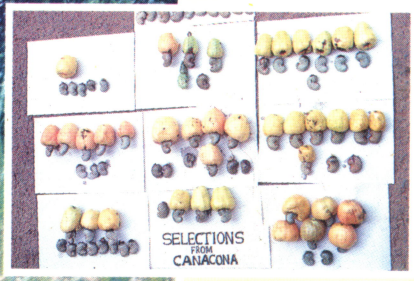
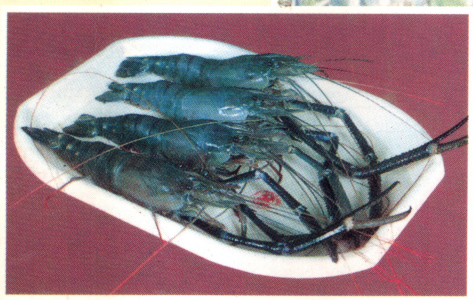
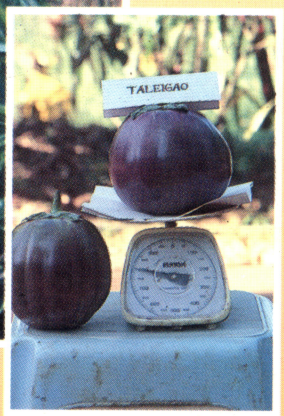
# ANNUAL REPORT

1996-97






ICAR RESEARCH COMPLEX - GOA
ELA, OLD GOA - 403 402

# ANNUAL REPORT

## 1996 - 97





## ICAR RESEARCH COMPLEX - GOA

(Indian Council of Agricultural Research)

ELA, OLD GOA - 403 402, INDIA

Published by :

**D.G.DHANDAR**

***DIRECTOR***

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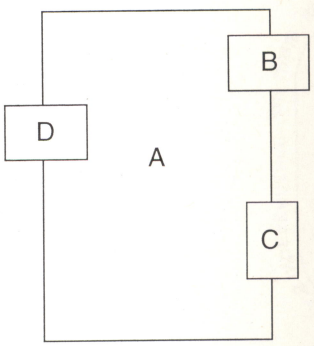
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Front Cover :




A - 'Indrayani - A fine grained scented rice variety performing well in Goa

B - Local Cashew selections

C - Taleigao - a local brinjal variety

D - Fresh water prawn, *Machrobrachium rosenbergii*

Back Cover - Laboratory cum Office building of ICARRC - Goa

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# 1. DIRECTOR'S INTRODUCTION

The ICAR Research Complex for Goa was established in 1975 as a research centre inderthe control of the ICAR Research Complex for North Eastern Hill Region, Shillong. The dministrative control of the complex was shifted to Central Plantation Crops ResearchInstitute, Kasaragod, in 1976. The Complex was upgraded to the status of an independent institute vith effect from 1st April, 1989, there by enabling it to effectively cater to the increasing gricultural research, education and extension needs of Goa and its adjoining region. To meet he transfer of technology requirements of the farming community of the state, a Krishi Vigyan Kendra was added on to the Institute in 1983.

## Mandate

The original mandate of the Institute in brief is "Introduction and improvement of all otential crops and species/breeds of livestock, their production and scientific exploitation ncluding various aquatic resources for improving fish production".

The modified present mandate of the Institute is as follows:

1. To conduct strategic and applied research on potential agricultural and horticultural crops, livestock and fisheries in relevance to agro-climatic situations of Goa
2. To disseminate the improved technology developed
3. To act as a centre for training in updated technologies
4. To collaborate with national and international Institutes/Agencies in developing and transferring new technologies
5. To generate nucleus planting materials
6. To provide consultancy services
7. To act as a repository of information on Western Ghat Agricultural systems

## Staff and Budget

The total staff strength of Institute, including the posts sanctioned under VIII Plan, was 92 and that of Krishi Vigyan Kendra, 26. The total annual expenditure of the Institute was Rs. 128.25 lakhs which included the amount spent under Plan (Rs. 67.43 lakhs), Non-Plan (Rs. 43.93 lakhs) and KVK (Rs. 16.89 lakhs), besides Rs. 1.51 lakhs spent under other funded schemes like Govt.of India Integrated Cashew Development Scheme, Adhoc scheme on Cashew Germplasm of Goa and NARP funding for the establishment of ARIS Cell.

## Research Activities

With an overall objective to increase the agricultural productivity of the region, 20 research projects were structured which were ongoing during the year under report. They comprised of seven projects in Crop Science, five in Horticulture, three in Animal Sciences, two in Fisheries and three in Transfer of Technology. Three research projects were completed

in the previous year. The Krishi Vigyan Kendra also functions as the Extension wing o Institute, in addition to its regular identified transfer of technology programmes.

### Research Advisory Committee

The ongoing research programmes were evaluated and achievements reviewed i light of local agricultural requirements and identified thrust areas, by the Research Adv Committee constituted for the Institute, in its meeting held on 9 May, 1996. The comm also gave suitable suggestions for the strengthening of the research programmes o Institute.

### Staff Research Council

On the lines of suggestions made by the Research Advisory Committee, the on individual research projects are evaluated and technical programmes finalized by the Research Council of the Institute. The Seventh Annual Research Council meeting held o 10-11 June, 1996, which was attended by the representatives of the Development Departm of Government of Goa, besides the nominated subject matter specialists of the Staff Res Council, finalized the technical programmes of the 20 research projects for the year 97. Similarly, in the Eighth Annual Research meeting held during 5-6 June, 1997, in Dr.B.S.Sonde, Vice Chancellor, Goa University was the Chief Guest, the progress ma the research projects during 1996-97 was reviewed.

### Institute Management Committee

The second Institute Management Committee constituted in 1994, met on 4 Oc 1996, reviewed the progress of infrastructure development and approved the important fin and administrative proposals of the Institute for the year.

### KVK Local Management Committee

The Local Management Committee constituted with the representation from government and non-government organizations and farmers, met on 12 June, 1996, rev the progress of transfer of technology programmes of the Krishi Vigyan Kendra as p modified norms of the council and approved the technical programmes for 1996-97.

### Institute Joint Staff Council

With an intent to increase the cooperation between the management and empl and promote harmony amongst staff, the Joint Staff Council met twice during year (25.9 and 26.2.1997).

### Collaboration with other Organizations and Development Agencies

The Institute has been maintaining a close collaboration with the State Depart of Agriculture, Animal Husbandry and Veterinary Services, Fisheries, Rural Develo Agency and Horticultural Development Corporation, in identifying the areas of research p

nd active involvement in their development programmes, through mutual participation in the oint meetings and various training and extension programmes. In the process of finalization f research priorities of the Institute, the expertise and experience of specialists of other elevant ICAR Institutes, neighbouring Agricultural Universities and Goa State Departments re obtained in major meetings and committees arranged for the purpose. The Institute has ointly identified areas of inter-institutional collaborative research with the University of gricultural Research, Dharwad, in which infrastructural and man power facility available under oth the organizations would be utilised for common research programmes. The Institute was lso recognized by the University of Agricultural Sciences, Dharwad, as a centre of post raduate studies. Scientists of the Institute are also actively involved in the academic rogrammes of Goa University.

The Institute is a participant member in various state level committees constituted by he Government of Goa. There exists a close and reciprocal involvement in various rogrammes conducted by agencies like NABARD, CADA, Sanjivani Sugar Factory, Central ntegrated Pest Management Centre, Margao, banks, cooperatives, Mahila Mandals, private urseries, panchayats, etc. The Institute is participating in the agricultural programmes of All ndia Radio and Doordarshan, Panaji Centres. The Institute also has combined research and echnology transfer programmes with Baba Atomic Research Centre, Mumbai, Cashew Development Board, Government of India, Cochi and Government Polytechnic, Panaji.

**Visit of Parliamentary study team**

A study team of the Parliamentary Standing Committee on Agriculture comprising of 10 Members of Lokh Sabha, visited the Institute on 28-29 October, 1996 and reviewed the activities and programmes carried out, in relation to the agricultural requirements of Goa. The team appreciated the research efforts being taken up by the Institute in spite of the inadequate manpower and infrastructural facilities available at present.

**Publications**

During the year, the Institute had brought out two priced Technical Bulletins. A descriptive and illustrated compendium of mango varieties of Goa was brought out as, "Mangoes of Goan origin with propagation and culture". An illustrated publication on rabbit rearing suitable for humid tropics entitled, "Technology package for meat rabbit production", was released for the benefit of farmers and small scale entrepreneurs. In addition, two information handouts on the accomplishments of the Institute, three extension folders including two on cashew and one on groundnut cultivation and two technical folders on duck-fish and poultry-fish integrated farming systems, were also published.

**Library**

The Institute is subscribing 21 foreign and 34 Indian journals and has a stock of 865 books (60 books purchased during 1996-96) and 620 bound back volumes on various aspects relevant to the activities of the Institute. The Krishi Vigyan Kendra also has its own collection of books relating to the farmer's requirements.

## Infrastructural Development

During the year under report, some important research facilities were added strengthen the ongoing programmes. A Fisheries Field Laboratory building with analy facilities, was inaugurated on 1 December, 1996, by Dr. K.L.Chadda, Deputy Director Gen (Horticulture), ICAR, New Delhi. This facility will be subsequently used for the establishm of freshwater prawn hatchery. DELTA-T, a completely automatic weather recording station computer facility, was established, which will be connected to the LAN facility to be crea in the Main Laboratory building which is progressing fast. With the Rs. 5.00 lakhs assista from NARP of the Council, a room was modified and an ARIS Cell facility was establis comprising of three Pentium computers, server, Modem, laser printer and a high power U In addition, three more Pentium computers, an inkjet colour printer and a Page Maker softw were added to the Institute. To strengthen the research programmes of the Institute, a HP analytical facility with high speed centrifuge and BOD were procured/installed during the y

## About this Report

This Annual Report for the year 1996-97, contains in the following pages, highlig of research achievements, report on the ongoing and completed research projects and gen information covering various committees, staff and budget position, visitors, appointme transfers, training, meeting, seminars and symposia attended by the staff of the Instit their publications and weather data recorded at Old Goa. It is hoped that this report will informative and useful to researchers, development authorities and the farmers alike.

**(D. G. DHANDAR)**
DIRECTOR

# 2. RESEARCH HIGHLIGHTS

## . Crop Science

### *ice*

Among the seven fine grained/scented ce varieties evaluated, the variety Indrayani as consistently yielded better than other arieties during the last four seasons. The ooled averages of last four seasons has hown that Indrayani has recorded 6.35 t/ha ield followed by Pawan 4.73 t/ha and Pusa asmati-1 (3.74 t/ha).

The three years pooled data on valuation of rice varieties for salt affected oils revealed that the yield of CSR-4 (3.53 ha), CSR-10 (3.44 t/ha) and Palghar-1 (3.26 ha) were consistently higher as compared to e local variety, Korgut (1.95 t/ha).

In a field trial to identify profitable ulse/oilseed crops and varieties, for residual oil moisture conditions in rice fallows, the owpea variety V-118 excelled over local lsano in duration, branching habit, (7 ranches/plant), pods (56/plant) pod to seed atio (0.71) and the grain yield (668 kg/ha). he groundnut variety DH-3-30 was found etter as compared to DH-30, in terms of umber of pods (16/plant) test weight and the od yield (667 kg/ha) as a consequence of etter root growth (30 cm) and higher dry natter production (23/plant). The pigeon pea ariety S-31 was better in terms of number of ods (6/plant) pod to seed ratio (0.54) and test veight (9.5 g). The variety ICPL-27 was good n terms of test weight (10 g) and the grain ield (316 kg/ha) although its pod to seed ratio 0.32) was less.

For the management of *Helicoverpa armigera* in red gram grown in rice fallows, *Bacillus thuringiensis* and neem based biopesticides were tried. The results were compared with the recommended chemical insecticides. The results have shown that the biopesticides could be an idea components in the IPM of *H. armigera.*

### *Sugarcane*

In sugarcane, three years study (one plant crop and two ratoons) revealed that the variety Co 90009 recorded the highest yield of 105.7 t/ha with a sugar recovery of 9.38 per cent and commercial cane (CCS) 9.81 t/ha followed by Co 90006 (103 t/ha) with sugar recovery 8.15 per cent and 8.42 t/ha .

In a field study, drip irrigation was found to have a positive influence in increasing the millable canes (52,200/ha) cane height and number of internodes/cane in a second ratoon scheduling irrigation at an IW/CPE ratio of 1.00 recorded more girth and length of internodes. The individual cane weight was highest (1.16 kg /cane) at I1 level in drip irrigation. Drip irrigation yielded 86.03 t/ha of cane yield as compared to 76.02 t/ha in furrow irrigation. The cane yield was highest at I3 level both in drip (98.66 t/ha) and furrow irrigation (86.13 t/ha). Drip irrigation recorded higher water use efficiency(1.33 t/ha) in relation to furrow irrigation (0.80 t/ha cm) and in both the methods, water use efficiency was maximum at II level. The economic analysis indicated that the total cost of producltion is higher with drip system (Rs.20,081/ha) as compared to furrow system (Rs. 11,048/ha) owing to higher fixed cost (Rs. 11,940/ha/year) incurred in installation of drip system. Although the gross returns were higher (Rs. 78,449/ha) in

drip system, the net returns were lower (Rs.58,638/ha). Among the irrigation levels I3 recorded higher gross returns and net returns in both the methods. With the additional sugarcane area irrigated (1.11 ha) through savings in water by drip system, income per mm of water used is more in drip system.

***Others***

Custard apple seeds were extracted with different organic solvents for obtaining insecticide principle. Among the solvents tried, ether extract was found to be having more active principle. Topical application of the extract even at 1:7 dilution, resulted in more than 50 per cent mortality with the test insects, *Dysdercus cingulatus.* There is a slight reduction in haemolymph total protein level.

**B. Horticulture**

***Cashew***

In a survey under an adhoc project, 'Collection of cashew germplasm in Goa and establishment of gene bank', about 60 numbers of potential genotypes were located in different cashew growing zones in Goa. They include high yielders, bold nut types and bold nut with bigger apple size.

The existing cashew germplasm collection of 66 (31 local accessions, 33 introductions, one related species and one coloured mutant) accessions were increased to 68 by two new additions, viz., Ullal-4 and Puttur Sel-1. Balli-2 recorded the highest nut yield of 4.5 kg/tree in the current season with 32.7 per cent shelling, while the cumulative yield for seven years was 14.55 kg/tree. Other local accessions like Malorem and Mardol-5 had the average nut weight of 10.6, 9.1 g respectively with 31.9 and 30.2 of shelling per cent. Among the intro accessions, VTH-59/2 gave the highe yield of 4.07 kg/tree. But, with resp cumulative yield for seven years, HE recorded the highest yield of 9.62 k followed by BTH-59/2(8.27 kg/tree).

***Mango***

With two new additions n Appemidi (pickling type) and Mundap Table variety), the mango germ collection has a total of 82 acces Furtado, Colaco Branca and Maxima y 5.5 , 4.85 and 4.5 t kg of fruits per tre average fruit size of 282.5, 269.3 and 2 respectively. Mankurad recorded the h pulp contents of 72 per cent follow Furtado (69 %). Kesar recorded the h fruit yield (17.02 kg/tree) with medium fruits (275 g), the highest pulp cosnte percent) and 21.7 percent among the p varieties, while hybrids viz., HB-56, and Amrapali yielded 23.8,23.2 and 22 tree respectively. Ratna recorded the h average fruit weight of 457.5 g follow HB-45(425.5 g). However, Amrapali fru 75 per cent pulp contents with 24.4°

***Oil palm***

All the oilpalm hybrids did not significantly either in growth or yield o fruit bunches, both in current season ar in respect of cumulative yield for three

***Coconut***

In an experiment to identify pro forage grass/legume species and varieties for intercropping in coconu hybrid napier PBN-16 recorded highe width (2.26 cm), weight of leaf (175 g stem (285 g) per tiller with lower leaf to ratio (1:1.63) higher forage yield (19.6

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nd crude protein (10.5 %) as compared to ocally popular NB-21(16.74 t/ha-forage yield). he Guinea grass (variety Punjab Guinea-23) recorded moderately good yield (12.04 t/ a) with lower moisture (75.8 %) although its eaf to stem ratio was higher (1:2.11). The *etaria* grass, although recorded a lower leaf stem ratio (1:1.79) was found to be a poor ielder (5.88 t/ha).

Among the perennial legume forages *Stylosanthus scabra* recorded relatively igher plant height (86 cm), trifoliate leaves 238/plant), branches(15 primary and 34 econdary) with better forage yield (3.39 t/ha).

**C. Animal Sciences**

A study on crossbred pigs to find out he appropriate age of marketing, indicated hat by increasing the crude protein content f the commercial feed to 23 per cent through he incorporation of groundnut cake at 20 per ent level, the average daily weight gain of he weaned crossbred pig can be increased nd the market weight of 32 kg can be btained at about six months under the local onditions.

In a study on evaluation of varying nergy protein level in rabbit for better erformance, the growth rate of cross bred abbit was higher i.e. 21.3 g/day when the rude protein level in the compounded feed as increased to 21.5 per cent from 17.5 per ent. When *karad* hay was incorporated in the ow cost feed, the digestibility was 65.7 per ent. However, the digestibility was ncreased by 7 per cent when fungal treated *arad* hay was incorporated in the ompounded rabbit feed.

In a study on adoption of improved echniques to increase the fertility and ecundity in rabbits, no adverse effect was observed on litter size when oestrous was induced 30 days post farrowing. It was observed that fertility was improved by breeding female within 24-48 hours after kindling. It was also observed that calcium and phosphorus level was low in low fertile rabbits and the orals calcium supplementation improves it survival rate. Semen preserved in tris media could show more mortality than in sodium citrate after 48 hours.

**D. Fishery Science**

In a field trial on rice-freshwater prawn integration, direct broadcasting of rice variety Vytilla-1 in late May established a good kharif crop. *Macrobrachium rosenbergii* recorded good growth inspite of heavy mortality due to local fishes and other predators, which entered the trial plots. In another trial on use of neem based insecticide in the eradication of weeds fishes. *Mystus* sp was identified as one more weed fish under the freshwater pond system in addition to nine species already identified. Bioneem was found to be effective in killing *Aplochelus* sp and *Mystus* sp in 5 to 6 hours at the lowest concentration of 0.0050 ppm.

**E. Transfer of Technology**

During the year 1996-97, the Krishi Vigyan kendra conducted 91 training courses in the disciplines of Crop Science, Horticulture, Home Science, Plant Protection and Animal Science and imparted skill oriented need based training to 1,507 participants comprising of practicing farmers and farm women, rural youth and grassroot level extension workers. The participation of women in these training was 47 per cent . The Training Associates participated in 55 special training programmes conducted by various agencies and developmental departments.

During the year, a Rabi groundnut campaign, Farmers convention, Field days, World Food Day exhibition and Women in Agriculture day were organised.

Four radio talks, three TV programmes and two video cassettes were prepared and five popular articles were published during the year.

Under Farm Advisory services, various critical inputs were distributed under LLP and demonstration in rice and groundnut were laid out registering 33.5 and 60.3 per cent yield increase, respectively.

Under National Demonstration, demonstrations were laid out covering 6.8 in Nerul village under three crop sequen i.e. monocrop, double crop and multiple c and yield increase of 33.01 per cent in 62.3 percent in basmati rice, 41.0 per cen groundnut and 61.0 per cent in pulses recorded by virtue of improved packag practices demonstrated.

Under On Farm Research, vari activities like survey of SC/ST beneficia supply of critical inputs, collaboration State Department of Agriculture in waters programme and problem oriented resea work were initiated during the year.

# 3. REPORT ON ONGOING RESEARCH PROJECTS

## 3.1 Crop Sciences

### Evaluation of short duration and fine grained/scented rice varieties for Goa

(H.R. Prabhudesai)

During the year, two sets of experiments, one in short duration group and other in fine grained /scented group each containing seven varieties were taken up at the Institutes farm in a randomised block design (RBD) with three replications.

Standard agronomic practices were followed in both the trials with regard to crop cultivation. The observations in respect of growth and yield contributing characters such as plant height, length of earhead, number of productive tillers, number of grains/panicle, number of filled grain, panicles/$m^2$, and 1000 grain weight and yield/plot were recorded.

Among the seven short duration rice varieties evaluated during kharif 1996 season, the variety Vikas (Fig 1) outyielded the rest of the varieties yielding 5.58 t/ha which was however statistically at par with the check variety Jyoti (5.08 t/ha). There was a good relation between various yield contributors characters and the yield as seen in Table 1.

In the second set of trial on fine grained/scented rice varieties during kharif, results showed that the variety Indrayani (Fig 2) out yielded the rest of the varieties with an yield of 5.66 t/ha. Another variety Pusa Basmati-1 stood at second with an yield level of 4.75 t/ha closely followed byvariety Pawan yielding 4.25 t/ha. The results showed positive correlation between some of the yield contributory characters like the number of productive tillers, number of panicles/$m^2$, Number of tillers/hill, number of filled grains/ panicle (Table 2).

All the varieties showed desired level of aroma under field conditions.

During the rabi season of 1996-97, the same two sets of trials were repeated in order to educate their performance.

The results showed that among the short duration rice group, the variety Tulsi has registered the highest yield of 6.4 t/ha followed by another recommended variety Annada (IET-6223) which yielded 6.16 t/ha. The variety Vikas which has recorded high yield in kharif season was relagated to third position yielding 6.06 t/ha. All the three varieties however were found to surpass the yield of local check variety Jyoti (5.5 t/ha).

**Table 1. Performance of short duration rice varieties during kharif 1996**

| Sl. No. | Variety | Earhead length (cm) | Plant height (cm) | Number of tillers per hill | Number of panni-cles per m2 | Number produc-tive tillers | Number of fill-led grains | 1000 grain weight (gm) | Yield t/ha | Days for 50 % flowe-ring | Duration |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Aditya | 24.0 | 94.83 | 11.86 | 561.6 | 10.1 | 132.4 | 32.6 | 4.0 | 77 | 105 |
| 2. | Abhaya | 21.7 | 95.50 | 12.10 | 532.0 | 10.0 | 134.3 | 24.3 | 3.41 | 78 | 112 |
| 3. | Annada | 23.9 | 95,50 | 11.90 | 479.0 | 9.8 | 150.7 | 34.0 | 2.58 | 75 | 110 |
| 4. | Jyoti | 22.2 | 93.00 | 12.70 | 525.3 | 11.4 | 146.8 | 34.6 | 5.08 | 78 | 115 |
| 5. | Tulsi | 23.4 | 97.60 | 13.60 | 546.0 | 12.0 | 150.4 | 22.3 | 4.60 | 76 | 110 |
| 6. | Vikas | 24.6 | 93.10 | 14.53 | 572.3 | 13.8 | 167.8 | 31.3 | 5.58 | 79 | 110 |
| 7. | Ravi | 25.4 | 104.90 | 12.13 | 476.6 | 10.2 | 130.3 | 25.6 | 3.25 | 78 | 115 |
| | CD(P=0.05) | 1.36 | 1.08 | 1.28 | 60.34 | 1.09 | 4.42 | 7.74 | 0.61 | | |

**Table 2. Performance of fine grained/scented rice varieties during kharif 1996**

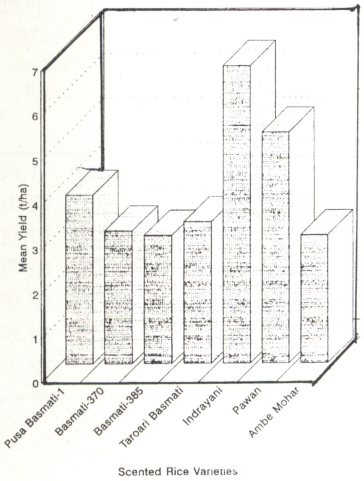
| Sl. No. | Variety | Plant height (cm) | Earhead length (cm) | No. of tillers per hill | No.of panni-cles per $m^2$ | No. of produc-tive tillers | No.of filled grains perfor-mance | 1000 weight | Yie t/h |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Basmati-370 (M-108) | 132.3 | 23.7 | 19.46 | 857.3 | 18.2 | 141.6 | 20.2 | 2. |
| 2. | Basmati-385 (M-102) | 131.1 | 24.8 | 11.33 | 513.3 | 10.0 | 137.5 | 19.6 | 3. |
| 3. | Taroari Basmati (M-109) | 146.6 | 25.5 | 14.60 | 671.3 | 13.6 | 185.4 | 21.5 | 3. |
| 4. | Pusa Basmati-1 (M-127) | 118.1 | 26.8 | 20.06 | 731.6 | 18.3 | 155.0 | 20.0 | 4. |
| 5. | Indrayani | 119.8 | 24.7 | 22.9 | 1009.3 | 19.9 | 258.1 | 21.2 | 5. |
| 6. | Pawan | 112.4 | 25.3 | 20.6 | 847.6 | 19.5 | 170.2 | 21.6 | 4. |
| 7. | Ambemohar | 171.8 | 24.7 | 11.6 | 665.3 | 13.5 | 178.0 | 20.8 | 2. |
| | CD(P=0.05) | 6.66 | 1.58 | 1.89 | 27.5 | 3.45 | 17.7 | 1.42 | 0. |

The results of the second group comprising the five grained/scented varieties during rabi showed that the variety Indrayani retained its position at number one out yielding others varieties with an yield of 7.25 t/ha which was found to be significantly higher than rest of the varieties. Pawan (5.91 t/ha) stood second while Pusa Basmati-1 was at third position with 3.5 t/ha.

The results were found to be highly significant and there was correlation between all the major yield contributing characters studied (Table 2).

The comparative performance of fine grained/scented varieties for previous five consecutive seasons indicates that the variety`Indrayani has yielded consistently well recording an overall mean yield of 5 t/ha during kharif and 6.69 t/has during seasons (Fig.1).

Fig. 1 Performance od secnted rice varieties in G

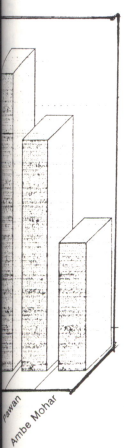


kharif 1996

| 1000 weight | Yield t/ha |
|---|---|
| 20.2 | 2.8 |
| 19.6 | 3.5 |
| 21.5 | 3.7 |
| 20.0 | 4.7 |
| 21.2 | 5.6 |
| 21.6 | 4.2 |
| 20.8 | 2.9 |
| 1.42 | 0.3 |

mean yield of 5.6
9 t/has during ra

rice varieties in Goa




**. Evaluation of salt tolerant rice varieties**
(H.M.Wasnik)

The field experiments were conducted uring the kharif seasons of 1993-94, 1994-95 nd 1995-96 in a randomised block design with hree replications on saline soils at the farmers eld. The soils were silty clays to silty clay oam, with sodium chloride as a dominant oluble salt (Table 3). The trial consisted of even salt tolerant rice varieties i.e. CSR-4, CSR-10 Palghar-1, Panvel-1, Panvel-2 Co-43 nd Korgut. The three year pooled results evealed that the rice yield of CSR-4(3.53 t/ha), CSR-10 (3.44 t/ha) and Palghar-1 (3.26 t/ha) vere consistently higher and significantly uperior to the local variety Korgut (1.95 t/ha). he more number of productive tillers, higher umber of panicles per metre square area and nore test grain weight contributed for higher ield of these varieties as compared to local ne. The varieties Panvel-1 (2.82 t/ha), Co-43 (2.74 t/ha) and Panvel -2 (2.66 t/ha) were n par with each other but yielded superior to the local variety Korgut under Goa conditions (Table 4 & 5).

**Table 3. Characteristics of saline soils**

| | |
|---|---|
| Fine | 6.25 % |
| Silt | 25.76 % |
| Clay | 57.00 % |
| W.H.C. | 47.00 % |
| pH | 5.00-6.00 |
| E.C. | 4 to 15 d 5 $m^{-1}$ |
| Organic C | 1.20 % |
| C.E.C. | 28.0 mc/100 g |
| Total Bases | 25.0 me/100 g |
| CaO | 0.15 % |
| $P_2O_5$ | 0.25 % |
| $K_2O$ | 1.10 % |

**Table 4. Mean performance of salt tolerant rice varieties (1993-94 to 1995-96)**

| Sl.No. | Variety | Height (cm) | No. of tillers | Panicles /hill | 1000 grain weight (g) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| 1. | CSR-4 | 89.03 | 6.3 | 2.95 | 25.23 | 3.53 |
| 2. | CSR-10 | 84.07 | 6.3 | 2.84 | 24.90 | 3.44 |
| 3. | Palghar-1 | 85.67 | 6.3 | 2.82 | 28.00 | 3.26 |
| 4. | Panvel-1 | 84.43 | 5.7 | 2.68 | 26.33 | 2.82 |
| 5. | Panvel-2 | 77.06 | 6.0 | 2.73 | 24.43 | 2.66 |
| 6. | Co-43 | 76.10 | 5.3 | 2.68 | 24.26 | 2.74 |
| 7. | Korgut | 144.6 | 3.67 | 2.66 | 25.56 | 1.95 |
| | C.D. (P=0.05) | 7.17 | 1.23 | 2.2 | 1.43 | 0.63 |

**Table 5. Performance of salt tolerant rice varieties (t/ha) (mean of three years)**

| Variety | 1993 | 1994 | 1995 | Averag |
|---|---|---|---|---|
| 1. CSR-4 | 4.34 | 3.14 | 3.12 | 3.5 |
| 2. CSR-16 | 4.08 | 3.29 | 2.93 | 3.4 |
| 3. Palghar-1 | 3.85 | 2.90 | 3.03 | 3.2 |
| 4. Panvel-1 | 3.26 | 2.70 | 2.49 | 2.8 |
| 5. Panvel-2 | 2.79 | 2.54 | 2.64 | 2.6 |
| 6. Co-43 | 3.13 | 2.30 | 2.78 | 2.7 |
| 7. Korgut | 1.92 | 1.90 | 2.02 | 1.9 |
| C.D. 5% | 0.72 | 0.56 | 0.62 | 0.6 |

### 3. Evaluation of high yielding varieties of sugarcane

(H.M.Wasnik)

*Second ratoon*

In all, there were eight varieties planted in January, 1994 and the harvesting was done for its second ratoon during February,1997. The results indicated that the sugarcane variety Co-90009 out yielded rest of varieties by recording the highest yield of 87 t/ha with 19 per cent brix and 8.82 per cent s recovery. This was followed by the v Co-85061 recording an yield level of 8 ha with 18,6 per cent brix and 8.70 per sugar recovery. The third variety Co-9 recorded an yield level 83.20 t/ha with per cent brix and 8.5 per cent sugar reco In general, there was a good relationshi the yield contributing characters like gi cane, height of cane, weight of cane and of sugarcane (Table 6).

**Table 6. Performance of sugarcane varieties as second ratoon during 1996-97**

| Sl. No | Variety | Height of cane (cm) | Weight of cane (kg) | Girth (cm) | Brix (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| 1. | Co-9006 | 2.92 | 2.06 | 2.29 | 18.80 | 83.20 |
| 2. | Co-90009 | 2.69 | 2.32 | 2.31 | 19.03 | 87.0 |
| 3. | Co-85134 | 2.77 | 1.82 | 2.23 | 18.37 | 79.85 |
| 4. | Co-85016 | 2.90 | 1.68 | 2.26 | 18.42 | 72.30 |
| 5. | Co-86141 | 2.76 | 1.74 | 2.25 | 18.59 | 72.57 |
| 6. | Kolhapur | 2.68 | 1.66 | 2.09 | 17.98 | 65.30 |
| 7. | Co-85061 | 2.83 | 1.82 | 2.25 | 18.62 | 85.45 |
| 8. | 84 WL 22 | 2.59 | 1.56 | 2.15 | 18.18 | 66.97 |

three years)

| Average |
|---|
| 3.53 |
| 3.44 |
| 3.26 |
| 2.82 |
| 2.66 |
| 2.74 |
| 1.95 |
| 0.63 |

82 per cent sug
wed by the varie
eld level of 85.5
and 8.70 per ce
d variety Co-900
3.20 t/ha with 18
ent sugar recover
od relationship wi
racters like girth
nt of cane and yie

ng 1996-97

| Yield (t/ha) |
|---|
| 3.20 |
| 87.0 |
| 9.85 |
| 2.30 |
| 2.57 |
| 5.30 |
| 5.45 |
| 6.97 |

**able 7a. Performance of sugarcane varieties as first ratoon during 1996 - 97**

| l. lo. | Variety | Height of cane (cm) | Weight of cane (kg) | Girth (cm) | Brix (%) | Yield (t/ha) | Recovery (%) |
|---|---|---|---|---|---|---|---|
| . | Co-740 | 2.47 | 1.68 | 2.0 | 18.90 | 89.10 | 9.2 |
| . | Co-7527 | 2.56 | 1.75 | 2.05 | 19.0 | 19.0 | 9.0 |
| . | Co-85061 | 2.55 | 1.69 | 2.01 | 19.22 | 90.5 | 8.6 |
| . | Co-8014 | 2.52 | 1.65 | 1.93 | 18.50 | 81.20 | 8.4 |
| . | Co-C-671 | 2.49 | 1.29 | 1.90 | 19.50 | 52.50 | 9.20 |
| . | Co-89018 | 2.51 | 1.42 | 1.97 | 18.84 | 69.20 | 7.8 |
| . | Co-90006 | 2.50 | 1.81 | 2.06 | 19.0 | 92.0 | 9.0 |
| . | Co-90009 | 2.51 | 1.85 | 2.10 | 20.0 | 97.0 | 9.2 |

**Table 7b. Performance of sugarcane as plant cane during 1996-97**

| Sl. No. | Variety | Height of cane (cm) | Weight of cane (kg) | Girth (cm) | Brix (%) | Yield (t/ha) | Recovery (%) |
|---|---|---|---|---|---|---|---|
| . | Co-90006 | 2.63 | 2.33 | 2.27 | 29.10 | 132.0 | 9.2 |
| . | Co-90009 | 2.65 | 2.41 | 2.45 | 19.50 | 138.0 | 9.5 |
| . | Co-90014 | 2.56 | 2.15 | 2.20 | 19.20 | 102.5 | 8.9 |
| . | Co-7527 | 2.65 | 2.45 | 2.55 | 19.45 | 130.0 | 9.5 |
| . | Co-85061 | 2.60 | 2.20 | 2.35 | 19.20 | 104.0 | 9.0 |
| | C.D. (P=0.05) | | | | | 12.5 | |

*First ratoon*

The best eight sugarcane varieties with high sugar content were planted during January 1995 and harvested in February 1997 for its first ratoon. The results indicated that the sugarcane variety Co-90009 out yielded all the varieties by recording the highest yield of 97 t/ha with 20 per cent brix and 9.2 per cent sugar recovery. This was followed by another sugarcane variety Co-90006 recording an yield level of 92 t/ha with 19 per cent sugar recovery. The third variety Co-7527 also showed a good performance recording an yield level of 91.0 t/ha with 19 per cent brix and 9.0 per cent sugar recovery (Table 7a and b).

**4. Studies on water management in sugarcane**
(B.L. Manjunath)

During the year, the trial was continued with the second ratoon in sugarcane with four replications under split plot design. The main plot treatments included the irrigation methods (viz., drip and furrow irrigation) and sub plot treatments included three irrigations levels (IW/CPE ratios of 0.50, 0.75 and 1.00).

The average daily pan evaporation during the year varied from 2.03 m/day to 5.50 mm/day; the lowest record in the month of January and the highest in the month of May. Similarly, the monthly pan evaporation varied from 63.00 mm to 170.5 mm. The work deficit

was observed in seven months during the year indicating the requirement for irrigation (Table 8).

In tune with average daily pan evaporation the irrigation interval in different treatments of furrow irrigation varied. The irrigation interval was reduced to a low of 9 ($1_3$) to 18 days ($1_1$) when the pan evaporation reached a peak (5.50 mm/day) during the month of May for a fixed irrigation water depth of 50 mm. The per cent soil moisture before irrigation was 6.79, 7.03 and 7.27 when the irrigation was scheduled based on IW/CPE ratio of 0.5, 0.75 and 1.00 respectively.

Drip irrigation found to have a better influence in increasing the millable canes (52,200/ha) in relation to furrow irrigation (50,740), the $I_3$ level (IW/CPE=1.00)

To find out the consistency amo the sugarcane varieties tested for performance, the mean yield date of one crop and two ratoons of midlate varieties calculated which indicated that the va Co-85061 with an yeild of 115.6 t/ha another variety Co-85061 with an yiel 115.6 t/ha and another variety Co-7527 an yield level of 109.7 t/ha sho consistently good yeild. These varieties moderate recovery (8.56 and 9.4 respectively) as compared to varieties Co-7914 (10.97 %) Co-8014 (10.88%) 671 (10.35%) and Co-8011 (10.3 However, the commercial cane sugar (C. was more in both the varieties of Co-8 (9.89 t/ha) and Co-7527 (10.34 t/ha) indic their superiority over others (Table 9).

**Table 8. Water budgeting for different months during the year**

| Sl No. | Month | Average pan evaporation (mm/day) | Monthly pan evaporation (mm) | Actual Rainfall during the year (mm) | Excess (+) or deficit (-) (mm) |
|---|---|---|---|---|---|
| 1. | January | 2.03 | 63.00 | 0.00 | -63.00 |
| 2. | February | 3.64 | 102.00 | 0.00- | 102.00 |
| 3. | March | 4.17 | 129.28 | 0.00 | - 129.28 |
| 4. | April | 5.10 | 153.00 | 0.70 | - 152.30 |
| 5. | May | 5.50 | 170.50 | 0.60 | - 169.90 |
| 6. | June | 4.25 | 127.50 | 1040.80 | 913.30 |
| 7. | July | 3.63 | 112.50 | 1131.80 | 1019.30 |
| 8. | August | 3.31 | 102.60 | 340.80 | 238.20 |
| 9. | September | 2.40 | 72.00 | 131.90 | 59.90 |
| 10. | October | 2.11 | 65.29 | 223.50 | 158.21 |
| 11. | November | 2.43 | 73.00 | 6.40 | -66.60 |
| 12. | December | 2.32 | 71.95 | 4.40 | -67.55 |

W/CPE=1.00)

consistency amon
es tested for th
ield date of one pl
midlate varieties v
ted that the vari
of 115.6 t/ha a
61 with an yield
ariety Co-7527 w
09.7 t/ha show
These varieties w
3.56 and 9.43
ed to varieties
014 (10.88%) Co
o-8011 (10.32
cane sugar (C.C.
rieties of Co-850
10.34 t/ha) indicat
ers (Table 9).

| Excess (+) or deficit (-) (mm) |
|---|
| -63.00 |
| 102.00 |
| - 129.28 |
| - 152.30 |
| - 169.90 |
| 913.30 |
| 1019.30 |
| 238.20 |
| 59.90 |
| 158.21 |
| -66.60 |
| -67.55 |

**able 9. Yield performance of midlate varieties plant cane and two ratoons (1992 to 1995)**

| .No. | Variety | Yield (t/ha) | Recovery (%) | C.C.S. (t/ha) |
|---|---|---|---|---|
| | Co-740 | 83.2 | 8.10 | 6.74 |
| | Co-85061 | 115.6 | 8.56 | 9.89 |
| | 84 WL22 | 84.2 | 10.16 | 8.55 |
| | CoC-671 | 77.6 | 8.56 | 8.89 |
| | CoC-7914 | 79.2 | 10.97 | 8.69 |
| | Co-8231 | 75.2 | 9.56 | 7.19 |
| | Co-85016 | 92.6 | 9.12 | 8.44 |
| | Co-8011 | 83.5 | 10.32 | 8.62 |
| | Co-8014 | 75.5 | 10.88 | 8.21 |
| 0. | Co-7219 | 84.5 | 9.10 | 7.71 |
| 1. | Co-7527 | 109.7 | 9.43 | 10.34 |
| 2. | Co-7704 | 102.6 | 8.10 | 8.31 |
| 3. | Kollhapur | 83.0 | 7.87 | 6.32 |

***Plant cane***

The best five sugarcane varieties with high sugar content namely Co-90014, Co-90009, Co-90006, Co-7527 and Co-85061 were planted during January 1996 and harvested in February,1997. The results indicated that the sugarcane variety Co-90009 out yielded all the varieties by recording a plant cane yield of 138 t/ha with 19.5 percent brix and 9.5 percent sugar recovery. This was followed by another sugarcane variety Co-90006 recording an yield level of 132 t/ha with 19.15 per cent brix and 9.1 per cent sugar recovery. The third variety Co-7527 also showed a good performance recording yield level of 130 t/ha with 19.42 per cent brix and 9.0 per cent sugar recovery.

Amongst the 13 latest varieties tested for their performance for three years of one plant cane and two ratoons, the variety Co-90009 has recorded an yield of 105.7 t/ha with sugar recovery of 9.38 per cent followed by variety Co-90006 (103 t/ha) with sugar recovery of 8.15 per cent. The variety Co-90009 also recorded 9.8 t/ha of C.C.S. followed by the variety Co-90006 (8.42 t/ha).

**Table 10a. Performance of latest released varieties of sugarcane (one plant and ratoons) (1993 to 1996)**

| Sl.No. | Variety | Yield (t/ha) | Recovery (%) | C.C.S (t/ha) |
|---|---|---|---|---|
| 1. | Co-90002 | 83.6 | 9.21 | 7.70 |
| 2. | Co-90004 | 85.5 | 9.07 | 7.75 |
| 3. | Co-90005 | 84.4 | 8.89 | 7.72 |
| 4. | Co-90009 | 105.7 | 9.38 | 9.91 |
| 5. | Co-90007 | 82.9 | 9.71 | 8.05 |
| 6. | Co-90006 | 84.0 | 8.28 | 6.95 |
| 7. | Co-90006 | 103.3 | 8.15 | 8.42 |
| 8. | Co-900010 | 99.3 | 8.24 | 8.18 |
| 9. | Co-8391 | 81.9 | 8.11 | 6.64 |
| 10. | Co-85134 | 93.4 | 8.20 | 7.64 |
| 11. | Co-85135 | 89.5 | 8.84 | 7.91 |
| 12. | Co-86141 | 79.8 | 8.95 | 7.24 |
| 13. | Co-89018 | 94.3 | 8.53 | 8.03 |

**Table 10b. Performance of sugarcane (one plant and two ratoons)(1994 to 1997)**

| Sl.No. | Variety | Yield (t/ha) | Recovery (%) | C.C.S (t/ha) |
|---|---|---|---|---|
| 1. | Co-90006 | 98.32 | 8.65 | 8.50 |
| 2. | Co-90009 | 105.36 | 8.69 | 9.15 |
| 3. | Co-85134 | 88.28 | 7.94 | 7.01 |
| 4. | Co-85061 | 97.50 | 8.54 | 8.33 |
| 5. | Co-86141 | 88.76 | 8.48 | 7.51 |
| 6. | Kolhapur | 82.28 | 8.56 | 7.04 |
| 7. | Co-85016 | 84.08 | 8.53 | 7.14 |
| 8. | 84 WL22 | 75.82 | 7.21 | 5.48 |

recording significantly higher number of millable canes in both furrow (58,890/ha) and drip (54,630/ha) irrigation methods. The millable cane height and the number of internodes/cane also showed a similar trend.

The girth of the internodes were significantly better in drip irrigation (2.60 cm) as compared to furrow irrigation (2.14 cm) In both the methods, scheduling the irrigation at an IW/CPE ratio of 1.00 recorded significantly more girth and length of internodes. The individual cane weight was highest (1.16 kg/cane) at the $I_3$ level in drip irrigation as compared to the same level in furrow irrigation (1.02 kg/cane) while the lowest weight was recorded at $I_1$ level in both methods (0.81 kg in drip and 0.83 kg/cane furrow method) (Table 11).

All the quality parameters of sugarcane (viz. brix percent, purity per cent, POL per cent and recovery per cent) were relatively better with furrow irrigation compared to drip irrigation. Brix per cent ranged from 14 to 21 in drip method while it was 17 to 22 per cent in furrow method. The recovery per cent was highest at $I_1$ level

(one plant and t

| C.C.S (t/ha) |
|---|
| 7.70 |
| 7.75 |
| 7.72 |
| 9.91 |
| 8.05 |
| 6.95 |
| 8.42 |
| 8.18 |
| 6.64 |
| 7.64 |
| 7.91 |
| 7.24 |
| 8.03 |

1994 to 1997)

| C.C.S (t/ha) |
|---|
| 8.50 |
| 9.15 |
| 7.01 |
| 8.33 |
| 7.51 |
| 7.04 |
| 7.14 |
| 5.48 |

e level in furr
hile the lowest ca
$I_1$ level in both t
and 0.83 kg/cane
).

y parameters
ent, purity per ce
ery per cent) we
rrow irrigation
on. Brix per ce
drip method while
urrow method. T
nest at $I_1$ level bo

drip (10.36) and furrow (10.39) irrigation ethods while it was lowest at $I_3$ levels in oth the methods (Table 12).

More irrigation to the second ratoon rop $I_3$ irrigations of 5 cm depth each, mounting to 67.5 cm in total both in drip and rrow irrigation. However, furrow irrigation ccounted an additional 27.7 cm of irrigation ue to conveyance losses. Among the ifferent levels, $I_1$ received nine irrigations otal 45 cm), $I_2$ received $1_3$ irrigations (total 7.5 cm) and $I_3$ received 18 irrigations (total 0 cm).

Drip irrigation yielded 86.03 t/ha of ane yield as against 76.02 t/ha in furrow rigation. The cane yield was highest at $I_3$ evel both drip (98.66 t/ha) and furrow rigation (86.13 t/ha). The lowest cane yield (63.41 t/ha) was recorded at $I_1$ level in furrow irrigation.

The commercial cane sugar (C.C.S) was highest at $I_2$ level in drip irrigation (7.52 t/ha) and at $I_1$ level(6.59 t/ha) in furrow irrigation. The C.C.S. was lowest at $I_3$ level both in drip and furrow irrigation due to low recovery percentages recorded in these treatments. However, drip irrigation on an average recorded relatively more C.C.S. (6.55 t/ha) as compared to furrow irrigation (6.22 t/ha). (Table 13).

Drip irrigation recorded higher water use efficiency (1.33 t/ha. cm) in relation to furrow irrigation (0.80 t/ha cm) and in both the methods water use efficiency was maximum at II level, suggesting higher cane yield per unit amount of water used (Table13).

**able 11. Growth and yield contributing characteristics of sugarcane (second ratoon) s affected by irrigation treatments**

| rrigation<br>Method<br>level | Millable canes (000/ha) | Millable cane height(m | No.of inter-nodes | Girth of inter-nodes | Length of inter-nodes | Individual cane weight (kg) |
|---|---|---|---|---|---|---|
| 1 | 45.77 | 1.78 | 20.2 | 2.26 | 7.55 | 0.81 |
| Drip | | | | | | |
| 2 | 52.22 | 2.10 | 2.7 | 2.73 | 8.41 | 0.99 |
| 3 | 58.8 | 92.47 | 26.0 | 2.81 | 9.09 | 1.16 |
| Mean | 52.28 | 2.12 | 25.7 | 2.60 | 8.35 | 0.99 |
| 1 | 45.50 | 1.75 | 17.7 | 1.81 | 8.21 | 0.83 |
| Furrow | | | | | | |
| 2 | 50.74 | 1.97 | 21.0 | 2.14 | 8.34 | 0.87 |
| 3 | 54.63 | 2.20 | 24.2 | 2.48 | 9.58 | 1.02 |
| Mean | 50.74 | 1.97 | 22.9 | 2.14 | 8.71 | 0.91 |
| F Test | NS | NS | NS | * | NS | NS |
| Main Plot | | | | | | |
| C.D (p=0.05) | — | — | — | 0.29 | — | — |
| Sub Plot | | | | | | |
| C.D.(P=.0.05) | | | | | | |
| F Test | * | * | * | * | * | * |
| C.D.(P=0.05) | 6.61 | 0.15 | 1.54 | 0.24 | 0.50 | 0.18 |
| nteraction | | | | | | |
| F Test | NS | NS | NS | NS | NS | NS |

**Table 12. Quality parameters of sugarcane as affected by irrigation treatments**

| Irrigation Method/level | | Brix (%) | POL (%) | Purity (%) | Recover (%) |
|---|---|---|---|---|---|
| Drip | $I_1$ | 21.26 | 19.36 | 91.06 | 10.36 |
| | $I_2$ | 18.36 | 16.68 | 90.85 | 8.54 |
| | $I_3$ | 13.94 | 11.18 | 80.20 | 4.80 |
| Mean | | 17.85 | 15.75 | 87.37 | 7.90 |
| Furrow | $I_1$ | 21.66 | 19.41 | 89.61 | 10.39 |
| | $I_2$ | 17.42 | 15.50 | 88.98 | 7.74 |
| | $I_3$ | 16.56 | 14.32 | 86.47 | 6.94 |
| Mean | | 18.55 | 16.41 | 88.35 | 8.36 |

**Table 13. Sugarcane yield and water use efficiency as affected by irrigation treatm**

| Irrigation method/level | | No. of Irrigation (5 cm depth) | Quantity of water* (cm) | Yield (t/ha) | C.C.S. (t/ha) | W.U.E (t/ha-cm |
|---|---|---|---|---|---|---|
| Drip | $I_1$ | 9 | 45.0 | 71.33 | 7.39 | 1.58 |
| | $I_2$ | 13 | 67.5 | 88.11 | 7.52 | 1.30 |
| | $I_3$ | 18 | 90.0 | 98.66 | 4.73 | 1.10 |
| Mean | | 13 | 67.5 | 86.03 | 6.55 | 1.33 |
| Furrow | $I_1$ | 9 | 45+18.45 ** | 63.41 | 6.59 | 1.00 |
| | $I_2$ | 13 | 67.5+27.67 | 78.52 | 6.08 | 0.83 |
| | $I_3$ | 18 | 90+36.90 | 86.13 | 5.98 | 0.68 |
| Mean | | 13 | 67.5+27.67 | 76.02 | 6.22 | 0.80 |
| * Excluding the ERF | | | Main plot | NS | NS | * |
| | | | F Test C.D.(5%) | — | — | 0.29 |
| ** Water lost in conveyance | | | Sub plot 'F' | * | * | * |
| | | | C.D.(5%) | 8.89 | 0.54 | 0.10 |
| | | | Interaction F | NS | * | NS |
| | | | C.D.(5%) | — | 0.77 | — |

**5. Studies on rice based cropping systems**

(BL Manjunath)

A field trial was conducted in rice fallows in a randomised block design with three replications to identify a profitable based cropping system. During khar short duration rice variety Jyothi cultivated and in rabi, four pulse crops greengram (varieties Pusa baisaki and

n treatments

| | Recovery (%) |
|---|---|
| | 10.36 |
| | 8.54 |
| | 4.80 |
| | 7.90 |
| | 10.39 |
| | 7.74 |
| | 6.94 |
| | 8.36 |

rigation treatmer

| C.S. /ha) | W.U.E (t/ha-cm) |
|---|---|
| 39 | 1.58 |
| 52 | 1.30 |
| 73 | 1.10 |
| 55 | 1.33 |
| 59 | 1.00 |
| 08 | 0.83 |
| 98 | 0.68 |
| 22 | 0.80 |
| NS | * |
| — | 0.29 |
| * | * |
| 54 | 0.10 |
| * | NS |
| 77 | — |

lify a profitable ri
During kharif, ariety Jyothi w ur pulse crops vi sa baisaki and P

6), blackgram (varieties K-3 and T-9), geonpea (varieties ICPL-27, ICPL-87, S-31 nd DT-7) and cowpea (varieties V-118 and ocal Alsano) and one oilseed crop viz., roundnut (varieties DH-3-30 and DH-40) ere grown as second crop under residual soil noisture conditions with recommended ackage of practices.

Observations on different growth arameters indicated that both the varieties of reengram and blackgram are short statured, ess biomass producing varieties completing heir life cycles in 70-80 days. Among the igeonpea varieties, S-31 was found to have nore plant height (58,3 cm), branches (19/ lant), leaves (84/plant) leaf area per plant 458 $cm^2$), root growth (14.1 cm) and dry natter production per plant (25 g) as ompared to other varieties. The variety CPL-27, was better in its leaf area per plant 763 $cm^2$), root growth (19.2 cm) and dry natter production per plant (30 g) (Table 14).

The cowpea variety V-118 was found etter in its branching habit (7 branches/plant) nd moderate in its leaf area (643 $cm^2$/plant), oot growth (14 cm) and dry matter production 16 g/plant). The variety excelled over the ocal Alsano in terms of pods per plant (56), od to seed ratio (0.71) and the grain yield 668 kg/ha).

The groundnut variety DH-3-30 was ound better over variety DH-40 in terms of lant height (16 cm), branches (8/plant), leaf area(1788 $cm^2$/plant), root growth (30 cm) and dry matter production per plant (23 g). The variety was also better in terms of pods per plant (16), test weight and pod yield (667 kg/ ha) over the variety DH-40 (588 kg/ha-pod yield).

The pigeonpea variety S-31 was better in terms of pods per plant (61) and pod to seed ratio (0.54) and test weight (9.5 g). The variety ICPL-27 was good in terms of test weight (10 g) and the grain yield (316 kg/ha) although its pod to seed ratio was less (0.32). The variety S-31 was next best in order with a grain yield of 283 kg/ha (Table 15).

The economic of cultivation of these pulse and oilseed crops as a second crop in rice fallows indicated that cowpea (var :V-118) is better in terms of both gross returns (Rs. 13,880/ha), net returns (Rs. 11,055/ha) and returns per rupee invested which was followed by groundnut (variety DH-3-30) (net returns - Rs. 6731/ha). Among the pigeonpea varieties ICPL-27 recorded a net return of Rs. 4200/ha while growing of greengrown and blackgram varieties was found not remunerative (Table 16).

In terms of biomass production, rice-cowpea (var. local Alsano) system was found superior compared to all the other systems. In terms of rice equivalent rice-cowpea (var:V-118) recorded the highest (60.8/ha) along with net returns (Rs.22,855/ha) indicating superiority of the system (Table 17).

**Table 14. Growth parameters in different varieties of pulses and groundnut**

| Crop/varriety | Plant height (cm) | Branches /plant | Leaves /plant | Leaf area ($cm^2$) | Root growth (cm/plant) | DM produc (g/plant) |
|---|---|---|---|---|---|---|
| Greengram | | | | | | |
| Pusa baisaki | 21.0 | 1.0 | 4.7 | 131.5 | 4.8 | 3.3 |
| PS-16 | 21.2 | 1.0 | 5.0 | 68.0 | 5.2 | 3.7 |
| Blackgram | | | | | | |
| K-3 | 15.8 | 1.0 | 9.0 | 84.4 | 7.5 | 3.3 |
| T-9 | 14.0 | 2.0 | 10.0 | 182.0 | 10.0 | 4.3 |
| Redgram | | | | | | |
| S-31 | 58.3 | 18.6 | 83.7 | 458.0 | 14.1 | 25.0 |
| DT-7 | 42.8 | 14.0 | 42.1 | 277.3 | 12.0 | 18.0 |
| ICPL-27 | 49.2 | 16.6 | 75.4 | 762.7 | 19.2 | 30.0 |
| ICPL-87 | 46.7 | 14.4 | 62.1 | 385.1 | 13.0 | 14.0 |
| Cowpea | | | | | | |
| V-118 | 41.7 | 7.0 | 22.7 | 642.6 | 14.0 | 15.6 |
| Local Alsano | 55.4 | 6.3 | 34.1 | 2281.4 | 23.0 | 36.0 |
| Groundnut | | | | | | |
| DH-3-30 | 15.8 | 8.1 | 78.2 | 1788.0 | 30.0 | 23.0 |
| DH-40 | 14.4 | 7.4 | 78.7 | 907.0 | 12.0 | 17.0 |

**Table 15. Yield and its attributes in different varieties of pulses and groundnut**

| Crop/variety | Pods Plant | Pod Length (cm) | Seeds /pod | Pod to seed ratio (gm) | Test weight (100) | Grain yield (kg/ha) | Haulm/s (t/ha |
|---|---|---|---|---|---|---|---|
| Green gram | | | | | | | |
| Pusa baisak | 8.3 | 5.7 | 8.0 | 0.69 | 3.5 | 73.7 | 1 |
| PS-16 | 6.0 | 5.2 | 7.6 | 0.70 | 4.0 | 31.3 | 1 |
| Blackgram | | | | | | | |
| K-3 | 7.3 | 3.6 | 4.6 | 0.67 | 4.8 | 66.4 | |
| T-9 | 9.0 | 3.9 | 5.3 | 0.64 | 4.5 | 58.3 | 1 |
| Redgram | | | | | | | |
| S-31 | 60.9 | 3.7 | 2.2 | 0.54 | 9.5 | 283.0 | 2 |
| DT-7 | 45.7 | 4.5 | 2.7 | 0.56 | 8.5 | 169.0 | 1 |
| ICPL-27 | 55.7 | 4.4 | 3.0 | 0.32 | 10.0 | 316.0 | 2 |
| ICPL-87 | 41.4 | 3.9 | 3.8 | 0.41 | 9.5 | 167.3 | 1 |
| Cowpea | | | | | | | |
| V-118 | 55.6 | 13.7 | 9.9 | 0.71 | 10.0 | 667.6 | 2 |
| Local Alsano | 9.0 | 14.2 | 11.8 | 0.61 | 25.0 | 193.0 | 5 |
| Groundnut | | | | | | | |
| DH-3-30 | 16.0 | 3.0 | 2.0 | 65.9 | 58.0 | 666.6 | 2 |
| DH-40 | 13.0 | 2.8 | 1.8 | 69.3 | 47.5 | 587.9 | 1 |

## PLATE 1




1. Pusa Basmati (M - 127) performing well under Goa Condition




2. Pawan - A local fine grained rice variety



3. Groundnut seed multiplication of Dh - 3-30 in the Institute




4. V - 118 - A short duration high yielding cow pea variety for Goa

**ble 16. Economics of rice based crops**

| op/Variety | Yield (kg/ha) | Stover haulm yield | Gross returns (Rs./ha) | Cost of cultivn. (Rs./ha) | Net returns (Rs./ha) | Returns/ Rs. invested |
|---|---|---|---|---|---|---|
| reen gram | | | | | | |
| Pusa baisaki | 74 | 1.11 | 1.961 ) | 2200 | — | — |
| PS-16 | 31 | 1.22 | 897 ) | | — | — |
| ack gram | | | | | | |
| K-3 | 66 | 1.10 | 1.760 ) | 2200 | — | — |
| T-9 | 55 | 1.43 | 1.518 ) | | — | — |
| geonpea | | | | | | |
| S-31 | 283 | 2.45 | 6.028 | 2500 | 3528 | 1.41 |
| DT-7 | 169 | 1.04 | 3.536 | 2450 | 1086 | 0.44 |
| ICPL-27 | 316 | 2.88 | 6.752 | 2550 | 4202 | 1.65 |
| ICPL-87 | 167 | 1.48 | 3.562 | 2450 | 1112 | 0.45 |
| owpea | | | | | | |
| V-118 | 668 | 2.08 | 13.880) | 2825 | 11,055 | 3.91 |
| Local Alsano | 193 | 5.70 | 7.215) | | 4,390 | 1.55 |
| roundnut | | | | | | |
| DH-3-30 | 667 | 2.67 | 10,006) | 3,275 | 6731 | 2.05 |
| DH-40 | 587 | 1.96 | 8,708) | | 5433 | 1.66 |

**able 17. Productivity of rice based cropping systems**

| ropping system | Biomass produced (t/ha) | Total production in terms of rice equivalent (Q/ha) | Total net income (Rs./ha) |
|---|---|---|---|
| ice - Green gram | | | |
| Annada) (Pusa Baisaki) | 16.62 | 44.9 | 11,561 |
| ice-Blackgram (K-3) | 16.57 | 44.6 | 11,360 |
| ice-Pigeonpea (ICPL-27) | 18.01 | 51.3 | 16,002 |
| ice-Pigeonpea (S-31) | 17.54 | 50.3 | 15,328 |
| ice-Cowpea (V-118) | 17.56 | 60.8 | 22,855 |
| ice - Local Alsano | 20.70 | 51.9 | 16,190 |
| ice-Groundnut (DH-3-30) | 18.15 | 55.6 | 18,531 |
| ice-Groundnut (Dh-40) | 17.36 | 53.9 | 17,233 |

## 6. Studies on pest management problems in rice based cropping systems for Goa

(Mani Chellappan and Chidananda Prabhu)

Evaluation of eco-friendly insecticides for the management of pulse pod borer, *H. armigera.*

Replicated field trials were conducted in the Institutes to evaluate the efficacy of the bio pesticides. The trial were laid out on RBD with three replications. Red gram variety, DT-7 was used for the trial. Trea (Table 18) were given when the crop flowering.

Among the treatments monocro was very effective (Fig 2) combina *Bacillus thuringensis (B.t.)* and insecticides have resulted in consi higher yield when compared to the cont independent treatments. Though end treatment gave higher yield, statisti was at poor with the combined treatm *B.t.* + neem insecticides (Table 18).

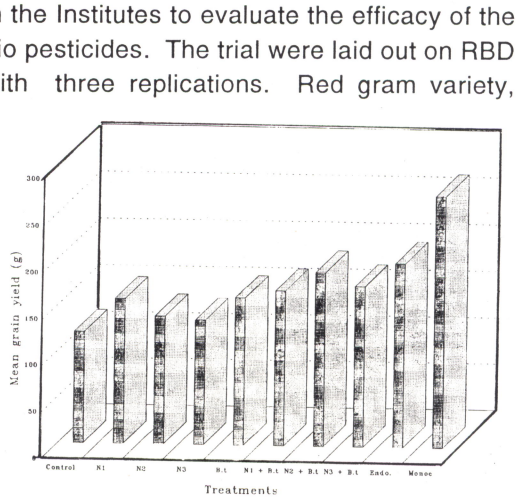



Fig. 2 Effect of bio-pesticid management of H. a

**Table 18. Effect of bio-pesticides in the management of pod borer, *Helicoverpa arr***

| S.No. | Treatment | Mean yield of healthy pods (No/plot)* | Mean yield of hea grains (g) |
|---|---|---|---|
| 1. | Control | $1563^{b}$ | $120^{b}$ |
| 2. | Neem I | $1641^{b}$ | $156^{b}$ |
| 3. | Neem II | $1720^{b}$ | $138^{b}$ |
| 4. | Neem III | $1468^{b}$ | $134^{b}$ |
| 5. | *B. thuringiensis* | $1919^{ab}$ | $159^{ab}$ |
| 6. | Neem I + *B.t* | $2130^{ab}$ | $167^{ab}$ |
| 7. | Neem II + *B.t* | $2322^{ab}$ | $187^{ab}$ |
| 8. | Neem III + *B.t* | $2296^{ab}$ | $173^{ab}$ |
| 9. | Endosulfan | $2334^{ab}$ | $198^{ab}$ |
| 10. | Monocrotophos | $2774^{a}$ | $271^{a}$ |

Values following the same alphabet are not significantly different DMRT(p=0.05)
*plot size : 5 x 2.75 m

the trial. Treatm
when the crop sta

tments monocrotop
Fig 2) combinatio
s *(B.t.)* and
ulted in consider
pared to the control
s. Though endosu
er yield, statistical
ombined treatment
es (Table 18).

f bio-pesticides
ement of H. arm

*Helicoverpa armig*

an yield of health grains (g)

120[b]
156[b]
138[b]
134[b]
159[ab]
167[ab]
187[ab]
173[ab]
198[ab]
271[a]

DMRT(p=0.05)

**Studies on the biologically derived materials for the management of insect pests**

(Mani Chellappan and Chidananda Prabhu)

boratory experiments were conducted in
e following lines.

**Mass culturing of test insects**

**able19. Biology of *Dysdereus cingulatus***

| festages | Duration (days) |
|---|---|
| gg | 7 |
| instar | 2 |
| instar | 3 |
| instar | 5 |
| instar | 5 |
| instar | 6 |
| dult | 10 |

The test insect was reared on the oaked cotton seeds for further experiments sing the plant products. Total life span of ne insect was 38 (Table 19). Mostly the V nstar insects were used for the experiments.

The plant products viz., custard apple eed was extracted through different solvents Chart 1) using Soxhletts apparatus. The naximum turnover of the oil was noticed with ne ether (15 %). Other organic solvents like nethanol and acetone yielded very less oil rom the custard apple seed powder.

Chart 1. **Extraction**

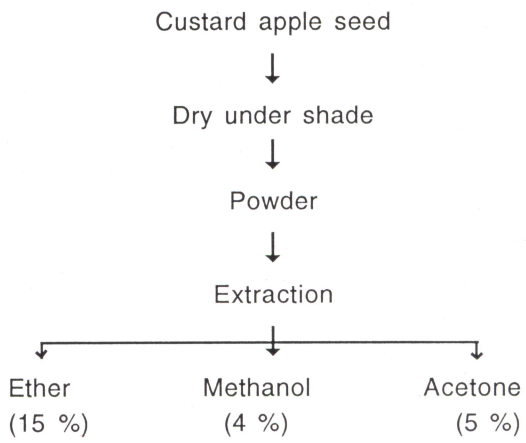



**Table 20. Effect of custard apple seed extract on *D. cingulatus***

| Treatment | Mortality (%) |
|---|---|
| Ether extract | |
| 1:0 | 100.0 |
| 1:1 | 83.3 |
| 1:1.5 | 78.4 |
| 1:3 | 68.0 |
| 1:6 | 41.7 |
| 0:1 | 10.0 |
| Methanol | 30.0 |
| Acetone | 25.0 |

Ether extract of the custard apple seed when used undiluted has resulted in 100 per cent mortality of the insects. There was a proportional decline in the mortality of the insect as the dilution of the extract increased

(Table 20). In 1:6 dilution there occurred some malformed insects while molting into adult. The insects treated with different concentration were used for biochemical works.

Total protein of the haemolymph was estimated using burette method (Chart 2). Within 24th a slight reduction in the total protein level was observed when the ether extract applied topically without dilution (Table 21).

Chart 2 **Protein estimation**

Haemolymph

↓

Spin at 10,000 rpm at 4 °C

↓

Supernatant

↓

50 µl aliquot

↓

2 ml burette reagent

↓

Incubate for 5 min at room temperature

↓

Read at 555mm

**Table 21. Effect of custard apple seed ether extract on haemolymph protein of D. *cingulants***

| Treatment | Protein content (g/100 ml) |
|---|---|
| Control | 19.81 |
| Ether extract | |
| 1:0 | 17.59 |
| 1:6 | 19.63 |

For the lepidopteran insect viz., the c hairy caterpillar, 0.5 µl of the ether e was found to be effective which caused 5 cent mortality (Table 22). All h concentrations have resulted in 100 pe mortality.

The total protein level of the haemolymp gone down drastically due to the ether e treatment (Table 23 )

**Table 22. Effect of custard seed extra the castor hairy caterpillar**

| Treatment | Mortality (% |
|---|---|
| Topical application | |
| 0.5µl | 5 |
| 1.0µl | 10 |
| 1.5µl | 10 |
| 2.0µl | 10 |
| 0.0µl | |

**Table 23. Effect of custard seed extra haemolymph protein conte castor hairy caterpillar**

| Treatment | Protein conte (g/100ml) |
|---|---|
| Control | 9.2 |
| Ether extract (0.5ul) | 6.3 |

nsect viz., the ca
l of the ether ext
e which caused 50
le 22). All hig
sulted in 100 per c

f the haemolymph
ue to the ether extr

**stard seed extract**
**hairy caterpillar**

| Mortality (%) |
|---|
| 50 |
| 100 |
| 100 |
| 100 |
| -- |

**stard seed extract**
**n protein content**
**y caterpillar**

| Protein content (g/100ml) |
|---|
| 9.26 |
| 6.37 |

## PLATE 2



1. Improper moulting in *Dysdercus cingulatus* due to custard seed extract treatment



2. Malformed hairy caterpillar after the treatment with custard seed extract



3. Larval pupal intermediate caused by the extract of custard apple seed



4. Cashew grown in mine reject soil

## .2 Horticulture

### . Collection of cashew germplasm in Goa and establishment of germplasm bank (Ad-hoc Project)

(A.R.Desai and Leebu Babu)

urvey was initiated during the year 1996-97 o locate the promising local cashew enotypes in Goa. Different cashew growing ones of the state were surveyed and so far bout 65 numbers of potential genotypes were ocated for their such vital characters as bold ut type, big apple size, high yielding ability, tc. Zone-wise collections with their features re presented in Table 24.

### . Survey, collection, conservation and evaluation of horticultural crops

(AR Desai , DG Dhandar and VY Gaonkar)

***Cashew***

The cashew germplasm comprising of 27 local accessions, 39 introduction, related species *(A. microcarpum)* and one coloured mutant was maintained. Two new collections namely Ullal-4 and Puttur Sel.1 were added to the germplasm collection. As a result, the present germplasm collection is increased to 68 accessions.

The observations in respect of nut yield, nut characters, shelling percentage and apple weight were recorded in local accessions as well as in introductions.

Performance of 16 local accessions (1996-97) is presented in Table 25. Balli-2 recorded the maximum nut yield of 4.5 kg/tree followed by Nanora-2(1.83 kg/tree) in current season, while their corresponding values with respect to cumulative yield for seven years were 14.55 and 4.74 kg/tree. The average nut size in Balli-2 was about 6 g shelling and percentage was 32.7 as compared to n 34.1 per cent in Nanora-2, Mardol-5, Loutolim, CHWL-1 and Malorem had the bold nuts with average weight of 10.6,9.3, 9.2 and 9.1 g respectively. But, only Malorem and Mardol-5 showed good shelling percentage of 31.9 and 30.2 respectively. Mardol-5 recorded the highest apple weight of 108.7 g followed by 89 g in IA Farmagudi.

Table 26 reveals the performance of 17 introduced cashews accessions planted at 2 x 2 m spacing. VTH-59/2 gave the highest nut yield of 4.07 kg/tree, followed by VTH-539 (3.3 kg/tree) and HB-1600 (2.4 kg/tree). But, in terms of cumulative yield over a period of last seven years, HB-1600 recorded the highest yield of 9.62 kg/tree followed by VTH-59/2 (8.27 kg/tree), VTH-539 (7.56 kg/tree) and M-26/2 (6.96 kg/tree). The highest average nut weight of 9 g was observed in HB-1608, while it was 7.6 g in VTH-154 and 7.2 g in VTH-107/31. Regarding apple weight , all the introductions performed poorly,. However, HB-1608 and HB-1600 recorded the average apple weight of about 66 and 62 g respectively. In general, the shelling percentage was 28 per cent majority of the varieties except BPP-1, HB-1600 and HB-1608.

**Table 24. Local cashew trees with desired traits located during survey (1996**

| S.No. | Zone | Total number of trees | Approximate age (years) | Special features. |
|---|---|---|---|---|
| 1. | Valpoi | 4 | 12-20 | Bold nut types ( 9 g); medium-big a (60-80 g) High yielding trees |
| 2. | Salcete | 13 | 15-35 | Medium to bold nuts (7.8-11.8 g); m sized apple; medium to yielders (15- |
| 3. | Sanguem | 3 | 20-30 | Medium sized nuts (7-8 g); medium apple(80g); medium to high yield |
| 4. | Bardez | 11 | 12-30 | High yielders (30-35 kg); small-medi nuts (5.38-8.88 g); one ultra bold nut type (15.5 g) |
| 5. | Ponda | 4 | 20 | Medium sized nut types; high yield bunch bearing short bearing phase |
| 6. | Bicholim | 5 | 15-20 &40 | Medium-bold nut types (6.66-12.5 g) medium sized apple, bunch bearing and high yield (30-40 kg) |
| 7. | Canacona | 17 | 7-25 | Bold nuts (10 g); medium to big apple 100 g); medium to high yielders |
| 8. | Pernem | 4 | 12-15 | Bold nuts(10 g); medium to big appl (80-100 g); high yielders (25-40 kg) |
| 9. | Quepem | 3 | — | Small bold nuts (6.25-9.8 g); 10 to 2 yield; medium to big apple (90-100 g |
| 10. | Tiswadi | 1 | 15 | Medium nut (8 g) and high yield; big (100 g) |

survey (1996-97)

eatures.

medium-big apple
trees

(7.8-11.8 g); mediu
o yielders (15-35)

-8 g); medium size
high yield

g); small-medium
e ultra

es; high yield and
earing phase

s (6.66-12.5 g);
bunch
(30-40 kg)

um to big apple (50
h yielders

um to big apple
rs (25-40 kg)

9.8 g); 10 to 20 k
pple (90-100 g)

high yield; big ap

**Table 25. Performance of local cashew accessions (1996-97)**

| | Name | Nut yield (kg/tree) | Average nut weight (g) | Shelling (%) | Average Apple weight (g) | Cu. yield (kg/tree) (7 years) |
|---|---|---|---|---|---|---|
| . | I.A. Farmagudi | 0.8 | 8.07 | 27.7 | 89.0 | 3.41 |
| . | Balli-2 | 4.5 | 6.1 | 32,7 | 41.07 | 14.55 |
| . | Balli-3 | 0.5 | 6.8 | 22.9 | 46.00 | 1.67 |
| . | Balli-5 | 1.04 | 6.8 | 26.6 | 65.5 | 3.66 |
| . | Buipal-1 | 0.21 | 6.7 | 27.8 | 33.5 | 1.18 |
| . | C-3 | 0.18 | 3.1 | — | 37.6 | 1.16 |
| . | CHWL-1 | 0.4 | 9.2 | 26.3 | 70.6 | 0.62 |
| . | Betul-1 | 0.04 | 7.2 | 26.7 | 66.5 | 0.52 |
| . | Gutko | 0.3 | 7.4 | — | 59.3 | 1.04 |
| 0. | Mardol-5 | 0.52 | 16.6 | 30. | 106.7 | 1.45 |
| 1. | Nanora-2 | 1.83 | 3.5 | 34.1 | 21.3 | 4.74 |
| 2. | P-2 | 0.48 | 8.9 | 29.2 | 74.0 | 3.70 |
| 3. | Uguem-5 | 0.30 | 4.3 | 24.7 | 33.4 | 2.03 |
| 4. | Vethal-1 | 0.36 | 7.9 | 29.7 | 88.0 | 0.49 |
| 5. | Malorem | 0.62 | 9.1 | 31.9 | 54.8 | 0.86 |
| 6. | Loutoulim | 0.52 | 9.3 | 24.7 | 52.9 | — |

**Table 26. Performance of introduced cashew accession**

| | Name | Nut yield (kg/tree) | Average nut wt(g) | Average apple wt(g) | Shelling (%) | Cumulative Yield (kg/tree) (7 years) |
|---|---|---|---|---|---|---|
| 1. | BLA 39-4 | 0.88 | 3.7 | 13.8 | 29.23 | 2.74 |
| 2. | VTH 59/2 | 4.07 | 5.3 | 23.3 | 28.80 | 8.27 |
| 3. | VTH-30/4 | 0.43 | 5.2 | 37.7 | — | 1.58 |
| 4. | VTH-125 | 0.20 | 5.07 | 34.2 | — | 1.34 |
| 5. | VTH-539 | 3.3 | 4.3 | 43.3 | 29.73 | 7.56 |
| 6. | VTH-154 | 0.9 | 7.6 | 43.9 | 29.73 | 1.54 |
| 7. | M-10/4(VC-1) | 1.3 | 4.4 | 30.4 | 30.19 | 3.93 |
| 8. | M-26/2(VC-2) | 1.08 | 6.3 | 20.0 | 33.3 | 6.96 |
| 9. | VTH-107/31 | 0.13 | 7.2 | 27.3 | — | 0.6 |
| 10. | BPP-1 | 2.14 | 4.3 | 21.3 | 27.5 | 4.3 |
| 11. | BPP-2 | 2.1 | 3.7 | 15.8 | 29.7 | 6.09 |
| 12. | BPP-4 | — | — | — | — | — |
| 13. | BPP-5 | 0.11 | 4.4 | 4.63 | — | 1.32 |
| 14. | HB-1598(K) | 0.58 | 4.6 | 38.8 | 30.0 | 5.41 |
| 15. | HB-1600 | 2.4 | 6.6 | 62.4 | 27.2 | 9.62 |
| 16. | HB-1608(D) | 1.42 | 7.9 | 66.4 | 26.92 | 3.83 |
| 17. | HB-1610 | 0.06 | 7.1 | — | — | 0.06 |

***Mango***

Mango germplasm collection of 82 accessions as detailed below was maintained.

*Local Accessions*

a. Bearing age ..... 14

b. Non-bearing age ..... 21

c. Nursery age..... 24

*Introductions*

a. Hybrids..... 13

b. Popular varieties..... 8

c. New additions ..... 2

**Total** **82**

Two new additions were Appemidi, a pickling type and Mundappa, a table variety. The observations with respect to fruit characters and yield were recorded in local varieties, popular varieties and hybrids.

Colaco Branca, Furtad, Maxima and Mankurad, the local mango varieties, yielded 4.85, 5.5,4.5 and 4.2 kg of fruits per tree, with average fruit size of 253.7, 281.7, 204.5 and 270.5 g respectively (Table 27). Mankurad recorded the highest pulp contents of 72 per cent followed by Furtad and Hilario(68 per cent) , while Colaco Branca and Maxima had the pulp contents of 65 and 62 per cent 19.6 and 21 per cent TSS respectively these varieties differed significantly in re of variations in fruit size quality (Table Regular bearing tendency of Colaco B and Maxima was confirmed.

From among the introductions fruited in the season 1996-97, Kesar yi 17.02 kg of fruits per tree(Table 29) fol by Kalpadi(11 kg). Among the hybrids 56 and HB-87 recorded the highest yi about 23 kg of fruits per tree in the c season.

Variations in fruit size and qua introduced mango varieties and hybrid presented in Table 30. Fruit size signifi varied from 166g (Kalapadi) to (Himayuddin), while in case of hybrids, significantly recorded the highest fruit w of 457 g followed by HB-45 (3383g) an 56 (308g). Per cent pulp was not signifi different in popular varieties. In genera had about 60-70 per cent of pulp. How hybrids (Neelgoa, Amrapali and HB-45) more than 70 percent pulp,which were par with one another. Kalapadi recorde highest TSS of 27.8 per cent. Sim Ratna, Amrapali and HB-87 had higher of 23-25 per cent.

**Table 27. Performance of local mango varieties**

| Name | Year of planting | Yield/tree | |
|---|---|---|---|
| | | Number | Weight (kg) |
| Hilario | 1989 | 8.0 | 1.80 |
| Mankurad(K) | 1989 | 12.0 | 4.20 |
| Colaco Branca | 1989 | 16.3 | 4.85 |
| Salcette Mussarat | 1989 | 6.0 | 1.45 |
| Furtad (K) | 1989 | 21.0 | 5.50 |
| Maxima | 1989 | 20.5 | 4.50 |

**Table 28. Variations in fruit size and quality**

| Variety | Average Fruit Weight (g) | Pulp contents (g/fruit) | Pulp (%) | TSS($^0$B) |
|---|---|---|---|---|
| Hilario | 2.50.0 | 170.0 | 68.34 | 18.2 |
| Mankurad(K) | 2.70.5 | 194.0 | 71.73 | 20.0 |
| Colaco Br. | 2.53.7 | 188.3 | 65.40 | 19.6 |
| Sal.Mussarat | 2.28.0 | 149.0 | 65.34 | 16.2 |
| Furtad (K) | 2.81.7 | 192.5 | 68.34 | 19.1 |
| Maxima | 2.04.5 | 128.9 | 62.78 | 21.4 |
| F Test | @ | @@ | @@ | @ |
| LSD (5%) | 4.4.15 | 27.5 | 4.95 | 2.7 |

**Table 29. Performance of introduced mango varieties/hybrids (1996-97)**

| Variety | Year of planting | Fruit yield/tree | |
|---|---|---|---|
| | | Number | Weight (kg) |
| Alfonso | 1982 | 10.67 | 3.58 |
| Kesar | 1984 | 63.50 | 17.02 |
| Kalapadi | 1984 | 101.00 | 11.10 |
| Himalyuddin | 1990 | 10.00 | 4.00 |
| Neelum | 1989 | 39.00 | 8.19 |
| **Hybrids** | | | |
| Ratna | 1984 | 16.0 | 6.26 |
| Neelgoa | 1984 | 61.0 | 14.70 |
| HB-56 | 1984 | 76.5 | 23.80 |
| HB-45 | 1991 | 31.5 | 11.53 |
| HB-151 | 1984 | 268.0 | 22.80 |
| HB-87 | 1984 | 94.5 | 23.20 |
| Amrapali | 1984 (1992) | 101.0 | 19.20 |
| K x B | 1990 | 23.5 | 4.40 |
| Arka Anmol | 1989 | 2.5 | 0.89 |

**Table 30. Fruit size and quality of introduced mango varieties/hybrids und conditions (1996-97)**

| Variety | Average fruit weight (g) | Pulp contents (g/fruit) | Pulp (%) | TS |
|---|---|---|---|---|
| Alfonso | 287.5 | 203.5 | 70.98 | |
| Kesar | 275.0 | 188.7 | 68.38 | |
| Kalapadi | 166.7 | 103.3 | 61.85 | |
| Himayuddin | 330.0 | 226.7 | 68.40 | |
| Neelum | 184.5 | 128.8 | 69.77 | |
| F test | @@ | @@ | N.S | |
| LSD (5 %) | 69.2 | 55.58 | — | |
| Hybrids | | | | |
| Ratna | 457.5 | 307.5 | 65.57 | |
| Neelgoa | 232.5 | 180.0 | 77.60 | |
| HB-56 | 308.5 | 215.6 | 69.44 | |
| HB-45 | 383.7 | 271.0 | 70.95 | |
| HB-151 | 111.3 | 62.2 | 58.07 | |
| HB-87 | 229.4 | 155.8 | 67.40 | |
| Amrapali | 231.3 | 175.0 | 75.74 | |
| K x B | 177.5 | 96.2 | 54.22 | |
| Arka Anmol | 270.0 | 181.7 | 67.18 | |
| FTest | @@ | @ | @@ | |
| LSD (5 %) | 1550.52 | 118.95 | 8.56 | |

***Vegetables***

Seeds of some local vegetables such as okra, amaranthus and brinjal were collected from Taleigao and Agassaim villages and Mapusa market. Amaranthus and brinjal seeds were sown for preliminary multiplication.

**3. Evaluation of oilpalm hybrids (D x P) under Goa conditions**

(AR Desai and DG Dhandar)

The analysis of data on growth and yield parameters of five oilpalm hybrids revealed that the hybrids did not show any significant difference in their growth 31). The yield components viz., num FFBs and total weight of FFBs per pal did not show any significant variation in 97 season as well as in cumu performance from 1994-95 to 19 However, numerically, the number of varied from 4.47 (18 D x 32 P) to 6.1 x 266P) with the corresponding values and 11.23 during current season cumulative performance respect Similarly, the yield of FFBs per palm r from 15.68 kg (35 D x 291 P) to 27.56 D x 266 P) in the current season with trend in cumulative performance.

## 4. Standardization of agrotechniques for pineapple in Goa

(DG Dhandar and AR Desai)

A field trial was laid out in 1990 using Kew pineapple to find out the optimum dose of potassium (K) for pineapple in Goa. The treatments consisted of 0, 6, 8,1 0 and 132 g of K per plant per year. The plant population adopted was 53,500 per hectare and each plot consisted of 40 plants. A constant dose of 12 g of N and 4 g of $P_2O_5$ per plant was given uniformly. Data on vegetative growth, fruiting and fruit quality aspects were collected for the plant crop which was ready during 1992. The results on effect of K levels on fruit characters are presented in Tables 32 and 33 respectively.

It was observed that none of the vegetative, flowering, maturity, yield and fruit characters were significantly affected by various K levels. The fruit yield ranged from 83.38 to 94.4 t/ha. The average fruit weight ranged from 1.92 to 2.17 kg.

This trial was continued for the ratoon crops. Data on the first and second rations were collected to assess the effect of K doses on yield and quality of pineapple. The results (Tables 33a and b) revealed that none of the characters studied was significantly affected by K levels in both first and second ratoon crops. Hence it can be concluded that 50 ppm basal level of K in soil was quite adequate to maintain the productivity and fruit quality. However, the yields of ratoon crops were poor compared to the plant crop.

The trial was re-laid to confirm the results, with same levels of K (0,6,8, 10 and 12 g/plant/year) and uniform doses of N (16g/plant) and $P_2O_5$ (4 g/plant) in 1994. The results (Table 34a) on vegetative growth and flowering revealed non-significant effect of K levels. Subsequently, the fruit characters (Table 34b) and preliminary yield levels were also observed to follow the same trends.

It is concluded that a minimum dose of 6 g of K per plant per year is quite adequate to maintain the productivity and quality of pineapple fruit (cv.kew) under Goa conditions.

**Table 31. Performance of oilpalm hybrids during the year**

| Hybrids (D x P) | Growth | | FB Yield/palm | | Cumulative FFB yield/palm (1994-95 to 1996-97) | |
|---|---|---|---|---|---|---|
| | Height(cm) | Girth(m) | Nos. | Weight(kg | Nos. | Weight(kg) |
| 1. 82 D x 266 P | 5.11 | 1.91 | 5.62 | 27.56 | 10.52 | 35.84 |
| 2. 124D x 266 P | 5.10 | 1.99 | 6.10 | 20.60 | 11.23 | 25.94 |
| 3. 18 D x 32 P | 5.09 | 1.94 | 4.47 | 21.39 | 7.13 | 26.31 |
| 4. 35 D x 291 P | 5.45 | 1.91 | 4.60 | 15.68 | 9.30 | 21.03 |
| 5. 65 D x 111P | 4.85 | 1.72 | 5.00 | 22.84 | 9.47 | 26.91 |
| F test | NS | NS | NS | NS | NS | NS |

**Table 32a. Effect of K levels on vegetative characters of the kew pineapple in**

| Treatments K levels g/plant | Weight of plant (kg) | Rate of leaf production/ month | Average No.suckers/ plant | Average no.of slips/ plant | Average crown weight(kg) | Average crown length(cm) |
|---|---|---|---|---|---|---|
| 0 ($T_1$) | 3.41 | 3.3 | 1.2 | 4.47 | 0.26 | 23.15 |
| 6 ($T_2$) | 3.01 | 3.7 | 1.4 | 7.37 | 0.30 | 23.09 |
| 8 ($T_3$) | 3.19 | 3.3 | 1.0 | 4.83 | 0.28 | 21.43 |
| 10 ($T_4$) | 3.30 | 3.4 | 1.1 | 5.07 | 0.27 | 20.76 |
| 12 ($T_5$) | 3.39 | 3.9 | 1.4 | 4.83 | 0.29 | 22.39 |
| F value | 0.90 | 0.65 | 0.38 | 2.05 | 0.56 | 1.59 |
| F test | NS | NS | NS | NS | NS | NS |

**Table 32b Effect of K levels on maturity, ripening and yield of kew pineapple in**

| K level g/plant | Time taken for first harvest after planting (months) | Time taken for maturity and ripening of fruit after flowering (months) | Yield |
|---|---|---|---|
| 0 ($T_1$) | 21.7 | 5.1 | 90.7 |
| 6 ($T_2$) | 21.8 | 5.3 | 92.3 |
| 8 ($T_3$) | 21.8 | 5.0 | 89.4 |
| 10 ($T_4$) | 21.8 | 5.4 | 83.3 |
| 12 ($T_5$) | 21.8 | 5.4 | 94.4 |
| F value | 3.08 | 1.3 | 0.7 |
| F test | NS | NS | N |

**Table 32c Effect of K levels on fruit characters of kew pineapple in Goa.**

| K levels g/plants | Average fruit weight (kg) | Average fruit length (cm) | Average fruit breadth (cm) | T.S.S. brix | Juice (%) | Flesh (%) |
|---|---|---|---|---|---|---|
| 0 ($T_1$) | 2.09 | 19.05 | 13.42 | 11.87 | 43.89 | 69.7 |
| 6 ($T_2$) | 2.12 | 19.08 | 13.55 | 12.77 | 43.06 | 72.5 |
| 8 ($T_3$) | 2.06 | 18.70 | 13.52 | 12.73 | 42.66 | 71.0 |
| 10 ($T_4$) | 1.92 | 17.88 | 13.17 | 13.00 | 40.28 | 69.7 |
| 12 ($T_5$) | 2.27 | 18.91 | 13.36 | 12.33 | 49.47 | 66.3 |
| F value | 0.71 | 0.87 | 0.34 | 0.03 | 3.28 | 2.9 |
| F test | NS | NS | NS | NS | NS | NS |

**Table 33a. Effect of K levels on yield and fruit characters of pineapple variety Kew (first ratoon)**

| Treatments of kg/plant | Yield (t/ha) | Average fruit | Average fruit weight (kg) | Average fruit length (cm) | Average crown breadth (cm) | Average crown length (cm) weight (kg) |
|---|---|---|---|---|---|---|
| 0 | 12.40 | 1.60 | 17.10 | 12.50 | 0.260 | 18.8 |
| 6 | 16.70 | 1.59 | 16.90 | 12.35 | 0.278 | 21.2 |
| 8 | 16.50 | 1.71 | 16.70 | 12.41 | 0.271 | 20.6 |
| 10 | 14.90 | 1.53 | 16.80 | 12.42 | 0.244 | 18.6 |
| 12 | 17.90 | 1.55 | 16.80 | 12.40 | 0.265 | 20.6 |
| F Test | NS | NS | NS | NS | NS | NS |
| SEM ± | 3.80 | 0.21 | 1.24 | 0.43 | 0.020 | 1.70 |
| CD 5 % | 1.80 | 0.65 | 3.82 | 1.33 | 0.060 | 5.24 |

**Table 33b. Effect of K levels on yield and fruit characters of pineapple variety Kew (second ratoon)**

| Treatments k(g/plant) | Yield /ha | Average fruit weight (kg) | Average fruit length (cm) | Average fruit breadth cm) | Flesh (%) | Juice (%) | TSS Brix | Average crown weight (kg) | Average crown length (cm) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 15.73 | 1.042 | 14.06 | 9.81 | 72.65 (58.54) | 38.82 (38.54) | 13.25 | 0.174 | 17.19 |
| 6 | 17.70 | 1.137 | 13.44 | 10.07 | 74.96 (59.75) | 37.68 (37.88) | 13.63 | 0..203 | 19.91 |
| 8 | 19.79 | 1.162 | 13.78 | 10.17 | 69.52 (56.50) | 39.23 (38.77) | 13.78 | 0.178 | 17.55 |
| 10 | 15.95 | 1.005 | 12.84 | 9.62 | 73.32 (58.93) | 37.16 (37.55) | 14.00 | 0.184 | 18.52 |
| 12 | 14.26 | 1.151 | 13.24 | 10.18 | 73,72 (59.18) | 36.73 (37.14) | 14.25 | 0.189 | 18.14 |
| SEM ± | 1.0 | 0.80 | 2.28 | 2.42 | 1.74 | 0.71 | 0.39 | 0.003 | 0.29 |
| F Test | NS | NS | NS | NS | NS | NS | NS | NS | NS |

**Table 34a. Effect of potassium levels on vegetative growth and flowering in kew pineapple**

| Treatments K/plant | Flower initiation (days) | 50 per cent flowering (days) | Leaf production rate / Month /plant |
|---|---|---|---|
| $K_0$ | 282 | 326 | 2.48 |
| $K_6$ | 313 | 325 | 2.40 |
| $K_8$ | 278 | 349 | 2.34 |
| $K_{10}$ | 258 | 325 | 2.30 |
| $K_{12}$ | 294 | 323 | 2.58 |
| 'F' test | NS | NS | NS |

**Table 34b. Effect of K levels on fruit characters**

| K level | Fruit weight (kg) | Fruit length (cm) | Fruit diameter (cm) | Gross wei (g) |
|---|---|---|---|---|
| $K_0$ | 6.69 | 11.17 | 8.94 | 118.09 |
| $K_6$ | 0.90 | 13.0 | 9.69 | 140.32 |
| $K_8$ | 0.77 | 12.12 | 9.55 | 153.87 |
| $K_{10}$ | 1.09 | 14.38 | 11.19 | 180.75 |
| $K_{12}$ | 0.76 | 12.53 | 9.59 | 125.65 |
| 'F' test | NS | NS | NS | NS |

## 5. Intercropping studies of grasses and forage legumes coconut

(BL Manjunath and RNS Sundaram)

An experiment was initiated during the year to identify a profitable forage grass/ legume species and their varieties for inter cropping in coconut under local agro-climatic conditions. The experiment was laid out in a randomised block design with three replications by inclusion of four forage grasses (viz., Guinea grass, Setaria grass, PBN-16 and NB-21) and four legume forages (*Stylosanthus scabra, Stylosanthus hamata, Centrocema* and fodder cowpea) in Benaulim variety of coconut which is nine years old. The rootslips of the forage grasses and the seeds of the forage legumes were brought from Indian Grass land and Fodder Research Institute, Regional Centre, Dharwad and University of Agricultural Sciences, Dharwad and were planted during rainy season of 1996. The observations were recorded in terms of different growth and yield parameters. The plant height was highest (173.2 cm) in NB-21 grass while the number of tillers were maximum (21) in Punjab Guinea-123 variety of Guinea grass Table 35a. The NB-21 grass also recorded more number of nodes per tiller (8), more number of leaves per tiller (13) and the leaf length (70 cm). However, the leaf width was maximum (2.26 cm) in case of PBN-16, which is an improved hybrid napier recommended by IGFRI. The internodal length was better (17.4 cm) in case of Guinea g The hybrid napier PBN-16 also rec higher weight of leaf (175 g) and stem g) per tiller with lower leaf to stem (1:1.63) and higher forage yield (19.64 t/ compared to NB-21(16.74 t/ha-forage thus suggesting its suitability in place 21 (Table 35b). The Guinea grass Punjab Guinea-123 recorded moderately yield (12.04 t/ha) with lower moisture pe (75.8) although its leaf to stem ratio higher (1:2.11). The *Setaria* grass, alt recorded a lower leaf to stem ratio (1 was found to be a poor yielder (5.88 Among the perennial legume for *Stylosanthus scabra* recorded rela higher plant height (86 cm), bifoliate l (238/plant), branches (15-primary an secondary) with better forage yield (3.3 although the moisture content of the was less (44.1 %). The *Stylosanthus h* and *Centrocema,* although were better to stem ratio (10.91 and 10.92 respect were found to be poor yielders (0.90 t/h 0.28 t/ha respectively). The fodder c (variety DFC-1) had a good vine length cm) with highest forage yield (3.51 (Table 35c). The forage grasses and le were analysed for different nu parameters like moisture, Neutral Det Fibre (NDF), Acid Detergent Fibre hemicellulose, cellulose and crude prot cent both in leaf and stem separately. observed that the moisture percen

highest in *Setaria* grass particularly in leaf (83.9 %) while it was lowest in the stems of NB-21 grass (69.5 %), thus, giving an indication about the palatability of these grasses (Table 35d). The crude protein content was highest (10.5 %) in PBN-16 leaves as compared to NB-21(8.75 %), thus showing the supremacy of PBN-16 leaves over NB-21 grass particularly for milching cattle. Among the legume forages, the fodder cowpea had a relatively higher moisture percent (82.3 % in leaves) and was followed by the two species of *Stylosanthus*. The cellulose content of fodder cowpea (Table 35e) was found to be higher (37.9 %) as compared to *Centrocema* (19.9 %) indicating their selections for feeding to cattle.

**Table 35a. Growth parameters of different forage grasses as intercrops in coconut (Mean of three cuttings)**

| Forage grass/variety | Plant height (cm) | Tillers /tillers | Nodes /tiller | Leaves /tiller | Leaf length (cm) | Leaf width (cm) | Internodal length (cm) |
|---|---|---|---|---|---|---|---|
| Guinea (Punjab Guinea-128) | 132.6 | 21.3 | 5.3 | 7.6 | 53.8 | 1.71 | 17.4 |
| Setaria | 105.7 | 18.2 | 7.1 | 8.1 | 48.7 | 1.01 | 10.3 |
| PBN-16 | 148.7 | 12.3 | 6.7 | 11.3 | 68.4 | 2.26 | 10.3 |
| NB-21 | 173.2 | 13.4 | 7.9 | 12.9 | 69.6 | 1.88 | 14.4 |
| Hybrid napiers | | | | | | | |
| DHN-1 | 198.6 | 11.0 | 9.1 | 17.6 | 58.5 | 1.71 | 14.9 |
| DHN-2 | 187.7 | 12.1 | 8.3 | 11.3 | 72.8 | 2.29 | 16.5 |
| DHN-3 | 163.3 | 14.4 | 7.6 | 12.3 | 66.3 | 1.85 | 15.8 |

**Table 35b. Yield and its attribute in different forage grasses as intercrops in coconut (Mean of three cuttings)**

| Forage grass/variety | Weight of leaves of (g/tiller) | Weight of stem (g/tiller) | Leaf: stem | Moisture (%) | Forage yield (t/ha) |
|---|---|---|---|---|---|
| Guinea | | | | | |
| (Punjab Guinea-123) | 93 | 196 | 1:2.11 | 75.8 | 12.04 |
| Setaria | 58 | 104 | 1:1.79 | 86.5 | 5.88 |
| PBN-16 | 175 | 285 | 1:1.63 | 75.6 | 19.64 |
| NB-21 | 73 | 133 | 1:1.82 | 86.8 | 16.74 |
| Hybrid napiers | | | | | |
| DHN-1 | 24 | 94 | 1:3.92 | 69.5 | 11.17 |
| DHN-2 | 89 | 97 | 1:1.09 | 63.2 | 15.70 |
| DHN-3 | 40 | 41 | 1:1.04 | 67.7 | 12.00 |

**Table 35c. Growth and yield attributes in different forage/legume as interc coconut**

| Particulars | *Stylosanthus scabra* | *Stylosanthus hamata* | *Centrocema* | Fodder c (DFC |
|---|---|---|---|---|
| Plant height (cm) | 23.3 | 53.3 | 5.23 | 33.0 |
| Trifoliate leaves | 279.2 | 188.0 | 10l.7 | 16.4 |
| Branches-Primary | 14.5 | 11.7 | 4.3 | 2.6 |
| Secondary | 33.8 | 29.9 | 14.0 | 0.9 |
| Vine length(cm) | — | — | 118.2 | 125.2 |
| Weight of leaves (g/plant) | 13.5 | 11.0 | 48.0 | 22.5 |
| Weight of stem g/plant | 14.5 | 10.0 | 44.0 | 35.3 |
| Leaf: stem | 1:1.07 | I:0.91 | 1:0.92 | 1:1.57 |
| Moisture (%) | 44.1 | 51.8 | 60.4 | – |
| Forage yield (t/ha) | 3.39 | 0.90 | 0.28 | 3.51 |

**Table 35d. Nutrient analysis of forage grasses**

| Crop | Moisture | NDF | ADF | Hemicelulose | Cellulose |
|---|---|---|---|---|---|
| Setaria | | | | | |
| Leaf | 83.86 | 57.60 | 38.95 | 18.65 | 27.75 |
| stem | 79.84 | 62.48 | 40.16 | 22.32 | 35.35 |
| Mean | 81.85 | 60.04 | 39.55 | 20.48 | 31.55 |
| Guinea | | | | | |
| Leaf | 71.00 | 42.86 | 26.51 | 16.35 | 20.18 |
| Stem | 80.50 | 50.37 | 28.40 | 21.97 | 26.85 |
| Mean | 75.75 | 46.62 | 27..45 | 19.16 | 23.52 |
| PBN-16 | | | | | |
| Leaf | 79.69 | 44.90 | 20.81 | 24.09 | 30.66 |
| Stem | 79.50 | 77.75 | 58.90 | 18.85 | 37.93 |
| Mean | 79.09 | 61.32 | 39.85 | 21.47 | 34.29 |
| NB-21 | | | | | |
| Leaf | 79.89 | 44.00 | 20.60 | 23.40 | 23.10 |
| Stem | 69.53 | 70.45 | 58.70 | 11.75 | 30.39 |
| Mean | 74.71 | 57.22 | 39.65 | 17.57 | 26.74 |

**Table 35e. Nutrient analysis of forage legume**

| Crop | Moisture | NDF | ADF | Hemi Cellulose | Cellulose | CP |
|---|---|---|---|---|---|---|
| *S. scabra* | | | | | | |
| Leaf | 81.2 | 35.5 | 19..0 | 16.5 | 25.8 | 15.15 |
| Stem | 76.5 | 57.8 | 43.0 | 14.8 | 27.3 | 10.25 |
| Mean | 78.8 | 46.6 | 31.0 | 15.6 | 26.5 | 12.70 |
| *S. hamata* | | | | | | |
| Leaf | 80.3 | 30.2 | 20.0 | 10.2 | 24.2 | 14.87 |
| Stem | 74.1 | 53.0 | 38.4 | 14.6 | 25.8 | 12.25 |
| Mean | 77.2 | 41.6 | 29.2 | 12.4 | 25.0 | 13.56 |
| *Centrocaema* | | | | | | |
| Leaf | — | 38.84 | 18.4 | 20.4 | 21.4 | 10.50 |
| Stem | — | 61.5 | 39.0 | 22.5 | 19.4 | 9..62 |
| Mean | 72.3 | 50.2 | 28.7 | 21.5 | 20.4 | 10.06 |
| *Fodder cowpea* | | | | | | |
| Leaf | 82.30 | 17.8 | 9.4 | 8.4 | 19.0 | — |
| Stem | 78.50 | 77.7 | 58.9 | 18.8 | 37.9 | — |
| Mean | 80.40 | 47.7 | 34.1 | 13.6 | 28.4 | 18.75 |

**6. Utilisation of mine reject soils for fruit production**

(HM Wasnik)

As per the technical programme, Sirigao mines of M/s Chowgule and Co. was selected for implementing the mango and cashew based models on mine reject soils of Goa. Pits (400 nos.) were dug in the spacing of 5 x 5 m in one hectare area, filled with 10 kgs of farm yard manure. About 200 of cashew grafts (Vengurla-4) and 200 of mango grafts i.e. Amrapali (50), Hilario (50), Balli (50) and Mussarat (50) were planted during the onset of monsoon 1996. It was observed that there was 80 per cent survival in both mango and cashew grafts under mine reject soils.

## 3.3 Animal Sciences

### 1. Studies on cross bred pigs to find out appropriate age of marketing

(AR Bhattacharyya, RNS Sundaram, EB Chakurkar)

During the year, the effect of feeding high proten diet was studied through the comparative growth rate in cross bred pigs. The control diet with 18 per cent crude protein and 2,600 Kcal was compared with an experimental diet with 23 per cent CP and 2,650 Kcal. Chemical composition of the two diets were analysed for proximate principles (Table 36) The ADFF and CP content of control diet were 14.25 and 18.13 per cent where as that of experimental feed was 13.82 and 23.o per cent respectively. Two groups of five cross bred pigs each, were and the trial was conducted for a pe days. Fortnightly weight was individual animal. The data colle analyzed for daily weight gain efficiency. The initial and final feed control group was 7.79 per cent an cent. For experimental group, the intake was 7.1 per cent and 5.04 p body weight (Table37) DE value o intake was 184.2 Kcal 135.6 average daily weight gain of 23 recorded in the experimental group w cent CP in diet. The study indicat increasing the CP content incorporation of ground nut cake cent level in the commercial feed, t weight of 32 kg can be obtained a age of six months.

**Table 36. Performance of pigs in the feeding trial**

| Observations | Experimental feed | C |
|---|---|---|
| Feedgrower mesh | 80.0 | |
| GNC | 20.0 | |
| CP (%) | 23.0 | |
| DE | 2840.0 | 2 |
| Initial weight (kg) | 15.3 | |
| Final weight(kg) | 33.0 | |
| Weight gain (75 days) | 17.6 | |
| Average daily Gain(gm) | 236.0 | |
| Feed efficiency | 5.4 | |
| Cost of feed (Rs) | 6.5 | |

**Table 37. Chemical composition of control and pleurotus treated karad hay**

| | Control feed | KRD PL 20 feed | KRD20 feed | KRD | |
|---|---|---|---|---|---|
| NDF | 17.32 | 24.7 | 28.7 | 64.76 | |
| ADF | 12.70 | 16.12 | 19.74 | 46.92 | |
| CEL | 10.76 | 14.06 | 14.74 | 33.75 | |
| LIG | 6.82 | 8.72 | 8.17 | 14.62 | |
| CP | 18 | 17.35 | 16.50 | 3.75 | |
| DE | 2725.00 | 2625.00 | 2675.00 | 1900.00 | 1 |

## PLATE 3



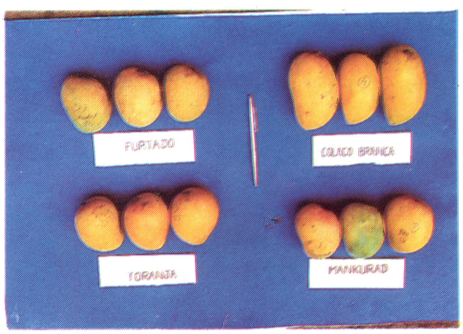

1. Balli - 1 A promising local cashew accession for higher yield, bold nut and bigger apple size



2. Balli - 2 Another promising local cashew accession for higher nut yield and bigger apple size



3. Amrapali - A suitable mango hybrid for Goa




4. Popular mango cultivars of Goa

| Control |
|---|
| 100.0 |
| — |
| 17.5 |
| 2800.0 |
| 17.1 |
| 25.1 |
| 8.0 |
| 106.6 |
| 7.3 |
| 6.0 |

| ed hay and feed |
|---|
| KRDPL |
| 58.41 |
| 36.05 |
| 29.67 |
| 11.35 |
| 5.65 |
| 1825.00 |

## 2. Evaluation of varying energy protein level in rabbit diet for better performance

(RNS Sundaram, EB Chakurkar)

Two diets with isocaloric value and two protein level were formulated. The digestible energy value/kg of feed was 2,875 Kcal, for control diet and 2,940 for experimental diet. The crude protein value of the diet was 17.5 per cent and 21.5 per cent for control and experimental feed. The feeds were processed for pellet making and the trials were conducted for the prescribed schedule. Two feeding trials were conducted with 12 cross bred weaner rabbits of l to 1.5 kg bodyweight. Average daily weight gain of control group was 15.66 g and that of experimental group was 21.3 g. The cost of control and experimental feed was Rs.5.05 and 5.65 /kg. The average dry matter intake/day was 74.02 g and 67.83 g/kg body weight for control and experimental group respectively. Feed efficiency for experimental group was 5.44 whereas that control group was 7.27 indicating higher feed efficiency with the CP level at 21. 5 per cent (Fig.3). Karad hay was processed and inoculated with *Pleurotus florida* and fermented for 30 days. The biodegraded by-product was analysed for chemical composition. To develop a low cost, protein enriched feed, experimental diets with fermented and non fermented karad hay was formulated. The karad hay was incorporated at 20 percent level in the control ration replacing wheat bran to reduce the cost of rabbit feed. Chemical composition of the control and experimental feeds are presented in Table 37. The digestion trial with karad hay was conducted on weaner rabbits for 21 days and the results were compiled for dry matter intake and digestibility studies. Effect of feeding high fibre diet in young rabbits were compared with control feed intake/day Fig 4.

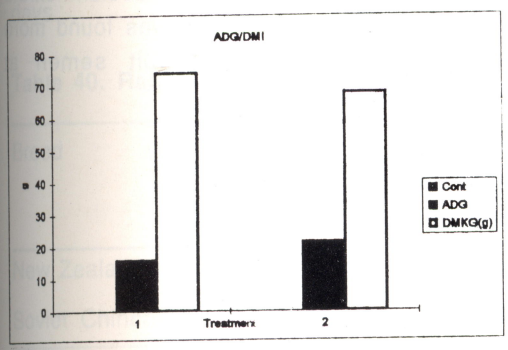



Fig. 3. Effect of feed protien level on daily weight gain in rabbit

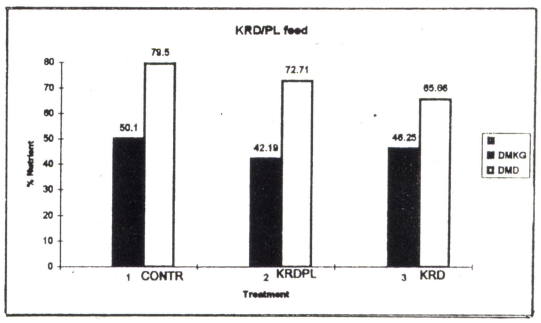



Fig. 4. Effect of fermented karad incprporated feed on daily weight gain in rabbit

the average dry matter digestibility for control, treated and untreated karad hay feed was 79.5 g, 72.71 g and 65.66 g. Dry matter intake per kg body weight for control and fungal treated and untreated karad incorporated diet was 50.1, 42.19 and 46.25 g respectively.

### 3. Adoption of improved techniques to increase the fertility and fecundity in pigs and rabbits

(EB Chakurkar, AR Bhattacharyya and RNS Sundaram)

The main aim of the project was to improve fertility and fecundity so as to get maximum number of young ones per year per animal. In this regard attempts were made to adopt improved techniques. Sows were induced for oestrous after 30 days of furrowing using prostaglandins. Rabbits were bred within 24 hours of kindling so as to get more kindlings in a year.

***Pigs***

Eight farrowings of landrace cross and nine of Yorkshire sows were studied. The average slitter size in Landrace cross sows at birth was 5.37 and at weaning it was 3.62. In Yorkshire average age size at birth was 5.77 whereas at weaning it was 5.44. To reduce remating interval in sows oestrous was induced in eight sows by injecting pg f2 and PMSG. There was no adverse effect observed on litter size when oestrous was induced 30 days post farrowing. Litter size was improved by introducing new breeding male rabbits. Thirty eight kindlings were studied for litter size at birth and weaning. Remating interval was reduced and female does were bred within 24-48 hours after kindling. It was observed that f improved by breeding female wi hours after kingling. The litter siz and weaning were 4.47 and 4.41 re when does were remated within 24 whereas, the litter sizes were 3.22 respectively, when does were rem 10-60 days of kindling. Bio composition of rabbit blood serum i and lactating does was studied. shown in fig.5. It was also obs calcium land phosphorus level was fertile rabbits. Effect of various fa sex, breed, age and weight biochemistry was studied and it was that age has significant effect on ph level (Table 38). Oral supplementation a week before kindling improved kit survival rate serum calcium levels of pregnant an does (Table 39). Semen samp collected from rabbit breeding b studied for initial motility, live/de count and total sperm count (Table collected semen was diluted with sodium citrate egg old diluters and at refrigeration temperature, it was that semen preserved in tris me show more motility than in sodi after 48 hours. Tris media was fo suitable to preserve rabbit s refrigeration temperature

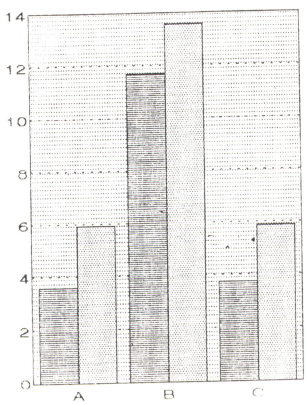



Fig. 5. BLOOD BIOCHEMISTRY OF PREGNANT AND LACTATING DOES

A. Protein gm%, B. Calcium mg%, C. Phosphoru

**Table 38. Effect of various factors on blood biochemistry in rabbits**

| Factor | | Glucose | | Protein | | Calcium | | Phosphorus |
|---|---|---|---|---|---|---|---|---|
| Sex | M | 101.76 | M | 5.29 | M | 9.71 | M | 5.46 |
| | F | 99.79 | F | 5.62 | F | 9.78 | F | 5.34 |
| Breed | PB | 100.98 | PB | 4.49 | PB | 9.68 | PB | 5.39 |
| | CB | 101.80 | CB | 4.29 | CB | 9.08 | CB | 5.29 |
| Age | A | 100.06 | A | 5.26 | A | 9.78 | A | 6.88 |
| | Y | 98.29 | Y | 5.18 | Y | 9.73 | Y | 4.70 |
| Weight | L | 100.85 | L | 5.36 | L | 9.79 | L | 4.33 |
| | H | 99.80 | H | 5.20 | H | 9.70 | H | 5.88 |

@ Significant difference at 1 % level
M=male F=female PB=pure breed CB=cross breed A=adult Y=young L=low H=high

**Table 39. Serum calcium level and litter performance after oral calcium supplementation**

| Parameter | Control | Treatment I | Treatment II |
|---|---|---|---|
| Serum Calcium | 9.38 | 9.88 | 10.38 |
| pregnant doeSerum calcium lactating doe | 11.64 | 12.71 | 12.84 |
| Litter at birth | 5.00 | 4.80 | 5.12 |
| Litter at weaning | 2.85 | 3.50 | 4.12 |

Treatment I - Oral calcium after kindling for seven days
Treatment II - Oral calcium supplementation per kindling seven days to post kindling seven days

**Table 40. Rabbit semen studies**

| Breed | Volume | Total sperms | Dead sperms (%) | Durability in triss media (h) | Durability in sodium citrate (h) |
|---|---|---|---|---|---|
| New Zealand white | 1.25 | 39 x 10 | 15.0 | 48 | 24 |
| Soviet Chinchilla | 0.65 | 58 x 10 | 18.5 | 24 | 8 |

## 3.4 Fishery Sciences

Under Fishery Science and within the mega project, 'Introduction and evaluation technology package for culture and propagation of appropriate fish and shellfish species under Goa conditions', there are two ongoing projects relating to rice-freshwater prawn integration and freshwater weed fish eradication.

## 1. Rice-freshwater prawn culture suitable for Goa

(S Subramanian, BL Manjunath, AV Nirmale, KN Mohanta)

With recent developments in aquaculture in the country, freshwater prawn culture has assumed importance for both internal market and export. Goa being a state with immense potential for prawn farming, a suitable technology package of rice-prawn integration for Goa and its adjoining region, has been aimed at through this project. This would also sustain the much required rice cultivation in the State, through increase in the income generation from the paddy fields by suitable incorporation of economically viable additional component like prawn in the existing practices.

One field of 0.1 ha size with a pond of 0.01 ha within, was identified, suitably modified and prepared for the integration. Previous trial with Vyttila-I the rice variety screened and identified suitable for the integration, gave a Kharif yield of 3.0 t/ha. During kharif 1996, Vyttila-1 was successfully raised under the sudden deep water situation by direct sowing of seeds during late May and the establishment was also good. However, the crop was severely damaged by birds at the milky stage, as there was no other crop in the field during the time.

Juveniles of freshwate
*Macrobrachium rosenbergii* (PL 20
procured from Fisheries College
Krishi Vidyapeeth, Ratnagiri and
the prepared field. The prawns hav
an individual growth of 150 g/8 m
tough there was heavy predation
fishes and crocodile which hav
serious problems to the trial due to
The project is in progress.

## 2. Use of neem based pesticid eradication of weed and fishes

(S Subramanian, Mani Chellap KN Mohanta)

Under the project, the effec
based pesticide in the eradication
carnivorous and weed fishes of
culture system is evaluated. In a
nine species of local and carnivor
identified last year, one more speci
*Mystus* sp. was also recorde
freshwater pond system.

The repeat trial with neem o
air breathing cat fish (*Heteropneust*
not have any effect even at high
However, Bioneem was effective
both minow and cat fishes. In the
of lab trials conducted with Bione
concentrations ranging from 0.00

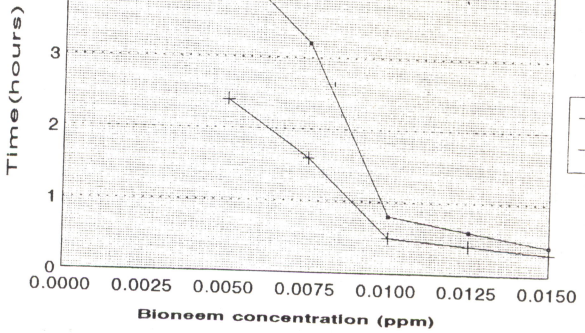


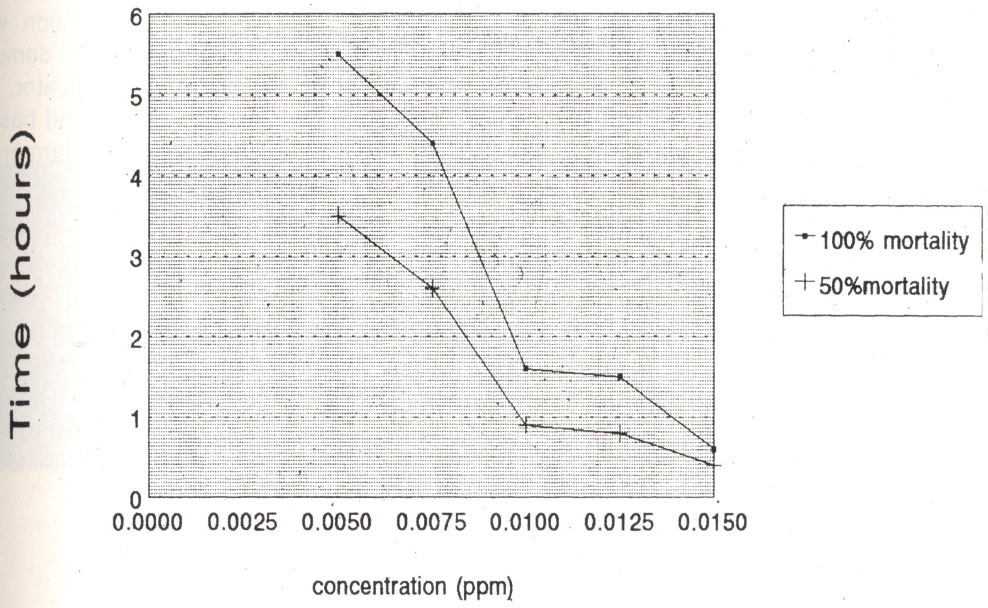

Fig. 6. Effect of Bioneem on eradication of Aplocheilus sp

ppm, on *Aplochielus* sp. and *Mystus* sp., it was seen that Bioneem was effective in both species within 5 to 6 hours , even at the low concentration of 0.005 ppm. In the trials conducted with ten fish of 7 to 10 cm size each at six treatments of 0, 0.0025, 0.0075, 0.0100, 0.0125 and 0.0150 Bioneem concentrations for each species. Observations were recorded at 30 minutes intervals for six hours. From Fig.6, it may be seen that 100 per cent mortality occurred within one hour, for bioneem concentrations above 0.010 ppm, in *Aplocheilus* sp. However, at the concentration 0.005, 50 per cent mortality occurred at two and half hours and 100 percent mortality occurs before five hours.

In *Mystus* sp. also a similar trend was observed (Fig. 7 ). However, in the case of *Mystus* sp., the time taken for mortality at corresponding Bioneem concentrations, was about one hour more. Concentrations below 0.005 ppm, were ineffective in both the species within six hours. The trials are in progress.

Azadirachtin, the active ingredient of the neem product, appear to inhibit the intake of dissolved oxygen by blood at the gills, which could be seen from the swollen condition the gills of fish killed by Bioneem.

Fig. 7. Effect of Bioneem on eradication of Mystus sp.



## 3.5 Transfer of technology

The Krishi Vigyan Kendra attached to the Main Institute serves as the extension wing of the Research Complex with a mandate to transfer proven agricultural technolgies to the fields through various activities. From the year 1994-95 the transfer of technology projects were re-grouped under the revised norms of the Council.

The work was carried out under three sub projects.

### 1. Training and other activities

(RNS Sundaram, S Subramanian, VY Gaonkar, Sunetra Talaulikar, HR Prabhudesai, AV Nirmale, HR Chidananda Prabhu, VS Sakharkar, KK Metar and Scientists)

During the year 1996-97, the Krishi Vigyan Kendra conducted 92 skill oriented need based training programmes both on the campus as well as off campus in various disciplines like crop sciences, horticulture, animal sciences, home science and plant protection and trained 1,507 participants in three categories viz., practicing farmers and farm women, rural youths and grass rot level extension functionaries comprising of 628 males and 879 female participants. The details of the training conducted in different disciplines are provided in Table 41.

**Participation in extension activ**

During the year under r participated in various seminars, special training programmes co various agencies like State D NABARD, CADA, ZUARI, K IFFCO, Nationalised banks, F Mahila mandals and gave technic on various topics of interest to p

The KVK celebrated the Wo on October 16th 1996, in collabo Department of Agriculture at Kala Panaji. An impressive exhibitio arranged on the occasion.

The KVK organized a Rab campaign on November Ist 19 Institute premises in which 75 f officials from various departments Dr.K.L. Chadha, DDG (Hort), an Srivastava, Chief Secretary, Gov Goa participated. An exhibition arranged on the occasion and de the use of groundnut decorticato containing groundnut seeds and b were also distributed to the farm occasion.

The KVK organized a convention on March 22nd collaboration with Department of at Extension training Centre, Ela Ex-trainee convention was inau Shri D.G.Narvekar, Honble M Agriculture, Government of Goa in containing secatteurs were distrib ex-trainees.

on activities

under report, KVK
eminars, melas and
mes conducted by
State Departments
ARI, KKRIBHCO,
anks, Farm clubs
technical guidance
est to participants.

the World food day
collaboration with
at Kala Academy,
exhibition was also
n.

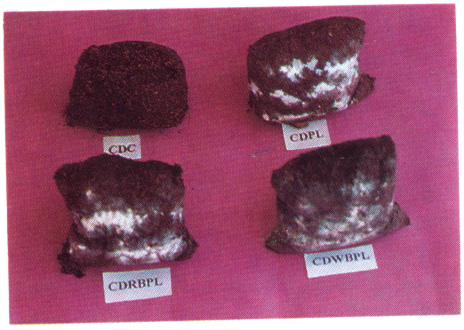
a Rabi groundnut
lst 1996 at the
ch 75 farmers and
artments along with
Hort), and Dr. G.C.
ary, Government of
exhibition was also
and demonstrated
corticator. The kits
ds and basmati rice
he farmers on the

ed a Ex-trainee
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ment of Agriculture
tre, Ela, Old Goa.
as inaugurated by
nble Minister of
Goa in which kits
e distributed to the

## PLATE 4



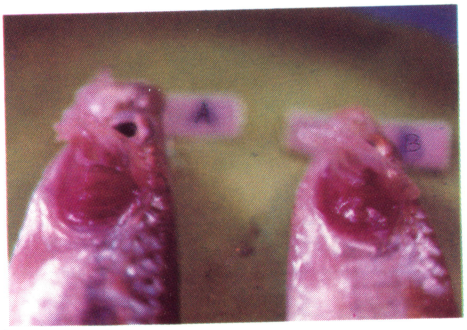
1. Fungal degradation and enrichment of cashew apple waste with *Pleurotus florida*




2. Effect of enrichment on biodegradation of coir dust with *Pleurotus florida*



3. Improved litter born through hormone induced ovulation




4. Effect of azadirachtin on the gills of *Aplochieles* sp
   a. Exposed normal gill
   b. Swollen gill due to the action of azadirachtin

**Table 41. Training programmes conducted during 1996-97**

| Sl. No. | Title of the course | Dura-tion (days) | No. of courses conducted | | | No. of participants | | |
|---|---|---|---|---|---|---|---|---|
| | | | ON | OFF | Total | Male | Female | Total |
| **1. CROP SCIENCES** | | | | | | | | |
| *A. Practicing farmers and farm women* | | | | | | | | |
| 1. | Basmati rice production | 2 | 2 | 1 | 3 | 24 | 13 | 37 |
| 2. | Pulses and oilseeds cultivation practices | 2 | 2 | 4 | 6 | 48 | 45 | 93 |
| 3. | Organic farming | 2 | 1 | 3 | 4 | 63 | 01 | 64 |
| 4. | Veermicomposting | 2 | 1 | 2 | 3 | 16 | 27 | 43 |
| 5. | Integrated nutrient management | 2 | - | 1 | 1 | 9 | 19 | 28 |
| 6. | Sugarcane ratoon management practices | 2 | - | 2 | 2 | - | 20 | 20 |
| | Sub total of A | 38 | 6 | 13 | 19 | 160 | 125 | 285 |
| *B. Rural youth* | | | | | | | | |
| 1. | House hold garbage disposal | 2 | 1 | 1 | 2 | 7 | 15 | 22 |
| 2. | Groundnut seed production | 2 | - | 1 | 1 | 9 | 5 | 14 |
| 3. | Preparation organic compost | 2 | 2 | - | 2 | 31 | 3 | 34 |
| 4. | BGA Production techniques | 2 | 1 | - | 1 | 8 | - | 8 |
| | Sub total of B | 12 | 4 | 2 | 6 | 55 | 23 | 78 |
| *C. Extension functionaries* | | | | | | | | |
| 1. | Organic farming | 2 | 1 | - | 1 | 10 | — | 10 |
| 2. | Modern irrigation system and moisture conservation | 2 | 1 | — | 1 | 10 | — | 10 |
| | Sub total of C | 4 | 2 | — | 2 | 20 | — | 20 |
| | Grand total (A+B+C+) | 54 | 12 | 15 | 27 | 235 | 148 | 383 |
| **2. HORTICULTURE** | | | | | | | | |
| *A. Practicing farmers and farm women* | | | | | | | | |
| 1. | Cashew production technology | 3 | 10 | — | 10 | 199 | 2 | 201 |
| 2. | Mushroom cultivation | 1 | 2 | — | 2 | 15 | 5 | 20 |
| 3. | Rose cultivation | 1 | 1 | 1 | 2 | 17 | 32 | 49 |
| 4. | Coconut based cropping system | 2 | 1 | 1 | 2 | 24 | 0 | 24 |
| 5. | Improved cultivation practices for vegetables | 1 | — | 1 | 1 | 0 | 23 | 23 |
| 6. | Cultivation of fruit crops | 1 | — | 2 | 2 | 23 | 28 | 51 |
| 7. | Kitchen gardening | 1 | — | 1 | 1 | 0 | 33 | 33 |
| | Sub total of A | 42 | 14 | 6 | 20 | 278 | 123 | 401 |

**Table 41. Training programmes conducted during 1996-97 contd...**

| | | | | | | |
|---|---|---|---|---|---|---|
| *B. Rural youth* | | | | | | |
| 1. Propagation of important horticultural crops | 3 | 2 | — | 2 | 20 | |
| 2. Mushroom cultivation | 2 | 2 | — | 2 | 15 | |
| Sub total of B | 10 | 4 | — | 4 | 35 | |
| Grand total ( A+B+C) | 52 | 18 | 6 | 24 | 313 | 1 |

**3. PLANT PROTECTION**

| | | | | | |
|---|---|---|---|---|---|
| *A Practicing farmers and farm women* | | | | | |
| 1. Integrated pest management | 1 | 1 | -- | 1 | 4 |
| 2. Weed management | 1 | - | 1 | 1 | 5 |
| 3. paddy pests & their management | 1 | — | 1 | 1 | 10 |
| 4. Pest management in fruit crops | 2 | 1 | — | 1 | 7 |
| 5. Pest Management in vege Table crops | 1 | — | 1 | 1 | 5 |
| 6. Pest Management in plantation crops | 2 | 1 | — | 1 | 4 |
| Sub total of A | 8 | 3 | 3 | 6 | 35 |
| *B. Rural youth* | | | | | |
| 1. Spawn production | 1 | 4 | — | 4 | 23 |
| Sub total of B | 44 | — | 4 | 23 | 10 |
| *C. Extension functionaries* | | | | | |
| 1. Biological control | 1 | 1 | — | 1 | 2 |
| Sub total of IC | 1 | 1 | — | 1 | 2 |
| Grand total (A+B+C) | 13 | 8 | 3 | 11 | 60 |

**4. ANIMAL SCIENCES**

| | | | | | |
|---|---|---|---|---|---|
| *A. Practicing farmers and farm women* | | | | | |
| 1. Backyard poultry farming | 2 | 2 | — | 2 | — |
| 2. Management of dairy cows | 2 | 1 | — | 1 | 7 |
| Sub total of A | 6 | 3 | — | 3 | 726 |

**Table 42. Extension activities**

| Sl.No. | Activities | Date | No. | No. of partici | |
|---|---|---|---|---|---|
| | | | | Male | Femal |
| 1. | World food day | 16-10-1996 | 1 | 175 | 25 |
| 2. | Rabi groundnut campaign | 01-11-1996 | 1 | 55 | 20 |
| 3. | Exhibition | 16-10-1996 | 1 | 175 | 25 |
| 4. | -do- | 22-03-1997 | 1 | 60 | 15 |
| 5. | Ex-trainee convention | 22-03-1997 | 1 | 60 | 15 |
| 6. | Video cassette | — | 6 | 15 | 12 |
| 7. | Slide show | — | 11 | 120 | 25 |
| 8. | New slides prepared | — | 147 | — | — |
| 9. | Radio broadcast | — | 6 | — | — |
| 10. | T.V.telecast | — | 2 | — | — |
| 11. | Popular articles published | — | 8 | — | — |

**Bench mark survey**

Bench mark survey has been conducted in Madkai village of Ponda taluka, which is situated in North Goa district. Fifty respondents were interviewed by personal interview method from the seven wadas of Madkai village. Ninety per cent of the respondents were belonging to Hindu religion. Six and four per cent of the respondents were belonged to Budhist and Christian religion, respectively.

Majority of the farmers depend on monsoon for water source and only six per cent of the respondents were having their own source of irrigation i.e. well. Main crop of Madkai village is rice (variety-Jaya & Jyoti)

Educational status of youth up to thirty age was critically analyzed and the data revealed that forty four per cent of the youth had education upto matriculation. Only three per cent of youth had completed graduation. Farmers are applying chemical fertilizers to rice crop. However application fertilizers to horticultural cor negligible.

Twenty two per cent of were having cows and buffaloe dung is used as a cooking fuel

**2. Farm advisory services**

(RNS Sundaram, S Subrar Gaonkar, Smt. Sunetra M Tal Prabhudesai, AV Nirmale, HR Prabhu, VS Sakharkar, KK Met

Under this sub proj programmes viz., lab to land National demonstration and demonstration on oilseeds/p included.

**Lab to land programme**

During the year, under the programme, 54 farm families were Betqui, Taleigao and Nerul, village

Tiswadi and Bardez talukas, respectively and bench mark survey was made for all the families. Suitable technologies for transfer to each of the farming families were identified and critical inputs like high yielding seeds of rice and groundnut cashew and mango grafts, vegetable seeds, pig units, smokeless chullas and pesticides were supplied to the beneficiaries.

### A. Crop Science

The lab to land programme was implemented to include 12 farm families at Taleigao village of Tiswadi Taluka. During kharif 1996, rice seed was supplied to the beneficiaries as this was the last year of implementation of the programme. Variety Ananda was supplied and training in management aspects was imparted.

In Taleigao village, where the improved short duration variety Annada with appropriate package of practices was demonstrated increase was yield on an average 9.6 q. The cost of cultivation including family and hired labour was Rs.13,275/- where as the demonstration yield gave 38.2 q. of grain which fetched an income of Rs.22,740/- ha @ Rs.700/- q thus giving a net income of Rs. 9,465 ton/ha. Thus a cost benefit ratios of 1: 1.71 was released in respect of rice cultivation. The details of demonstration results and the cost benefit analysis are presented in Table 43 and Table 44, respectively.

During Rabi however, due to the drastic cut in the fund allocation only one family at Agasaim was supplied with Dh-3-30 groundnut seed. The total area under demonstration during the year was 2.5 ha. The demonstration plots were visited regularly for observations and recording yield data.

The demonstration once again established the superiority of Dh-3-30k groundnut yielding 20.2 q/ha as against the local check variety JL-24 (12,8 q/ha). The cost of cultivation worked out to Rs. 7,350/- The pod yield of 20.2 q fetched Rs. 28,280/-.ha. The beneficiaries of demonstration have seen the impact of proven technology and their response was good. The details of demonstration results and the cost benefit analysis are presented in Table 43 and 44 respectively.

### B. Animal Sciences

Under Animal Sciences, 4 farm families were selected in Taleigao and Nerul village and 4 pig units were supplied containing one female and one male pig per each unit. All the units are performing well.

### C. Home Science

In Home Science, 20 families were selected from Betki village under lab to land programme during the year 1996-97. Metallic portable chullas were given as impact for the beneficiaries. The improved chullas are scientific modifications of traditional chullas. They ensure proper combustion and reduce losses due to convention and radiation and thus utilizes the heat value of fuel efficiency. It was observed that in improved chullas the consumption of fuel is 50 per cent less than ordinary chullas, thus saving fuel and time in cooking. It does not require blowing and thus reduces health hazard in women folds. It helps to minimize drudgery in kitchen.

**D. Pant Protection**

Weed being the major constraint the rice production and since, labour is very costly in Goa state. More emphasis was given to weedicides in weed man Under lab to land programme about Anilophos was distributed among 2 at Nerul village.

**Table 43. Achievements of demonstration under lab to land programme**

| Sl. No. | Village/Taluka | No. of families adopted | Area ha/Animal | Inputs supplied | Demon. yield /ha | Local check /ha | P in |
|---|---|---|---|---|---|---|---|
| 1. | Crop Science | | | | | | |
| | Taleigao (Tiswadi) | 12 | 2.2 | Rice seed (Annada) Anilophos | 38.2 | 28.6 | |
| | Agasaim (Tiswadi) | 1 | 0.3 | Groundnut seed (Var-Dh-3-30) | 20.2 | 12.6 | |
| ***2. Horticulture*** | | | | | | | |
| | Betqui (Ponda) | 17 | 6.8 | Cashew grafts (Var- V-4) Mango grafts (Var-Amrapali) | | Yield not yet | |
| | Betqui(Ponda) | 6 | 2.4 | Bhendi seed (Var Parbhani Kranti) Cluster bean seed (Pusa Navbahar and Ragira) | 95 | 54.33 | |
| ***3. Animal Science*** | | | | | | | |
| | | 3 | Pig | (I male + I female) unit; pig units are performing well | | | |
| | Nerul (Bardez) | 1 | Pig | -do- | | | |
| ***4. Home science*** | | | | | | | |
| | Betqui (Ponda) | 20 | — | Metallic chullas; consumption of fuel in chulla is 50 per cent less than ordinar | | | |
| | Grand total | 54 | 1.7 | | | | |

**Table 44. Cost benefit analysis of lab to land programme**

| Sl. No. | Crop | Average yield (q/ha) | Cost of production (Rs./ha) | Gross returns (Rs./ha) | Net returns (Rs./ha) |
|---|---|---|---|---|---|
| 1. | Rice | 38.2 | 13,275 | 22,740 | 9,465 |
| 2. | Groundnut | 20.2 | 7,350 | 28,280 | 20,930 |

### *National Demonstration*

During the year 1996-97, the National demonstration was conducted at Nerul village in Bardez taluka under three cropping sequences viz., Kharif-rice (4.8ha), Rabi-groundnut (1.6 ha) and summer-pulse (0.4 ha). The target had to be reduced due to unavailability of funds during Rabi and summer.

During the kharif season 4.8 ha area comprising of 14 families was supplied with Annada foundation seed and other inputs like fertilizer, pesticides, weedicide as per the need. Training was imparted to improve their skill.

During Rabi, the original target of 3.2 ha had to be reduced by 50 % to 1.6 ha due to fund constraints. Groundnut seed of Dh-3-30, Dkh-40 and JL-24 totaling 320 kgs was supplied. Similarly training component was also included.

During summer 04. ha area was taken for pulse cultivation and cowpea seed was given to two farmers. The demonstrations plots were visited regularly for observation and the yield data recorded. The results are presented in Table 45.

It was seen that during kharif a cost benefit of 1:1.84 was achieved in rice cultivation, whereas it was 1.43 in case of groundnut in Rabi. The details are furnished in Table 46.

**Table 45. Results of national demonstration**

| Season | Crop | Variety | No. of Demon-strations | Area (ha) | Average yield(q/ha) | | Per cent increase |
|---|---|---|---|---|---|---|---|
| | | | | | Demonstation | Local check | |
| Kharif (Monocrop) | Rice | Annada | 12 | 4.8 | 42.3 | 31.8 | 33.01 |
| Rabi (double crop) | Rice | Annada | | | | | |
| | Groundnut | Dh-3-30<br>Dh-40<br>J1-24 | 4 | 1.6 | 22.8 | 14.3 | 59.4 |
| Summer (Multiple cropping) | Rice | Annada | --- | --- | 6.8 | 4.2 | 61.0 |
| | Groundnut | Dh-3-30 | | | | | |
| | pulse | Local cowpea | 2 | 0.4 | | | |

**Table 46. Cost benefit analysis of National demonstration**

| Crop | Variety | Area (ha) | Yield Q/ha | Cost of cul-tivation | Gross returns Rs./ha | C.B. ratio Rs./ha |
|---|---|---|---|---|---|---|
| Rice | Annada | 4.8 | 42.3 | 12,500 | 29,610 | 1:2.36 |
| Rice | Annada | | | | | |
| Groundnut | Dh-2-20 | 1.6 | 22.8 | 7,400 | 31,920 | 1:4.31 |
| Rice | Annada | | | | | |
| Groundnut | Dh-3-30 | | | | | |
| Pulse | Alsando | 0.4 | 6.8 | 3,500 | 17,000 | 1:4.00 |

Cost of paddy for sale @ Rs.700/q
Cost of groundnut for sale @ Rs.1,400/q
Cost of cowpea for sale @ Rs.2,500/-

Through the National Demonstration, the advantage of having two crop of three crop sequence instead of monocrop as established and demonstrated to the beneficiaries who have taken the cropping system as beneficial.

**3. On farm Research**
(All KVK staff and Scientists)

***Client oriented research***

Under problem oriented research, a field visit with Scientists from BARC, Mumbai was conducted to survey the sweet potato weevil problem and IPM by use of sex pheromone septa as a tool.

***Water shed management***

During the year under report the KVK participated in State level meeting as a Kis Mela at Codar Watershed organized Directorate of Agriculture, Government Goa.

**Front line demonstrations**

During the year, a target of 20 ha un Rabit groundnut was identified to farmers Mencurem and Sal villages in Bicholim tal as per guidelines of FLD. Training advanced production technologies was a imparted to the prospective beneficiaries

***Nursery activities***

During the year, the following plant materials were prepared to supply to beneficiaries of lab to land program research activities and for the general sale the farmers.

**Table 46. Planting materials prepared and supplied during 1997**

| Sl.No. | Planting materials | Quantity (no.) |
|---|---|---|
| 1. | Cashew grafts | 6,176 |
| 2. | Mango grafts | 2,436 |
| 3. | Arecanut seedlings | 5,123 |
| 4. | Pepper | 236 |
| 5. | Guava layers | 105 |
| 6. | Other ornamentals | 685 |
| | Total | 14,761 |

## PLATE 5




1. Shri D.G. Dayananda Narvekar, Hon'ble minister for Agriculture, Govt. of Goa, releases the Institute's publication. Director, Department of Agri., Govt. of Goa and Director and Training Organisers, ICARRC Goa are also seen in the picture



2. Dr. G.C. Srivastava, Chief Secretary, Govt. of Goa in the presence of DDG (Hort), Director ICARRC- Goa and Director, Dept. of Agriculture, Govt. of Goa, inaugurated the Rabi Campaign



3. Shri Vivek Rai, Secretary, (Agriculture) Govt. of Goa at the ICAR Research Complex exhibition hall organised on the eve of kissan mela




4. Exhibition stall of ICAR RC - Goa, is flooded with visitors during the world food day function

# 4. REPORT ON COMPLETED PROJECTS

## 4.1. Intercropping studies in coconut

(BL Manjunath, MS Balbatti and DG Dhandar)

### Introduction

The coconut holding in Goa, by and large is very small and when these units are monocropped they do not provide adequate income to the dependent families. However, these coconut lands are conducive to produce a variety of annuals, biennials and perennials. Since coconut is planted at a wider spacing due to its characteristic morphological features, the inter and inter-row spaces in coconut gardens are adequate to provide the best forms of cropping system without adversely affecting the productivity of the palms. This is because, in coconut gardens, the utilization of photosysnthetically active radiation and soil space is to the tune of 40 per cent and 23 per cent respectively and remaining wasteful resources can be effectively tapped throughout the companion crops. This, besides giving intermittent returns, will also meet the varied needs of the farmer and provide gainful employment to family labour.

In order to exploit the full potential of the system on scientific lines, it is essential to study for the compatible crops and varieties and their management that suits best to the local agro-climatic conditions. With this background, an attempt was made to identify a profitable crop combination with coconut for the agro-climatic conditions of Goa.

### Materials and Methods

the trial was conducted between 1993 to 1996 at the ICAR Research Complex for Goa situated on the west coast of India having humid tropical climate with temperature ranges 18 to 35°C and mean annual rainfall of 2,750 mm. The soil type is lateritic with slightly acidic reaction. The plot consisted of 11 years old coconut palms planted at a spacing of 8 x 8 m with mango (variety Amrapali) at the centre of four coconuts, allowing nearly 40 per cent of the photosynthetically active radiation through the canopy.

Three annual crops, ginger (*Gingiber officianale*), turmeric (*Curcuma longa*) and pineapple (*Ananas comosus*) land four vegetable crops for each season of Kharif, bhendi (*Abelmoschus esculentus*), cucumber (*Cucumis sativus*), clusterbeans (*Cymopsis tetragonaloba*) and ridge gourd (*Lugffa acutangula*), in Rabi season, chillies (*Capsicum frutencens*), brinjal (*Solanum melongena*), clusterbeans and vegetable cowpea (*Vigna sinensis*) and during summer, tomato (*Lycopersicon esculentum*), bhendi, vegetable cowpea and amaranthus (*Amaranthus* sp) were initially tried by replicating three times on rotation basis in

each season both in the open light conditions and in the interspaces of coconut. Care was taken to leave 1.8 m radius area free around the palm. Coconut was managed as per the recommended package of practices. A fertilizer dose of 500 g N, 320 g $P_2 0_5$ and 1,200 g $K_2 0$ per palm was given in two splits annually. The details of management practices followed for various intercrops are summarised in Table 47.

**Results and Discussion**

Among the three annual intercrops tried, ginger (variety Sangli local) gave a better yield of fresh rhizomes (37.15 q/ha) leading to a net additional return of Rs.33,950/- as compared to turmeric (variety Krishna or PCT-13) which gave an average yield of 70.62 q/ha) of fresh rhizomes leading to a net additional return of Rs.28,290/ha. Pineapple (variety Giant kew) yielded 40.57 q/ of Rs.28,290/ha. Pineapple (variety Giant kew) yielded 40.57 q/ha of fruits per ha with a net return of Rs.5,000/ha. Besides, ginger and turmeric also found to generate additional on-farm employment to the tune of 153 to 158 mandays/ha (Table 48). the labour input for pineapple was found to be nearly two thirds to that of ginger and turmeric besides requiring lesser fertilizers and irrigation requirements. Thus, ginger can be a suitable intercrop for high input management systems while pineapple can suit for many of the local situations. For vegetable intercrop during kharif season, bhendi (variety A anamika or Parbhani kranti) found m remunerative with better yield (7.47 q/ha) a net returns (Rs.4,150/ha) which was follow by clusterbeans (variety Pusa navbah which yielded 5.71 q/ha resulting in a return of Rs.1,450/ha. These crops also ha a potential to provide employment to extent of 52 to 60 mandays/ha. Cucumi (variety white long) and ridge gourd (vari Arka sujatha) found not suitable as intercro in coconut as they are prone to anthracno disease under shade. For rabi seas intercropping, local brinjal (var. Agasaim) w found to be a suitable and profitable interc with an yield potential of 36.89 q/ha amounti to a net return of Rs.12,290/ha as compar to other crops. The clusterbeans growth ha was found to be affected when planted October as compared to June planting bo in terms of plant height (93 cm against 1 cm during kharif) and consequently numb of fruit bunches per plant and the yield (4. q/ha). Although chillies (variety Arka Rohi comes up well under coconut shade ( with 1 cm plant height, 10 fruiting branches/pla and 13 fruits/plant), it is prone to mites a leaf curl disease. Similarly, vegetab cowpea(variety local) is also found to affected by coconut shade leading to less monetary returns.

**Table 47. Cultivation details of the intercrops**

| Sl. No. | Intercrops | Variety | Sowing time | Method of planting | Spacing (cm) | Gross area utilized by the intercrop |
|---|---|---|---|---|---|---|
| 1. | Ginger | Sangli local | May-Jun | Beds | 25 x 25 | 50 |
| 2. | Turmeric | Krishna/PCT-13 | May Jun | Beds | 25 x 30 | 50 |
| 3. | Pineapple | Giant kew | Jun-Jul | Trenches | 70 x 30 | 50 |
| 4. | Bhendi | Arka anamika /Parbani kranti | Jun-Jul Jan-Feb | Ridges and furrows | 50 x 30 | 75 |
| 5. | Cucumber | White long | Jun | -do- | 200 x 50 | 75 |
| 6. | Clusterbeans | Pusa navbahar | Jun Jul | -do | 45 x 30 | |
| 7. | Ridge gourd | Arka sujatha | Jun | -do- | 200 x 50 | 75 |
| 8. | Chillies | Arka Lohit | Oct-Nov | -do- | 60 x 30 | 75 |
| 9. | Brinjal | Local Agasaim | Oct-Nov. | -do- | -do- | 75 |
| 10. | Vegetable cowpea | Local | -do- | -do- | 45 x 30 | 75 |
| 11. | Amaranthus | Local | Jan-Feb | Flat beds | — | 75 |
| 12. | Tomato | Arka abha/Megha | Jan-Feb | Ridges and furrows | 60 x 45 | 75 |

**Table 48. Average yield and economics of intercrops in coconut**

| Crop (variety) | Yield (q/ha) (Rs./ha) | Grosss returns | Cost of cultivation | Net returns (Rs./ha) | Man days /ha |
|---|---|---|---|---|---|
| I Annuals | | | | | |
| Ginger (Sangli local) | 37.15 | 64,500 | 30,550 | 33,950 | 153 |
| Turmeric (Krishna or PCT-13) | 70.62 | 59,300 | 31,010 | 28,290 | 158 |
| Pineapple (Giant kew) | 41.17 | 17,240 | 12,240 | 5,000 | 103 |
| II. Seasonals | | | | | |
| (a) Kharif Bhendi (Arka anamika or Parbhani kranti | 7.47 | 6,990 | 2,840 | 4,150 | 52 |
| Clusterbeans (Pusa navbahar) | 5.71 | 5,130 | 3,680 | 1,450 | 60 |
| b) Rabi | | | | | |
| Chillies (Arka lohit) | 3.82 | 4,820 | 5,440 | — | 112 |
| Brinjal (Agassaim) | 36.89 | 17,730 | 5,440 | 12,290 | 101 |
| Veg. Cowpea (local) | 1.05 | 2,100 | 2,450 | — | 52 |
| Clusterbeans (Pusa navbahar ) | 4.49 | 5,830 | 5,030 | 800 | 75 |
| c) Summer vegetables | | | | | |
| Cowpea(local) | 2.42 | 4,840 | 3,070 | 1,770 | 62 |
| Bhendi (Arka anamika or Parbhani kranti) | 6.02 | 6.030 | 3,820 | 2,210 | 83 |
| Coconut | 4,206 nuts | 17,990 | 14,340 | 17,540 | 62 |
| Mango | 3.94 | 13,890 | | | |

**Table 49. Effect of intercropping on the yield of coconut**

| | Nut yield | | | |
|---|---|---|---|---|
| | Before inter cropping | After intercropping | | |
| | (1992-93) | (1993-94) | (1994-95) | (1995-9 |
| No. of coconut palm | 101 | 101 | 100 | 100 |
| No. of nut bearing palms | 40 | 72 | 88 | 89 |
| Per cent of trees bearing nuts | 40 | 71 | 88 | 89 |
| Total nut yield | 516 | 2,142 | 3,326 | 3,411 |
| Nut yield/palm | 13 | 30 | 37 | 37 |
| Area - 0.6 ha | | | | |

Nut yield recorded from June to May each year (Table 49). One palm was removed due to red
palm weevil attack.

For summer season, intercropping with short duration vegetables like bhendi (variety Arka anamika or Parbhani kranti) was found more remunerative (Rs.2,210 net returns) as a consequence of better yield (6.02 q/ha). Vegetable cowpea (variety local) was nextbest in order. Amaranthus was not a suitable intercrop during summer as its vegetative growth was slow. Tomato (variety Arka abha or Megha), although established well, the fruit seed was poor (2-3/plant) and was found susceptible le to bronze wilt vir

*Effect of Intercropping on coconut*

Intercropping was found to have positive influence on the main crop (coconu as reflected by percentage of trees beari nuts (40 per cent of trees during p intercropping against 89 per cent after thr years of intercropping) and the nut yield (5 nuts during pre-intercropping period to 3,4 nuts after three years of intercropping in ( ha area). Consequently, the nut yield p palm has increased from 13 to 39 per ye after intercropping.

## 4.2. Fish - Poultry farming systems under Goa conditions

( S Subramanaian, NS Nair,
AR Bhattacharyya, AV Nirmale)

### Objectives

To identify the combination proportions and evolve farmingsystems to recycle poultry wastes into fish production under
a) duck and fish and
b) chick and fish integrations in freshwater bodies under Goa conditions.

### Introduction

Goa has reasonable inland water resources in having many small and large water bodies which offer good scope for composite / mixed culture with three to six species of fast growing freshwater carps and other suitable fish species. Intensive poultry farming is also popular in Goa. Because of the unique food habits (majority are non-vegetarians) and tourism in Goa, there is always a good demand for fish and livestock products. Under the poultry-fish integrated farming systems, the dropping of the birds are utilized in the production of plankton which is the basic food of the carps. In addition, the feed wastes which spill over, are also consumed by the fish. In these combinations, only the birds have to be maintained and pond fertilization and supplementary feeding which have to be otherwise taken up for the growth of the fish, are not required.

### Infrastructure

Under the poultry - fish integration, the duck - fish and chicken - fish combinations were tested under the local freshwater conditions. For the establishment of the trial infrastructure, three ponds of 0.10, 0.06 and 0.05 ha, respectively were excavated.

### i) Duck - fish integration

### Materials and Method

### Floating duck house

A floating duck house of 5 x 2 m size was designed and fabricated to house 30 to 40 ducks which would cater to the requirement of about 0.15 ha pond area. The house is made of angle iron frame, welded wire mesh sides and bottom, light weight synthetic roofing and four plastic drums attached to the bottom. The house has a front door for management and slanting trap door for the ducks to move in and out. Subsequently, the duck house was modified by reducing the size to 3 x 2 m, to accommodate about 25 to 30 birds and for increased stability.

### Experimental unit

The trials were conducted in a 0.1 ha size pond with White Peking ducts which are dual purpose birds. Six week old ducks of about 800 g each, were reared in the pond/ cage, for six months. For the first year, 35 birds were reared and the subsequent two years the number was reduced to 20 ducks.

Three to four species of carps namely catla, rohu, mrigal and common carp, in combination, were stocked at 6,000 / 4,000 per ha during the first and subsequent years, respectively.

The birds were fed and watered daily ad libitum inside the cage and no pond fertilization or supplementary feeding of fish was resorted to. The spill over of duck feed and duck dropping were allowed to fall in the pond at different places by moving the duck cage daily. The ducks were initially trained to come back to cage in the evening after spending the day outside the cage. However,

due to some practical difficulties, the ducks were retained in the cage itself.

To estimate the amount of dropping the ducks void, a separate trial was conducted with ten ducks, their dropping collected and analysed for total nitrogen.

For comparison of growth rates a separate unit of similar flock of 15 ducks were maintained. Similarly, another pond was maintained with only carps and pond fertilization but without supplementary feeding.

**Results and Discussion**

The performance of both ducks reared under pond/floating cage conditions and the carps reared in the ponds through recycling of bird wastes, were better than those reared separately.

The White Peking ducks gained about 1,200 g weight at the end of six month rearing in the floating cage (two kg final average weight of individual duck), from the initial weight of 800 g at six weeks age. However, when the ducks at the initial weight of 1,600 g were reared in the floating cage for dual purpose, the weight gain over six months was only 400 g (i.e., two kg final weight).

The average percentage egg production in the initial batch of ducks reared in the floating cage was only 6.4 (range 4.4 to 11.0) and there was no egg laying in a similar flock maintained in deep litter system. In another batch of ducks maintained in the floating cage for eight months, the average egg production ranged from 34.2 to 57.8 per cent, but the egg production was restricted only to five months and during other period the ducks were moulting. The percentage egg production for a similar flock of 22 birds maintained under deep litter system was ranging from 31.2 to 50.0, during all the months excepting o when the ducks were moulting (Table 5

The performance of ducks in floa cage/pond was healthier and free from disease and mortality compared to the d litter system.

The daily dropping of ducks w estimated to be 67 g/800 g size bird and g/ adult bird of 2.00 kg size, on dry ma basis, which contained 2.03 per cent nitrog and 13.20 per cent crude protein. On average, one hectare pond would receive to 1,125 kg of duck dropping containing 2 kg of nitrogen per month, at 200 to 250 b / ha rearing density. That means about 10,0 to 12,000 kg of duck dropping could recycled through fish in one hectare po every year.

In the first trial with four carp speci namely catla, rohu, mrigal and common ca stocked at 6,000/ha, a partial harvest of 4 fishes with an average 334 g, recorded production rate of 2,000 kg / ha / 6 month The individual growth of fish was upto one in catla, 450 g in rohu, 400 g in mrigal a 500 g in common carp.

The trial was continued with parti stocking to restore the 6,000 / ha stocki density. The harvest indicated individu growth of carps upto 2.0 kg / 15 month a 800 g / 6 month periods and a production ra of 4,500 kg / ha.

The trial conducted for the third ye recorded a fish production rate of 4,652 k ha / 16 months, with the individual maximu growth of 1.0 to 3.5 kg.

The fourth year's trial conducted wi three carp species of catla, rohu and mriga also gave a production rate of 4,000 kg/h However, the fish production rate in the duc

fish trial conducted in a 0.05 ha pond with two carp species (rohu and mrigal) was only 1,505 kg / ha / 10 months.

The details of the individual maximum growths of carp observed in duck-fish pond compared to that of control pond for the period are given in table 51.

The condition factors of the four carps reared under the integrated systems compared to other systems during the period of study was quite satisfactory, the details of which are furnished in table 52.

**Table 50. Comparative egg production under integrated poultry-fish culture systems.**

| Sl. | Month | Percentage egg production (average) | | | |
|---|---|---|---|---|---|
| | | White Pekin ducks(22) | | Austro-white chicken(30) | |
| | | Deep litter control | Floating cage with wire mesh floor | Deep litter control | Poultry shelter with wire mesh floor |
| | **1991** | | | | |
| 1. | Jul. | 50.0 | 46.2 | 42.6 | 26.8 |
| 2. | Aug. | (Moulting) | 57.8 | 58.5 | 46.0 |
| 3. | Sep. | 37.8 | 34.2 | 60.3 | 73.3 |
| 4. | Oct. | 32.9 | (Moulting) | 56.4 | 66.5 |
| 5. | Nov. | 31.2 | -do- | 49.5 | 47.8 |
| 6. | Dec. | 33.8 | -do- | 35.9 | 48.4 |
| | **1992** | | | | |
| 7. | Jan. | 43.8 | 47.8 | 35.2 | 46.2 |
| 8. | Feb. | 33.0 | 38.0 | 35.5 | 35.9 |
| 9. | Mar. | — | — | 35.5 | 32.0 |
| | Overall | — | — | 45.2 | 47.1 |

**Table 51. Maximum growth performance of carps in control and duck-fish culture ponds.**

| Species | Length (cm) | Weight (kg) |
|---|---|---|
| Duck-fish pond (0.1 ha/16 months) | | |
| Catla | 60 | 3.500 |
| Rohu | 75 | 3.250 |
| Mrigal | 55 | 1.750 |
| Common carp | 42 | 1.000 |
| Control pond (0.05 ha/10 months) | | |
| Rohu | 48 | 1.500 |
| Mrigal | 39 | 0.750 |

Table 52. Condition factor (k) of carps reared under different environs.

| Sl. no. | Carp species | Condition factor under | | | |
|---|---|---|---|---|---|
| | | Duck-fish pond | Poultry-fish pond | Control pond | Irrigation tank |
| 1. | Catla | 1.13 | 1.62 | — | 1.10 |
| 2. | Rohu | 1.24 | 1.16 | 1.28 | 1.07 |
| 3. | Mrigal | 1.08 | 1.21 | 1.09 | 1.04 |
| 4. | Common carp | 1.35 | — | — | — |

**ii) Chicken - fish integration**

**Materials and Method**

**Poultry shelter over pond**

A poultry shelter of 10.0 x 2.5 m size with ten RCC pillars, sloping asbestos corrugated sheet roof and welded mesh sides and bottom, was designed and constructed inside the 0.1 ha pond in one corner. The shelter was also provided with two doors for entry and waterers and feeders for the birds, with a capacity to accommodate about 50 birds. The construction is such that the bird dropping and the spill overs of feed fall into the pond direct.

**Experimental unit**

The trials were conducted in a 0.1 ha pond. In the poultry shelter constructed over the pond, Austro-White hybrid chicken were reared, initially from the six weeks old stage and subsequently after the layer stage (six month old), for periods ranging from six to eight months. Each year for the four trials conducted, 30 birds were taken, excepting one year when only 22 layer birds could be reared. The birds were fed and watered ad libitum.

For comparison, similar flock of Austro-White birds from the same batch were reared separately under deep litter system and th growth and egg production were recorde

To estimate the daily poultry droppi going into the pond, eight layers we separately reared for 14 days, their droppi collected and analysed for dry matter a nitrogen content.

For three years under study, thr species of carp namely catla, rohu and mrig were cultured at the stocking density of 3,0 to 4,000 /ha and only for one year comm carp was also added for the culture. The po was not fertilized and the fish were not give any supplementary feeding.

**Results and Discussion**

In the initial year, the layer hybrid bird reared in the poultry shelter over pond, gav an overall average egg production of 47.1 pe cent compared to 45.2 per cent recorded b the birds reared under deep litter system. Th percentage egg production ranged from 26 during the first month to 73.3, the details o which are furnished in table. Similarly, th average egg production of the layer bird reared in the pond shelter during the secon trial was higher (62.1%) compared to 58.5 pe cent obtained in the deep litter system. Th average initial body weight of layers wa 1.480 kg and they attained an average fin body weight of 1.710 kg in pond shelt

compared to 1.540 kg of the deep litter system, after a period of six month rearing (Table 53).

In another trial conducted with the six weeks old chicks in the pond shelter, the birds were observed to start laying eggs from the fifth month. The average egg productions for the last five of the total nine month rearing (ie 5,6,7,8 and 9th months) in the pond shelter, were 33.6, 30.5, 41.4, 43.1 and 62.7 per cent, respectively. The final average body weight of birds after nine months rearing was 1.373 kg. Similarly, another trial conducted during in the next year for a period of eight months in the pond shelter also gave comparable results. The birds started laying eggs at the age of five and half months and attained peak production at the eighth month of rearing. The average egg productions at 5th, 6th, 7th and 8th months were 29.5, 37.8, 41.3 and 61.9 per cent, respectively. The initial body weight of six weeks old chicken was 197 g, which increased to 492 g after eight weeks, indicating a faster growth rate when the chicks were shifted to the poultry shelter over pond. The average final weight of birds was 1.580 kg over eight months.

The birds reared under the poultry shelter over pond showed better growth, better egg production and disease free condition. This may be due to the wire mesh bottom and healthier condition of the poultry shelter over pond.

The poultry birds were observed to void 32.85 g of dropping/500 g bird and 100 g per 1.500 kg bird per day, on dry matter basis, which contained 2.46 per cent nitrogen and 16.0 per cent crude protein. With 300 to 500 birds, one hectare pond would receive 30 to 50 kg of poultry dropping, adding 738 to 1,230 g of nitrogen to the pond daily. This means that 10,000 to 18,000 kg of poultry dropping could be recycled in one hectare pond through fish in the system in a year.

**Table 53. Comparative performance of egg production of chicken in poultry shelter over pond and deep litter system.**

| Month | Average percentage egg production under | |
|---|---|---|
| | Deep litter | Pond shelter |
| **1992** | | |
| October | 55.0 | 59.0 |
| November | 55.4 | 60.1 |
| December | 51.5 | 62.3 |
| **1993** | | |
| January | 67.9 | 66.8 |
| February | 69.6 | 61.8 |
| March | 51.5 | 62.2 |
| Overall | 58.5 | 62.1 |
| Initial body weight | 1.480 kg | 1.480 kg |
| Final body weight | 1.540 kg | 1.710 kg |

In the initial trial with three carp species of catla, rohu and mrigal stocked with 4,000 / ha stocking density, the fish production rate obtained was 4,049 kg / ha /18 months which included continuation of the fish stocked late in the previous year and the stocking density adjusted during the start of the second year by partial stocking with prereared advanced fingerlings. The condition factor of the three species reared under the poultry-fish system were 1.62 for catla, 1.16 for rohu and 1.21 for mrigal (Table 52).

The second trial conducted with advanced fingerlings of three carp species also gave a production rate of 4,000 kg/ha, with the individual growth ranging from 800 g to 1.000 kg. In the third trial conducted with the stocking density of only 3,000 / ha, a production rate of 3,500 kg / ha / 15 months was obtained.

The fourth trial conducted with advanced fingerlings of four carp species viz. catla, rohu, mrigal and common carp, at the stocking density of 4,000 / ha, yielded a production rate of 4,100 kg / ha / 16 months. The harvest data indicated individual growth ranging from 1,740 to 2,800 kg for the same period.

Thus for the four consecutive trials, the fish production rate was more than 3,500 kg / ha with advanced fingerlings of three to four carp species at 4,000 / ha stocking density and 30 layer birds.

**Conclusions and Recommendations**

1. The floating cage with plastic flo and wire mesh floor, is most suitable for du fish integration, which can be easily adopt by fish farmers having backyard poultry.

2. The poultry shelter construct inside the pond either with RCC pillars or w bamboo, with wire mesh bottom, is health and promotes better growth and egg layi than even deep litter system.

3. Trials on duck-fish integration w 200 to 300 White Pekin ducks and 4,000 5,000 of three to four carp species per hecta could give fish production rate of over 4,0 kg / ha / 16 months and a net individual weig gain of 2 kg/bird/year for ducks reared floating cage, consecutively for three yea

4. Trials on chicken-fish integrati with 300 to 400 Austro-White hybrid lay birds and 4,000 of three carp species p hectare could give a fish production rate 3,500 to 4,000 kg/ha/ 16 months and over per cent average egg production in the poul shelter, consecutively for four years.

**Economics**

Based on the results obtained in t trials, economics have been worked a suggested for both 1) Duck-fish and Chicken-fish integrations, in a 0.2 ha pond the rates prevailing during 1996-97 ( Table and Table 55, respectively).

**Table 54. Economics on Duck-fish culture system in a 0.2 ha pond (based on 1996-97 rates).**

| | | |
|---|---|---|
| A) | Non-recurring expenditure | |
| | Night shelter | Rs. 5,000/- |
| B) | Recurring expenditure | |
| | 1) Cost of six week old ducklings (60 nos.) @ Rs.30/- per bird | Rs. 1,800/- |
| | 2) Cost of feed for ducks for 300 days i.e. 24 bags of 70 kg each @ Rs.630/- per bag | Rs.15,100/- |
| | 3) Cost of fish seed (1,200 nos.) including transportation charges | Rs. 1,200/- |
| | 4) Labour charges @ Rs.40/- for 45 man days & miscellaneous expenditure | Rs. 1,900/- |
| | 5) 20 per cent of the capital expenditure for night shelter maintenance | Rs. 1,000/- |
| | **Total Expenditure** | Rs.26,000/- |
| C) | Receipts | |
| | 1) Sale of 800 kg fish @ Rs.40/- per kg | Rs.32,000/- |
| | 2) Sale of 12,000 eggs @ Re.1/- per egg | Rs.12,000/- |
| | 3) Sale of meat (120 kg) @ Rs.40/- per kg | Rs. 4,800/- |
| | **Total Receipts** | Rs.48,800/- |
| D) | Profit | |
| | Total Receipts | Rs.48,800/- |
| | (-) Total Expenditure | Rs.26,000/- |
| | Net Profit | Rs.22,800/- |

**Table 55. Economics on chicken-fish culture system in a 0.2 ha pond (based on 1996-97 rates).**

| | |
|---|---|
| A) Non-recurring expenditure | |
| Cost of poultry shelter (30 m2) | Rs. 8,000/- |
| B) Recurring expenditure | |
| 1) Cost of six week old birds (hybrid) @ Rs.40/- per bird | Rs. 3,200/- |
| 2) Cost of feed | |
| i) Grower mash 640 kg @ Rs.560/- per 70 kg bag | Rs. 5,100/- |
| ii) Layer mash for one year 35 bags of 70 kg each, @ Rs.560/- per bag | Rs.19,600/- |
| 3) Cost of fish seed (1,000 fingerlings) | Rs. 1,200/- |
| 4) Labour charges @ Rs.40/- for 40 man days & miscellaneous expenses | Rs. 1,700/- |
| 5) 20 per cent of the capital investment for poultry shelter maintenance | Rs. 1,600/- |
| **Total Expenditure** | Rs.40,400/- |
| C) Receipts | |
| 1) Sale of 800 kg fish @ Rs.40/- per kg | Rs.32,000/- |
| 2) Sale of 22,000 eggs @ Rs.1.50 per egg | Rs.33,000/- |
| 3) Sale of poultry meat (120 kg) @ Rs.45/- per kg | Rs. 5,400/- |
| **Total Receipts** | Rs.70,400/- |
| D) Profit | |
| Total Receipts | Rs.70,400/- |
| (-) Total Expenditure | Rs.40,400/- |
| **Net Profit** | Rs.30,000/- |

**Salient features of poultry-fish culture**

Poultry-fish culture is one of the most economic integrated farming systems, which has the following salient features:

1. Fish utilize the spilled over poultry feed and their dropping.
2. Poultry dropping save the need for pons fertilization and supplementary feeding for fish.
3. Ducks keep aquatic plants in check.
4. The cost of duck feeding is partially reduced as ducks forage in the pond when let out of shelter during day time.
5. Ducks loosen the pond bottom which

increases the pond productivity.

6. Ducks uniformly distribute their dropping throughout the pond which is in effect labour saving device.

7. No additional space is required for duck or chicken rearing.

8. Fish, eggs and meat are produced in a single unit area and it ensures higher profit with fewer inputs. The integrated system also ensures recycling of organic wastes which otherwise would pollute the environment.

**Publications**

Subramanian, S., Nair, N.S. and Nirmale A.V., 1993. Technology for poultry-fish integrated farming systems under freshwater conditions of Goa. Training notes, ICAR Research Complex for Goa (Mimeo.): 6 p.

Subramanian, S., Nair, N.S. and Sundaram, R.N.S., 1996. Duck-fish integrated farming system for Goa. ICAR Research Complex for Goa, Technical Folder No.10: 6 p.

Subramanian, S., Nair, N.S. and Nirmale, A.V., 1996. Poultry-fish integrated farming system for Goa. ICAR Research Complex for Goa, Technical Folder No.11: 6 p.

**Radio Talks**

— Ensure higher returns with low input through duck-cum-fish farming (Konkani). Broadcasted on 10.5.1989 (10 minutes) by AIR, Panaji.

— Integrated fish farming systems for Goa (Konkani). Broadcasted on 15.10.1996 (10 minutes) by AIR, Panaji.

## 4.3. Rice-cum-fish culture suitable for Goa

(S Subramanian, JR Faleiro, BL Manjunath)

**Objectives**

a) To evolve a rice-fish integrated culture technology suitable for low-lying paddies in Goa.

b) To identify suitable rice varieties and fish species for the combination under local conditions.

**Introduction**

Rice cultivation is a major agricultural operation in Goa. About 40,000 hectares of land is presently under rice. In most of the rice fields, particularly in the low lying paddies, it is possible to increase income substantially by the incorporation of fish culture with out much additional expenditure towards the fish component.

Many rice fields in the villages of Bardez, Tiswadi, Ponda, Salcete and Canacona taluks of Goa are suitable for establishing the system. Many fields in these villages of Goa already have marginal bunds and a pond situated inside for irrigation during rabi and summer. These can be straight away put under the rice-fish combination. Out of about 16,000 ha of Kherlands in Goa, atleast in 9,600 ha, two crops of rice are cultivated in a year, wherein it would be easy to integrate fish culture.

The basic principle behind the integration is that the abundantly produced plankton in the stagnant water maintained for the rice crop, is recycled through a

combination of fast growing carp species. The fertilization applied for the rice crop induces the production of plankton for the use of fish, which would go waste otherwise.

The trials were initiated to evaluate the suitability low lying paddy fields for the rice-fish integration, and to identify fish and rice varieties suitable for the combination.

Recently, there is a slow shift from rice to perennial crops like coconut, by conversion of low lands to high lands, due to increase in the cost of rice cultivation and declining returns. As rice and straw are important commodities, this declining trend has to be checked. Introduction of fish culture as an additional component in the traditional rice fields would be an attractive proposition to sustain rice cultivation.

## Materials and Methods

### Trial Plots

Two experimental plots of 0.1 ha size each and adjoining upland on one side, were established by construction of one meter high bunds on the other three sides. On the lower side, 0.01 ha area was excavated into one meter deep pond to facilitate the fish to get collected during rice transplanting, harvest and non-rainy period. The relationship of pond size to the total field has been tried at 1:3 and 1:4, elsewhere in the country. However, based on the previous preliminary trials conducted at Kerala, a proportion of 1:10 was field tested taking into consideration the cost of excavation of pond area, at the same time trying to keep the productivity at a higher level. It would also be easy to harvest the fish from this retreat ponds. The inlets and outlets of the field were provided with tubes and fitted with wire mesh to prevent water overflow, escape of stocked fish and entry of unwanted fish from outside. The position of the inlet and outlet pipes can be adjusted to regulate water level.

### Fish species

Based on the earlier trials and taking advantage of the fast growing combinations of Indian major carps, three to four species namely catla, rohu, mrigal and common carp were stocked at 1,500 to 2,000 / ha at the ratio of 2:2:1:1, respectively. As it was observed that the south-west monsoon inundates the fields and ponds by the beginning of June in the west coast and stockable carp seeds are available only during August/September, the crucial and potential growth months, with full water, are not utilised for fish growth.

Similarly, in spite of precautions taken to prevent the entry of carnivorous fish certain air breathing fish species like cat fish and murrels were observed to gain entry into the rice field during rains, migrating along the moist surfaces over the bund, resulting in heavy predation of stocked carp seeds. To over come the problem, advanced fingerlings were raised in a separate pond during the previous year and only carp seeds of 10 to 15 cm size (100 to 150 g) were stocked in the pond inside the field during the end of May just before the onset of monsoon, to get maximum growth period.

No supplementary feeding of fish was resorted nor fertilizer applied to the pond.

### Rice variety

As a principle, rice varieties of medium to long duration and medium to tall in height which are generally not susceptible common pests and diseases are to be selected for the rice-fish combination, depending upon the

time of onset of monsoon, water stagnation, depth of water during various period of farming, etc. Suitability of both transplanting and direct sowing are also to be ascertained. It was observed that many low lying rice fields in this region experience sudden flooding during the first heavy rains in June and also near draught situation during summer, making it difficult to select rice varieties and the method of planting besides water management and harvest. Performance of rice varieties under the prevailing water logged conditions during Kharif and minimum water levels during late Rabi were observed.

Initial trials conducted earlier have indicated the suitability of rice variety Jyothi for the combination both during Kharif and Rabi seasons, when the water level in the field could be managed to the desired level. However, other rice varieties brought from similar coastal regions and through Institutions such as Rice Research Institute, Cuttack and Vyttila Rice Research Station of the Kerala Agricultural University, were tested under the local conditions for suitability to the combination both during Kharif and Rabi seasons.

Two main parameters tested were the plant height and yield under water logged conditions. Initially, eight medium duration rice varieties viz., MO-5, MO-6, MO-7, BPT-1235, Pusa-205, Sarjoo, Mahaveera and Karna, were tested for their suitability during Rabi, 1989-90. Seedlings of the above varieties were raised and transplanted in the experimental plot in a randomized block design. In a second trial, ten promising rice varieties viz., V-1, V-2, V-3, Neeraja, Red Triveni, 1727 culture, CR-383-10, BPT-1235, CR-626-26-2-3 and CMR-30 were tested during Kharif, 1991, for identifying a suitable variety. Parameters like plant height, number of tillers, number of productive tillers and yield were recorded. In subsequent trials, the performance of the same ten rice varieties were tested during Kharif and Rabi, 1992-93, under prevailing conditions, so as to accommodate two rice crops in a year for the rice-fish integration. In the next trial during Kharif,1993, in addition to the identified rice variety Vyttila-1, four varieties namely Panidhan, Utkal Prabha, CR-626-26-2-3 and CR-617-16-10-2, brought from CRRI, Cuttack and selected on the seedling performance with regards to height, were raised and transplanted under deep water condition of over 50 cm depth. In Rabi, 1993-94, rice varieties Kalinga-III and Bharat Prabha were tested under water logged conditions. The screened rice variety, Vyttila-1 was again tested for its performance under water logged conditions during Rabi, 1994-95.

Recommended package of practices for rice cultivation excepting application of insecticide, were followed.

**Water management**

Water column of a certain minimum height is required for sufficient production of plankton which form the food of the selected carp species. Therefore, in an ideal situation, water level should be slowly raised in the field, after the transplanting of rice, keeping pace with the growth of rice plant. However, the water level should never be more than half the height of the plant. This could be done by suitably adjusting the inlet and outlet pipes in the bunds. Preliminary trials conducted had confirmed the above procedure for successful establishment of rice crop and sufficient water column in the field. In the prevailing conditions of the trial plots, water level regulation during monsoon period was not possible due to no water situation prior to

monsoon and sudden stagnation of water in the field during the on set of monsoon without the possibility of water drainage. Therefore, establishment of rice crop was achieved either by direct sowing during premonsoon month without irrigation of the crop or by transplanting with taller than normal seedlings and adjustment of transplanting time without affecting the flowering, depending upon the condition of the field.

**Results and Discussion**

In the first trial to screen rice variety suitable for the combination under deep water conditions in low lying experimental plot, out of eight varieties, BPT-1235 recorded highe average height of 92.5 cm and yield of 8.3 t/ha during Rabi, 1989-90. The details on th performance of the eight rice varieties teste are given in Table 56.

In the second trial involving te varieties including the best performer of th earlier trial, namely BPT-1235, were tested fo the height , yield and other parameters unde water logged condition during Kharif, 1991 an the results indicated that the varieties V-1, V 2, V-3 and Neeraja had desirable height o more than one meter and yield more than tw ton/ha (Table 57).

**Table 56. Performance of rice varieties under water-logged condition (Rabi, 1989-90)**

| Rice variety | Average height (cm) | Yield (t/ha) |
|---|---|---|
| MO-5 | 89.2 | 5.59 |
| MO-6 | 82.5 | 5.56 |
| MO-7 | 89.8 | 7.78 |
| BPT-1235 | 92.5 | 8.33 |
| Pusa-205 | 87.6 | 6.67 |
| Sarjoo | 85.0 | 6.87 |
| Mahaveera | 80.8 | 6.63 |
| Karna | 91.2 | 6.60 |

**Table 57. Performance of rice varieties suitable of rice-fish culture (Kharif, 1991).**

| Rice Variety | Height (cm) | No. of tillers | No.of productive tillers | Yield (t/ha) |
|---|---|---|---|---|
| V-1 | 169.6 | 5.4 | 5.2 | 3.0 |
| V-2 | 164.6 | 6.4 | 6.2 | 2.3 |
| V-3 | 163.4 | 9.8 | 8.8 | 2.5 |
| Neeraja | 113.2 | 6.2 | 6.2 | 2.6 |
| Red Triveni | 95.0 | 9.4 | 9.2 | 2.0 |
| Culture-1727 | 96.2 | 7.0 | 7.0 | 2.0 |
| CR-383-10 | 85.2 | 7.4 | 7.0 | 3.0 |
| BPT-1235 | 88.6 | 7.0 | 6.8 | 2.5 |
| CR-626-26-2-3 | Damaged | - | - | - |
| CRM-30 | Damaged | - | - | - |

The same eight rice varieties were tested during subsequent Kharif and Rabi. However, they could record only 3.10 t/ha for BPT-1235, followed by Vyttila-1 (2.79 t/ha), Vyttila-3 (2.79 t/ha) and Vyttila-2 (2.75 t/ha), during Kharif, 1992. Though the yields were non-significant, the data on height of plant during Kharif, were statistically significant. Vyttila-1 was the highest with 168.9 cm followed by Vyttila-2 (164.9 cm), Vyttila-3 115.1 cm) and Neeraja (113.3 cm). During Rabi, 1992-93, Vyttila-1 yielded highest with 7.96 t/ha followed by CR-383-16 (7.69 t/ha) and BPT-1235 (6.94 t/ha). All the three varieties had height over 2.50 cm. From the above , it may be seen that Vyttila-1 had performed well both in Kharif and Rabi trials in terms of yield and plant height, in addition to non-lodging character in spite of its height. Results of the performance of rice varieties under water logged condition during Kharif and Rabi, 1992-93, are furnished in Table 58.

During the Kharif trial in 1993, advanced seedlings of four new varieties from CRRI, Cuttack and the identified variety namely Vyttila-1 were raised and successfully transplanted in deep water conditions having 50 cm water depth. Though the growth and flowering were normal, seed setting was very poor in all the five varieties due to severe bird attack during the milky stage of the crop. The Rabi trial in 1993-94 with Kalinga-II and Bharat Prabha rice varieties was also severely damage The performance of the already identified variety, Vyttila-1, was again studied under water logged condition during 1994-95. The transplanted rice established well under stagnated condition and yielded 7.42 t/ha for the 120 days growth period. Other parameters observed were as follows:

**Table 58. Performance of some deep water rice varieties during Kharif and Rabi, 1992-93.**

| Rice Variety | Plant height (cm) | | Yield (t/ha) | |
|---|---|---|---|---|
| | Kharif | Rabi | Kharif | Rabi |
| Vyttila-1 | 168.9 | 100.1 | 2.88 | 7.96 |
| Vyttila-2 | 164.9 | 120.9 | 2.75 | 4.53 |
| Vyttila-3 | 115.1 | 112.1 | 2.79 | 2.64 |
| Neeraja | 113.3 | 92.0 | 1.69 | 5.66 |
| Red Triveni | 95.5 | 132.9 | 2.61 | 3.98 |
| CR-383-16 | 87.3 | 112.3 | 2.57 | 7.69 |
| Culture-1727 | 96.3 | 95.1 | 2.71 | 6.73 |
| BPT-1235 | 89.1 | 90.5 | 3.10 | 6.94 |

1. Plant height - 80.6 cm
2. Average number of panicles / plant - 11.4
3. Grains / panicle - 174.5
4. Grain weight / panicle - 4.25 g
5. Grains / hill - 1,284
6. 1,000 grain weight - 22.6 g

It was also observed that almost all rice varieties grow taller than usual under the influence of water stagnation. Direct sowing trials tried during premonsoon month (May) could not succeed due the absence of premonsoon showers or sudden submergence of crop during first monsoon flooding as the trial plots did not have the facility for water drainage. It is hoped that in fields having such drainage or water regulatory facility, direct sowing during April or May months would be successful in establishing the rice crop in the integrated system. However, transplanting with taller-than- usual rice seedlings was successful in establishing the crop.

As fish seeds were available late during September/October and small in size, they could not be stocked. Therefore, advanced fingerlings of about 100 to 150 g weight were prereared in the floating nursery located in the irrigation tanks or in cement cisterns, during the previous season with maintenance feeding only.

On two occasions, the floating nylon cage was damaged by crabs and the seeds could not be collected from the tank. Direct stocking was also tried in the rice-fish trial, but with very heavy mortality. In trials where advanced fingerlings were stocked with the onset of monsoon or after the rice crop was established in the field, the growth performance of fish was alright. The individual fish growth was observed up to 800 g/ 6 months during the initial trial. In one of the subsequent trials, individual maximum of 1.500 kg was recorded during the six month growth period. In a late stocking trial, th individual fish growth recorded 300 to 500 for four months rearing time with 70 per ce survival. In another trial involving stockin density of 2,000 / ha, in spite of escape an mortality, the production rate was 1,250 kg ha / 8 months, with individual maximu around 1.000 kg.

A field trial was also conducted in a tri plot of 0.1 ha size in farmer's plot and wi 50 advanced fingerlings of carps (100 to 15 g weight) raised separately during the previou season and 100 acclimatized Pearl Spo seeds along with Jyothi as rice varie transplanted during Kharif and the harve recorded fish growth upto 1.5 kg in carps, 20 g in pearl spot and total yield of 30 kg fis along with 200 kg rice yield in five month period.

**Conclusions and Recommendations**

1. In low lying paddy fields with facility t hold water upto 0.5 m depth for a perio of 5 to 9 months, it would be possible t integrate rice cultivation with carp culture

2. Facility for water level management an cultivation of two rice crops (Kharif an Rabi) would be an ideal situation for th synchronized culture.

3. One tenth area of the field is sufficie for the excavation of pond as the fis retreat, in contrast to 1/3 to 1/5 area tested and suggested elsewhere.

4. Proper sloped bunds with inlet and o points would be effective in giving goo performance of the system.

5. The method of rice establishment in th field would be either direct sowing transplanting of raised seedlings as p the situation prevailing in the area. fields where mater management

difficult, transplanting over sized rice seedling would also give desired results.

6. Under the influence of water stagnation, the rice crop was observed to grow taller than usual.

7. Initial trials had shown that Jyothi rice variety is suitable for the combination both in Kharif and Rabi seasons where water level management was possible.

8. Three years consecutive screening trials had indicated that the rice variety, Vyttila-1 was suitable for rice-fish integration, under water inundated condition and also for less water situation. Vyttila-1 gave a yield of over 3.00 t/ha during Kharif and 7.00 t/ha during Rabi periods. It was characterized by its growth over 1.00 meter in height and non lodging nature.

9. It is also possible take two rice crops and a summer crop aswell, depending on the water availability.

10. By a method of raising advanced fingerlings of 100 to 150g weight and about 15 cm size separately during the previous season and using those advanced fingerlings for stocking in the rice-fish integration during May/June month, just before the onset of monsoon would help utilise the period abundant of water (June to September), when the fish seeds are not available usually. This also gives an impetus for fast growth of fish during the remaining short period and prevents the predation of stocked candidate fish species by the carnivorous and air-breathing fishes that might enter the plot in spite of precautions taken.

11. The traditional carp combination of catla, rohu, mrigal and common carp at the stocking density of 1,500 to 2,000 / ha of the entire field could give a production rate of 1,250 kg during the eight months of integrated culture, the revenue of which would be much more than that of rice. The individual growth of fish would also be more than 1.000 kg, which can be readily marketed.

**Calendar of operation**

Based on the results of the above trials, a calendar of operation has been suggested below for adoption in low lying area where water level management is possible:

| Month | | Operation |
|---|---|---|
| May / June | - | Preparation of field, bunds and pond. Sowing of rice. Liming the pond @ 300 kg/ha. Release of advanced fingerlings in pond 15 days after liming. |
| June & July | - | Water level management. |
| August / September | - | Draining water from the field. Harvest of rice crop. |
| September | - | Transplanting of second crop of rice. Water regulation. |
| October & November | - | Water regulation. |
| December / January | - | Harvest of second crop of rice. |
| January / February | - | Harvest of fish. Cultivation of third crop such as sesamum, cowpea, water melon, groundnut or vegetables, if possible. |
| April / May | - | Harvest of third crop. |

## Economics

Economics of the system has been calculated based on the results of the field trials conducted at Goa upto 1995 and also on similar trials conducted at Kayangulam, Kerala, upto 1985 and projected for a 0.1 ha field with a 0.02 ha pond inside (Table 59). While the projection is for cultivation of first crop in 0.2 ha area, the second and third crops are restricted to only 0.1 ha only, assuming that water may not be adequate to take up the cultivation in the entire area. The initial expenditure towards digging the pond upto one meter depth and raising bunds of 60 x 100cm on three sides of running length of 140 meter, is not taken into consideration for computing the economics. The calculations were based on the average of rates prevailing during 1996.

**Table 59 Economics of rice-fish culture system in 0.2 ha field**

| Sl. no. | Particulars | First crop (0.2 ha) | Second crop (0.1 ha) | Third crop (o.1 ha) | Fish | Total yield/ year (kg) | Total cost/ 0.2 ha (Rs.) | Total cost/ 1.0 ha (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. | Expenditure (Rs.) * | 1,200 | 700 | 300 | 500 | — | 2,700 | 3,500 |
| 2. | Yield (kg) | | | | | | | |
| | Rice | 500 | 300 | — | — | 800 | 4,800 | 24,000 |
| | Straw | 350 | 300 | — | — | 650 | 650 | 3,250 |
| | Sesamum/ Water melon | — | — | 30/300 | — | 30/300 | 600 | 3,000 |
| | Fish (carps) | — | — | — | 250 | 250 | 10,000 | 50,000 |
| 3. | Gross returns (Rs.) ** | 3,350 | 2,100 | 600 | 10,000 | — | 16,050 | 80,250 |
| 4. | Net profit (Rs.) | 2,150 | 1,400 | 300 | 9,500 | — | 13,350 | 66,750 |

* Expenditure includes preparation of land, pond, liming, sowing, transplanting, manuring, cost of seed fish seed, fertilizers and harvesting charges.

** Calculated at the prevailing rates of Rs.6/- per kg of rice,

Re.1/- per kg of straw, Rs.20/- per kg of sesamum, Rs.2/- per kg of water melon and Rs.40/- per kg of fish.

Important features of rice-fish integration Rice-fish combination is an important integration having immense potential for implementation in many of the rice fields and is having the following salient features:

1. The introduction of fish component in the system could increase the income there by inducing the sustenance of rice cultivation which is becoming an increasingly uneconomic crop.

2. The system envisages maximum utilization of the available land and biological resources available. Three crops and fish could be raised in a year, enhancing the income generation.

3. The natural produced plankton in the field due to manuring the rice crop is effectively utilized for fish growth, which otherwise will go waste.

4. Utilization of plankton by fish and fish faeces for fertilizing the field is the effective way of organic waste recycling.

5. Only minimum area is used for pond excavation (1/10 area) and this along with water stagnation facilitates faster fish growth.

6. Stocking of prereared advanced fish fingerlings in the month of May results in better survival and growth of fish.

7. Due to water stagnation and fish movement, weed growth in the field is minimized.

8. Marketable fish of over one kg size are harvested with in a short period of about eight months.

9. Pond bunds can be utilized for growing vegetables, fodder banana, etc., for additional income.

10. Rice-fish integration generates much homestead employment and the much needed carbohydrate and protein are produced in the same field with minimum input.

**Future areas of research**

Based on the results of the previous trials in the rice-fish integration in freshwater areas, experiments may also be initiated for implementing the integrated system in the brackishwater areas with salt resistant rice varieties during monsoon months w and fish species such as pearl spot, mullets, etc. Freshwater prawn being an economically important commodity, rice-freshwater prawn combination could also be tried in which survival system has to be evolved for the small-sized prawn juveniles against the predation by carnivorous fishes and minnows which may enter the culture field.

**Publication**


1. Subramanian, S. 1988. Rice-fish culture: Status and potential for increased production in Southwestern states of India. J. Indian Fish. Assoc., 18:103-108.

2. Subramanian, S. 1993. Improved approaches in synchronous rice-fish culture. Paper presented at the National Meet on Aquafarming systems Research - prospects and potentials, organised by CIFA and OUAT, Bhubaneswar, 10 - 11 February 1993.


Radio talk : AIR talk on Paddy-cum-fish culture suitable for Goa of 12 minutes duration broadcasted on 15-3-89 (in Konkani), Panaji.

# 5. GENERAL INFORMATION

## 5.1 Institute Management Committee

The Second Institute Management Committee (IMC) was constituted with effect from 30-8-1994 for a period of three years. The committee met on 4-10-1996 and discussed matters related to the general functioning of the institute, execution of civil works, equipment purchase etc.

The composition of the Committee is as follows:

1. **Dr. D. G. Dhandar** - Chairman
   Director, ICAR Research Complex for Goa
   Ela, Old Goa - 403 402

2. **Dr. R.N. Pal** - Member
   Assistant Director General (PC), ICAR)
   Krishi Bhavan, New Delhi - 110 001

3. **Dy. Director of Agriculture** - Member
   Govt. of Goa, Vidyut Bhavan
   Panaji

4. **Director (Horticulture)** - Member
   Directorate of Horticulture
   Government of Maharashtra
   Old Secretariate, Pune

5. **Dr. N.C. Hulamani** - Member
   Director of Instruction (Hort.)
   University of Agril. Sciences
   Dharwad - 580 005, Karnataka

6. **Shri Tomy Thomas** - Member
   113, Samachar Apartments
   Mayur Vihar, Phase I
   New Delhi - 110 096

7. **Shri Ramalinga Reddy** - Member
   8-2-603/L/15
   Near Noor Nagar
   Road No. 10, Banjara Hills, Hyderabad

8. **Finance and Accounts Officer** - Member
   Central Institute of Fisheries Education
   Versova, Bombay - 400 061

9. **Dr. R. N. S. Sundaram** - Member
   Senior Scientist
   ICAR Research Complex for Goa
   Old Goa - 403 402

10. **Dr. E. B. Chakurkar** - Member
Scientist
ICAR Research Complex for Goa, Ela
Old Goa - 403 402

11. **Shri B. L. Manjunath** - Member
Scientist, ICAR Research Complex for Goa
Ela, Old Goa - 403 402

12. **Shri S. Sadashiva** - Member Secretary
Asst. Admn. Officer
ICAR Research Complex for Goa
Ela, Old Goa - 403 402

## 5.2 Research Advisory Committee

The Research Advisory Committee (RAC) was constituted by ICAR; New Delhi with effect from 9th March, 1995, for a period of three years, reviews the research achievements of the institute. The committee met once on 9-5-1996 and suggested the thrust areas for further research. The committee consisted of the following members.

1. **Dr. K.V.A. Bavapa** - Chariman
FAO Expert, Karoothvilla
Eravakkad, Kumaranellur-679 552, (Kerala)

2. **Dr. G. D. Radder** - Member
Director of Research
University of Agricultural Science
Dharwad - 580 005, (Karnataka)

3. **Dr. R. T. Gunjate** - Member
6, Nutan Co-op. Housing Society
Shirodkar Bldg., Sabniswada
Sawantwadi - 416510
Sindhudurg (Maharashtra)

4. **Dr. S. Ray** - Member
Director of Animal Husbandry and veterinary
Services (Retd.), Deluxe Apartments
Tonca, Caranzalem - Goa

5. **Dr. T. J. Varghese** - Member
Director of Instruction (Retd.)
College of Fisheries (UAS, Bangalore)
Mangalore - 575 002, (Karnataka)

6. **Shri Tomy Thomas** - Member
113, Samachar Apartments
Mayur Vihar, Phase I
New Delhi - 110 096

7. **Shri Ramalinga Reddy** - Member
8-2-603/L/15
Near Noor Nagar
Road No. 10, Banjara Hills, Hyderabad. (A.P.)

8. **Dr. D. G. Dhandar** - Member
Director, ICAR Research Complex for Goa
Ela, Old Goa - 403 402

9. **Dr. R. N. Pal** - Member
Asst. Director General (PC), ICAR, Krishi Bhavan
New Delhi - 110 001

10. **Dr. S. Subramanian** - Member Secretary
ICAR Research Complex
Ela, Old Goa - 403 402

## 5.3 Staff Research Council

To evaluate the progress of the ongoing research projects, consideration new research project proposal, monitor the follow-up action on the recommendation of QRT with respect to technical programmes of the institute, ICAR, New Delhi constituted the Staff Research Council Committee (SRC), with effect from 14-7-1997 for a period of three years. The committee consisted of the following members and met on 10-11, June, 1996, during the period under report.

1. **Dr. D. G. Dhandar** - Chairman
Director
ICAR Research Complex for Goa
Ela, Old Goa - 403 402

2. **Dr. J. V. Goud** - Member
Ex Vice-Chancellor
(UAS, Dharwad), Sanjay Building, Narayanpur
Dharwad - 580 005

3. **Dr. N. C. Hulamani** - Member
Director of Instruction (Hort.), UAS
Dharwad - 580 005

4. **Dr. I. G. Chavan** - Member
Ex-Head of the Division of Animal Sciences
MPKV, Rahuri
5, Vijaya Housing Society
University Road, Pune (Maharastra)

5. All Project Leaders - Members

6. Shri B. L. Manjunath - Member Secretary
Scientist
ICAR Research Complex for Goa
Ela, Old Goa - 403 402

## 5.4 Local Management Committee (K.V.K.)

The Local Management Committee which comprises of both government officials and non-governmental representatives of different categories such as farmers, farm women, social worker etc., who are directly or indirectly associated with the agriculture development of the State, is periodically monitoring the activities of Krishi Vigyan Kendra attached to the Institute. During the period under report, the Committee met on 12-7-1996 and reviewed the progress of work and approved the technical programmes for the year.

The following were the members of the new committee :

1. Dr. D. G. Dhandar - Chairman
Director
ICAR Research Complex for Goa

2. Director of Agriculture, Govt. of Goa - Member

3. Director of A.H. & V.S., Govt. of Goa - Member

4. District Animal Husbandry Officer - Member
Directorate of AH & VS, Govt. of Goa

5. Assistant Director (Training), FTC, Ela, Old Goa - Member

6. Shri Vithal Benaulikar - Member representative of small farmers

7. Shri Tatyasaheb Shinde - Member representative of big farmers

8. Ms. Muriel D'Souza - Member representative of farm women

| | | |
|---|---|---|
| 9. | Fr. Luis | - Member<br>Social worker<br>(male) |
| 10. | Mrs. Mangala Wagle | - Member<br>Social worker<br>(female) |
| 11. | Mr. Sebi Fernandes | - Member<br>representative<br>of young farmers |
| 12. | District Project Officer (Agriculture) | - Member |
| 13. | Mr. J. Dorado<br>Project Officer<br>NABARD, Panjim | - Member |
| 14. | Officer Incharge, Govt. Estuarine Fish Farm<br>Dhauji, Old Goa | - Member |
| 15. | Dr. N.S. Dhume<br>Nutrition Board, Dir. of Health Services<br>Govt. of Goa | - Member |
| 16. | The Director<br>Social Welfare Dept., Govt. of Goa | - Member |
| 17. | Dr. S. Subramanian / Dr. R.N.S. Sundaran<br>Training Organiser (KVK)<br>ICAR Research Complex, Old Goa | - Member Secretary |

## 5.5 Institute Joint Staff Council

With an objective to promote harmony and better relationship amongst staff, a thirteen member Institute Joint Staff Council (IJSC) was constituted with effect from 23-8-1994 for a period of three years. The committee met twice on 25-9-1996 and 26-2-1997 during under report.

The Committee consisted of the following members :

| | |
|---|---|
| Dr. D. G. Dhandar, Director | - Chairman |

*Official side*

| | | |
|---|---|---|
| 1. | Shri B. L. Manjunath, Scientist | - Member |
| 2. | Dr. H. M. Wasnik, Senior Scientist | - Member |
| 3. | A. V. Nirmale, Trg. Assoc. (Anim. Sci.) | - Member upto 24-2-97 |

| | | |
|---|---|---|
| 4. | Shri A.P. Shenoy, AFAO | - Member upto 25-2-97 |
| 5. | Shri M.S. Balbatti, Farm Superintendent | - Member |
| 6. | Shri S. Sadashiva, Asst. Admn. Officer | - Member |
| 7. | Dr. S. Subramanian, Senior Scientist | - Member Secretary |

*Staff side*

| | | |
|---|---|---|
| 1. | Shri K. K. Metar, Trg. Asst., KVK | - Member |
| 2. | Shri Krishnanath R. Naik, Asst. | - Member |
| 3. | Shri K. Yeshodharan, Sr. Clerk | - Member & CJSC upto 11-11-1996 |
| 4. | Shri Gangadhar Dhargalkar, SS Gr. II (Peon) | - Member |
| 5. | Shri Giri T. Madkaikar, Suppt. Staff, Gr. I (Maz.) | - Member |
| 6. | Shri Mahesh B. Parsekar, J.T.A. | - Member Secretary & CJSc from 12-11-96 |

## 5.6 Staff of the Institute

| Name | Designation | Specialisation | Remarks |
|---|---|---|---|
| *Managerial* | | | |
| D.G. Dhandar, Ph.D. | Director | Horticulture | |
| *Scientific* | | | |
| A.R. Bhattacharya M.V.Sc., FRVCS | Head, Section of Animal Sciences | Animal Reproduction | upto 31-8-1996 |
| S. Subramanian, Ph.D. | Senior Scientist & I/C, KVK | Fish & Fishery Science | |
| H.M. Wasnik Ph.D. | Senior Scientist | Soil Science | |
| R.N.S. Sundaram M.V.Sc. | Senior Scientist | Animal Nutrition | |
| B.L. Manjunath M.Sc. (Ag.) | Scientist | Agronomy | |

| | | | |
|---|---|---|---|
| E. B. Chakurkar M.V.Sc. | Scientist | Animal Reproduction | |
| Satish Modak Ph.D. | Scientist | Agronomy | |
| Mani Chellappan Ph.D. | Scientist | Agril. Entomology | |
| A. R. Desai M.Sc. (Ag.) | Scientist | Horticulture | |
| Dr. S. B. Barbuddhe | Scientist | Vet. Public Health | from 5-7-96 |
| Shri Kedar Nath Mohanta | Scientist | Fish & Fishery Science | from 11-7-96 |
| Dr. B. K. Swain | Scientist | Poultry Science | from 10-3-97 |

## 5.7. Transfers

| Names & Designation | From | To | Date (w.e.f) |
|---|---|---|---|
| Shri Jagdesh Ramani Supertendest | ICAR (RC) Goa, | NRC for Groundnut Junagadh | 13-9-96 |
| Smt. Rupa Raikar Jr. Clerk | ICAR (RC) for Goa | CPCRI, Kasaragod | 19-8-96 |

## 5.8 Appointments

| Name | Post | Specialisation | Date of joining |
|---|---|---|---|
| Dr. S. B. Barbuddhe | Scientist | Vet. Public Health | 5-7-96 |
| Shri Kedar Nath Mohenta | Scientist | Fish & Fishery Science | 11-7-96 |
| Dr. B. K. Swain | Scientist | Poultry Science | 10-3-97 |
| Shri Leeba Babu | Research Associate | Horticultre | 15-10-96 |

## 5.9. Resignation

| | | |
|---|---|---|
| Shri Ashok Rant | Supporting Staff (G.I) | 17-6-96 |

## 5.10. Retirement

| | | |
|---|---|---|
| Dr. A. R. Bhattacharya | Principal Scientist | 31-8-96 |

## List of Staff Strength of ICAR Research Complex for Goa

| Sl.No. | Name of the Posts | Post Sanctioned | | | No. of Employees in Position | | | No. of Vacant Posts | | | No. | No. | No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MI | KVK | T | MI | KVK | T | MI | KVK | T | SC | ST | OBC |
| 1. | Scientific | 20 | 1 | 21 | 13 | - | 13 | 7 | 1 | 8 | 2 | - | - |
| 2. | Technical | 23 | 15 | 38 | 19 | 9 | 28 | 4 | 6 | 10 | 6 | - | 3 |
| 3. | Administration | 16 | 3 | 19 | 10 | 1 | 11 | 6 | 2 | 8 | 2 | - | - |
| 4. | Supporting | 33 | 7 | 40 | 30 | 5 | 35 | 3 | 2 | 5 | 5 | - | - |
| | Total | 92 | 26 | 118 | 72 | 15 | 87 | 20 | 11 | 31 | 15 | - | 3 |

## 5.11 Budget of the institute 1996 - 97

| | | |
|---|---|---|
| Non Plan | 44.00 | 43.93 |
| Plan | 67.55 | 67.43 |
| K V R | 16.90 | 16.89 |
| Govt. of India Under integrated Cashew Devpt. Scheme | - | 0.63 |
| Collection of Cahew Germplasm in Goa and Establishment of germplasm Bank | - | 0.88 |
| NARP Computer Cell | 5.00 | 5.00 |
| Total | - | **128.76** |

## 5.12 Infrasturcture Development

### *1. ARIS Cell*

With the Rs. 5.00 lakhs assistance from NATP, ICAR, New Delhi, a room has been modified and furnished for the installation of ARIS Cell. The Council also provided a LAN Server (16 user), three Work Stations (Intel Pentium, SVGA colour monitors), a laser printer, MS modem and an UPS, with two 1.5 ton air conditioners which were installed in the room and commisioned. E-mail service also connected with this and operational through the local NIC, Panaji.

### *2. Computer facility*

Addtional computers were procured and put to use in Administration and Accounts sections. ARFIS is installed and monthly accounts are computerised and send to Council through E-mail. For the Technical Cell modern word processing softwares and an inkjet printer were procurred and installed.

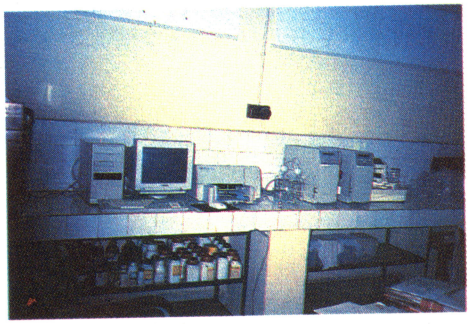
### *3. Analytical facilities*

High Performance Liquid Chromatograph including the accesseries was procurred and commissioned in the Plant Protection laboratory. High speed table top centrifuge, incubator, analytical balance and an autoclave were added subsequently. In the Animal Sciences laboratory, a Kjeltek analyser and a spectrophotometer with a computer attachment have been installed and put to use.

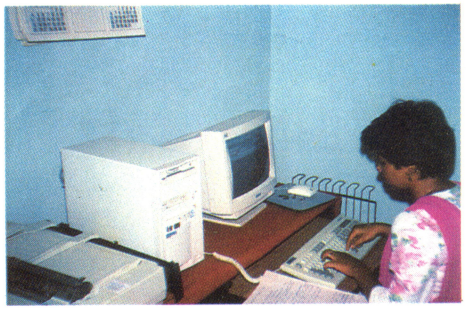
### *4. Fisheries field laboratory*

A fisheries field laboratory with analytical facilities was inaugurated by Dr. K. L. Chadha,

## PLATE 6



1. View of Plant protection analytical laboratory with HPLC and other sophisticated instruments



2. A section of the ARIS cell of the institute



3. Delta - T, an automatic weather station installed in the institute



4. A View of Fisheries Field Laboratory Building with Analytical Facilities.

DDG ( Hort.), ICAR, New Delhi in the presence of Dr. G. C. Srivastava, Chief Secretary, Government of Goa. This facility will also accomodate a proposed freshwater prawn hatchery.

***5. Automatic weather station***

An automatic weather station (Delta-T) was installed with facilties to record air temperature, soil temperature, wind velocity, wind direction, rain fall, sun shine hours and relative humidity. This will be subsequently linked up with the LAN being established in the Institute.

## 5.12 Important Visitors

| | |
|---|---|
| 14-4-96 | Capt. DEVENDER SINGH KAIRON<br>Commanding officer, C. F. Laboratories<br>Mumbai |
| 27-4-96 | DR. M. M. HOSMANI<br>Director of Extension, U.A.S. Daharwad |
| | Dr. G. D. RADDER<br>Director of Research, U.A.S. Dharwad |
| | DR. G. S. SULIKERI<br>Prof. and Head of the Dept. of Horticulture, U.A.S. Dharwad |
| 27-4-96 | T. S. SUNDER SINGH M.Sc. (Ag.)<br>Private Agriculture consultant, 56/B/2, S.T.C. Road<br>Tirunellvelli (TN) |
| 8-5-96 | DR. K.V.A. BAVAPPA<br>Ex. Director, CPCRI, Kasaragod |
| 20-5-96 | DR. (MRS.) VEENA GUPTA<br>Scientist Medicinal and Aramatic Plants<br>National Bureau of Plant genetic<br>Resources, New Delhi |
| 6-6-96 | SHRI BALDEV SINGH<br>Dy. Director (Hort.)<br>Intigrated Dev. Programme, Punjab |
| | SHRI AMRIT SINGH<br>Asst. Director (Hort.)<br>I. W. Dev. Programme Punjab |

| | |
|---|---|
| 22-6-96 | DR. V. ALAGESAN M.Sc. (Ag.) Ph.D.<br>Prof. (Agril. Extn.)<br>Regional Research Station<br>TNAU<br>Paiyur (T.N.) |
| 2-7-96 | DR. MAHADEVAPPA<br>Vice Channcellor, U.A.S. Dharwad |
| 24-7-96 | DR. M. K. NAIR<br>Director, CPCRI, Kasaragod |
| 21-7-96 | SHRI. G. S. RAM<br>Economic Advisor<br>Ministry of Agriculture, Govt. of India |
| 5-9-96 | GAJENDRA SINGH<br>D.D.G. (Engineering)<br>ICAR, New Delhi |
| | S. D. SHASHIDHARA<br>Head, Division of Agricultural<br>Engineering, U.A.S. Dharwad |
| 6-9-96 | DR. MICHEL<br>Vice Chancellor, KAU |
| 3-10-96 | P. N. SHUKLA<br>D.D.A. Dept. of Agriculture, Goa |
| 13-10-96 | Dr. P. J. RAO<br>Principal Scientist, IARI New Delhi |
| 14-10-96 | Dr. SHARMA<br>Principal Scientist, Extn. Divin. of ICAR<br>New Delhi |
| 1-11-96 | Dr. K.L.CHADHA<br>D.D.G. (Hort.) ICAR, New Delhi |
| 1-11-96 | Dr. G.C. SRIVASTAVA<br>Chief Secretary, Govt. of Goa |
| | Dr. D. S. ANANTH<br>Member, ICAR |

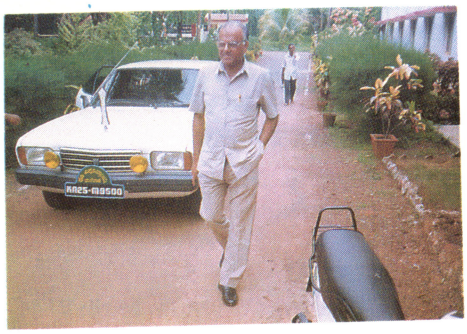
## PLATE 7



1. Honerable members of Parliament and Institute Staff during the visit of Parliamentary Standing Committee on Agriculture



2. Dr. K.L. Chadha, DDG (Hort) inaugurates the Fisheries field laboratory in the presence of Dr. D.G. Srivastava, Chief Secretary, Govt. of Goa and Dr. D.G. Dhandar, Director, ICAR RC - Goa



3. Dr. Mahadevappa, Vice Chancellor, UAS Dharward, during his inter-institutional collaborative visit to ICARRC - Goa



4. Dr. D.G. Dhandar, Director, ICARRC - Goa, is seen with international scientists during his visit to Tel Aviv, Israel for 5th International Mango Symposium

| | |
|---|---|
| 19-11-96 | Dr. ABIDI<br>Director of Central Institute, Fisheries of Education<br>Mumbai |
| 9-12-96 | Dr. T. S. KHUSPE<br>Ex. Director, Extn. NPKV Rahuri |
| 10-12-96 | Mr. JINDAL<br>Section Officer, ICAR, New Delhi |
| 22-12-96 | Dr. A. S. KATARIA<br>Sr. Scientist, IARI, New Delhi |
| 29-12-96 | Dr. R. P. GUPTA<br>Professor and Head<br>Dept. of Mathematics and Statistics, IASRI, New Delhi |
| 14-1-97 | SHRI JAGDISHMANN,<br>Chairman, Cotton, Marketing Board<br>Haryan |
| 10-2-97 | E. BHASKARA RAO<br>Director, National Research Center for Cahew |
| 21-2-97 | PROF. URILAVI, Israiel |
| 7-3-97 | DR. RAI,<br>Head of Dept., NRC Camel, Bikaner |
| 22-3-97 | DINESH YADAV<br>A. E. Muncipal Corporation Delhi |
| 30-3-97 | DR. SHELLY PRAVEEN<br>Scientist, IVRI, New Delhi |

**Visit of study Team of Parliamentary Standing Committee on Agriculture (28 - 29,October 1996)**

A fourteen member delegation comprising of following Honoroble members of Parliament and Secretaries had visited the Institute. The committee critically reviewed the progress made by the Institute in all fronts. The chairman and the members of the committee have appreciated whole heartedly the achievements made by the Institute.

| | |
|---|---|
| Shri Santosh Kumar Gangwar - | Chairman |
| Sri Ramnarayan Goswami - | Convenor |
| Gulam Mohamad Mir Magami - | Alternate Convenor |

Maulana Habibur Rahman Noman
Shri Sohanveer Singh
Shri Sukdeo Paswan
Shri Madan V. Patil
Shri Anantha Sethi
Shri Padmasen Chaudhary
Shri Suresh Pachouri
Dr. Ramalingam
Shri Kota Sydaiah
Shri S. Balshekar, Depty — Secretary
Shimati Roki Srivastawa, — Joint Secretary

## 5.14 Membership in important Committees, Bodies and Professional societies/ Associations

**DG Dhandar**

*Life member*

Indian Society for Plantation Crops, Kasaragod; Horticultural Society of India, New Delhi and Indian Science Congress, Calcutta.

*Member*

Local Advisory Committeeof All India Radio, Panaji, Goa; Steering Committee of State Level Bankers, Goa; Management Committee of Sanjivani Sugar Factory, Usgao, Goa; State Level Coordination Committee for sugarcane, horticulture, spices and watershed projects, Goa; Board of Studies, Department of Botany, University of Goa.

**S Subramanian**

*Life member*

Asian Fisheries Society, Manila, Philippines; Inland Fisheries Society of India, CIFRI, Barrakpore; Marine Biological Association of India, CMFRI, Cochin; Agricultural Research Association, Karnal; Indian Fisheries Association, CIFE, Bombay and Association of Aquaculturists, CIFA, Bhubaneshwar.

*Member*

Association of Rice Research Workers, CRRI, Cuttack; Botanical Scoiety of Goa, Panaji and Indian Science Congress, Calcutta.

**RNS Sundaram**

*Life member*

Animal Nutrition Society of India

*Member*

Indian Veterinary Association
Mycological Society of India

**EB Chakurkar**

*Life member*

Indian society for study of Animal Reproduction (ISSAR)
Indian Association for the Advancement of Veterinary Research

*Member*

Goa Veterinary Association

**AR Desai**

*Life member*

Indian Associations of Hill farming, Barapani, Meghalaya.

*Member*

Horticultural Society of India, New Delhi
Indian Society for plantation crops, CPCRI, Kasaragod

**BL Manjunath**

*Life member*

Indian Society of weed science

**Mani Chellappan**

*Member*

Plant Protection Association of India
Entomological Society of India

**SB Barbuddhe**

*Life member*

Indian Association of Microbilogists, Immunologists and Specialists in Infectious Diseases(IAVMI)

**VY Gaonkar**

*Member*

Botanical Society of Goa
Mushroom Society of India

**HR Prabhudesai**

*Member*

Secretary, State level sub committee on sugarcane Development, Government of Goa

Botanical Society of Goa

Decan Sugar Technologists Associates (DSTA) Pune

Indian Science Congress Association (ISCA)

Agriculture Officers Association

District level judging committee for sugarcane productivity awards

Rice Research Workers Association CRRI, Cuttack Orissa

**VS Sakharkar**

*Life member*

Indian Association for the Advancement Veterinary Research (IAAVR)

Maharashtra Society of Extension Education; Society of Extension Education, TNAU, Coimbatore;

*Member*

Agricultural Extension Review, directorate of Extension, New Delhi

## 5.14 Publications

### A Research papers


Chakurkar E.B., Bhattacharyya A.R and Sundaram R.N.S 1996 improved artificial vagina for rabbit semen collection. *Indian J. Animal Reproduction* 17(2).154

Chakurkar E.B. Sundaram R.N.S and Bhattacharyya A.R.1997 Efficacy of benzyle benzoate and ivermectin in the treatment of lear mite infestation in rabbits. *Indian Vet* J. 74(4), 288-289.

Mani C. Subramaniaym B. and Rao P.J. 1996 Azadirachtin induced changes in 20-hydroxyecdysone, *Curr. Sci.* 71(14):72-73.

Rao P.J and Mani C., 1996, Neem and insect pest management, *Shashpa* 3(1): 57-72

Sakharkar, V.S and Sundaraswamy, B., 1996 Factors affecting yield of soybean in Nagpur district of Maharashtra state: A discriminant function analysis. Maha. *J. Extn. Edn.* 15: (In press).

Sundaram R.N.S. Chakurkar E.B. and Bhattacharyya A.R., (1996). Voluntary feed intake and nutrient digestibility of exotic meat rabbits under tropical coastal climate. *Indian Vet. J.*, 74 (1) 80-81

**B. Review article/Bibliography**

Singh K.A. and A.R. Desai 1996 World Bibliohtsphy (1900-1995) on tree response to defoliations Res. Bulletin No.38. ICAR Research Complex for N.E.H. Region, Barapani

**C. Popular article**

'Cashew Cultivation' published in sahakar Surabi dated June 1996

**VY Gaokar and D G Dhandar**

'Household vermicompost preparation' published in Sunaprant dated 26th June, 1996

**HR Prabhudesai**

'Aroma from rice fields' published in the Navhind times dated 30th June,1996

**HR Prabhudesai**

Goa's Basmati Experience publishhed in the Navhind times dated 7th July,1996
HR Prabhudesai

**HR Prabhudesai**

'Coconut manuring' published in Gomantak dated 19th July, 1996.

**VY Gaonkar and DG Dhandar**

'Towards safer food for all' published in the Herald dated 16th October,1996

**HR Prabhudesai**

**D. Papers presented in symposia/workshop**

Barbuddhe S.B. Malik S.V.S. and L.K. Gupta 1997. Cytolytick potentials of lymphocytes in bovine listerioisis pp 197.

Barbuddhe S.B. Malik, S.V.S and Gupta L.K 1997. Seroreactivity of antigens of Listeria Monocytogens pp. 210

Chakurkar E.B., and Sundaram R.N.S 1997. Effect of oral calcium on litter size at birth and weaning in rabbits. Abstract of paper presented in *National Symposium on Biotechnology in Animal Health and production for Economic Development in Asia in respect of Global Scenario held at Pune, January, 22-23, 1997* organized by Indian Association for Advancement of Veterinary Research.

Chandra, R. and Desai A.R.(1996) Influence of drying techniques on quality of turmeric power. Paper presented in the *XII Symposium on Plantation crops organised by Indian Society* for Plantation crops at Rubber Research Institute of India, Kotayam, Kerala from 27-29, November,1996

Chandra, R; Singh A.K. and Desai, A.R. 1996. Crop improvement in turmeric. Paper presented in the *XII Symposium on Plantation crops* organised by Indian Society for Plantation crops at Rubber Research Institute of India, Kotayam, Kerala from 27-29, November,1996

Gupta L.K. Barbuddhe S.B. land Malik S.V.S 1997. Role of reactive nitrogen intermediates, reactive oxygen intermediates and phagocytosis in bovine listeriosis p196

Manjunath B.L., Balbatti M.S., and Dhandar D.G. 1996. Intercropping in coconut for higher monetary returns Paper presented in the *XII Symposium on Plantation crops* organised by Indian Society for Plantation crops at Rubber Research Institute of India, Kotayam, Kerala from 27-29, November,1996

Mathew P. A. and Dhandar D. G. 1996. Cardozo Mankurad - A breakthrough in mango selection Paper presented in the *5th International Mango Symposium, Tel Aviv, Israel* from 1-6, September, 1996

**E. Reports, Bulletins, Technical bulletin and Miscellaneous publications**

Anon, 1996. Background material for Study Team of the Parliamentary Standing Committee on Agriculture, 54p

Anon, 1997. Mangoes of Goan origin with propagation and culture. Eds. D. G. Dhandar, P. A. Mathew and S. Subramanian, 63p

Gaonkar, V.Y. 1996. Improved cultural practices for cashew. *Technical folder No.9,* ICAR Research Complex, Ela, Old Goa *Eds.* D. G. Dhandar R. N. S. Sundaram and S. Subramanian

Gaonkar, V.Y., Mathew, P. A. and Nagabhushanum, S. 1996. Top working of unproductive cashew trees to improve yield. Technical folder No.7, ICAR Research Complex, Ela, Old Goa *Eds.* D. G. Dhandar and S. Subramanian

ICAR Research Complex-Goa 1997. Annual Report (1995-96) *Eds.* B. L. Manjunath and S. Subramanian. 74p

Krishi Vigyan Kendra, Annual report 1995 *Eds.* V.S. Sakharkar and V.Y. Gaonkar

Krishi Vigyan Kendra, Annual report 1996 *Eds.* V.S. Sakharkar and R.N.S. Sundaram

Prabhudesai, H. R. 1996. Groundnut production technology. Technical folder No.8, ICAR Research Complex, Ela, Old Goa

Prabhudesai, H. R. 1996. Training note on BGA production technology. ICAR Research Complex, Ela, Old Goa

Prabhudesai, H. R. 1996.Training notes on recent HVY of rice and technology for basmati cultivation. ICAR Research Complex, Ela, Old Goa

Prabhudesai, H. R. 1996. Training notes on biofertilizers and organic manures in rice cultivation ICAR Research Complex, Ela, Old Goa

Sundaram, R.N.S and Chakurkar E.B. 1997 Technology package for meat rabbit production. *Eds.* B. L. Manjunath and S. Subramanian, 23p

Sundaram R.N.S and Chakurkar E.B. 1997 Preservation land enrichment of green fodder. Technical folder No.12, ICAR Research Complex, Ela, Old Goa *Ed.* S. Subramanian

Subramanian, S., Nair, N. S. and Sundaram, R. N. S. 1996. Duck-fish integrated farming system for Goa. Technical folder No.10, ICAR Research Complex, Ela, Old Goa

Subramanian, S., Nair, N. S. and Nirmale, A. V. 1996. Poultry-fish integrated farming system for Goa. Technical folder No.11, ICAR Research Complex, Ela, Old Goa

## 5.16 Participation in Seminar / Symposium / Workshop

Seminar on neem based pesticides on 16th May 1996 at Panaji, Goa organised by M/s. Godrej Soaps
**Mani Chellappan and HRC Prabhu**

International seminar on Globalisation, food security and sustainable agriculture from 30th and 31st July 1996 at New Delhi, organised by Third World Countries New Delhi
**Mani Chellappan**

Fifth International Mango Symposium, Tel Aviv, Israel from 1-9-1996 to 6-9-1996
**DG Dhandar**

World Food Seminar, Panaji, Goa on 16th October, 1996 organised jointly by Department of Agriculture, Government of Goa and ICAR Research Complex-Goa
**KVK staffs and All Scientists**

Secon International Crop Science Congress, New Delhi from 17-11-1996 to 24-11-1996, organised by National Academy of Agricultural Sciences and ICAR, New Delhi.
**DG Dhandar**

Seminar on HPLC systems, Panaji, Goa on 17th December, 1996 organised by M/s Chromeline
**Mani Chellappan and HRC Prabhu**

IV Annual Conference of IAAVR and National Symposium on Biotechnology in animal health and production for economic development in Asia in respect to global Scenario, University of Pune, Jan 22-23, 1997 organized by Indian Association for the Advancement of Veterinary Research
**EB Chakurkar and SB Barbuddhe**

Plantation crops Symposium (Placrosym) - XII, Kottayam, Kerala from 27-29, November, 1996 organized by Indian Society of plantation crops
**BL Manjunath**

Workshop of Zone IX held at Sirsi, Karnataka on 28 to 30th August,1996.
**HR Prabhudesai**

Zonal Workshop of KVK and TTC of Zone VIII, Madurai, Tamil Nadu, from 30-11-1996 to 2-12-1996 organized by Krishi Vigyan Kendra
**RNS Sundaram and VS Sakharkar**

Seminar on Floriculture bloom in Goa, Panaji, Goa on 23rd August,1996, organised by M/s Microplantae
**AR Desai, Mani Chellappan, VY Gaonkar and HRC Prabhu**

Coconut Seminar, Panaji, Goa on 1-3-1997 organised by Directorate of Agriculture
**VY Gaonkar**

## 5.17 Important meetings attended

Review cum action plan meeting of KVK and TTC of Zone VIII organized by J.S.S Krishi Vigyan Kendra at Suttur, Mysore between 8- 9 April 1996
**S Subramanian and VS Sakharkar**

Staff Research Council meeting of CPCRI, Kasaragod on 30, May, 1996.
**BL Manjunath**

Staff Research Council meeting of N.R.C. on cashew, Puttur on 1 June,1996.
**BL Manjunath**

State level meeting on National Watershed Development Project for Rainfed Areas (NWDDPRA) on 12, June, 1996 at Secretariat, Panaji.
**BL Manjunath**

CADA meeting on Tillari Project at Secretariat, Panaji on 8, July,1996.
**BL Manjunath**

Orientation meeting on ARIS-LAN establishment organised by ICAR at Krishi Anusandhan Bhavan, New Delhi on 16th July, 1996
**S Subramanian**

Peer Review committee meeting on Perspective Plan, ICAR, New Delhi from 15 September, 1996 to 18 September, 1996
**DG Dhandar**

Directors meeting, ICAR, New Delhi from 13 October, 1996 to 18 October 1996
**DG Dhandar**

17th CADA Board meeting of Salaulim irrigation project at Quepem on 18th October, 1996
**HR Prabhudesai**

Groundnut rabi campaign (ICAR Research Complex-Goa) on 1st November, 1996
**All Scientists and KVK personnel**

25th meeting of official language implementation Committee (6th January 1997) at Hotel
ni, Panaji, Goa.
**l Wasnik**

Meeting on promotion of flower and vegetable in Goa (Horticultural Development
rporation, Goa) on 30th January, 1997
**Subramanian, AR Desai and VY Gaonkar**

Meeting of State Steering Committee for Goa State mission for Cashew Development
7-2-1997, Panaji, Goa
**Gaonkar**

Meeting of Directors (Horticulture), ICAR, New Delhi, from 3 March, 1997 to 7 March,
7
**Dhandar**

District level selections committee meeting for sugarcane awards in the chamber of
ty Director of Agriculture, Panaji, Goa on 21rd March, 1997
**Prabhudesai**

## Lectures presented

Biological control (5.6.96) organised by KVK-ICARRC at Ela, Old Goa
**Chellappan**

Integrated pest management (25.5.96) organised by KVK-ICARRC at Ela, Old Goa
**Chellappan**

Technologies for basmati cultivation (25.5.1996) organised by Bank of India, Shiroda
ABARD
**abhudesai**

Rice production technology (24.6.96) organised by Rastriya chemicals and fertilizers
(RCF) Assolna, Salcete
**abhudesai**

Rice production technologies (25.6.1996) organised by PPCL Limited at Benaulim
**abhudesai**

ultivation of Oyster mushroom lecture cum demonstration for the students and staff
el College Nuvem on 29-6-96
**nkar**

ecent development in Horticulture lecture for the B.D.O's and Mamlatdars, at F.T.C.
96
**nkar**

Mushroom Pests (19.7.96 ) organized by Directorate of Agriculture, Government of Goa at Ela, Old Goa.
**Mani Chellappan**

Technologies for basmati rice cultivation (27.8.1996) at ETC Old Goa
**HR Prabhudesai**

Recent HYV of paddy and production of Basmati rice in Goa ( 28.8.1996 & 15.1.1997). Production Technology under central sector Minikit programme organized by Department of Agriculture, Government of Goa at ETC, Old Goa.
**HR Prabhudesai**

Pulses and oilseeds cultivation (11.9.1996) at Satteri Temple, Morlem organised by CADA.
**HR Prabhudesai**

Water management for horticultural crops lecture for the chairman of the various water distribution societies of CADA on 12-9-96
**VY Gaonkar**

Pests of fruits (19.9.96) organised by KVK-ICARRC at Ela, Old Goa
**Mani Chellappan**

Improved sugarcane varieties, their identification at field level, characteristic features and package of practices for sugarcane (26.9.1996) at ETC Old Goa.
**HR Prabhudesai**

Fertilizer management for rice and sugarcane (18-10-96) at CADA training Programme at Panchayat hall Davorlim and Velim organised by CADA.
**HR Prabhudesai**

Advanced technologies in rice production under various conditions in Goa (23-10-96 & 17-1-97) organised by Directorate of Agriculture at Ela, Old Goa.
**BL Manjunath**

Water management in rice (24-10-96 & 15-01-97) organized by Directorate of Agriculture, Government of Goa at Ela, Old Goa.
**BL Manjunath**

Mushroom pests (28.11.96) organized by Directorate of Agriculture, Government of Goa at Ela, Old Goa
**Mani Chellappan**

Technologies for groundnut production (30.11.1996) organized by Union Bank of India Sangolda
**HR Prabhudesai**

Nutrient Management in rice (16-1-1997) organized by Directorate of Agriculture, Government of Goa at Ela, Old Goa.
**BL Manjunath**



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Use of biofertilizers and organic manures in paddy cultivation (17.1.1997) organized by Department of Agriculture, Government of Goa at ETC Old Goa.
**HR Prabhudesai**

Groundnut cultivation in Goa (3.2.1997) organized by Directorate of Agriculture, Government of Goa at Ela, Old Goa
**HR Prabhudesai**

Poultry Keeping (8.2.1997) organised by KVK-ICARRC at Ela, Old Goa
**EB Chakurkar**

Vermiculture technology (9.8.1996) at Marmagoa Port trust (MPT) Hospital
**HR Prabhudesai**

Oil Palm cultivation in Goa lecture for Agril. Asst. Department of Agriculture Goa State, t F.T.C. on 14-2-97
**Y Gaonkar**

Paddy and groundnut cultivation in command areas (14.2.1997) organised by CADA at uncolim
**R Prabhudesai**

Basmati rice cultivation to CADA farmers (18.2.1997) organised by CADA, Quepem
**R Prabhudesai**

Science in day to day life lecture for students and staff of old Goa school, on National ience day (28-2-97)
**Gaonkar**

Importance and use of balanced fertilizer in rice (14 &17.3.1997) organized by Zonal il. Officer, Tiswadi
**Prabhudesai**

Sustainable farming systems in watershed (18.3.1997) organised by Zonal Agril Officer da.
**Prabhudesai**

## Programmes in electronic media

***Radio(AIR), Panaji***

Freshwater prawn farming in ponds and fields, on 17th April, 1996
**bramanian**

Improved cultivation practices for cashew on 18th April 1996
**aonkar**

Food for all, on 6th October 1996
**aonkar**

Characteristics and utilization of different types of soils in Goa, on 30th November, 1996
**HM Wasnik**

Sericulture, on 20th December, 1996
**Mani Chellappan**

Neglected crops of Gao, on 20th March 1997
**VY Gaonkar**

***Television (Doordarshan) Panaji, Goa***

Cultivation practices for horticultural crops, on 21st July 1996
**VY Gaonkar**

Mushroom cultivation on 21st Feb. 1997
**VY Gaonkar**

## 5.20 Participation in extension oriented programmes (Kisan melas/field days/ farmers meetings/exhibitions)

World Food Day exhibition on 16th October, 1996 at Kala Academy, Panaji, Goa
**KVK Staffs and Scientists**

State level meeting of NABARD at Nanaladeep Building on 8th November, 1996, Mapusa, Goa

**HR Prabhudesai**

State level Exhibition Goa Vision - 200l AD organized by Government of Goa between 19th December1996 to 18th January,1997 at Campal parade grounds
**KVK Staff and Scientists**

Institutional Training organized by Directorate of Agriculture between 2 - 28 February,1997
**HR Prabhudesai**

Kisan Mela, organized by ZAO Ponda at Codar in watershed area on 18-3-97
**HR Prabhudesai**

## 5.21 Trainings undertaken /undergone

Vermi composting at PES college Farmagudi on 7-9-96 along with practical demonstration to B.Sc. students organised by PES College Farmagudi
**HR Prabhudesai**



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On farm testing, organized by Krishi Vigyan Kendra, Thalamalai, Tamil Nadu from 19-1996 to 21-9-1996.

**S Sakharkar**

Special training programme in development and use of biofertilizers for Extension cials at Goa University on 25-3-1997 and presented a lecture on Introduction to Rhizobium, atobacter and Azospirilum and their importance in Indian Agriculture.

**R Prabhudesai**

## 2 Weather data

| | Rainfal (mm) | Temperature (°C) | | Average wind speed km/h | | Sunshine (total) | Relative humidity (%) | |
|---|---|---|---|---|---|---|---|---|
| | | Mean Max. | Mean | Min. | Mean | | 8.30h | 17.30h |
| uary | 0.0 | 32.2 | 20.2 | 26.2 | 0.8 | 313.8 | 78 | 56 |
| uary | 0.0 | 33.1 | 21.1 | 27.1 | 0.9 | 295.3 | 77 | 58 |
| ch | 0.0 | 32.7 | 24.2 | 28.4 | 0.9 | 272.3 | 83 | 69 |
| | 0.7 | 33.0 | 25.2 | 29.1 | 10.0 | 293.6 | 75 | 67 |
| | 0.6 | 33.3 | 26.2 | 29.7 | 11.0 | 280.1 | 76 | 67 |
| | 1040.8 | 31.2 | 25.5 | 28.3 | 13.0 | 177.2 | 85 | 72 |
| | 1131.8 | 29.0 | 24.4 | 26.7 | 13.0 | 81.2 | 91 | 87 |
| st | 340.8 | 29.0 | 24.3 | 26.6 | 11.0 | 115.3 | 91 | 86 |
| mber | 131.9 | 30.2 | 24.2 | 26.9 | 7.0 | 178.1 | 91 | 86 |
| er | 223.5 | 32.7 | 23.2 | 26.9 | 9.0 | 210.8 | 85 | 77 |
| mber | 6.4 | 32.9 | 22.3 | 27.6 | 7.0 | 273.9 | 80 | 65 |
| mber | 4.4 | 32.4 | 28.9 | 26.6 | 8.0 | 386.0 | 78 | 58 |
| ry | - | 31.5 | 19.9 | 25.1 | 8.3 | 9.9 | 81 | 57 |
| ary | - | 31.3 | 18.9 | 25.1 | 9.0 | 10.5 | 77 | 57 |
| | 0.1 | 32.4 | 23.7 | 28.1 | 0.1 | 256.0 | 84 | 69 |
| | 2881.0 | | | | | | | |

ainy days with RF 72.5 mm - 79 days.

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