April 2009
2.	Visit of Director and his team to Beodnabad village, South Andaman	22nd May 2009
3.	Visit to Diglipur for site selection of ORC	9th to 11th June, 2009
4.	1st PMC meeting for ORC	17th June, 2009
5.	2nd Technical meeting of Technological innovation for commercial exploitation of *Morinda Citrifolia* as livelihood for Island Farmers funded by NMPB, New Delhi.	25th to 26th June, 2009
6.	Brain Storming on Natural Resource Management in Island Ecosystem.	7th to 8th July, 2009
7.	Training to supporting staff for scale upgradation	3rd to 22nd August 2009
8.	IRC meeting	17th to 21st August 2009
9.	Scientific interaction with Dr. Kalam at CARI, Port Blair	3rd September, 2009
10.	Director and Team visit to Diglipur, North Andaman	9th to 12th September 2009
11.	IMC Meeting	6th October, 2009
12.	Hindi Chetna Month	13th September to 14th October, 2009
13.	Exposure on the role, vision and technological intervention in agriculture & allied field for Island by CARI to students of Tagore College, Port Blair	30th October, 2009
14.	Exposure visit of Bodoland Territorial Council Member & Officer, Kakrajhar, Assam	7th to 9th December, 2009
15.	National Seminar on production system management in adverse conditions for higher productivity in A & N Islands	22nd to 23rd December, 2009
16.	Visit of DDG (Hort.) with Director CARI & IVRI to Baratang & Havelock	24th to 28th Dec, 2009
17.	Director and Team visit to Campbell Bay and Nicobar	12th to 14thJanuary,2010
18.	IMC Meeting	25th January, 2010
19.	XXI All India BTISNET Coordinators' Meeting	3rd to 4th February,2010
20.	2nd PMC Meeting of ORC	6th February, 2010
21.	Kisan Mela	9th to 10th February,2010
22	All India group meeting on Rodent control & Agrl. Ornithology	19th to 20th March, 2010

21.	Kisan Mela	9th to 10th February,2010
22.	Panel Discussion on Development of Human Resources in Agriculture for A & N Islands and Tropical Island Nations : Need, Scope and Prospect.	22nd to 23rd February, 2010
23.	Horticulture Expo 2010 National Conference on Production of Quality Seeds, Planting Materials – Health Management in Horticultural Crops at NASC campus, Pusa, New Delhi	11th to 14th March, 2010
24.	R-goverence Training	15th March, 2010
25.	Hindi Workshop	16th March, 2010
26.	All India Group Meeting on Rodent Control & Agricultural Ornithology	19th to 21st March, 2010
27.	Visit of ISTM officials	20th March, 2010
28.	Visit of Commander in Chief, A & N Command	23rd March, 2010

LINKAGES AND COLLABORATION

Natural Resource Management

- Project Directorate for Farming Systems Research (PDFSR), Modipuram
- Indian Institute of Remote Sensing, ISRO, Dehradun
- Regional Research Station CSSRI, Canning Town, Kolkata, WB
- Space Application Centre, ISRO, Ahmedabad

Field Crops

- Directorate of Rice Research, Hyderabad
- Indian Institute of Pulse Research, Kanpur
- Directorate of Oil Seed Research, Jabalpur
- Indian Institute of Vegetable Research, Varanasi
- National Research Centre for Mushroom, Solan
- Central Arid Zone Research Institute, Jodhpur
- Coconut Development Board, Kochi, Kerala
- National Bureau of Agriculturally Important Microorganisms, Mau, UP
- Dr PDKV, Akola, Maharastra and CARI, Port Blair
- RMRC, Port Blair
- CIPMC, Port Blair, Ministry of Agriculture, GOI

Horticulture & Forestry

- CDRI, Lucknow, WNRF, Chennai, NMPB, New Delhi, Spice Board, Calicut, CPCRI, Kasaragod , IIHR, Bangalore, Centre for Protected Cultivation, IARI, New Delhi, Directorate of Agriculture, A & N Administration

Fisheries Science

- Annamalai University, Chidambaram, Tamil Nadu, Bharadhidasan University, Trichy, Tamil Nadu, Space Application Centre, Ahmedabad, INCOIS, Hyderabad, DBT, New Delhi.

Animal Science

- DBT, New Delhi, RMRC, ICMR, Port Blair, ICAR Institutes; IVRI, PD_ADMAS, CIRG, IGFRI, PDP, CARI, Izatnagar, DAHVS, A&N Admn. ,TANUVAS, TNAU, KLDB

Social Science Section

- NABARD, Port Blair, Tribal Council, Nicobar District, ACANI, Lead India, Prashar Bharati (Akash Vani & Doordarshan), Port Blair

DISTINGUISHED DIGNITARIES

- Mr. O.N. Jaiswal, M.C.O., (Retd.), PIB, Port Blair on 6th April, 2009
- Mr. Martin, Secretary, Tribal Council, Nicobar on 30th June, 2009
- Dr. M.S. Gill, Deputy Director (Project), PDCSR, Modipuram on 7th July, 2009
- H.E. Dr. A.P.J. Abdul Kalam, Former President of India on 3rd September, 2009
- Shri G.R. Chintala, GM, NABARD, Port Blair on 14th September, 2009
- Mrs. Manisha Bhatnagar, Dy. Director, ISTM, DOPT, New Delhi on 17th September, 2009
- Shri Sakti Sinha, IAS, Principal Secretary (Revenue), A & N Admn. on 6th October, 2009
- Shri G.C. Saxena, Secretary, Tourism, A & N Admnstration on 6th October, 2009
- Dr. R.C. Goyal, Pr. Scientist, IASRI, New Delhi on 22nd October, 2009
- Dr. K.P. Gore, Regional Head, CSWCRTI, Sunaleda, Korapur on 26th October, 2009
- Dr. H. Chandrasekharan, PI, Consortium for e-Resources in Agriculture (CeRA), Unit of Simulation and Informatics, IARI, New Delhi on 22nd October, 2009
- Mr. S.S. Choudhury, PCCF, A & N Islands, Port Blair on 7th November, 2009
- Mr. S. Homchaudhuri, Retd. Jt. Director, Social Welfare, Govt. of Assam, Guwahati on 7th November, 2009
- Mrs. Rahil Brahma, ACS Secretary, Agriculture, Bodoland Territorial Council, Kokrajhar, Assam on 7th December, 2009
- Mr. M.R. Basumatary, Executive Member (AGRI), Assam on 7th December, 2009
- Mrs. Rahil Brahma, ACS Secretary, Agriculture, Assam on 7th December, 2009
- Mr. P.B. Roy, District Agricultural Officer, Assam on 7th December, 2009
- Mr. J.P. Banerjee, District Agricultural Information Office, Assam on 7th December, 2009
- Major General Ajay Kumar Chaturvedi, Chief of Staff, A & N Command on 18th December, 2009
- Dr. H.P. Singh, DDG (Horticulture), ICAR, New Delhi on 24th December, 2009
- Dr. Mathura Rai, Director, IIVR, Varanasi on 22nd December, 2009

- Dr. MM. Anwar, Director, NRCSS, Ajmer on 22nd December, 2009
- Dr. Manjit Singh, Director, DMR, Solan on 22nd December, 2009
- Dr. S.K. Tandon, ADG (Engg.), ICAR, New Delhi on 22nd December, 2009
- Mr. Takashi Kume, Japan on 18th January, 2010
- Lt. Governor, Lt. Gen (Retd.) Bhopinder Singh, PVSM, AVSM, Port Blair on 3rd February, 2010
- Dr. T. Madan Mohan, Advisor, DBT, New Delhi on 3rd February, 2010
- Dr. Vishwa Mohan Katoch, Secretary, DHR & DG, ICMR, New Delhi on 3rd February, 2010
- Dr. M. Vijayan, Chairman, BTISnet Task Force on 3rd February, 2010
- Dr. Anil Kumar Singh, Deputy Director General (NRM), ICAR, New Delhi on 8th - 9th February, 2010
- Shri Tapan Mandal, IAS, Development Commissioner, A & N Admn. on 10th February, 2010
- Dr. N.K. Tyagi, Member, ASRB, New Delhi on 22nd February, 2010.
- Shri Vivek Rae, IAS, Chief Secretary, A & N Administration on 22nd February, 2010.
- Ms Archana Arora, IAS, Principal Secretary (Edu.), A & N Administration on 22nd February, 2010.
- Dr. S.S. Magar, Chairman, RAC, Ex-Vice Chancellor, KKV, Dhapoli, Maharastra on 22nd February, 2010.
- Dr. Dilip Kumar, Director & V.C. CIFE, Mumbai, Maharastra on 22nd February, 2010
- Dr. C.S. Chakrabarti, VC, WBUA & FS, Kolkata, W.B. on 22nd February, 2010
- Dr. D.P. Ray, VC, OUAT, Bhubaneswar, Orissa, Dr. P. Thangaraju, VC, TNV & ASU, Chennai, Tamil Nadu on 22nd February, 2010
- Dr. R.K. Mittal, Assistant Director General (Edn.), ICAR, New Delhi on 22nd February, 2010
- Dr. P. Vijayachari, Director, Regional Medical Research Centre, Port Blair on 19th March, 2010
- Dr. T.P. Rajendran, ADG (PP), ICAR, New Delhi on 19th March, 2010
- Dr. R.S. Tripathi, Network Coordinator, Rodent Control, CAZRI, Jodhpur, Rajasthan on 19th March, 2010
- Dr. V Vasudeva Rao, Network Coordinator of Agriculture Ornithology, ANGRAU, Hyderabad on 19th March, 2010
- Dr. AMK Mohan Rao, Rodent Specialist, NPPTI, Hyderabad on 19th March, 2010

DISTINGUISHED DIGNITARIES

PERSONNEL

Director

Dr. R. C. Srivastava

Head / Incharge Divisions / Section

Head, Division of Fish & Fishery Sciences	Dr. S. Dam Roy
Head, Division of Natural Resource Management	Dr. S.K. Ambast
Head Division of Horticulture & Forestry	Dr. D.R. Singh
Head i/c Division of Field Crops	Dr. T.V.R.S. Sharma
Head i/c Division of Animal Science	Dr. A. Kundu
Incharge, Social Science Section	Dr. Ajmer Singh
Administrative Officer	Shri Abhishek Srivastava
Finance & Accounts Officer	Shri Joseph George
Incharge, Planning, Monitoring & Coordination Cell	Dr. S.K. Zamir Ahmed
Incharge, Computer Cell	Dr. M. Balakrishnan
Incharge, Library	Shri P. Gangopadhyay
Incharge, Central Instrumentation Facility	Dr. Jai Sunder
Incharge, Legal Cell	Dr. S.K.Zamir Ahmed
Incharge, Garacharma Farm	Dr. T.V.R.S. Sharma
Incharge, Sippigaht Farm	Mr. I. Jaisankar
Incharge, Bloomsdale Farm	Dr. S. Ghoshal Chaudhuri
Estate Officer, Estate Section	Er. S.L.Paik
Incharge, Guest House	Dr. V.B. Pandey
Assistant Director, Official Language	Smt. Sulochana
Security Officer	Shri N.K. Pushp
Controlling Officer, Krishi Vigyan Kendra	Dr. Subhash Chand
Co-ordinator, Bioinformatics Centre	Dr. M. Balakrishnan
Incharge, RIRIC	Dr. S.K. Verma
Incharge PG Cell	Dr. Jai Sunder

List of Scientific Staff

Division of Natural Resource Management

Dr. S.K. Ambast, Head

Dr. S. Ghoshal Chaudhuri, Principal Scientist (Soil Science: SP&WC)

Dr. N. Ravisankar, Senior Scientist (Agronomy)

Dr. A. Velumurugan, Senior Scientist (Soil Science : CF&M)

Dr. T.P. Swarnam, Scientist Sr. Scale (Soil Science : CF&M)

Mr. T. Subramani, Scientist (Agronomy)

Dr. Sachchidanand Swain, Scientist (ASPE)

Division Of Field Crops

Dr. T.V.R.S. Sharma, Principal Scientist & Head I/c upto 31st January, 2010

Dr. Krishna Kumar, Senior Scientist (Plant Pathology) & Head I/c from 1st January

Dr. Ajanta Birha, Senior Scientist (Agrl. Entomology)

Dr. Pankaj Kumar Singh, Senior Scientist (Plant Breeding)

Dr. Someshwar Bhagat, Scientist (Plant Pathology)

Shri Israr Ahmed, Scientist (Biotechnology)

Dr. Naresh Kumar, Scientist (Plant Breeding)

Division of Horticulture & Forestry

Dr. D.R. Singh, Pr. Scientist & Head (May, 2009 onward)

Dr. M. Sankaran, Senior Scientist (Horticulture)

Miss R. Sudha, Scientist (Horticulture)

Shri I. Jaisankar, Scientist (Forestry)

Dr. Shrawan Singh, Scientist (Vegetables)

Division of Fish & Fisheries Science

Dr. S. Dam Roy, Head

Dr. Chandra Shekhar Chaturvedi, Senior Scientist (Fish & Fisheries)

Dr. Kamal Sarma, Senior Scientist (Fish & Fisheries)

Dr. P. Krishnan, Scientist (Fish & Fishery)

Shri. Grinson George, Scientist (Fish & Fishery Science)

Division of Animal Science

Dr. A. Kundu, Senior Scientist (Livestock Production & Management) & I/C Head

Dr. Madhu Sudan Kundu, Sr. Scientist (Animal Nutrition)

Dr. Jai Sunder, Sr. Scientist (Veterinary Microbiology)

Dr. S.K. Verma, Scientist Sr. Scale (Animal Nutrition)

Dr. S. Jeyakumar, Scientist Sr. Scale (Animal Reproduction)

Dr. T. Sujatha, Scientist (Poultry Science) on study leave

Dr. Arun Kumar De, Scientist (Animal Biotechnology)

Social Science Section

Dr. Ajmer Singh, Senior Scientist (Agricultural Economics) & Incharge.

Dr. Subhash Chand, Senior Scientist, (Agricultural Economics)

Dr. S.K. Zamir Ahmed, Senior Scientist (Agricultural Extension)

Dr. M. Balakrishnan, Scientist Sr. Scale (Computer Applications)

Krishi Vigyan Kendra

Dr. Subhash Chand, Controlling Officer

Sh. Nagesh Ram, Subject Matter Specialist (Fisheries) & Administrative Head

Mr. L.B. Singh, Subject Matter Specialist (Horticulture)

Dr. Abhay Kr. Singh, Subject Matter Specialist (Animal Science)

Mr. Bijaya Kr. Nanda, Subject Matter Specialist (Agrl. Engineering)

Mr. N.C. Choudhuri, T-6 (Animal Science)

COMMITTEES OF THE INSTITUTE

Research Advisory Committee

Dr. S.S. Magar,	Ex –Vice Chancellor, KKV, Dapoli - Chairman
Dr. P.N. Jha,	Member
Dr. R.P. Awasthi	Member
Dr. N. Mourya, Ex- Director, IAS	Member
Dr. D.D. Nambudiri, Dean Fisheries	Member
Dr. Arun Varma, Ex- ADG, ICAR	Member
Dr. Umesh Srivastava, ADG(Hort)	Member
Dr. R. C. Srivastava	Member
Smti Uma Bharti	Non official member
Shri Mohammed Azimuddin	Non official member
Dr. S. Dam Roy	Member Secretary

Institute Joint Staff Council

Technical Staff

Shri K. Babu Rao, T-2

Shri Kishore Tete, T-3

Administrative Staff

Shri P.K. Roy, Sr. Clerk

Smt. Florence Toppo, Jr. Steno

Supporting Staff

Shri K. Ali, S.S. Gr.II

Shri Dominic Ekka, S.S. Gr.

Official Side (Nominated by Director)

Dr. S.K. Ambast, HOD, NRM

Dr. S. Dam Roy, HOD, Fisheries Science

Dr. T.V.R.S. Sharma, HoD I / c Field crops

Administrative Officer

Finance & Accounts Officer

Estate Officer

Institute Management Committee

Dr. R.C. Srivastava, Director	Chairman
Dr. G.S. Parakash, HoD	Member
Dr. S. Dam Roy, HoD	Member
Dr. D.Nag, HoD, NIRJAFT, Kolkata	Member
Director of Agriculture, A & N Administration	Member
Director of Horticulture, Govt. of Orissa	Member
Director of Research, BCKVV, W.B.	Member
Smti. Uma Bharati, Mohanpura, Port Blair	Member
Shri. Md. Azimuddin, Mohanpura, Port Blair	Member
F. A. O., CRIJAF, Barrackpur , W.B	Member
Administrative Officer, CARI, Port Blair	Member Secretary

Official Language Implementation Committee

Dr. R.C. Srivastava, Director	Chairman
Dr. N. Ravisankar, Sr. Scientist	Member
Dr. Jai Sunder, Sr. Scientist	Member
Dr. S.K. Zamir Ahmed, Sr. Scientist	Member

Dr. M. Balakrishnan, Scientist (SS)	Member
Shri Abhishek Srivastava, Admn. Officer	Member
Shri Joseph George, F & AO	Member
Shri P. Gangopadhyay, T-6	Member
Shri A.K. Tripathi, T-5	Member
Dr. S.K. Verma, Scientist (SS)	Member Secretary

Purchase Advisory Committee

Dr. Jai Sunder, Sr. Scientist	Chairman
Dr. N. Ravisankar, Sr. Scientist	Member
Dr. P. Krishnan, Scientist	Member
Dr. S. Jeyakumar, Scientist (SS)	Member
Finance & Accounts Officer	Member
Administrative Officer	Member Secretary

Works Committee

Dr. A. Kundu, Pr. Scientist	Chairman
Administrative Officer	Member
Finance & Accounts Officer	Member
Estate Officer	Member Secretary

Condemnation Committee

Dr. Jai Sunder, Sr. Scientist	Chairman
Administrative Officer	Member
Finance & Accounts Officer	Member
Estate Officer	Member
Asstt. Admn. Officer (Store)	Member Secretary

Price Fixation Committee

Dr. A. Kundu, Pr. Scientist	Chairman
Dr. Kamal Sarma, Sr. Scientist	Member
Dr. M. Shankaran, Sr. Scientist	Member
Finance & Accounts Officer	Member
Shri A. K. Tripathi, T-5	Member Secretary

NEW ENTRANTS /TRANSER /PROMOTION

New Entrants

- Dr. Arun Kumar De, Scientist (Animal Biotechnology) joined on 28th August, 2009
- Dr. Ajmer Singh joined as Senior Scientist (Agricultural Economics) on 6th November 2009 upon transfer from DWR, Karnal
- Dr. A. Velumurugan, Senior Scientist, (Soil Science: CF&M) joined on 3rd October, 2009
- Dr. T.P. Swarnam joined as Scientist Sr. Scale (Soil Science : CF&M) on 3rd October 2009 upon transfer
- Dr. Sachchidanand Swain joined as Scientist (Process Engineering) on 15th March 2010
- Dr. Naresh Kumar joined as Scientist (Plant Breeding) on 15th March 2010

Transfer

- Dr T. Subramani, Scientist resigned from the ARS on 30th January, 2010

Promotion

- Dr. D.R. Singh, Principal Scientist, Horticulture & Forestry Division got promoted to Head, Horticulture & Forestry Division, CARI, Port Blair w.e.f. 29th May, 2009
- Shri Nehru Ram promoted as Junior Clerk on 30th November, 2009
- Shri Emil Lakra promoted as Junior Clerk on 30th November, 2009

Retirement

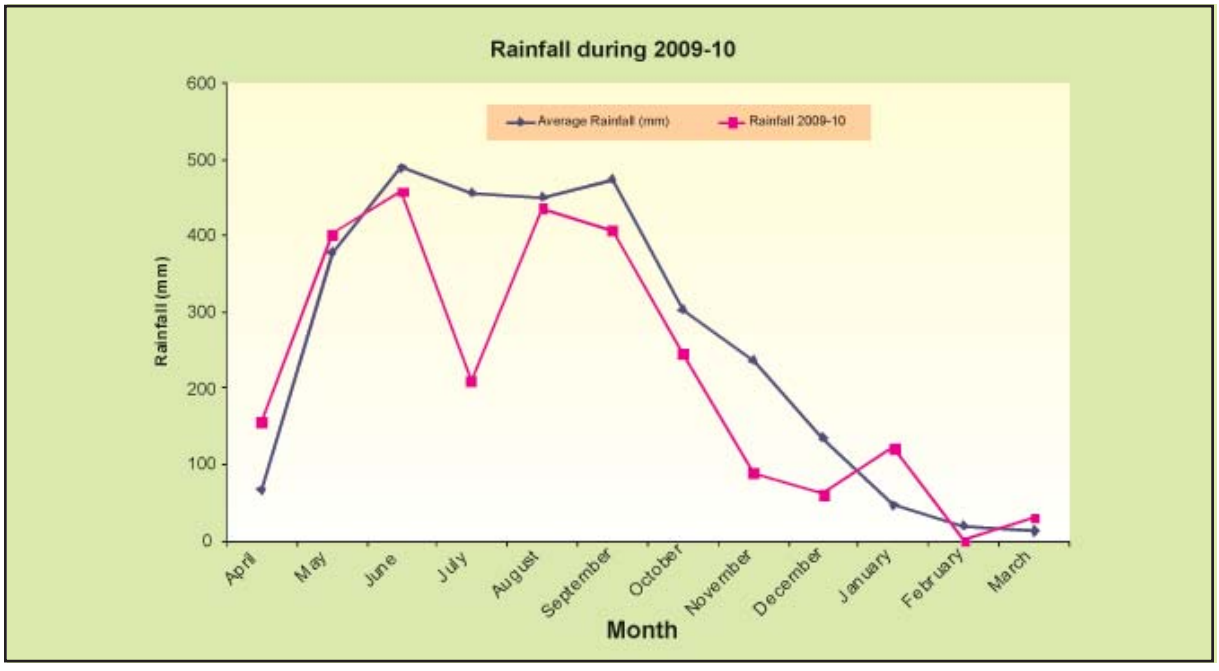
- Shri R. Kondaiah, T-4, Driver retired on 30th June, 2009
- Dr T.V.R.S. Sharma, Principal Scientist retired on 31st January, 2010
- Shri C. Kunjumani, Skilled Supporting Staff retired on 31st January, 2010
- Shri Emil Lakra, Junior Clerk retired on 28th February, 2010

Left to Heavenly Abode

- Late A. Dorairaj, S.S.Gr.I on 14th October, 2009
- Late Ibha Rani, S.S.Gr. I on 23rd January, 2010

Weather Parameters (2009-10) at CARI, Port Blair (11^{0}36' 35" N, 92^{0}42' 54" E)

Month & Year	Rainfall (mm)	Rainy Days	Maximum T (°C)	Minimum T (°C)	RH (%)	Wind Speed (KMPH)
April, 09	157.4	11	32.6	25.2	77.9	2.9
May, 09	403.1	19	31.7	25.3	83.7	7.7
June, 09	458.6	18	29.1	24.5	89.1	7.3
July, 09	209.5	15	30.3	25.0	87.4	4.5
Aug., 09	436.6	16	30.1	24.3	89.9	5.8
Sept., 09	408.2	20	30.1	24.5	90.0	5.1
Oct., 09	245.0	13	30.7	23.4	90.8	1.7
Nov.,09	89.2	3	30.1	23.6	85.6	2.8
Dec., 09	61.9	3	29.5	22.1	87.9	4.6
Jan., 10	122.7	4	29.8	17.4	88.3	4.7
Feb., 10	1.2	0	31.1	20.1	82.5	3.8
Mar., 10	30.6	1	32.1	19.7	83.3	5.0



CENTRAL AGRICULTURAL RESEARCH INSTITUTE
Port Blair - 744 101
Andaman & Nicobar Islands
Phone: 03192-250234, 250436
Fax: 03192-251068, 233281
E-mail: director@cari.res.in
Website: http://cari.res.in