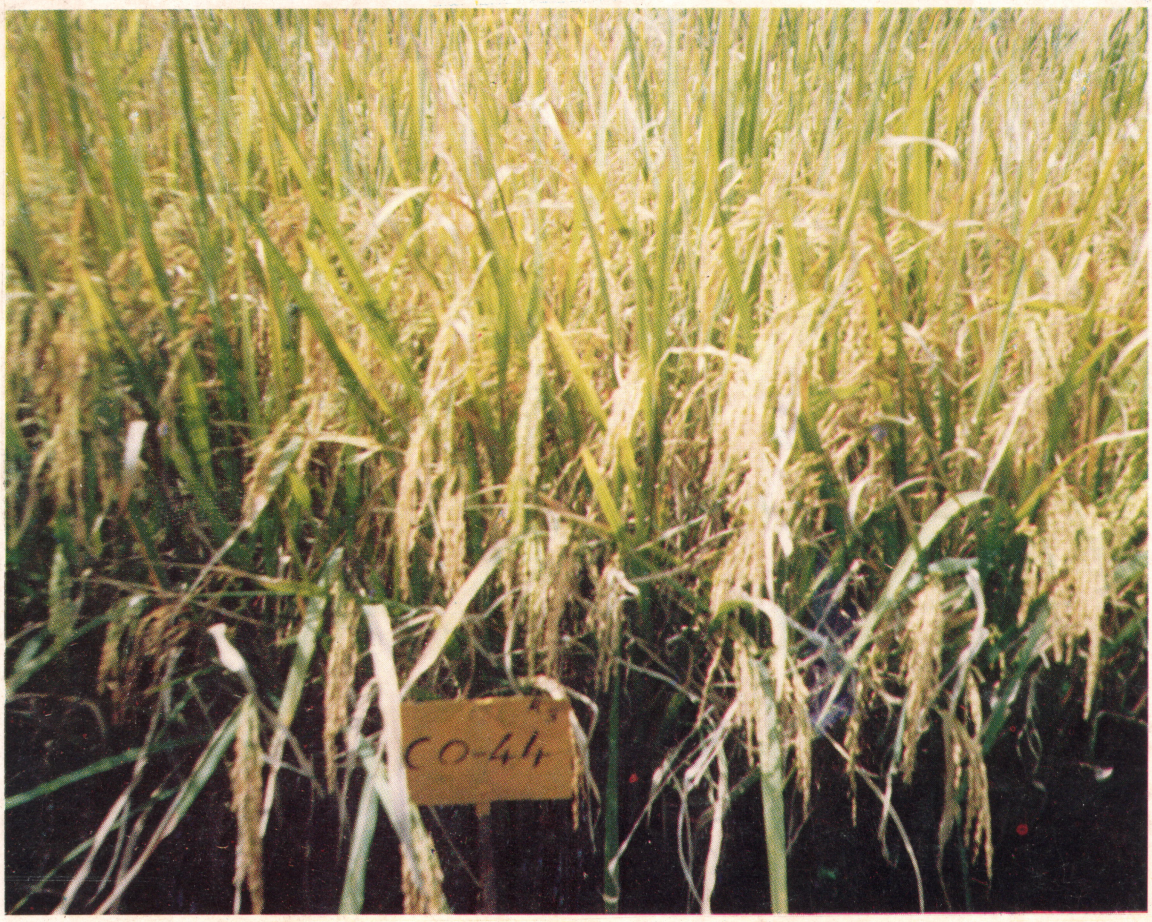

ANNUAL REPORT

1993-94

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ICAR

ICAR RESEARCH COMPLEX FOR GOA

ELA, OLD GOA - 403 402, GOA, INDIA

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

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Front Cover:

Top :- Co-44 - a medium duration high yielding promising variety of rice.

Bottom :- Varietial wealth of mangoes in Goa.

Cover design:

B.L. Manjunath

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1. Director's Introduction

About the Institute

Indian Council of Agricultural Research constituted the ICAR Research Complex for Goa during 1975 to cater to the agricultural research needs of Goa region. After being a research centre under the administrative control of ICAR Research Complex for North Eastern Hill Region, Shillong and Central Plantation Crops Research Institute (CPCRI) Kasaragod, the Research Complex was elevated to the status of an independent Institute in April, 1989. To bridge the gap in transfer of technology to the farming community, a Krishi Vigyan Kendra (Farm Science Centre) was also established in 1983.

Mandate

The Institute mandate covers "Introduction and improvement of all potential crops and various species / breeds of livestock, their production, and Scientific exploitation including various aquatic resources for improving fish production.

The present mandate of the Institute is as follows:

1. To conduct strategic and applied research on all potential agricultural and horticultural crops, livestock and fisheries, relevant to climate in Goa for improving productivity and post-harvest management
2. To help disseminate improved technology developed
3. To act as a repository of information on Western Ghats agricultural systems
4. To collaborate with national and international agencies in achieving the above mandate
5. To act as a centre for training in updated technologies
6. To provide consultancy services
7. To generate nucleus planting material

Staff and Budget

The total staff strength of the Institute and KVK was 74 and the annual expenditure including Plan, Non Plan and KVK for the year 1993-94 was Rs. 110.85 lakhs.

Research activities

There were 23 ongoing research projects comprising of seven in Crop Sciences, six in Horticulture, seven in Animal Sciences including Fisheries and three in Transfer of Technology. The major emphasis of the research projects was targeted for increase in the agricultural productivity in this region.

Research Council

The progress of the research work for the year 1993-94 was reviewed in the Fifth Staff Research Council meeting held on 17-18 June, 1994. The achievements of the research projects are presented in the research highlights of this report.

Institute Management Committee

To evaluate the financial and administrative performance and to accord sanction for the

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purchase of equipments and to execute the civil works, the Institute Management Committee has met on 30-12-1993.

Local Management Committee

To review the progress of activities under Krishi Vigyan Kendra and to formulate the future programme, the local management committee met once (17.6.1993) during the period under report.

Institute Joint Staff Council

With an objective to promote harmony and relationship for increased efficiency of work and to increase the co-operation between the staffs, the joint staff council met thrice (4.6.1993 27.9.1993 and 22.2.1994) during the year.

Study Circle

The Study Circle met twice (27.7.93 & 4.9.95) during the period and discussed and recommended publications of 10 research/popular articles.

Collaboration with Development Agencies/Organisations

To provide adequate production oriented research base, close collaboration is maintained with State Departments of Agriculture, Animal Husbandary, Fisheries and Forests. The work priorities are drawn in the joint meetings of the Officers of the State Departments and ICAR. A close liaison is also maintained with Agricultural Universities of neighbouring States, other ICAR Institutes, National Research Centres, AICRP centres, dealing with crops and livestock of local importance. There is an active involvement of officers and experts of the above organisations in the important meetings like Research Councils Institute Management Committee, Local Management Committee of KVK, besides the representatives of the Council. The Institute is represented a different State level committees such as Horticulture, Spices, Sugarcane and Watershed projects.

Guidance on various farm technologies were provided to departmental staff and farmers in the meetings and trainings conducted by National Bank for Agriculture and Rural Development (NABARD), Rural Development Agency (RDA), Command Area Development Authority (CADA) etc. The Institute is having technical collaboration with Sanjivani Sugar Factory on Sugarcane cultivation. Besides giving periodical radio talks on various topics of local importance, the Institute provides guidance on the formulation of Agricultural programmes of All India Radio and Doordarshan Panaji.

The Institute is also involved in collaboration with Integrated Pest Management Centre Margao and State Department of Agriculture.

The Scientists of the Institute are actively participating in the academic activities of Goa University. The Senior Scientists of the Institute are also functioning as external evaluators for post graduate theses of students of neighbouring Universities.

Liabrary

The Institute is subscribing 18 foreign and 32 Indian journals and has 751 books, 514 bound back volumes. The KVK has 232 books covering various aspects on agricultural production.

About this Report

This Annual Report of the year 1993-94 of ICAR Research Complex for Goa, briefly highlights the research findings of the Institute followed by report on the ongoing projects. A detailed report on the concluded project entitled "Nutritional requirement of promising varieties of sugarcane and paddy under Goa condition to optimise fertilizer inputs" also highlights the salient achievements of the said project. At the end of the report, general information on important Institute committees, staff position, budget, visitors, publications, participation in extension oriented programmes, appointments, transfers and weather data of Goa is provided for reference.

Director

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5.16 P
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2. Research Highlights

Field Crops: Evaluation of medium duration (120-130 days) rice varieties during kharif season showed that the varieties Sarjoo - 52, MO - 7, Tulsi and Vibhava with an yield potential of about 5 to 5.5 t/ha during kharif season and around 6.5 to 7.0 t/ha during rabi season showed good performance and are suitable alternatives for ruling variety of the State, Jaya. Among the short duration varieties, Narendra - 2, Vikas and Kalinga - 1 with an yield potential of 4 t/ha during kharif season performed better along with State's ruling variety Jyoti.

Among the four neem based compounds / insecticides viz. Limnool, Neem rich - II, Nimbecidine and Achook evaluated for their efficacy against the leaf folder infestation, along with Monocrotophos. It was observed that all the neem based compounds were equally good in controlling the pest.

The evaluation of salt tolerant varieties for the Khazan lands of Goa, showed that the variety C.S.R.-4 with an yield potential of 4.3 t/ha out yielded all the other varieties, followed closely by C.S.R. - 10 (4.0t/ha) and Palghar - 1 (3.8t/ha).

Studies on varietal evaluation of sugarcane indicated that as first ratoon crop, variety Co-85061 gave the highest yield of 78 t/ha with 18.5 per cent brix followed closely by Co-7527 (77 t/ha) with higher brix per cent of 20.0. The other two varieties which also recorded promising yields were Co-85018 and CoC - 671 with yield potential of 72.C t/ha and brix of 20.5 per cent. Among the latest varieties which have been evaluated for their performance as plant cane, variety Co- 89018 proved to be superior over others (yield 90.0 t/ha) followed closely by other three varieties viz. Co-90006, Co-85134 and Co-90009 with yield potential around 85 to 90 t/ha.

Horticulture and Plantati

Crops: Out of 14 local accessions planted the Institute, Balli-2 was the highest yield accession based on yield obtained for the p four years. The average yield per tree in 19 94 was 2.10 kgs with desirable nut and ap characters.

Survey and collection of local mar varieties have facilitated to establish germplasm collection of 68 distinct varieties the Institute. Out of these, the collections v Black Culas, Monteiro and Reynold have go commercial potential. Besides, a big frui clone of Hilario and a clone of Udgo v outstanding fruit quality have also been ad to the mango collection during the year. Cu @ 20 ml per tree to 12 year old Mankurad tr induced good flowering and yield increase 60.4 per cent over untreated trees.

Observations on vegetative charac namely height, girth and rate of leaf produc of five oil palm hybrids indicated that no sig cant differences existed among them and a no difference was observed in the produc of female inflorescence though the hybri D x 291 P produced the highest numbe female inflorescences. The same hybrid produced the highest male inflorescence w was on par with the hybrid 180 x 32 P significantly higher, over other hybrids.

Analysis of data for vegetative and f characters in Kew pineapple (treated wi doses of 0 to 12 g per plant) in plant crop two ratoons did not show any significant i ence of K levels on any of the charac studied. The basal level of K in soil was 50 which appeared satisfactory for good pro tion of pineapple in Goa.

Animal Sciences: Studies on formance of cross bred pigs indicated introduction of new boar reduced the nur of still births in pure and crosses. The gr was faster in pure bred at the initial stages

12th week and declines thereafter, while the crossbred maintained faster growth rate till 20th week resulting in higher marketable weight. This is in confirmity with the results recorded earlier.

Feeding cashew apple waste upto 30 per cent level was found beneficial as it has not reduced either feed intake or digestibility.

Castration studies indicated that higher weight gain (208 g/day) was obtained in castrated group as compared to intact group (166 g/day). This could be attributed mainly to more fat deposition in the castrated group.

Further studies on the problem of agalectia in rabbits indicated that increased crude protein content in the feed can be effective in controlling the problem of agalectia in meat type rabbits.

Fermentation of rice bran with 5 per cent molasses and 2 per cent Baker's yeast was found to be an effective technique to enrich the rice bran in increasing crude protein content from 6.3 per cent to 8.5 per cent and digestibility from 68.7 per cent to 72 per cent. Fermentation of coir dust for 60 days at 80 per cent moisture level has found to reduce the lignin content by 9.6 per cent.

The Japanese quails attained maturity by eighth week and started laying. They reached peak production (68.8%) by 16th week and maintained good production upto 28th week after which the egg production was poor. These results are in conformity with earlier findings.

Fishery Science: Under the Poultry-fish integrated culture system the three species carp combination gave a fish production of 3,500 kg/ha for 15 months period. The poultry birds reared in the shelter over the pond attained weight of 1580 g in 8 months from the initial weight of 197 g per chick, the average fish growth was 2.5 kg for catla, 2.3 kg for rohu and 1.7 kg for mrigal and the birds started laying eggs at five and half months and attained a peak production at 8th month (61.9%).

Under the rice-fish culture, the rice variety Vytilla-1, again performed well in kharif and rabi, indicating its suitability to the rice-fish combination.

Transfer of Technology: The Krishi Vigyan Kendra (KVK) which is the extension wing of this Research Complex organised 74 Training courses in various disciplines like Crop Science, Horticulture, Animal Science and Home Science. Altogether, 1359 participants comprising of farmers and farm women, rural youths and extension personnel of developmental departments were imparted skill oriented training.

Under the research cum demonstration, 23 field demonstrations including 20 demonstrations of each 2000 m^2 area were laid out in Crop Sciences under medium duration rice, sugarcane and groundnut crops. Under Horticulture, six demonstrations were conducted on technologies like cashew top working, nutrition garden, treatment of stem bleeding affected palms and cultar use in mango. In Animal Sciences, 21 livestock units viz., poultry, rabbits and pigs were established at farmer's place. In Home Science, four demonstrations on fruits and vegetable preservation were conducted in collaboration with All India Women's Conference.

Krishi Vigyan Kendra also participated in various other extension activities like Farmer's convention on modern irrigation systems on 9th February 1994 where in the working of drip and sprinkler irrigation systems were demonstrated by different private agencies.

World Food Day was celebrated on 16th October 1993 in collaboration with the Department of Agriculture, Government of Goa. An exhibition was arranged on the occasion. 'Women in Agricultural' Day was held on 4th December 1993.

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3. Report on Ongoing Projects

3.1 Crop Sciences

1. Screening of rice varieties suitable for Goa

(KD Patil, HM Wasnik, JR Faleiro, S Chander Rao, HR Prabhudesai)

Rice is the major food crop of Goa and occupies nearly one third of the total cropped area, accounting for 86 per cent of the food grain production of the state. With an objective to find out superior high yielding rice varieties for the three distinct land types namely 'Kher' (coastal sandy loams), 'Morod' (laterite uplands) and 'Khazan' lands (coastal saline soils); the ICAR Research Complex for Goa introduced varieties from other major rice growing states of the country and evaluated their performance under local conditions. In addition to this, other aspects such as monitoring the incidence of pests and diseases and devising suitable control measures, evaluation of salt tolerant varieties were studied. The work done on these aspects and results obtained are presented below.

Screening of short and medium duration rice varieties

a) Varietal evaluation

An experimental trial with eleven medium duration varieties was laid out during 1992-93 rabi season under agro-ecological conditions of Goa. The recommended cultural practices were carried out. The observations in respect of (1) height of plants (2) number of tillers (3) number of productive tillers (4) length of panicle (5) number of grains / panicle (6) number of chaffy grains / panicle (7) number of panicles / m^2 (8) weight of panicle (9) 1000 grain weight and (10) yield/ha were recorded. The results indicated that among the medium duration varieties, the variety Sarjoo-52 gave the best performance by yielding 8.2 t/ha, followed by variety MO-7 (7.2 t/ha) during the rabi season of 1992-93. Other two varie namely Jaya (State's ruling variety) and with yield levels of 6.2 t/ha and 6.0 t/ha res tively performed reasonably well in com son. These varietal differences in yield le were statistically significant. In general, t was a good correlation between the var yield contributing characters such as num of productive tillers, number of grains/pan length of the panicle and 1000 grain weig

During the kharif season of 1993, short duration varieties were evaluated their performance both in terms of grain y as well as for some of the important gro and yield contributing characters. Data vealed that there was not much differenc the performance of various varieties with v ety Narendra-2 giving the highest yield of t/ha followed closely by Vikas (3.8 t/ha) Kalinga-1 (3.7 t/ha). These differences we however, statistically not significant. Amo the medium duration varieties, variety Ja with an yield of 6.0 t/ha out yielded all the ot varieties, followed closely by Vibhava (5. ha), Tulsi (5.3 t/ha) and MO-7 (5.2 t/ha). The differences were, however, not significant

b) Monitoring of insect pests and diseas in short and medium duration rice vari ies

The important pests and diseases n ticed in short duration varieties were ca worm, leaf folder, blast and false smut at ve low intensity.

Nine short duration rice varieties we evaluated for their performance during t kharif season of 1993. The incidence of inse pests were monitored periodically. The impo tant insect pests recorded were i) ri caseworm, *(Nymphula depunctalis)* and rice leaf folder, *(Cnaphalocrocis medinalis* Among these two, leaf folder found to be t most serious and the peak infestation o curred between 49 to 56 days after transplan ing.

c) Survey and surveillance for insect pests of rice in Goa

Regular surveys were conducted during kharif, along with the officials of the Integrated Pest Management centre, Margao. A moderate to high intensity of brown plant hopper *(Nilaparvata lugens)* damage was observed in many parts of the State particularly in Tiswadi and Pernem taluka. Other pests recorded were leaf-folder *(Cnaphalocrocis medinalis)*, gundhi bug *(Leptocorisa* sp), green leafhopper (*Nephotettix* sp.), caseworm (*Nymphula depunctalis*) and stemborer (*Scirpophaga* sp). Beside the insect pests, biological control agents like wolf spider (*Lycosa* sp), mirid bug (*Cyrtorhinus lividipennis*) and staphalynid beetle (*Paederus fuscipes*) population had also been recorded.

d) Evaluation of neem products on rice pests

During kharif 1993, four neem based insecticides viz. Limnool, Neem rich - II, Nimbecidine and Achook were evaluated along with monocrotophos for the control of leaf folder, (*Cnaphalocrocis medinalis*) in rice (variety Jaya) at the Institute's farm. The trial was laid out in the R.B.D. with five replications. Three sprays of the above insecticides were given at 30, 45 and 60 days after transplanting. The results presented in Table 1. revealed that a peak infestation occurred between 49 and 56 days after transplanting. All the neem based compounds viz. Limnool, Nimbecidine and Achook were equally effective and their yields were similar to that of monocrotophos treatment.

e) Evaluation of salt tolerant varieties

(HM Wasnik)

To screen the rice varieties for salt tolerance, a replicated trial with seven salt tolerant rice varieties namely CSR - 4, CSR - 10, Palghar - 1, Panvel - 1, Panvel - 2, Co-43, and Korgut was undertaken with three replications during the kharif season of 1993, on farmer's field in Bardez Taluka of North Goa district. The results showed that the variety CSR-4, out yielded (43.42 q/ha), all the other varieties followed by CSR-10, (40.08 q/ha) and Palghar - 1 (38.50 q/ha) There was a significant increase in number of tillers, length of panicle, number of grains per panicle and test weight in these varieties as compared to local variety Korgut (Table 2).

Table 1: Evaluation of neem based insecticides in rice (variety - Jaya) during kharif, 1993

No	Treatment	Mean leaf damage due to leaf folder attack per m^2							Yield t/ha
		Days after transplanting							
		21	28	35	42	49	56	63	
1.	Neem rich II	0.02	0.00	0.00	0.02	0.42	0.52	0.20	2.7
2.	Limnool	0.00	0.04	0.02	0.00	0.34	0.50	0.20	3.4
3.	Nimbecidine	0.04	0.02	0.04	0.02	0.30	0.58	0.20	3.3
4.	Achook	0.00	0.02	0.02	0.00	0.34	0.54	0.50	3.6
5.	Monocrotophos	0.04	0.02	0.00	0.02	0.32	0.38	0.24	3.6
6.	Control	0.02	0.04	0.02	0.00	0.46	0.42	0.32	3.0

Table 2: Growth and yield parameters of salt tolerent rice varieties at Farmer's field during kh 1993

Variety	Plant height (cm)	No. of productive tillers	Length of panicle (cm)	No. of grains panicle	No. of panicles per m^2	1000 grains weight	Yie q/
CSR-4	89.4	6	21.2	109	289	26	43.4
CSR-10	84.5	5	22.1	117	265	26	40.0
Palghar-1	85.4	5	20.4	108	260	36	38.5
Panvel-1	85.4	5	21.7	134	248	34	32.5
Panvel-2	73.5	6	18.2	135	245	26	29.9
Co-43	91.6	5	22.8	115	227	22	31.3
Korgut	147.8	3	26.2	116	189	34	19.1
C.D. 5%	7.2	1.1	1.21	12.0	21	1.4	N.

2. Evaluation of Sugarcane varieties for Goa

(KD Patil, HR Prabhudesai)

Sugarcane is one of the important cash crops of Goa, occupying nearly 1600 ha with an annual production of 65-70 thousand tonnes. The present, ruling variety of the State Co-740, though a moderately good yielder is suffering from number of other problems like, susceptibility to various diseases such as grassy shoot, smut and mosaic and consequential yield losses. Therefore, to find a suitable replacement for this variety, the ICAR Research Complex for Goa undertook varietal evaluation trials. The results are presented below.

Fourteen sugarcane varieties which were initially planted in the month of January 1992 as a plant cane were further grown as first ratoon crop during 1993-94 and then harvested in the month of January 1994. Results showed that the variety Co-85061 gave the highest yield of 149.3 kg/plot (78.6 t/ha) with 18.5 per cent brix in the month of January 94; followed closely by Co-7527 with yield level of 146.3 kg/plot (77.0 t/ha) and brix per cent of 20.3. The other two varieties which also r corded the promising yields were Co-850 and Co-671 with yield levels of 72.5 t/ha ar 72.2 t/ha respectively. In comparison, th currently ruling variety of the state namely C 740 yielded only 58.9 t/ha with a brix per ce of 18.3. This indicated that, varieties like C 85061, Co-7527 are not only good yielders a a plant cane but also yield reasonably well a ratoon crops. The varieties Co-85018 and Co 671 are also good ratooners with compara tively higher brix recordings (20% and 20.8 respectively) and could be preferred over Co 740. In general, there was a good correlatio between yield contributing characters lik height of the cane, girth of the cane and weigh of the cane.

Another set of thirteen latest (released varieties and especially more suited to th Konkan region of Goa (Coastal tropical cli mate), were planted in Jan' 93 and were harvested in the month of Jan' 94. Data indi cated that the variety Co-89018 proved to be superior over other varieties and yielded 90.6 t/ha with a brix recording of 20 percent (as a plant cane) in the month of Jan '94; followed closely by another variety, namely Co-9000

PLATE 1

C0-44 - a medium duration high yielding promising variety of rice

Drip irrigation trial to optimise irrigation scheduling in sugarcane

A field trial in sweet potato for weevil control

Cashew - a promising crop in mine reject soils

with an yield level of 89.0 t/ha and brix per cent of 20.0. Two other varieties which also gave promising yields were Co-85134 (88.7 t/ha) and Co-90009 (85.8 t/ha) with brix recordings of 17 and 18 per cent respectively.

3. Utilization of mine reject soils for crop production

(HM Wasnik)

To study the integrated nutrient management under mine reject soils, an experiment was conducted in split plot design with cashew grafts and cashew seedlings as main plot treatments and subplot treatments included comparison of organic manure (poultry manure 5 kg per plant) and inorganic fertilizers (500:125 : 125 g N : P_2O_5 : K_2O per plant) and poultry manure (5 kg per plant) + 500 : 125 : 125 g of N : P_2O_5 : K_2O per plant along with control with three replications (six plants per plot.) The experiment was conducted during the kharif season (1991-92 and 1992-93) at Sirigaon Mines of M/s Chowgule & Company, Goa. The results indicated that there was a significant increase in plant height, canopy spread, number of branches, trunk girth, number of flowering shoots, and fruits per plant due to the application of poultry manure and NPK fertilizers over control in both cashew grafts and cashew seedlings. But more number of flowering shoots and fruits per plant were recorded in the treatments where poultry manure and NPK fertilizers were added together in both cashew grafts and cashew seedlings (Table 3). There was also a gradual increase in soil pH, organic carbon, available P, K, Zn and Fe content of soils due to the application of poultry manure and NPK fertilizer as compared to control both in cashew grafts and cashew seedlings (Table 4).

There was also a gradual increase in nitrogen, phosphorous, potassium, zinc, iron, copper and manganese contents in cashew leaf due to application of organic and chemical fertilizers over control (Table 5).

Table 3: Growth and yield of cashew as influenced by different treatments under mine reject soils of Goa

Treatments	Plant ht (m)	Canopy spread (m) E-W.	N-S	No. of branches	Trunk Girth (cm)	No. of fruits per plant
Cashew grafts	2.83	3.61	3.35	4	45.60	7
Cashew seedlings	2.73	1.64	1.59	2	22.00	-
C. D. (5%)	0.15	0.15	0.15	-	19.20	-
M_0	1.96	1.68	1.73	2	21.00	-
M_1	2.42	2.12	2.05	2	28.65	-
M_2	3.08	2.82	2.60	3	34.00	-
M_3	3.72	3.89	3.50	3	51.65	15.0
C. D. (5%)	0.15	0.15	0.15	-	19.20	-

M_0 - Control
M_1 - 5 kg Poultry manure per plant
M_2 - 500:125:125g NPK per plant
M_3 - 500:125:125g NPK + 5 kg Poultry manure

Table 4: Nutrient status of mine reject soils as influenced by different treatments

Treatments	pH	E.C. mmhos cm	Organic C (%)	Available P kg/ha	Available K kg/ha
Cashew grafts	6.2	0.01	0.23	12	64
Cashew seedlings	6.2	0.01	0.31	13	77
M_0	5.9	0.01	0.15	9	48
M_1	6.1	0.01	0.17	11	53
M_2	6.3	0.01	0.22	13	71
M_3	6.4	0.01	0.53	16	110

Table 5: Nutrient content of cashew leaf as influenced by different treatments

Treatments	N (%)	P (%)	K (%)	Zn	Fe	Cu	Mn
				(ppm)			
Cashew grafts	1.47	0.29	0.36	17	1510	16	546
Cashew seedlings	0.95	0.21	0.36	17	1293	11	970
M_0	1.10	0.18	0.30	11	898	8	393
M_1	1.16	0.21	0.34	15	1390	13	497
M_2	1.24	0.27	0.38	18	1500	15	788
M_3	1.35	0.33	0.42	23	1817	20	1353

4. Studies on Water Management in Sugarcane

(BL Manjunath, KD Patil, MS Balbatti)

Sugarcane is one of the important cash crops of India and in particular Goa. The water appears to be the principal limiting factor for sugarcane particularly in Goa, as availability of water for irrigation is becoming scarce. With the changing situations of environment, while the requirement of irrigation spreads over eight months in a year. Hence the utilisation of available scarce water resources for better crop production through adoption of efficient method of irrigation is absolutely essential. As the response to irrigation is not uniform throughout the spread at graded levels, fixing an optimum level of irrigation is equally important.

With this background in view, an attempt is being made to adjudge an efficient method along with optimum irrigation level for better utilisation of scarce water resources for sugarcane under the agroclimate conditions of Goa with the following objectives.

1. To evolve an efficient method of irrigation for better utilisation of scarce water resources for sugarcane.

2. To determine the most economic level of

irrigation for optimum growth and yield in sugarcane.

3. To workout the economics of the systems.

The experiment was laid out in a split plot design with four replications using sugarcane variety Co-7527. The two irrigation methods viz. furrow and drip irrigation were laid out as main plot treatments and the sub plot treatments included three irrigation levels fixed at an IW/CPE ratio of 0.5 (I_1), 0.75 (I_2) and 1.00 (I_3). The irrigations were scheduled in both the methods through regular collection of pan evaporation data to meet the required ratios by fixing an irrigation depth of 5 cm for each irrigation.

A progressive decline in the irrigation interval was observed at all the three irrigation levels under furrow irrigation, from February to May as the pan evaporation increased due to atmospheric demand.

As observed in the Table 6, the irrigation interval decreased from 24 days to 16 days in I_1, 18 days to 12 days in I_2 and 12 days to 8 days in I_3 due to the evaporative demand.

Regular observations on plant growth parameters are being collected. The data on number of tillers showed a positive influence of drip irrigation in influencing the number of tillers (1,35,200/ha) as compared to furrow irrigation (1,20,800/ha). Among the irrigation levels, scheduling of irrigation at an IW/CPE ratio of 0.75 resulted in comparatively more number of tillers (1,31,200/ha) although the results were non-significant. The experiment is still continuing.

Table 6: Irrigation interval as influenced by pan evaporation in furrow method of irrigation

Standard met. week	Period	Pan evaporation (mm)	Effective rainfall (mm)	Irrigation Interval (days)		
				I_1	I_2	I_3
9	Feb 26 - Mar 4	30.2	-	24	18	12
10	Mar 5 - 11	31.5	-	22	17	11
11	Mar 12-18	29.4	-	24	18	12
12	Mar 19-25	35.1	-	20	15	10
13	Mar 26 - Apr 1	31.9	-	22	17	11
14	Apr 2 - 8	35.8	-	20	15	10
15	Apr 9-15	37.6	18.7	20	15	10
16	Apr 16-22	43.9	-	16	12	8
17	Apr 23-29	46.0	-	16	12	8
18	Apr 30 - May 6	43.5	-	16	12	8

Table 7: Number of tillers (000/ha) as affected by irrigation methods and levels, in sugarcane

	I_1	I_2	I_3	Mean	'F' test
Drip irrigation	130.9	138.2	136.5	135.2	'NS'
Furrow irrigation	118.3	124.1	120.0	120.8	
Mean	124.6	131.2	128.3		
'F' Test		'NS'			

I_1 --- $\frac{IW}{CPE} = 0.5$

I_2 --- $\frac{IW}{CPE} = 0.75$

I_3 --- $\frac{IW}{CPE} = 1.00$

3.2 Horticulture

1. Selection of high yielding types of cashew, mango and other fruits and their multiplication

(PA Mathew, DG Dhandar, VY Gaonkar and JR Faleiro)

Cashew

Survey on elite high yielding cashew types facilitated to collect an accession from Paikul (Valpoi) with high yield and medium size nuts. Grafts of 10 elite trees located earlier were prepared from germplasm collection and evaluation at the Institute farm.

Yield data collected from 14 local accessions maintained at 2m x 2m spacing (planted in 1987) had indicated that one accession Balli - 2 was quite promising with an average yield of 2.10 kg/tree for the season 1993-94. The average yield (Table 8) of this entry was the highest among all accessions (0.97 kg/tree) for the last four years with satisfactory apple size (68.84g) and colour (yellow).

Among four hybrids obtained from Kerala, H.B - 1600 continued to perform well. However, the yield levels were lower than V-4, the standard variety for Goa (Table 9).

Among 11 high yielding accessio brought from outside Goa, one released vari ety, M 26/2 from Tamil Nadu showed highe yield (1.29 kg/tree). M 26/2 is a compact clone with medium size nut and poor apple size (Table 10). However, V-4 remained superio to this variety also.

One trial with eight NRC cashew selec tions and another trial with 12 local selections are in progress to select suitable types fo Goa.

Two bold nut types, Vectore-56 and Kankady were added to the germplasm col lection of cashew. Fifty grafts of V-6 the latest release from RFRS, Vengurla were procured and established for scion bank with a view to procure nucleus planting material.

Survey for cashew has been carried out in collaboration with the Directorate of Agricul ture, Goa and fifty elite trees has been located with bold nut, good yields, big apple size, etc. The maximum nut weight recorded from these accessions was 16.0 g.

As part of the programme to raise nucleus

Table 8: Yield of local accessions of cashew

Accession	Yield of raw nuts (kg/tree)						Average nut weight (g)	Average apple weight (g)
	1990	1991	1992	1993	cummulative	Average		
1A	0.130	0.104	0.648	0.685	1.567	0.392	10.63	98.24
Balli-2	0.172	0.522	1.075	2.097	3.866	0.967	7.31	69.84
Balli-3	0.000	0.000	0.103	0.167	0.270	0.068	7.00	93.03
Balli-5	0.040	0.044	0.226	0.585	0.895	0.224	7.25	73.39
Buipal-1	0.000	0.000	0.032	0.026	0.058	0.015	10.60	57.20
C-3	0.000	0.159	0.048	0.031	0.238	0.060	6.90	67.40
Choal-1	0.000	0.016	0.018	0.013	0.047	0.012	13.00	92.50
Betul-1	0.000	0.000	0.144	0.172	0.316	0.079	6.86	82.71
Gurko	0.000	0.040	0.241	0.000	0.281	0.070	8.00	81.50
Mardol-5	0.000	0.083	0.123	0.277	0.483	0.121	11.89	117.76
Nanora-2	0.061	0.147	0.233	0.950	1.391	0.348	4.67	39.37
Paiguini-2	0.029	0.230	0.257	0.465	0.981	0.245	9.12	102.3
Uguem-5	0.000	0.217	0.526	0.234	0.977	0.244	4.29	34.62
Vethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
V-4	0.090	1.015	0.750	1.300	3.155	0.789	7.04	38.13

Table 9: Yield of cashew hybrids

Hybrid	Yield of raw nuts (kg/tree)						Average nut weight (g)	Average apple weight (g)
	1990	1991	1992	1993	cummula-tive	Average		
HB-1608	0.000	0.000	0.101	0.417	0.518	0.130	8.42	84.42
HB-1600	0.000	0.151	0.790	1.726	2.667	0.667	6.36	50.80
HB-1598	0.000	0.000	0.765	1.123	1.888	0.472	6.12	59.28
V-4	0.090	1.015	0.750	1.300	3.155	0.789	7.04	38.13

planting materials of cashew, 3000 saleable grafts of V-4 were produced during the year for supply to growers.

Mango

Surveys for locating and collecting local mango varieties were intensified and necessary information to prepare a bulletin on Goan mangoes had been gathered. The local mango varieties collected and located are given below.

Table 10: Yield of high yielding accessions of cashew

Accession	Yield of raw nuts (kg/tree)						Average nut weight (g)	Average apple weight (g
	1990	1991	1992	1993	cummulative	Average		
BLA39-4	0.000	0.070	0.051	0.483	0.604	0.201	3.46	15.00
VTH-59/2	0.000	0.145	0.848	1.099	2.092	0.523	5.24	24.70
VTH-30/4	0.000	0.062	0.066	0.197	0.325	0.081	4.62	32.15
VTH-125	0.000	0.000	0.000	0.320	0.320	0.080	4.80	44.44
M-10/4	0.056	0.026	0.354	0.503	1.173	0.293	6.66	54.71
BPP-1	0.000	0.000	0.000	0.553	0.533	0.138	4.00	20.43
BPP-2	0.025	0.343	0.240	1.009	1.617	0.404	3.55	40.00
BPP-5	0.000	0.000	0.032	0.350	0.382	0.096	5.93	52.14
VTH-174	0.031	0.048	0.110	0.025	0.214	0.054	9.26	99.41
VTH-539	0.086	0.136	1.041	0.893	2.156	0.539	6.87	47.96
M26/2	0.000	0.231	1.443	1.285	2.959	0.740	7.04	34.09
V-4	0.090	1.015	0.750	1.300	3.155	0.789	7.04	38.13

Names of local mango varieties

1. Araujo*
2. Ananas*
3. Aqua Rosea*
4. Akno Malgess*
5. Bishop (Bispo)
6. Bardez Mussarat
7. Bemcorad
8. Ball
9. Babio
10. Bindao
11. Bismi (Red) *
12. Black Culas *
13. Culas (Colaco)
14. Cota*
15 Carreira Branca
16. Carreira (Karrel)
17. Colaco Branca
18. Chimut (Timoteo)
19. Costa
20. Durbate
21. Dhawo Mussarat*
22. Dourado
23. Dosi Ambo*
24. Elavayangan*
25. Fernandin
26. Furtad
27. Goa Alfonso
28. Hilario
29. Improved Mankurad Seedling *
30. Irmao Xavier *
31. Jose
32. Jesuit*
33. Japao
34. Jeronimo
35. Koita*
36. Kala Alfonso*
37. Mankurad (Malcorado)
38. Malgess
39. Maxima*
40. Monteiro*
41. Malgoa
42. Madame
43. Miranda
44. Matekin*
45. Manglech*
46. Macheron*
47. Oliveira
48. Oval Appus*
49. Papel Branco
50 Rebello
51. Rosa (Type I)
52. Rosa (Type II)*
53. Rotto*

Average apple weight (g)
15.00
24.70
32.15
44.44
54.71
20.43
40.00
52.14
99.41
47.96
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54. Salcette Mussarat
55. Sakri*
56. Saccaradin
57. Salgadin
58. Saldad*
59. Sakar Ambo*
60. St. Antony [Elongated fruit (Type I)]
61. St. Antony [Roundish oval fruit (Type II]
62. Rynold*
63. Timoz*
64. Tokio*
65. Toranjo
66. Tanque
67. Udgo
68. Xavier.

* Unreported but popular in certain localities of Goa.

Table 11 a. Characters of local mango varieties

Fruit weight (g)	Flesh(%)	T.S.S. (%)	Bearing behaviour
125-618	53.22-79.5	11.0-30.0	Except Xavier, Furtad and Sakri all others are alternate bearers.

The varieties mentioned in Table 11 b, are used for specific purposes, whereas majority of the varieties listed earlier are used for table purpose. Clonal variation among these varieties was quite common. Saccaradin is a sweet variety that possessed the best keeping quality because of its thick skin and hard flesh.

Table 11 b: Varieties of mango used for specific purposes

Sl. No.	Variety	Purposes
1.	Salcete Mussarat Bardez Mussarat	Jam, canning, other processed products
2.	Dosi Ambo	Candy making
3.	Karrel (Carreira), Babio, Manglech, Jose	Pickles preparation
4.	Rynold, Udgo, Xavier	Juice making
5.	Matekin	Raita making

Table 12: Comparison between Mankurad and improved seedling of Mankurad

Characters	Mankurad	Improved Seedling
Fruit weight (g)	278.0	320.0
Fruit size	small to medium	Medium to Big
Flesh (%)	75.98	78.29
T.S.S. (Brix%)	21.4	22.0
Presence of fibre	Fibreless	Fibreless
Skin colour	Yellowish orange	Yellowish orange
Flush colour	Deep pink mostly on ventral shoulder	Deep pink on both shoulders
Keeping quality	Poor	Slightly better
Flavour	Excellent	Excellent, similar to Mankurad
Bearing	Alternate	Regular

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BPP-1	0.000	0.000	0.000	0.553	0.533	0.138	4.00	20.43
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Keeping quality	Poor	Slightly better
Flavour	Excellent	Excellent, similar to Mankurad
Bearing	Alternate	Regular

Outstanding mango collections that need commercialisation and promotion

1. Improved Mankurad seedling

The tree was located at Altinho, Mapusa in the compound of Dr. A. B. Cardozo. It was a seedling of mankurad planted in 1958. The fruit was exhibited in an exhibition of mangoes organised by the Lions Club at Margao in May 1992, and fetched the first prize. The tree resembled Mankurad, the leading popular variety of Goa, except the intense red dolouration of the panicle. It was reported to be regular and early maturing, bigger in size oval fruits possessed excellent colour and aroma with fibreglass pulp. The flavour was also similar to Mankuad. Thus, the tree had acquired almost all the characters of its parent besides having other commercial attributes Table 12. This is a very rare phenomenon in nature. This seedling selection needs to be popularised for commercial cultivation. The keeping quality of this fruit is slightly better than its parent. The flesh per centage is also higher compared to Mankurad. Considering the above facts, this seedling is a real improvement over the existing Mankurad variety.

2. Irmao Xavier

This is an improved form of Xavier. The origin is unknown. This is popular in some localities of Bardez taluka in North Goa. Vegetatively the trees look similar to Xavier. Bearing is regular to irregular. Compared to Xavier, the above variety is big fruited, sweeter, fiberless, less juicy, better flavoured, round in shape and possesses better keeping quality. This variety needs to be promoted in place of Xavier which is medium sized, juicy, fibrous and oblong in shape with poor keeping quality.

3. Monteiro

The variety was located in Assolna of Salcette Taluka of South Goa. An alternate bearer producing fruits in clusters. Fruits are small to medium, kidney shaped, fibreless and extremely sweeter (T.S.S. 30%). The tree erect growing and suited for homestead cu vation considering for its excellent fruit qua Small fruit size does not warrant its comm cial cultivation.

4. Salgadin

An excellent variety located in Chan of South Goa and needs wider adoption. T tree is less vigorous with an open crown. T fruits are oblong, possess excellent col and flavour, medium sized fruits, borne oc sionally in clusters.

5. Rynold

A juicy variety located from Uthorda South Goa. The fruit is medium sized an valued for its excellent flavoured juice.

6. Black Culas

The tree was located in Galjibag Canacona Taluka in South Goa. Fruit is el gated like Culas. Even after ripening the f retains olive green colour, hence the lo name. The tree has no resemblance to Cu Compared to Culas, the variety is regular w sweet fruit and free from the turpentine flavo

7. Udgo clone-Neura Pecan

This clone was collected from Neu Pecan in Tiswadi taluka and reported to be best Udgo of Goa. The fruit is sweet and flavour and other qualities of the fruits excellent compared to other Udgo trees.

8. Hilario clone-Mairna

This clone of Hilario was collected fr Mairna (Siolim) of Bardez Taluka. The frui big and fleshy. The leaves show distinct wa ness compared to other Hilario trees.

The present germplasm collection c sists of 68 distinct varieties of local origin; clonal collections of Mankurad, five clones Hilario, one clone each in Udgo, Fernan and Salcete Mussarat; eight popular So Indian varieties (Ratnagiri Alfonso, Totap Kesar, Neelam, Alampur Benesh

Himayuddin, Kalappady, Vellaikolamban) and thirteen hybrids (Amrapali, Arka Puneet, Arka Anmol, Arka Aruna, HB-87, HB-56, HB-151, HB-45, Ratna, Sindhu, Neelgoa, Mallika and Kalappady x Bangalora).

Evaluation of the hybrids was continued during the year. The fruit quality was excellent in Ratna, Amrapali and HB-87. However, HB-87 is lacking in good colour and appearance. All are late maturing and hence the fruits become harvestable only by the end of May to June. Inspite of the rains in June in Goa, Amrapali among the three hybrid selections appears to be the least infested by fruit flies. The yield data pertaining to the hybrids, popular cultivars of South India are furnished in Table 13.

Kesar, a popular variety from Gujarat was found to be late maturing and hence the fruit quality suffered during the rains in June. Goan varieties like Hilario, Fernandin and Udgo that are late maturing like Kesar, are better flavoured and accepted in the Goan market. Therefore, the scope of commercial cultivation of Kesar is limited in Goa. Ratnagiri and Alfonso were severely suffered from spongy tissue in fruits. Kalappady, a popular variety of Kerala was found to be dwarf, late maturing regular and prolific in bearing with acceptable fruit quality.

Among the local varieties established, Maxima, Salgadin, Fernandin and Colaco Branco have flowered and yielded fruits. The evaluation work of germplasm is in progress.

Cultar (paclobutrazole) was tested for induction of flowering in Mankurad mango trees of 12 years old, at 10, 15 and 20 ml per

Table 13: Yield of hybrids, and popular South Indian varieties of mango

Hybrid/Variety	Year of planting	Average no. of fruits/ plant	Average weight of fruits/ plant (kg)	Average fruit weight (kg)	Cumulative yield/ tree	Remarks
Hybrids						
Amrapali	13.6.84	142	20.281	0.143	93.758	Less attack by fruit flies
Neelgoa	13.6.84	145	21.445	0.148	134.033	Susceptible to pink disease
Ratna	13.6.94	60	13.249	0.221	24.506	-do-
HB. 56	13.6.84	183	55.063	0.300	116.391	Lacks good fruit colour
HB.45	13.6.84	68.5	19.475	0.284	48.851	Poor fruit quality
HB.87	13.6.84	114	22.589	0.198	57.020	Susceptible to fruit flies, thrips
HB-151	13.6.84	162	11.571	0.071	33.230	Fruits small and late maturing
Varieties						
Kesar	13.6.84	138.5	30.753	0.222	32.586	Late maturing
Neelum	13.6.84	12	2.400	0.200	2.400	Susceptible to pink disease
Ratnagiri Alfonso	16.8.82	72.3	20.00	0.277	21.652	Fruits with spongy tissue
Kalappady	13.6.84	138.5	17.050	0.123	41.652	Very dwarf form

tree. The response appeared to be positive at 20 ml per tree with an increased yield of 60.4 per cent over control. The trial is in progress.

As nucleus planting material, 1800 grafts of mango hybrids viz Amrapali, Ratna and HB-87 were raised for distribution to the public during the year.

2. Selection of promising varieties of horticultural and plantation crops

(PA Mathew, DG Dhandar, S Chander Rao)

Oil Palm

The evaluation of five teneras planted in October, 1991 was continued. The data collected on the vegetative and flowering characters are presented in Table 14. By April, 1994 all the experimental palms have flowered, the preflowering duration being 2 years and 6 months.

The vegetative growth was highly satisfactory as revealed by height and girth increments and rate of leaf production. However, no significant differences for these characters were noticed between the teneras. The tenera 35 D x 291P indicated the shortest pre-flowering duration and was significant over other entries. The maximum number of male inflorescences were produced in 35D x 291P followed by 18D x 32P and the lowest number was in 65D x 111P which was significantly lower compared to 35D x 291P. As regards female inflorescence production, no significant difference was noticed between the entries though the highest number was observed in 35D x 291P. Considering all aspects, 35D x 291P appeared promising.

Incidence of red palm weevil, bud rot and leaf spot disease (*Colletotrichum* Sp.) were observed sporadically.

Post Entry Quarantine inspection of 50,000 oil palm seeds imported by M/s Godrej Soaps Ltd., Bombay was carried out during the year. The seeds were imported from Costa Rica.

Table 14: Growth and flowering of oil palm hybrids at Goa

Hybrid (Tenera)	Height increment (m)	Girth increment (m)	No. of leaves produced per month per year	Time taken for first flowering (months)	Cumulative number of inflorescences produced per plam for two years	
					Male	Female
82Dx266P	0.36	0.53	2.36	16.00	7.77	3.46
124Dx266P	0.51	0.48	2.54	17.77	7.00	3.31
18Dx32P	0.56	0.46	2.61	16.46	10.62	2.46
35Dx291P	0.58	0.40	2.56	11.62	12.92	6.85
65Dx111P	0.54	0.43	2.42	16.69	5.92	3.92
F	1.25	1.47	0.80	3.06*	3.09*	2.30
SEM+	0.08	0.04	0.10	1.36	1.63	1.11
	NS	NS	NS			NS

* significant at 5% level

Papaya

Populations of Thailand and Solo escapes from Papaya ring spot virus and were monitored for disease expression. Thailand showed expression of mild symptoms and Solo indicated no disease incidence even after one year. However, the fruits of Solo were very small.

3. Standardisation of agrotechniques for pineapple in Goa

(DG Dhandar, PA Mathew)

A trial to evalute various potassium (K) levels on fruit quality and yield of pineapple variety Kew was continued during the year. Data on the first and second ratoons were collected and analysed to assess the effect of K doses on yield and quality of pinapple (Table 15 and 16 respectively).

Table 15: Effect of K levels on yield and fruit characters of pineapple variety Kew (first ratoon)

Treatments of K g/plant	Yield (t/ha)	Average Fruit weight (kg)	Average Fruit length (cm)	Average Fruit breadth (cm)	Average Crown weight (kg)	Average Crownlength (cm)
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
SEM ±	3.80	0.21	1.24	0.43	0.020	1.70
CD 5%	11.80 NS	0.65 NS	3.82 NS	1.33 NS	0.060 NS	5.24 NS

Table 16: Effect of K levels on yield and fruit characters of pineapple variety Kew (second ratoon)

Treatments K (g/plant)	Yield t/ha	Average Fruit weight (kg)	Average Fruit length (cm)	Average Fruit breadth (cm)	Flesh (%)	Juice (%)	T.S.S. 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 ±	1.002 NS	0.802 NS	2.276 NS	2.416 NS	1.740 NS	0.715 NS	0.395 NS	0.003 NS	0.291 NS

The results showed that none of the characters studied were significantly affected by the various levels of K. Comparison for T.S.S. could not be done between treatments because of the non-availability of fruits before the rainy season. The ratoon crop was poor as evident from the yields.

In the second ratoon also the effect of K treatments on yield and other fruit characters were nonsignificant. Hence, it may be surmised that at 50 ppm basal level of K in the soil, application of K at 6 g/plant/year was quite adequate to maintain the productivity and quality of fruits. However, the yield of ratoon crops were poor compared to plant crop. The trail has been re-laid out to confirm the results.

Mauritius variety of pineapple is being extensively grown in some parts of Kerala and Karnataka. Hence, this was introduced to Goa. The performance of this clone as compared to Kew is given in Table 17. The average fruit weight is small but with excellent quality and high T.S.S. It is early bearing and completes harvest before the rains in June and hence fetches good price. Owing to less juice content, transport and keeping quality of the fruit is very good. The eyes on the fruit surface are raised and the leaves possess thorns on the margins. The flesh is golden yellow and is attractive being free from fibre. Fruits weigh only upto 1.5 kg. Hence suitable practices to enhance the fruit size is needed.

4. **Studies on coconut based cropping systems**

(BL Manjunath MS Balbatti, PA Mathew, DG Dhandar)

There is enormous scope for intensification of cropping in coconut by inter and mixed cropping with suitable crops, as sole cropping does not fully utilise the basic resources like soil, solar radiation, and aerial environment and does not provide adequate on farm employment and income. This is more so in coconut because unlike in annual crops, inter-

Table 17: Comparison of yield and other characters of Kew and Mauritius (Plant crop)

Sl. No.	Characters	Mauritius	Kew
1.	Average yield (t/ha)	43.60	94.40
2.	Average fruit weight (kg)	1.02	2.17
3.	Average fruit length (cm)	15.49	18.91
4.	Average fruit bredth (cm)	10.47	13.36
5.	Average flesh (%)	49.00	66.33
6.	Average juice (%)	21.98	49.47
7.	Average T.S.S. (Brix)	17.00	12.33
8.	Time taken for first harvest (months)	18.70	21.80
9.	End period of harvest	May	July
10.	Keeping quality	Very good	Poor

cropping in coconut does not affect the productivity of the main crop. But being done unscientifically, in terms of selection of crops and varieties and other management practices to be followed, it results in poor returns from the crops. Hence the envisaged project aims at developing coconut based cropping system suitable for the agro-climate conditions of Goa with the following major objectives.

1. To develop a crop combination model that will effectively utilise, soil, air space and incident sunlight for production of biomass.

2. To maximise the productivity and net returns from coconut plantations by identifying suitable cropping system.

3. To work out the economics of the system.

The trial was laid out in a Randomised Block Design with three replications with inclusion of locally preferred seasonal / annual intercrops as treatments in a coconut garden with mango (variety Amrapali) as component crop. During the year, the yield of main (coconut) crop was 3607 nuts with a gross return of Rs. 14,600/ha while the yield of component crop (mango) was 1.45 Q/ha with a gross return of Rs. 1159/ha, together accounting for a net return of Rs. 12,759/ha, as compared to base year (without intercropping) yield of 517 nuts/ha of coconut and 3.50 Q/ha of mango.

Among the intercrops grown in kharif, ginger yielded 62.55 Q/ha of fresh rhizomes with a net additional return of Rs. 62,187 /ha while turmeric yielded 117.29Q/ha of fresh rhizomes, with a net additional return of Rs. 42,161/ha. Pineapple yielded 40.57 Q/ha during the year with a net return of Rs. 3,573/ha (Table 18).

During rabi season, among the four additional intercrops introduced, cluster beans

Table 18: Yield of different intercrops under cropping system in coconut along with economics

Season	Crop	Yield (Q/ha)	Gross returns (Rs.)	Cost of Cultivation (Rs/ha)	Net Profit/Loss (Rs/ha)
	Ginger	62.55	93,750	31,563	62,187
Kharif	Turmeric	117.29	73,019	30,859	42,161
	Pine apple	40.57	16,229	12,656	3,573
	Cluster Beans	10.57	10,570	6,333	4,237
	Veg. Cowpea	1.71	3.420	2,760	660
Rabi	Chillies	10.17	12,204	6,146	6,058
	Brinjal	27.03	16,218	5,833	10,385
	Amaranthus	5.78	1,156	2,467	-1,311
Summer	Veg. Cowpea	2.42	4,840	3,073	1,767
	Tomato	0.78	936	6,667	-5,731
	Bhendi	7.19	7,190	4,427	2,763
	Coconut	3607 Nuts	14,600		12,759
		(517)*		3,000	
	Mango	1.45	1,159		
		(3.50)*			

* Base year (1992-93) Yield

yielded 10.57 Q/ha accounting to a net additional return of Rs. 4,237/ha while chillies yielded 10.17 Q/ha leading to a net additional return of Rs. 6,058/ha. Brinjal yield was 27.03 Q/ha with a net additional return of Rs. 10,385/ha. However vegetable cowpea performed poorly by yielding only 1.71 Q/ha leading to a net return of Rs. 660/ha.

During summer season, the cluster beans was rotated with tomato, vegetable cowpea with bhendi, ginger with amaranthus and turmeric with vegetable cowpea. Among these crops, bhendi was found to be profitable with an yield level of 7.19 Q/ha and net returns of Rs. 2,763/ha while vegetable cowpea (2.42 Q/ha) gave a net return of Rs. 1,767/ha. The other crops were non profitable.

The light interception through coconut-mango canopy was measured at regular intervals throughout the year using Line Quantum Sensor and for comparison a control plot was maintained in an open light condition by raising all the intercrops. It was observed that percentage transmission of light through the coconut - mango canopy varied from 16.49 per cent to 56.26 per cent compared to open light conditions. (Table 19).

5. Studies on management of major diseases of Plantation and fruit crops of Goa

(S Chander Rao)

a) Survey, isolation, identification and cataloguing of organisms associated with diseases

In continuation of the study during last four years, random disease survey of the crops like coconut (c), arecanut (a), oil palm (o), cashew (CA), mango (M), banana (B), papaya (P), sapota (S), guava (G), jackfruit (JF) and breadruit (BF) were carried out in 1993-94 also. The crop disease intensity for each taluka was prepared using the data collected. Soil samples collected from rhizosphere from the disease affected fruit plants were observed. Some of the identified organisms are *Alternaria alternata* (G,JF), *Aspergillus niger* (P, B), *Aspergillus candidus* (M, G, P), *Chaetomium* spp (S, JF), *Cladosporium cladiosporiodes* (BF, P,B), *Drechslera halodes* (P,G,M) *Fusarium solani* (P,S, B), *Humicola* SPP. (B,P,) *Nigrospora* spp (P,M), *Pencillium notatum* (M,B,P,G), *Pestalotiopsis pulmarum* (M,B,P,BF), *Pestalotiopsis* spp. (BF, JF) *Pythium aphanidermatum* (B,P,S,G), *Pythium*

Table 19: Seasonal PAR* (μ mol s^{-1} m^{-2}) under coconut and open light conditions

	Rabi 1993-94					Summer 1994		
	October	November	December	January	February	March	April	May
Coconut canopy	9.32	12.32	11.08	15.73	23.46	22.16	21.44	25.88
Full Radiation	26.28	74.73	38.85	34.74	47.35	45.88	47.49	46.00
% Transmission of light	35.46	16.49	28.52	45.28	49.54	48.31	45.15	56.26

* PAR - Photosynthetically Active Radiation
Measured by
Licor Line Quantum Sensor.

debaryanum (M,B) *Trichoderma viridis* (G,P,B,M), *Zygorhynchus* spp (JF,S).

To explore the possibility of aerial survey for mapping of different crops and their disease status through remote sensing, efforts are being made to get the co-ordination of National Remote Sensing Agency, Hyderabad.

Pathogenicity trial of fruit drop disease in bread fruit and Bio-assay studies of cultures *in vitro*

Fungal species of *Colletotrichum* and *Phytophthora* were isolated from the infected fruit tissues and stalks of breadfruit. It is observed that, the primary infection of *Collectotrichum* fungi noticed immediately after the emergence of inflorescence and becomes active and colonize the pedicel and upper end of the fruit during the fruit button stage onwards.

Later on *Phytophthora* as a secondary infection invades the fruits and leads tissue to decay. This is confirmed with the pathogencity test. Fruit borer insect or larvae is commonly seen associated with infected fruits.

In vitro bio-assay studies of five fungicides namely, Copper oxychloride (Blitox), Triedomorph (Calixin) Mancozeb (Indofil M-45) Carbendiazim (Bavistin) and Ceresan were tested. Preliminary results indicated that mancozeb at 100 ppm and Blitox at 200 ppm reduced the mycelial growth of Colletotrichum and *Phytophthora* respectively, upto 50 per cent over control (Table 20).

Trials conducted on control of bacterial blotch (wet rot) disease indicated that, by reducing the moisture content of the substrate to 50-60 per cent coupled with dipping or spray of substrate beds with formalin - 50 ppm solution reduced the disease incidence from 25 to 10 per cent.

6. Studies on Mushroom cultivation in Goa

(S Chander Rao, KD Patil, VY Gaonkar)

Under this Project, studies carried out on different aspects of mushroom production are summerised below

a) Collection and exploration of wild mushroom flora

Four types of wild mushrooms were collected and identified as *Volvariella* spp., *Tremella* spp., *Lentinus* spp., and *Coprinus* spp.

Coprinus comatis and *Podaxis pistillaries* mushrooms collected and isolated during last year, were tried for production of spawn. Among the various substrates for spawn making, wheat grain was found suitable for *Podaxis* spp. which colonised the entire bottle in 18 days compared to 25 days by using Jowar grain. In case of *Coprinus* mushroom species, chopped

Table 20: Bioassay of fungicides against the causal organisms of breadfruit drop disease

Fungicide treatment	Per cent reduction of mycelium over control			
	Colletotrichum		*Phytophthora*	
	100 ppm	200 ppm	100 ppm	200 ppm
Copper oxychloride	10	22	48	60
Triedomorph	0	16	10	30
Mancozeb	65	75	0	10
Carbendizim	25	30	10	25
Ceresan	0	5	0	0
Control	-	-	-	-

paddy straw bits were found ideal for spawn production which took only 12 days compared to 15 days for Jowar and 16 days for wheat grain.

b) Studies on utilisation of mushroom spawn as bio degradable agent

The experiment on mushroom spawn as a biodegradable agent has shown that paddy stubbles inoculated with mushroom spawn, three days after paddy harvest (Treatment No. 2) colonised upto 90-100 per cent within 18-20 days and were completely degraded. The samples analysed for cellulose, ligin and carbon have shown reduction in their content to an extent of 41.3, 31.4 and 26.5 per cent respectively over control (un inoculated stubbles) whereas nitrogen content of the inoculated stubbles was increased from 0.4 per cent (control) to 0.9 per cent. Thus the C:N ratio was narrowed down to 27.8:1 in treated stubbles compared to the control (85.0:1) (Table 21)

This experiment indicates, mushrooms spawn is an efficient recycling agent for faster degradation of cellulostic wastes and helps in enriching the soil condition.

c) Studies on pest and diseases of Oyster mushrooms

Regular observations recorded from commercial growing units indicated that, about 20 per cent damage of spoilage of mushroom beds or fruiting bodies were caused by pests and diseases incidence, out of which fungus, bacteria, insect and miscellaneous caused 6.0, 6.4, 5.6 and 2.0 per cent respectively. Fungal organisms like *Trichoderma, Coprinus, Aspergillus, Pencillium*, insects like Scarid and Phorid flies and bacteria like *Pseudomonas* spp were commonly encountered from mushroom growing units.

Few trials were conducted for the control of bacterial blotch (wet rot) which was identified as a major problem. The results indicated that, when moisture content of the substrate was reduced from 70 per cent (as generally recommended) to 50-60 per cent level and spraying or dipping in 50 ppm formalin solution reduced the disease incidence from 25 to 10 per cent.

d) Standardisation of *Calocybe indica* cultivation.

During year three trials were undertaken on cultivation of *Calocybae indica*. Only one trial, i.e. October-December was successful where yields upto 15 per cent biological efficiency were obtained.

Table 21: Effect of mushroom spawn used for degradation of paddy staw stubbles

Treatments	Moisture content of paddy straw/ stubbles (%)	Mycelial colonisation over stubbles (%)	Days	Approximate analysis of stubbles Cellulose (%)	Lignin (%)	C (%)	N (%)	C:N Ratio
T1 - Inoculation of spawn before paddy harvest	75-80	10	20	33.2 (10.3)	18.8 (7.8)	30.0	0.4	75.0:1
T2 - Inoculation 3 days after harvest	60-65	90-95	18-20	23.7 (41.4)	14.0 (31.4)	25.0	0.9	27.8:1
T3 - Inoculation 8 days after harvest	40	50	25	35.8 (1.4)	20.0 (2.0)	32.2	0.5	64.4:1
T4 - Inoculation 12 days after harvest	20	Trace	-	36.2 (10.3)	18.8 (7.8)	30.0	0.4	75.0:1
T5 - Control	-	-	-	40.4	20.4	34.0	0.4	85.0:1

3.3 Animal Sciences

1. Performance of crossbred pigs in Goa

(AR Bhattacharyya, RNS Sundaram, NS Nair)

A new strain in middle white Yorkshire boar was introduced from K.A.U., Trichur for production of pure and cross breds and for their evaluation. Reproductive performance was studied in pure Yorkshire (Y), Yorkshire local cross (YF_1), Yorkshire x local F_2 cross (Y F_2) and local x landrace F_2 cross (L F_2). Altogether, 15 farrowings were observed. The data is presented in Table 22.

From the Table 22, it can be seen that the lowest age at maturity and gestation period were in pure yorkshire followed by LF_2 crosses. It was observed that introduction of new boar has reduced the number of still birth in pure and F_1 crosses while it was nil in F_2 crosses. Further, an increase in litter size was observed by introduction of new strain.

The production performance in all the above groups were studied and the results are presented in Table 23.

From the results it may be noted that the growth rate of pure Yorkshire was faster in the initial stages (upto 12th week) and declined thereafter whereas in crossbreeds the faster growth rate was observed even upto 20th week.

No infectious disease was observed in the adult stock. However, there were sporadic cases of pneumonia in small piglets. One systemic disease (agalactia) was observed in

Table 22: Reproductive performance of pure and cross bred pigs

Breed	Age at maturity (days)	Gestation period (days)	Farrowings (No)	Average litter size	Average litter size	Still birth (No)
Y	318.5	114.5	5	7.2 (3-9)	0.83	4
YF_1	461.0	115.5	2	8.0 (5-10)	0.67	1
YF_2	372.0	115.0	1	5.0	0.96	-
LF_2	352.3	116.0	7	6.3 (3-10)	0.64	3

Table 23: Production performance of pure and crossbred pigs

Breed	Average body weight (Kg)			Average daily weight gain (g)		
	8 WK	12 WK	20 WK	8 WK	12 WK	20 WK
Y	8.5	12.9	19.8	137	157	123
YF_1	7.8	12.0	21.3	126	152	166
YF_2	8.9	12.8	21.4	142	139	154
LXF_2	8.2	12.9	21.6	135	168	155

landrace cross.

Feeding trial with cashew apple waste upto 30 per cent had shown no adverse effect on feed intake and digestibility.

Effect of castration on growth and carcase characteristics was studied in crossbreeds. The results are presented in the Tables 24 A and 24 B.

It was observed that the castrated group showed higher daily weight gain (208 g/day), as compared to intact group (166 g/day) with more fat deposition.

2. Introduction and performance studies of meat type rabbit in Goa

(RNS Sundaram, AR Bhattacharyya, EB Chakurkar and NS Nair)

Studies on breeding and production performance of exotic and cross bred meat rabbit under local climatic conditions were continued. During the year a total of 41 kindlings were recorded. Average litter size of Soviet Chinchilla (SC), New Zealand white cross and Grey giant cross was 4.0, 4.6 and 6.3 respectively. Average daily weight gain of New Zealand white cross was 16.31 g and that of SC cross was 17.49 g.

Concentrate feed with two levels of crude protein i.e., 13 per cent and 18 per cent, formulated and fed to adult doe to study the effect of nutrient level on production performance. Dry matter intake per day was 134g and 147g for control and experimental group respectively. The number of cases of agalactia recorded was over 28.57 per cent in experimental group fed with 18 per cent crude protein as compared to control group (53.33 %) (Table 25).

Table 24 A: Effect of castration on growth in crossbred pigs

Age (Wk)	Average body weight (Kg)		Average daily weight gain (g)	
	Castrated	Control	Castrated	Control
Birth	1.03	0.93	--	--
4	3.95	4.20	100	118
8	9.65	10.25	204	216
12	14.60	14.25	177	143
16	20.05	19.25	195	179
20	26.00	23.30	214	145
24	32.10	28.60	214	189
-	Overall average gain in body weight after castration		208	166

Table 24 B: Effect of castration on body fat deposition in crossbred pigs

	Back Fat (cm)			Loin Fat (cm)		
	I	II	III	I	II	III
Castrated	4.0	4.0	3.0	7.0	3.0	3.5
Control	3.5	3.0	1.5	4.1	2.5	2.0

Table 25 : Studies on agalactia-Effect of nutrient level on the production performance in rabbit

Feed ingredients	Energy level K cal/kg	Crude protein (%)	No of animals mated	No. of agalactia cases	Per cent of agalactia recorded
Experimental diet Goundnut cake (25%) Wheat bran (50%) Wheat (25%)	2.65	18.00	14	4	28.57
Control diet Goundnut cake (12%) Wheat Bran (63%) Wheat (25%)	2.58	12.93	15	8	53.33

Environmental temperature and humidity are the major factors which interfere with the growth and productivity in rabbit. To over come the environmental stress, and ayurvedic preparation was added in the rabbit diet @ 1 tablet/kg feed and feeding trial was conducted on eight young rabbits. The average daily weight gain was higher (16.78 g) in experimental group than in control group (15g). The average dry matter digestibility for experimental and control group was 69.96 per cent and 69.02 per cent, respectively, indicating that the incorporation of antistress tablet marginally increased the daily weight gain.

Benzyl benzoate application gave an effective control over menge mite in rabbits.

Salient achievements

1. To overcome the problem of agalactia, in rabbits, it was identified that the incidence can be reduced from 53.32 per cent to 28.5 per cent by increasing the crude protein content to 18 per cent in the concentrate feed.

2. Fermentation of rice bran with five per cent molasses and two per cent bakers yeast increased the crude protein content of bran from 6.3 per cent to 8.5 per cent and dry matter digestibility from 68.7 per cent to 72 per cent.

3. Physical parameters required for optimum fermentation of coir dust were identified. Bio degradation of coir dust at 80 per cent moisture level for 60 days reduced the lignin content of the substrate by 9.6 per cent.

3. Effect of feeding microbial protein on tissue growth and muscle protein turnover in rabbits

(RNS Sundaram)

Physical parameters important for solid state fermentation of coir dust viz., moisture percentage, fermentation period and substrate enrichment were studied by inoculating with *Pleurotus florida* spawn at different moisture levels from 40 per cent to 80 per cent. Fermented bio mass was evaluated for Acid Detergent Fibre (ADF) and Lignin content after 20 days. Samples inoculated at 40 per cent and 80 per cent moisture level has ADF 77.30 per cent and 73.82 per cent when compared to control (81.17%). Effect of fermentation period on biodegradation of coir dust was studied on 0, 30, 60 and 90 days. The results are presented in Table 26.

The crude protein content of control and 90 days fermented samples were 2.62 per cent and 8.75 per cent respectively. The lignin content was reduced by 11.7 per cent when coir dust was fermented for 90 days. Effect of substrate enrichment on lignin bio degradability in coir dust with *Pleurotus* sp was studied in 20 days fermented coir dust. Growth of mycelia in samples enriched with maize was higher when compared to control and other treatments viz., wheat bran and cellulose enriched samples. (Table 27). The acid detergent fibre was 76.12 per cent and 66.42 per cent for control and maize enriched samples, respectively. The crude protein content was higher in maize enriched substrate than in other treatments.

To enhance the nutritive value of rice bran, the ingredient was fermented with 5 per cent molasses and 2 per cent bakers yeast for five days. The crude protein and ADF content of treated rice bran was 8.56 per cent and 30.16 per cent, respectively as compared to 6.30 per cent and 37.44 per cent in untreated

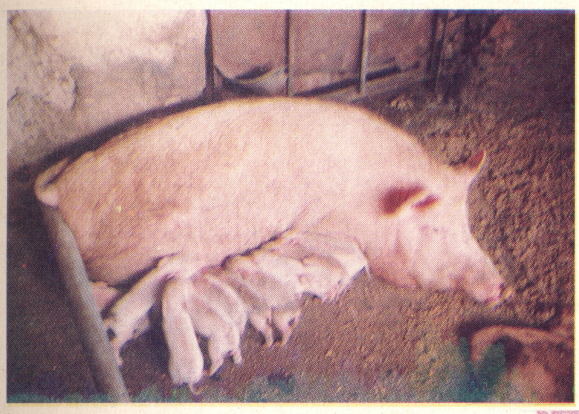
Table 26 : Effect of *Pleurotus florida* inoculation on solid state fermentation of coir dust

No. of days fermented	Acid detergent fibre (%)	Lignin (%)	Cellulose (%)	Crude protein (%)
0	74.20	44.51	24.58	2.62
30	71.28	39.40	23.94	5.25
60	70.13	34.79	22.85	6.12
90	67.60	32.80	19.40	8.75

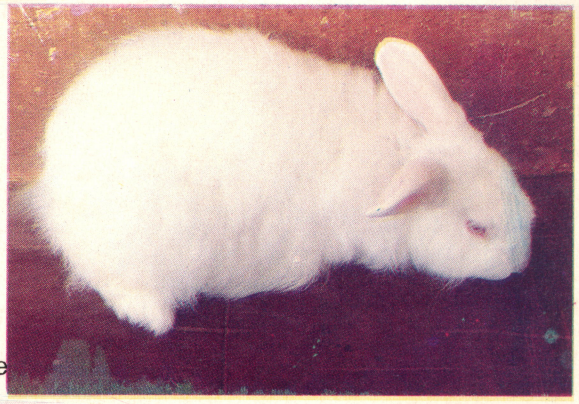
Table 27 : Effect of added substrate on coir dust fermentation

Substrate	Acid detergent fibre		Lignin		Crude protein	
	Composition	Per cent reduced	Composition	Per cent reduced	Composition	Per cent reduced
1. Coir dust	76.12	-	44.02	-	2.62	-
2. Coir dust + (80 part) maize (20 part)						
Control	66.42	-	36.18	-	3.91	-
Inoculated	59.10	7.32	29.82	6.36	7.85	3.94
3. Coir dust + wheat bran						
Control	67.04	-	39.44	-	3.50	-
Inoculated	63.24	3.80	34.20	5.24	7.00	3.50
4. Coir dust + cellulose						
Control	69.41	-	38.06	-	2.33	-
Inoculated	65.18	4.23	37.82	0.24	5.25	2.92

PLATE 3



Yorkshire breed of pig showing good litter size



Meat type rabbit - Newzealand white

Mange - a serious skin disease in rabbits

Screening of deep water rice varieties for rice - fish integration

rice bran. Enriched bran was incorporated in the rabbit feed at 25 per cent level and feeding trial was conducted on eight adult rabbits, for four weeks. The results of the trial is presented in Table 28.

Dry matter intake/kg body weight was higher in experimental group than in control group. Dry matter digestibility was higher (72.01 per cent) in experimental group than in control group (68.73%) indicating that the enrichment had improved the digestibility of rice bran.

4. Introduction and performance studies of ducks and Japanese Quails under Goa conditions

(NS Nair, RNS Sundaram, EB Chakurkar and AR Bhattacharyya)

A. Japanese Quails

The egg production in Japanese quails was recorded and presented in the Table 29.

From the Table 29 it may be noted that the quails attained maturity by second month and started laying. They attained peak production by fourth month and egg production declined after seventh month and was very poor after eighth month. This finding is in confirmation with the earlier findings.

The mortality in adult quails was very low (1.8%) and there was no outbreak of any major disease although these birds were reared without any vaccinations and routine medications.

Table 28 : Effect of feeding enriched rice bran on intake and digestibility in rabbit

Feed Composition	Control group	Experimental group
Wheat	25.00	25.00
Groundnut cake	25.00	25.00
Wheat bran	25.00	25.00
Rice bran + mineral mix	25.00 (untreated)	25.00 (enriched)
Average dry matter intake (g/day/animal)	87.99	97.25
Average dry matter digested (g/day/animal)	60.48	70.03
Dry matter digestibility (%)	68.73	72.01
Dry matter intake/kg body weight (g)	56.00	60.00

Table 29 : Egg production in Japanese quails

Age of birds (month)	Egg production (%)
2	28.9
3	55.0
4	68.8
5	48.8
6	45.0
7	42.5
8	30.2

B Ducks

For introduction and cross breeding in ducks, hatching eggs of 'desi' ducks were procured from the Government Duck Farm, Niranam, Kerala and were kept for hatching. The performance of these ducks is presented in the Table 30.

Table 30 Performance of desi duck

Egg weight	59.2 g
Fertility	63.0%
Hatchability	20.0%
Weight of one day old duckling	31.7 g
Weight at 1st week	51.7 g
Weight at 2nd week	86.0 g

The project was closed because the cross breeding of ducks in Government Duck Farm, Niranam has not given any encouraging result. On the other hand the performance of cross bred ducks was inferior to pure white pekin ducks.

5. Studies on reproduction aspects of meat animals to improve the fertility and fecundity

(EB Chakurkar, AR Bhattacharyya, RNS Sundaram and NS Nair)

The work under the project was initiated during the year under report, for the selection of breeding stock, production of litters and standardisation of analytical techniques.

The sows of pure Yorkshire breed were selected for breeding from different age groups and parity. These sows were bred with boar of the same breed. Data recorded on litters size at birth, at weaning and on three farrowings, are presented in theTable 31.

From the Table 31 it can be seen that the average litter size at birth was 7.70 where as at weaning it was 4.0. The average birth weight was 0.80 kg. Twelve piglets were kept for future studies. Similarly rabbit does of Soviet Chinchilla, New Zealand white, and Grey Giant breeds of different age group and parity were selected. Total 19 kindlings were studied for litter size at birth and birth weight.

Average litter size at birth in Soviet Chinchilla, New Zealand white and Grey Gaint breeds were 4.0, 4.5 and 5.5, respectively. Average birth weight was 39.13 in Soviet Chinchilla 41.5 in New Zealand White and 42 in Grey Gaint.

For ascertaining normal values of the herd, blood serum glucose was estimated by using Folin Wu method in four rabbits and five pigs. It was 90.32 mg/100ml and 131.93 mg/100ml for rabbit and pig, respectively. By biuret method serum protein was estimated in 12 rabbits and 8 pigs serum samples. It was 5.09 gm/100ml and 5.07 gm/100 ml for rabbit and pig, respectively. Further work is in progress.

Table 31 : Birth weight, litter size at birth and at weaning in different breeds

Animal	Birth weight (gms)	Litter at birth	Littersize at weaning
Sow	800.00	7.70	4.0
Rabbit Doe			
-Soviet chinchilla	39.13	4.0	1.5
-New Zealand white	41.50	4.5	0.8
-Grey Gaint	42.82	5.5	4.0

3.4 Fishery Science

Under Fishery Science, there are two projects on integrated fish farming, one on fish - poultry and another on rice-fish combinations.

1. Fish- Poultry farming system under Goa conditions

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

With an aim to recycle the poultry dropping through fish, a trial on poultry (chicken) - fish combination was conducted during the year under report. The trial was conducted with three fish species namely catla, rohu and mrigal, at a stocking density of 3000/ha and 30 Austro-White hybrid chicken. For a culture period of 15 months, the estimated fish production was 3,500 kg/ha. The individual maximum growth was 58 cm and 1.7 kg for mrigal.

The chicks were reared in the poultry shelter over fish pond for 8 months. The initial average body weight of six weeks old individual chick 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. This may be due to the wire mesh bottom and healthier and better condition of the shelter over fish pond. The average final weight of birds was 1580 g over eight months.

The birds started laying at the age of five and half months and attained peak production at the 8th month. The average egg production at 5th, 6th, 7th and 8th months were 29.5 per cent, 37.8 per cent, 41.3 per cent and 61.9 per cent respectively.

2. Rice-cum-fish culture suitable for Goa

(S Subramanian, BL Manjunath)

Utilization of the naturally produced plankton in the stagnated waters of rice field for the production of fish as additional output is the objective of this combination. During kharif, 1993, four rice 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 successfully transplanted in deep water condition (over 50 cm in depth), in addition to Vyttila-1 which was already screened to be a suitable variety. Even though flowering was normal, seed setting was very poor in all the five varieties tested.

In rabi 1993-94, rice varieties Kalinga-III and Bharat Prabha were transplanted under water logged condition.

Advanced fingerlings of carps were raised separately for stocking the rice-fish plot. However, stocking could not be done to the desired level due to heavy mortality in the rearing tank.

3.5 Transfer of technology

The Krishi Vigyan Kendra of ICAR Research Complex has been serving as the extension agency of the Research Complex in transferring the latest farm technology to the farmers through their vocational training to the farmers, farm women and rural youth as well as the extension staff of the development departments. It has been performing other functions like conducting on-farm research to verify the proven technologies at the field level, conducting field demonstrations at the farmers level to demonstrate the technologies and finally the implementation of the Lab to Land programme. During the year 1993-94, the krishi vigyan kendra implemented various transfer of technology activities.

1. Training and other activities

(HM Wasnik, VY Gaonkar, HR Pradbhudesai, SM Talaulikar, K Manikandan, KK Metar, P Lade and other Scientists)

During the year, the Krishi Vigyan Kendra (KVK) conducted 74 need based and skill oriented training courses and trained 135 participants comprising of farmers and farm women, rural youths and grass root level

extension personnel in the disciplines of crop Sciences, Horticulture, Animal Sciences and Home Science. The details of these training's are given in Table 32 a and b.

Lab to land programme

(HM Wasnik and KVK Staff)

Under this programme, 20 families were adopted under crop science, 50 in horticulture and 21 in animal science. The improved varieties of vegetable seeds, grafts of HYV of fruit plants, chicks and pigs, etc., were given to the families.

Under Crop Sciences, 20 farm families were selected in Saligao village of Bardez taluka in North Goa district. The preliminary survey was conducted to know their traditional cropping system which was either growing traditional pulse "Alsando" in rice fallows or keeping it fallow. Groundnut (var. Dh-3-30)

Table 32a : Details of Training programmes conducted by the Krishi Vigyan Kendra (KVK) during 1993-94

Sl. No.	Title of the course	Number of courses proposed			Number of courses conducted			Number of participants		
		ON campus	OFF campus	T	ON campus	OFF campus	T	M	F	T
I	Crop Science									
1.	Soil health and fertilizer management in field crops	2	3	5	2	-	2	29	10	39
2.	Rice based cropping system	2	2	4	-	-	-	-	-	-
3.	Ratoon management for sugarcane	1	2	3	1	-	1	20	9	29
4.	Production technologies for groundnut on residual moisture.	2	5	7	3	-	3	75	15	90
5.	Seed production techniques for groundnut	-	2	2	1	1	2	25	7	32
6.	Production technologies for pulses.	1	2	3	1	-	1	12	4	16
7.	Irrigation systems	1	-	1	1	-	1	50	17	67
8.	Vermiculture biotechnology	4	-	4	4	-	4	30	12	42
	Total	13	16	29	13	1	14	241	74	315
II	Animal Science									
1.	Backyard Poultry keeping	1	1	2	1		21	15	12	27
2.	Broiler keeping	2	1	3	3	-	3	36	12	48
3.	Layer keeping	2	1	3	2	-	2	30	6	36
4.	Rabbit rearing	1	1	2	1	-	1	8	2	10
5.	Piggery as an enterprise	1	1	2	1	-	1	7	-	7
	Total	7	5	12	8	1	9	96	32	128

Table 32a (Contd.) Details of training programmes conducted by Krishi Vigyan Kendra during 1993-94

Sl. No.	Title of the course	Number of courses proposed			Number of courses conducted			Number of participants		
		ON	OFF	T	ON	OFF	T	M	F	T
III	Horticulture									
1.	Coconut based cropping system	2	2	4	3	1	4	27	15	42
2.	Cashew cultivation technology	1	1	2	-	1	1	7	11	18
3.	Improved cultivation practices for vegetable	1	1	2	1	1	2	9	23	32
4.	Cultivation of fruit crops	1	1	2	-	1	1	-	21	21
5.	Production and propogation technology for roses	2	2	4	2	-	2	15	4	19
6.	Kitchen gardening	2	2	4	3	3	6	69	50	119
7.	Mushroom cultivation	4	2	6	7	-	7	42	65	107
8.	Mushroom spawn production	2	-	2	1	-	1	4	2	6
9.	Grafting techniques in cashew / mango	5	-	5	4	1	5	47	41	88
	Total	20	11	31	21	8	29	220	232	452
IV	Home Science									
1.	Home scale food preservation	3	4	7	5	1	6	-	116	116
2.	Low cost nutritious recipes	3	7	10	5	1	6	-	153	153
3.	Recipes from mushroom	1	2	3	1	-	1	-	20	20
4.	Crafts (Batik)	2	-	2	1	-	1	-	14	14
5.	Child care and preparation of weaning mix	2	2	4	-	1	1	-	50	50
	Total	11	15	26	12	3	15	-	353	353

was supplied to the beneficiaries alongwith other critical inputs like Rhizobium cultures, Gypsum, Thiram and pesticides. Training on scientific cultivation of groundnut was imparted and demonstration on seed treatment/sowing, gypsum application, etc., were held. The results obtained were encouraging and are presented in Table 33.

3. Research cum demonstration

(HM Wasnik and all KVK staff)

The Krishi Vigyan Kendra as part of its functions, laid out six demonstrations in horticulture on technologies, viz. top working, nutrition garden and treatment for stem bleeding affected palms. In home science, four demonstrations were conducted on fruits and veg-

Table 32 b : Training Programmes for Extension Functionaries

Sl. No.	Title	Number of courses proposed	Number of courses conducted	Number of participants
	Crop Science			
1.	Groundnut post harvest technology	2	1	14
2.	Approaches in biological pest control	2	1	15
	Total	4	2	29
	Horticulture			
1.	Coconut based cropping system	1	1	13
2.	Kitchen gardening	1	1	17
3.	Mushroom cultivation	1	1	19
	Total	3	3	49
	Home Science			
1.	Foods, nutrition and management for child development	2	2	33
	Total	2	2	33
	Grand Total	9	7	111

etable preservation in collaboration with All India Women's Conference, Panaji and Association for Women Entrepreneurs for Goa. In animal sciences two livestock units (poultry, rabbits and pigs) were established at farmers places.

Rice

One demonstration of 2000 m² was laid out at Anjuna village of Bardez taluka of North Goa district to evaluate the performance of seven short duration rice varieties viz., Pusa 205, Co-44, Mahaveera, Mo-7, ADT-37, Kalinga -1, and Sarjoo -52 which were earlier evaluated under the Research Project on rice at the ICAR Research Complex, Ela, Old Goa. The varieties were evaluated with Jyoti, a short duration rice variety. Altogether there were 24 plots comprising of three replications and eight treatments of varieties. The net plot size was 8 x 3 m.

All the standard package of practices were adopted and the yield data tabulated as given in Table 34.

From the initial results it was seen that the variety Mahaveera performed better in terms of yield at the farmers level. However, some more work is necessary to see their performance against a popular short duration

PLATE 4

The performance of CSR-4 - a salt tolerant rice variety on farmer's fields

A view of LMC to decide the programmes of KVK

Mushroom production - a popular training course under KVK

Dr. D. G. Dhandar, O.S.D., interacting with the ex-trainees trained by home science wing

Table 33 : Results of field demonstrations (Groundnut) under lab to land programme at Saligao (Rabi 93-94).

Sl. No.	Observations	Variety Dh-3-30	Control JL-24
1.	No. of plants/5m2	165.00	136.00
2.	No. of pods/plant	26.40	14.20
3.	Average length of Pods (cm)	3.68	3.28
4.	Average number of kernals/Pod	2.13	2.00
5.	Weight of 100 Kernels (gm)	108.00	
6.	Shelling percentage	70.89	65.00
7.	Duration (days)	105.00	120.00
8.	Yield (Q/ha)	23.80	14.50

variety i.e. Annada (IET 6223)

Sugarcane

In order to popularise a high yielding sugarcane variety as a replacement for the traditional long duration variety Co-740 which is prone to diseases like grassy shoot/whip smut, one field demonstration of 2000 m² was laid out in farmers field at Keri village in Bicholim Taluka of North Goa district. A promising high yielding sugarcane variety viz., Co-850061 and recommended mid late variety Co-7527 were given to the farmer with Co-740 as a control variety. There were four replications. Altogether 12 plots each of size 160 m² were laid out in RBD design.

All the standard package of practices were followed while planting. Fertilizer was applied @250 kg N, 125 kg $P_2 0_5$ and 150 kg K_2O/ha in three split doses succeeded by earthing up.

The results obtained were tabulated and are presented in Table 35.

From the results, it is seen that the variety Co-850061 has performed well, yielding 110 t/ha followed by midlate variety Co-7527 (98t/ha). The traditional variety Co-740 was found to be late maturing and yielding 65 t/ha.

Table 34 : Performance of seven short duration rice varieties on farmers field (Kharif 93)

Sl. No.	Name of variety	No. of Productive tillers	Length of earhead	No. of grains per m²	No. of Panicles per m²	Yield Q/ha
1.	Co-44	9.6	25.8	148.6	408.0	42.5
2.	Pusa - 205	10.2	26.4	168.8	440.0	44.8
3.	Mahaveera	10.7	26.4	172.4	453.0	46.2
4.	Mo-7	9.3	23.8	142.8	358.6	41.8
5.	ADT-37	9.7	21.8	168.8	420.5	36.2
6.	Kalinga-1	11.2	24.3	156.7	348.2	34.6
7.	Sarjoo - 52	10.2	26.3	180.2	371.6	41.2
8.	Jyoti (local)	12.8	24.5	160.4	418.8	40.6

Table 35 : Results of Sugarcane varieties on farmers field at Keri

Sl. No.	Observations	Name of the variety		
		Co-850061	Co-7527	Co-740
1.	Average number of tillers	12.4	9.50	7.6
2.	Average number of nodes	24.8	21.50	18.60
3.	Girth of cane (cms)	2.78	2.45	1.42
4.	Weight of cane (kg)	2.4	2.18	1.20
5.	Brix (%)	22.2	20.3	18.6
6.	Yield (t/ha)	110.0	98.0	65.0

Salt tolerant rice trial

In order to evaluate the performance of salt tolerant rice varieties for Khazan lands, one demonstration of 1000 m² was laid out at Aldona village of Bardez Taluka of North Goa district. Four varieties viz CSR-4, CSR-10, Palghar-1 and the traditional variety Korgut were planted in RBD design with four replications. There were 16 plots each of 60 m². Other inputs like fertilizer, weedicide and pesticides were also supplied on need basis. All the cultural practices were followed and the results obtained are presented in Table 36.

From the Table 36, it is seen that the variety CSR-4 has performed better than the other varieties yielding 31.5 Q/ha as compared to 17.2 Q by local Korgut variety.

HORTICULTURE

(1) Top working in cashew

In order to demonstrate the technology of top working in cashew to improve the productivity of local low yielding cashew trees, one demonstration was conducted at Madkai village. Five trees were top worked with the scions of V-4 variety of cashew. Out of five, four trees are in healthy condition. The yield data will be collected from fourth year onwards.

Table 36 : Performance of salt tolerant rice varieties at Aldona (Kharif 93-94)

Sl. No.	Observations	Variety			
		CSR-4	CSR-10	Palghar-1	Korgut
1.	Number of productive tillers	7.2	6.9	7.5	5.3
2.	Length of earhead (cm)	22.2	20.4	20.8	26.3
3.	Height of the plant (cms)	85.3	89.1	92.2	132.5
4.	Number of filled grains per earhead	120.0	96.2	89.6	93.5
5.	Yield (Q/ha)	31.5	29.8	30.2	17.2

(2) Nutrition Garden

In order to popularise the cultivation and the importance of fresh vegetables, fruits in daily diet, two demonstrations were laid out at Corlim and another at Madkai. improved variety vegetable seeds, the grafts of high yielding varieties of mango and other fruit crops were given. The vegetable varieties performed very well in the nutrition garden. The fruit plants are also in healthy state. The new variety of bhendi, "Parbhani Kranti", resistant to yellow vein mosaic became popular among the farmers. New perennial chilli variety "Pusa Sadabahar" was also given under nutrition garden demonstration.

(3) Use of cultar in mango

In order to test the effectiveness of the 'cultar' (Paclobutrazol) in overcoming the problem of alternate bearing in mango, a field trial was laid out at Chodan. The dosage of 10ml, 15ml and 20ml were tried for Mankurad varieties of mango. The first year data was encouraging. The trial will continue for three more years.

HOME SCIENCE

(1) Fruits and Vegetable Preservation

In home science, four demonstrations were conducted for the members of Mahila mandals and Association for Women Entrepreneurs for Goa. Technology for preparation of jams, squashes and pickles were given to these trainees by using locally available seasonal fruits and vegetables and preservatives like Citric acid, sodium benzoate and potassium metabisulphite.

ANIMAL SCIENCE

(1) Demonstration on livestock production

Pig rearing is popular in Goa as about 40 per cent population prefers pork. Generally local pigs are reared in scavanging system. Since the exotic pigs cannot be reared in scavanging system and concentrate feeding of pigs is not popular, rearing of crossbred pigs in semi-scavanging system with supplementary feeding was introduced. In order to demonstrate superiority of this system over the traditional method of rearing local pigs under scavenging system, five demonstration units with two crossbred sows and one boar, were established in Rivona, St. Estevem, Old Goa, Chawdi-Canacona and Agonda-Canacona. These demonstration units are serving as source of encouragement for other farmers, since the observation on production and reproduction have shown the superiority of rearing crossbred pigs in semi-scavenging system over the traditional pig rearing method.

Goa being the centre of influx of tourists, the demand for rabbit meat is good. So to popularise the rabbit farming, two demonstration units with two does and one buck were established at Rivona and Sulcorna.

Participation in All India Radio (Air) programme

The scientists and Training Associates of KVK, have participated in 10 radio talks, explaining various technologies for increasing agricultural production.

Participation in seminars/training

The training organiser and all the training associates attended the meeting on "Integrated KVK model" from 10th to 13th January 94 held at Hanumanmatti organised by Zonal Coordinating unit, Transfer of Technology (TOT), Bangalore.

4. Report on completed Research projects

1. Nutritional requirement of promising varieties of sugarcane and paddy under Goa condition to optimise fertilizer inputs

(HM Wasnik)

This project was initiated with following objectives:

1) To evaluate the requirement of N, P and K for different promising cultivars of sugarcane and paddy.

2) To evaluate the changes in soil fertility due to intensive management.

3) To correlate soil test values for N, P and K with yield.

4) To employ DRIS and other models to predict optimum N, P and K requirement at a given targetted yield.

Sugarcane is one of the important cash crop grown in Goa. The crop is cultivated in 1800 ha with a production of 86,000 tonnes. More than 90 per cent of the area is covered with a single variety namely Co-740. Productivity of sugarcane in the state is low (50t/ha) and so also the sugar recovery (8.5%)

Rice is the principal food crop of Goa which occupies an area of 54,000 ha accounting 31 per cent of the total cropped area and 86 per cent of food grain production. Rice is cultivated in three principal land types in Goa viz., 'ker' lands (coastal sandy and sandy loam soils), 'khazan 'lands (coastal saline soils) and 'morod' lands (Laterite uplands). The area covered under high yielding varieties in kharif and rabi seasons in 82 per cent and 19 per cent, respectively.

Materials and Methods

Sugarcane

A field experiment was conducted at the farm of ICAR Research Complex, Ela, Old Goa during 1985-87. The soil of the experiment field was sandy loam (pH 5.8). The available N, P and K contents were 369, 58 and 108 kg per ha. The six promising varieties of sugarcane (CoC-671, Co.-7704, Co.-6304, Co.-7527, Co.-740 and Co.-7405) suitable for the peninsular zone were tested under four levels of nitrogen (0,125,250 and 375 kg N/ha) both in plant and ratoon crops. The experiment was conducted in split plot design, allotting the varieties to the main plots nitrogen levels to the sub plots. The nitrogen in the form of urea was applied in two splits, one half each at sowing and 180 days of the crop. While $P_2 0_5$ and K_2O @ 125 and 150 kg/ha respectively as full dose was band placed at planting. There were three replications.

The gross plot size was 12.0 m x 5.4 m while net plot size 10.0 m x 3.6m.

Three budded setts were planted in March 1985 at 90 cm apart. The recommended cultivation practices were adopted throughout the cropping season. The data was recorded for millable canes, cane height, girth, cane weight, cane yield and commercial cane sugar (C.C.S.) during 1986 and 1987.

Another experiment in split plot design was conducted in sugarcane with varieties Co.-7527 and Co.-740 as main plot treatments and fertilizers viz., 250 kg N/ha, with nimin coated urea and phosphin as sub plot treatments. A dose of 125 kg each P_2O_5 and K_2O per hectare was also applied to all the plots with three replications during March 1992.

Rice

In rice, experiments were carried out in 3^3 factorial confounded design with 0, 75 and 150 kg N/ha, 0, 40 and 80 kg P_2O_5/ha, and 0, 40 and 80 kg K_2O/ha using rice accession IET 6223 with four replications during the kharif seasons of 1986, 1987 and 1988, respectively.

In another study, the rice experiment was laid out in a split plot design with three levels of green manuring (i.e. daincha) at the

rate of 0, 10 and 20 t/ha as a main plot and four levels of nitrogen at 0,50,100 and 150 kg N/ha as sub plot treatments. A dose of each 50 kg P_2O_5 and K_2O/ha was also applied to all the plots with three replications during the kharif season of 1989 using Jaya variety of rice.

An experiment was also conducted during kharif 1990-1991 to find out the effect of various organic treatments at different levels of nitrogen on the yield of rice under Goa conditions.

The experiment was laid out in split plot design (three replications) with four levels of organic treatments in the form of biofertilizer (Azatobactor), poultry manure (3 t/ha) and biofertilizer (Azatobactor) + Poultry manure (3 t/ha) alongwith control (No organic manure) as main plot and four levels of Nitrogen at 0, 50, 100 and 150 kg/ha as the sub plot treatments. A common dose of 50 kg P_2O_5 and K_2O/ha was also applied to all the plots with Jaya as the test variety. The observations on number of tillers, panicles per square meter, number of grains per earhead, thousand grain weight and yield of grain as well as straw were recorded. The results of all the above experiments are presented in the results and discussion section.

Results and Discussion

Response of promising sugarcane varieties to Nitrogen application

The data on different yield parameters and yield of cane is presented in Tables 1 and

Table1: Millable canes, height and girth of cane as influenced by 'levels of Nitrogen' in different varieties of sugarcane

Treatments	Millable canes (1000/ha)			Height (cm)			Girth (cm)		
	Plant Crop	Ratoon Crop	Mean	Plant Crop	Ratoon Crop	Mean	Plant Crop	Ratoon Crop	Mean
Varieties:									
CoC-671	62.88	32.26	47.57	2.39	1.44	1.92	2.57	2.36	2.47
Co-7704	89.12	64.62	76.87	3.23	2.38	2.81	2.80	2.63	2.72
Co-6304	110.88	67.53	89.21	2.99	2.30	2.65	2.46	2.48	2.47
Co-7527	79.88	69.89	74.89	3.53	2.30	2.92	2.97	2.81	2.89
Co-740	109.13	88.24	98.69	3.04	2.09	2.57	2.59	2.45	2.52
Co-7405	84.26	58.62	71.44	3.24	2.30	2.77	2.72	2.58	2.65
C.D. (P=0.05)	12.84	21.02	16.93	0.32	0.37	0.34	0.14	0.11	0.13
Levels of N									
N 0	71.81	56.05	63.93	2.92	1.97	2.45	2.53	2.42	2.48
N 125	90.89	68.10	79.50	3.09	2.11	2.60	2.67	2.55	2.61
N 250	97.83	61.22	79.53	3.10	2.23	2.67	2.80	2.64	2.72
N 375	96.79	69.39	83.09	3.20	2.22	2.71	2.74	2.60	2.67
C.D. (P=0.05)	6.23	12.94	9.59	0.13	0.10	0.12	0.10	0.07	0.09
Variety x N									
C.D. (P = 0.05)	N.S.	18.44	--	0.42	0.42	0.42	0.24	0.19	0.22

Table 2: Weight of the cane, cane yield and sugar yield as influenced by 'levels of Nitrogen' in different varieties of sugarcane.

Treatments	Weight of cane (kg/cane)			Yield of Sugarcane (t/ha)			Yield of CCS (t/ha)		
	Plant Crop	Ratoon Crop	Mean	Plant Crop	Ratoon Crop	Mean	Plant Crop	Ratoon Crop	Mean
Varieties:									
Co. C-671	0.96	0.65	0.81	43.01	20.97	31.99	4.24	2.29	3.27
Co-7704	1.38	1.35	1.37	112.16	87.23	99.70	9.96	9.41	9.96
Co-6304	1.08	1.06	1.07	122.99	71.58	97.29	11.32	7.36	9.34
Co-7527	1.89	1.42	1.66	137.24	99.24	118.24	12.99	11.96	12.48
Co-740	1.03	1.00	1.02	108.25	88.24	98.25	8.24	7.66	7.95
Co-7405	1.37	1.25	1.31	119.29	73.27	96.28	10.62	5.91	8.27
C.D. (P=0.05) Levels of N	0.31	0.18	0.25	25.93	37.83	31.88	2.32	3.69	3.01
N0	1.09	0.99	1.04	88.97	55.49	72.23	8.04	4.87	6.46
N 125	1.27	1.06	1.17	106.98	72.19	89.59	9.62	7.09	8.36
N 250	1.34	1.23	1.29	117.31	82.03	99.67	10.71	9.17	9.94
N 375	1.44	1.21	1.33	115.37	83.96	99.67	10.54	8.59	9.57
C.D. (P=0.05) Variety x N	0.10	0.07	0.09	6.63	9.06	7.85	9.73	7.43	8.58
							0.60	0.95	0.78
C.D. (P = 0.05)	0.38	0.23	0.31	29.46	42.40	35.95	2.65	4.20	3.43

2. The variety Co-7527 had performed better both as a plant and ratoon crop. The varieties Co-7704 and Co-740 were the next best in yield. The variety CoC-671 was found to be a very poor yielder and as such it was found unsuitable for the agroclimatic conditions of Goa. Co-7527 was found most promising and could be a substitude for ruling variety Co-740.

Co-7527 yielded significantly higher commercial cane sugar (CCS) than all the other varieties, with an yield level of about 13 tonnes and 12 tonnes of CCS per hectare in the plant and ratoon crops, respectively. Other varieties gave a mean yield of eight to nine tonnes per hectare with the exception of the variety CoC-671 which yielded only 3.2 tonnes of CCS/ha. The cane height, girth and cane weight was also higher in Co-7527 than other varieties of sugarcane.

Regarding the response to N application, it was found that application of Nitrogen at 250 kg/ha was found to be the best responsive dose resulting in higher yield both in plant and ratoon crops. The notable observation is that, at 0 kg N/ha, the yield of cane and CCS came down drastically where the ratoon yield is just 60 per cent of the plant crop (Table 2.). The present findings are in conformity with the

findings of the adjoining states also where Co. 7527 was found to yield 30 per cent more than other varieties.

Effect of slow release nitrogen (nimin coated urea) and phosphin on sugarcane production

The yield of sugarcane was increased by 10.85 per cent in Co -740 and 5.63 per cent in Co-7527 due to application of Nimin coated urea than urea alone. Similarly, the yield of sugarcane was increased by 6.52 per cent in Co-740 and 8.46 per cent in Co-7527 due to phosphin (Table 3).

To predict optimum N, P and K requirement at a given targeted yield for rice

It was observed for both the characters, paddy yield and straw yield, main effects of N,P, K and interactions NP and NK are found significant (Table 4). Their level of N(150 kg/ha) and second level of P(40kg/ha) with third level of K(80 kg/ha) recorded significantly more yield compared to the remaining levels of the corresponding effects.

In nitrogen and phosphorous interaction, third level of N (150 kg/ha) at second level of P (40 kg/ha) recorded significantly higher yield than all the other combinations except third level of N at the final level of P.

In nitrogen and potassium interaction third level of N (150 kg/ha) at all the levels of K (in the order second, third and first which are on par) recorded significantly more yield compared to the other combinations.

From the field experiments conducted on effects of increasing rates of N, P and K on yield response by paddy IET-6223 efficiency factors for native and added fertilizers have been calculated based on Mitscherlich-Bray equation (Table 5). Evaluation of site specific recommendation based on these efficiency factors, a rate of 44.46 kg N, 17.79 kg P_2O_5 and 25.50 K_2O/ha for getting 93.75 per cent of

Table 3 : Effect of slow release Nitrogen (Nimin coated urea) and phosphin on Sugarcance

Treatments of cane	Height of cane (m)	Weight (kg)	Girth (cm)	Brix (%)	Yield (t/ha)
Varieties					
Co-740	2.43	0.99	2.18	19.00	114.00
Co-7527	3.18	2.08	2.65	20.00	136.00
C.D. (P=0.05)	0.37	0.32	0.12	0.56	36.85
Levels of fertilizer					
M_0- Control	2.50	1.38	1.95	18.00	94.00
M_1-250 kg N/ha	2.78	1.53	2.35	19.00	125.00
M_2-250 kg N/ha + Nimin	2.99	1.60	2.55	20.00	136.00
M_3-250 kg N/ha+phosphin	3.08	1.65	2.80	21.00	147.00
C.D. (P=0.05)	0.13	0.11	0.08	0.18	10.94

Table 4:Effect of different combinations of N,P,K, on grain and straw yield of rice.

Treatment Kg/ha	Grain yield (q/ha)				Straw yield (q/ha)			
	P_0	P_{40}	P_{80}	Mean	P_0	P_{40}	P_{80}	Mean
N_0	27.40	30.14	27.57	28.37	51.80	56.74	52.14	53.56
N_{75}	37.12	42.01	41.35	40.16	70.18	79.40	78.12	75.91
N_{150}	47.16	48.03	44.23	46.47	89.03	90.80	83.65	87.83
Mean	37.22	40.06	37.72		70.30	75.66	71.30	
Treatment Kg/ha	K_0	K_{40}	K_{80}	Mean	K_0	K_{40}	K_{80}	Mean
N_0	24.10	29.58	31.42	28.37	45.30	55.94	59.43	53.56
N_{75}	40.80	37.71	41.98	40.16	77.08	71.29	79.37	75.91
N_{150}	45.70	47.71	46.01	46.47	86.49	90.07	87.01	87.83
Mean	36.86	38.33	39.80		69.59	72.44	75.27	
Treatment Kg/ha	K_0	K_{40}	K_{80}	Mean	K_0	K_{40}	K_{80}	Mean
P_0	34.65	30.13	38.89	37.22	65.53	71.94	73.53	70.30
P_{40}	38.97	40.62	40.59	40.06	73.41	76.82	76.76	75.66
P_{80}	36.98	36.25	39.93	37.72	69.85	68.55	75.51	71.30
Mean	36.86	38.33	39.80		69.59	72.44	75.27	

CD at P = 0.05 for N.P.K. = 3.36
CD at P = 0.05 for NP, NK, PK = 5.81

theoretical maximum yield 62.8, 53.39 and 54.30 q/ha respectively were recorded (Table 6)

To evaluate the N, P and K removal of rice.

The pooled average rice yield for the three years has shown a significant response for the nitrogen and phosphorous only. The dose of 150 kg N/ha has given significantly higher yield than other two levels studied. The case of phosphorous, 40 kg and 80 kg P_2O_5 has given significantly higher yield of rice than no phosphorous treatments, however the yield of rice at par in both P levels. There was no response to any interactions.

The response functions show the following relationship.

Table 5: Efficiency coefficients ofsoil test and added fertilizers

Nutrient	CI	Baule equivalent of soil	Baule unit	C	Baule equivalent of added fertilizer	CI/C
N	0.0006	501.67	0.4993	0.0237	12.7004	0.0253
P	O.0138	21.81	1.9141	0.0353	8.5269	0.3909
K	0.0054	55.74	1.8478	0.0254	11.8504	0.2126

Table 6: Site specific recommendations of N,P,K based on Mitcherlich, Bray equation (Kg/ha)

Nutrient	Theoritical maximum yield A(A/ha)	No. of Baules required. 0 (0%)	1 (50%)	2 (75%)	3 (87.5%)	4 (93.5%)
N	62.8	-	6.36	19.06	31.76	44.46
P	53.39	-	-	8.73	9.26	17.79
K	54.30	-	-	1.80	13.65	25.50

$Y=35.27 + 12.05\ N - 2.52\ N^2 + 0.73\ KP$

(1.76) (0.85) (0.30)

($R^2 = 0.91$)

Where Y is the yield (q/ha and the symbols N, P and K are the levels of nutrients used (either 0,1 or 2 as the case maybe) and N^2 is the square of the 'N' level (hence in N_2 level $N^2=4$). Figures in parenthesis are the response function on respective S.E's of the Regression Coefficients. From the second degree response function the nutrient dose worked out for getting the maximum yield in rice is 175 kg N/ha, 46 kg P_2O_5/ha and 50 kg K_2O/ha respectively under Goa state conditions. Where as average nutrients removed by paddy was the order of 135.63 kg/N, 18.46 kg/P and 66.87 kg K/ha (Table 7)

Table 7: Nutrients removal of paddy (Kg/ha) (1986-88)

Treatments	N			P			K		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
N_0 - 0 Kg N/ha	39.91	35.94	75.85	12.99	4.32	17.31	13.22	52.32	65.54
N_1 - 75 Kg N/ha	64.70	81.55	146.65	14.04	3.98	18.02	14.21	50.47	65.18
N_2 - 150 Kg N/ha	85.18	99.63	184.81	15.56	4.60	20.16	15.60	54.86	70.46
P_0 - N0 Phophorous	62.52	62.84	125.38	10.38	3.27	13.65	13.43	49.98	63.41
P_1 - 40 Kg P_2O_5/ha	65.39	76.64	142.03	16.06	4.83	20.89	15.65	51.54	67.19
P_2 - 80 Kg P_2O_5/ha	61.89	77.63	139.52	16.14	4.81	20.95	14.45	56.13	70.58
K_0 - N0 Potassium	59.72	69.77	129.49	12.91	4.39	17.22	12.26	44.07	56.33
K_1 - 40 Kg K_2O/ha	66.90	66.17	133.07	15.26	3.88	19.14	15.07	51.68	66.75
K_2 - 80 Kg K_2O/ha	63.17	81.18	144.63	14.40	4.63	19.03	14.46	61.91	76.37
Average	63.26	72.37	135.63	14.19	4.30	18.46	14.32	52.55	66.87
C. D. NPK (at 5%)	7.45	3.93	11.38	1.32	0.37	1.69	0.82	3.21	4.01
C. D. Interactions (at 5%)	12.91	6.80	19.71	2.29	0.64	2.93	1.43	5.56	6.99

Table 8 Effect of green manuring and levels of nitrogen on rice yield during 1989 Kharif

S. No.	Treatment	Grain Yield (Q/ha)	Straw (Q/ha)
1.	$M_0 N_0$ Control	30.56	97.50
2.	$M_0 N_1$-50 KgN/ha	40.26	103.61
3.	$M_0 N_2$-100 Kg N/ha	40.83	104.72
4.	$M_0 N_3$-150 Kg N/ha	45.78	103.04
5.	$M_1 N_O$-10 t GM/ha	46.89	100.28
6.	$M_1 N_1$-10t GM + 50 Kg N/ha	50.11	103.06
7.	$M_1 N_2$-10t GM + 100 Kg N/ha	52.87	106.94
8.	$M_1 N_3$-10t GM + 150 Kg N/ha	55.28	108.89
9.	$M_2 N_O$-20t GM/ha	40.11	101.39
10.	$M_2 N_1$ - 20t GM + 50 Kg N/ha	42.22	103.89
11.	$M_2 N_2$-20t GM + 100 Kg N/ha	48.61	97.50
12.	$M_2 N_3$-20t GM + 150 Kg N/ha	48.95	91.39
13.	M_O - 0 t GM/ha	39.36	102.21
14.	M_1-10 t GM/ha	51.29	104.79
15.	M_2-20 t GM/ha	44.97	98.54
16.	N_O-0 kg N/ha	39.19	99.72
17.	N_1-50 kg N/ha	44.20	103.52
18.	N_2-100 Kg N/ha	47.44	103.05
19.	N_3-150 Kg N/ha	50.00	103.00

Table 9: Yield and yield components of rice in relation to various organic and inorganic nitrogen levels during Kharif, 1990-91

Treatment	Productive tillers/hill	Plant height (cm)	Grains /earhead	Panicles/ m^2	1,000 grain weight (g)	Yield (t/ha) Grain	Straw
M_0N_0 - Control	7	81	99	288	27.5	1.92	7.42
M_0N_1 - 50 kg N/ha	7	86	98	308	28.6	2.53	8.14
M_0N_2 - 100 Kg N/ha	7	94	98	311	29.1	2.78	9.00
M_0N_3 - 150 Kg N/ha	7	95	107	323	29.5	3.11	9.56
M_1N_0 - Biofertilizer	7	84	101	281	27.9	2.03	6.91
M_1N_1 - 50 Kg N/ha	7	93	106	302	28.7	2.28	7.50
M_1N_2 - 100 Kg N/ha	6	95	116	310	28.9	2.58	9.25
M_1N_3 - 150 Kg N/ha	7	96	114	321	29.0	3.72	10.14
M_2N_0-Poultry manure	8	94	113	325	30.1	3.28	10.17
M_2N_1-50 Kg N/ha	8	101	111	323	30.6	3.89	10.78
M_2N_2-100 Kg N/ha	8	98	113	342	31.2	4.39	12.14
M_2N_3-150 Kg N/ha	9	101	121	346	30.9	5.00	12.64
M_3N_0 - Biofertilizer + Poultry manure	8	100	108	326	30.0	2.50	8.50
M_3N_1 - 50 Kg N/ha	9	102	113	344	30.2	3.54	10.20
M_3N_2 - 100 Kg N/ha	9	102	116	363	30.3	4.78	11.00
M_3N_3-150 kg N/ha	9	102	117	340	30.4	5.20	11.47
M_0 - no organic	7	89	101	308	29.2	2.58	8.52
M_1 - Biofertilizer (Azatobactor)	7	92	109	304	29.4	2.65	8.45
M_2 - Poultry manure 3 t/ha	8	99	115	334	30.2	4.14	11.44
M_3-Biofertilizer+ Poultry manure (3 t/ha)	9	102	114	343	30.3	4.00	10.29

Table 10: Yield of paddy grain (t/ha) as influenced by different organic and inorganic sources, during kharif 1990-91

Inorganic source	Organic sources				
	M_0	M_1	M_2	M_3	Mean
N_0	2.76	2.86	3.14	4.17	3.23
N_1	3.14	3.04	3.78	4.28	3.56
N_2	3.31	3.28	4.42	4.33	3.84
N_3	3.39	4.45	4.60	5.25	4.42
Mean	3.15	3.41	3.99	4.51	

C.D 5% for M = 0.18

C.D. 5% for N = 0.37

C.D. 5% for M x N = 0.28

Table 11 Yield of paddy straw (t/ha) as influenced by different organic and inorganic sources, during kharif 1990-91

Inorganic source	Organic souces				
	M_0	M_1	M_2	M_3	Mean
N_0	6.39	6.68	7.11	8.56	7.19
N_1	6.97	6.92	8.06	8.67	7.66
N_2	7.47	7.83	8.17	8.72	8.05
N_3	7.72	7.92	8.47	9.00	8.28
Mean	7.14	7.34	7.95	8.74	

C.D 5% for M = 0.34

C.D. 5% for N = 0.23

C.D. 5% for M x N = 0.22

Effect of Green manure 'dhaincha' and levels of nitrogen on rice yield

The yield of paddy grain and straw also increased with nitrogen along with green manuring @ 10 t green matter /ha over 150 kg N/ ha alone. The maximum grain and straw yield recorded was 55 and 109 q/ha respectively with 150 kg nitrogen alongwith 10 t/ha green matter. The yield obtained from green matter at 20 t/ha was at par with 150 kg N/ha (Table 8)

Influence of different organic and Inorganic Nitrogen levels on rice yield.

The results showed that there was a gradual increase in the different growth parameters in rice due to increase in nitrogen levels, whereas poultry manure alone helped to increase the number of tillers by 14.30 per cent, plant height by 11.30 per cent grain per earhead by 13.90 per cent, panicles per square meter by 8.40 per cent and test weight by 3.40 per cent over no nitrogen (Table 9). There was a significant increase in the levels of nitrogen upto 150 Kg N/ha. The yield of grain and straw was significantly higher in the treatments where poultry manure was applied at the rate of 3 t/ ha over that of control and biofertilizer (Azatobactor) treatments. The grain yield was increased by poultry manure to an extent of 60 per cent over no nitrogen and by 56 per cent over biofertilizer (Azatobactor) treatments, while the grain yield obtained with poultry manure alone was at par with poultry manure and biofertilizer (Azatobactor) (Table 10 & 11)

Conclusion

1. The sugarcane variety Co-7527 performed better with a cane yield of 137 t/ha and 100 t/ha and commercial cane sugar 13 t/ha and 12 t/ha in plant and ratoon crops, respectively. A dose of 250 kg N/ha was found to be the most economical dose resulting in higher yield, both in plant and ratoon crops.

2. The nutrient dose of 175 Kg N/ha, 46 Kg P_2O_5/ha and 50 kg K_2O/ha was worked out for getting the maximum yield in rice variety IET 6223 with a series of N,P,K nutritional trial. However, 136 Kg N, 19 Kg P and 67 Kg K/ha was removed annually by the paddy crop under the climatic condition of Goa.

3. The yield of paddy obtained with the application of green manuring (Dhaincha) @ 10 t/ha was equivalent to the yield of paddy obtained by application of 150 Kg N/ha.

4. There was 60 per cent increase in the yield of paddy with the application of poultry manure @ 3 t/ha over no nitrogen treatments.

Publications

1. K. Venugopal and H. M. Wasnik, 1987. "Prospects of increasing Sugarcane production and productivity in Goa". *Bhartiya Sugar, 12* (7) : 33-35.

2. K. Venugopal, J. R. Faleiro and H. M. Wasnik, 1987. "Strategies for increasing rice production in Goa". Paper presented at the seminar held at the Konkan Krishi Vidyapeeth, Dapoli on 21st and 22nd March 1987.

3. J. R. Faleiro and H. M. Wasnik, 1989. "Influence of NPK to paddy on the incidence of brown plant hopper. *Indian J Entomology, 51*(4): 484

4. H. M. Wasnik, 1990. "Response of Sugarcane varieties to nitrogen application in Goa State. *Bhartiya Sugar,* 15(4) : 25-27.

5. General Information

5.1 : Institute Management Committee

The President of ICAR constituted the first Institute Management Committee for a period of three years from 14.6.91 for the approval of important financial and administrative functions and operative guidance of the Institute. The committee consisted of the following members and met once (30.12.1993) during the period under report and discussed important points pertaining to the functioning of the Institute and accorded approval for the purchase of equipments and execution of civil works.

1. Dr D.G. Dhandar — Chairman
Officer on Special Duty
ICAR Research Complex for Goa
Ela, Old Goa 403 402

2. Dr. P. Rethinam — Member
Assistant Director General (PC)
ICAR, Krishi Bhavan
New Delhi 110 001

3. Director of Agriculture — Member
Government of Goa,
Vidyut Bhavan
Panaji - Goa

4. Shri C. N. Budhodakar — Member
Deputy Director(Hort)
Z. P. Pan Bazar
Sindhudurg, Kudal, Maharashtra

5. Dr. R. T. Gunjate — Member
Associate Director of Research
Regional Fruit Research Station (K.K.V)
Vengurla, Sindhudurg, Maharashtra

6. Shri Narayan Naik — Member
House No. 252, Cardoso Ward
Taleigao, Tiswadi, Goa

7. Fr. Inacio Almeida — Member
Pilar Seminary
Pilar, Goa

8. Shri A. Muthukaruppan — Member
Accounts Officer
National Institute of Oceanography
Dona Paula, Goa

9. Dr. K. D. Patil — Member
Principal Scientist (Plant Physiology)
ICAR Research Complex for Goa
Ela, Old Goa

10. Dr. A. R. Bhattacharyya — Member
Principal Scientist (Animal Reproduction)
ICAR Research Complex for Goa
Ela, Old Goa

11. Dr. S. Subramanian — Member
Senior Scientist (Fishery Science)
ICAR Research Complex for Goa
Ela, Old Goa

12. Shri S. Chander Rao — Member
Scientist (Plant Pathology)
ICAR Research Complex for Goa
Ela, Old Goa

13. Shri A.V.Shankarankutty — Member Secretary
Assistant Administrative officer
ICAR Research Complex for Goa
Ela, Old Goa

5.2 KVK Local Management Committee

The functioning of Krishi Vigyan Kendra which serves as the transfer of technology wing of the institute, is monitored by the Local Management Committee periodically. The Committee constituted by ICAR included official both from Government and Non-government bodies, representative of different categories of farmers, representatives from Rural Development Agency, NABARD, women representatives from Social Welfare Department etc., who are directly or indirectly involved in the process of agricultural policy making.

The Training Organiser of the KVK is the Member Secretary and the head of the host Institute is the chairman of the Local Management Committee.

During the year under report, the committee met once (on 17.06.1993) reviewed the progress of work done in the previous year and approved the plan of work for the current year.

The Training Organiser of the KVK is the Member Secretary and the Head of the host Institute is the chairman of the local management committee.

During the year under report, the Committee met once on 17.06.93, reviewed the progress of work done in the previous year and approved the plan of work to be carried out during the current year.

5.3 Institute Joint staff council

A Joint staff council was formed for the Institute with an objective to promote harmony and relationship for increased efficiency of work and to increase co-coperation between the employer and the employees. The Joint Staff Council is comprising of 13 members, six each from staff side and official side, the Officer on Special Duty being the chairman. The main aim of the Joint Staff Council is,

a) To supplement facilities and to represent matters concerning the constituent's services and

b) to improve the conditions relating to work and service, welfare of employees, and improvement of efficiency with regard to recruitment, promotions and discipline.

During the period under report, the following were the members of the Joint Staff Council which met thrice during the year under report (i.e. 4.6.1993, 27.9.1993 and 22.2.1994)

Official Side

1. Dr. D. G. Dhandar — Chairman
2. Dr. K. D. Patil/Shri P. A. Mathew — Member
3. Dr. H. M. Wasnik — Member
4. Dr. R. N. S. Sundaram — Member
5. Shri M. S. Balbatti — Member
6. Assistant Administrative Officer — Member
7. Dr. J. R. Faleiro/ Dr. S. Subramanian — Member Secretary

Staff Side

8. Shri. Mario Fernandes — Member
9. Shri. Prakash Jannaik — Member
10. Shri. Ashok D. N. Desai — Member
11. Shri. Subhash Melekar — Member
12. Shri. Diger Khandeparkar — Member
13. Shri. K. Yeshodharan — Member Secretary

5.4 Institute Grievance Cell

An Institute Grievance cell was constituted for the redressal of grievances of all the categories of staff, by election of five members representing the five categories and nomination of official members.

Following were the members of the Grievance cell.

Chairman

1. Dr. D. G. Dhandar — Officer on Special Duty

Nominated members

2. Dr. K.D. Patil — Principal Scientist
3. Dr. A. R. Bhattacharyya — Drawing and Disburisng officer
4. Shri. A.V. Shankarankutty — Assistant Administrative Officer

Elected members

5. Dr. N. S Nair — Scientific
6. Shri. Edward Crasta — Technical
7. Shri. Laxman R. Naik — Auxiliary
8. Shri. Krishnanath R. Naik — Administrative
9. Shri. Vittal P. Porwar — Supporting

5.5 Staff of the Institute

Name	Designation	Specialisation
Managerial		
DG Dhandar, Ph D.	Officer on Special Duty	Horticulture
Scientific		
KD Patil, Ph D	Head, Section of Crop Sciences	Plant Physiology
AR Bhattacharyya MVSc FRVCs	Head Section of Animal Sciences	Animal Reproduction
S Subramanian, Ph D	Senior Scientist	Fish & Fishery Science
HM Wasnik, Ph D	Senior Scientist	Soil Science
NS Nair, M V Sc NDPH	Scientist (Sel.Gr.)	Poultry Science
RN Shanmugasundaram M V Sc	Scientist (Sel.Gr.)	Animal Nutrition
PA Mathew, M Sc (Ag)	Scientist (Sel.Gr.)	Horticulture
JR Faleiro, Ph D	Scientist (Senior Scale)	Agrl. Entomology
S Chandar Rao, M Sc (Ag)	Scientist (Senior Scale)	Plant Pathology
BL Manjunath M Sc (Ag)	Scientist	Agronomy
EB Chakurkar M V Sc	Scientist	Animal Reproduction
Satish Modak Ph D	Scientist	Agronomy
Technical		
MS Balbatti, M Sc (Ag)	Far Superintendent (T-7)	Agronomy
VY Gaonkar, M Sc (Ag)	Training Associate (T-6)	Horticulture
HR Prábhudesai B Sc (Ag), PG Dip(PP)	Training Associate (T-6)	Agronomy
Sunetra M Talaulikar B Sc (Home Sci.) PG Dip (D & Ap N)	Training Associate (T-6)	Home Science
Avinash V Nirmale B V Sc	Training Associate (T-6)	Animal Science
K Manikandan, Dip (Ag)	Traning Assistant (T-4)	Agronomy
KK Metar, Dip (Ag)	Training Assistant (T-4)	Agrl. Extension
Premlatha Lade M Sc (Home Sci.)	Training Assistant (T-4)	Home Science

Administrative

A.V. Shankarankutty	Asst. Admn. Officer
M.K. Lakshmikutty	Superintendent

Statement showing the total staff strength of ICAR Research Complex and KVK as on 31-3-94 and number of SC/ST amongst them.

Category	No. of post sanctioned			No. of employees in position			Vacant Posts			No. of SC employment	No. of ST employment
	MI	KVK	T	MI	KVK	T	MI	KVK	T		
1	2	3	4	5	6	7	8	9	10	11	12
Scientific	14	1	15	12	-	12	2	1	3	2	-
Technical	9	9	18	9	7	16	-	2	2	3	-
Administrative	4	3	7	4+4*	3	7+4*	-	-	-	2	1
Auxiliary	1	1	2	1	1	2	-	-	-	-	-
Supporting	25	3	28	25	3	28	-	-	-	3	-
Total	53	17	70	51+4*	14	65+4*	2	3	5	10	1

MI - Main Institute

KVK - Krishi Vigyan Kendra

T - Total

* Four posts namely AAO, Superintendent and two Jr. Clerks temporarily borrowed from other ICAR Institutes

5.6 Budget of the Institute for the year 1993-94 (in rupees)

	Sanctioned RE	Actual expenditure
Plan	60,00,000	52,56,964
Non Plan	38,00,000	37,77,827
KVK	23,25,000	20,50,473
Total	121,25,000	110,85,264

5.7 **Important Visitors**

Dr. K.P. Kikani, Professor and Head, Department of Horticulture, Gujarat Agricultural University, Anand, Gujarat.

Dr. A.K. Basu, Director, Central Institute for Cotton Research, Nagpur.

Dr. R. Goaplkrishna, Ex-Vice Chancellor, Punjabrao Krishi Vidyapeet, Akola, Maharashtra.

Dr. M. V. Rao, Vice-Chancellor, Andhra Pradesh Agricultural University, Hyderabad.

Dr. L.P. Barbosa, Ex Chief Minister, Government of Goa.

Dr. P. Rethinam, Assistant Director General (PC), ICAR, Krishi Bhavan, New Delhi.

Dr. R.T. Gunjate, Associate Director of Research, Regional Fruit Research Station, Vengurla.

Shri. P. K. Desai, Director of Agriculture, Govt. of Goa, Panaji.

Dr. M. K. Nair, Director, CPCRI, Kasaragod, Kerala.

Dr. E.V.V. Bhaskar Rao, Project Co-ordinator (cashew), NRCC, Puttur.

Dr. S. Ray, Director, Department of Animal Husbandry and Vety. Services.

5.8 Membership ib Important Committees and bodies

Dr. D. G. Dhandar

Member : Local Advisory committee of All India Radio, Panaji, Goa, Steering Committee of State Level Bankers, Goa: Management Committee of Sanjivani Sugar Factory, Usgao, Goa: State Level Co-ordination/Advisory Committees for Sugarcane, Horticulture, Spices and Watershed Projects, Goa; Board of Studies on Botany, University of Goa, Indian Society for Plantation Crops Kasaragod and Horticulture Society of India New Delhi.

Chairman : State level Sub-Committee for Sugarcane Development in Goa.

Dr. K.D. Patil

1. Life member of the Indian Society for Plant Physiology.

2. Member of the Indian Society of Agricultural Science

3. Member of the Association of Maharashtra Agricultural Universities.

4. Member of the Indian Society for coastal Agricultural Research.

Dr. A.R. Bhattacharyya

1. Founder member of ISSAR (Indian Society for the Study of Animal Reproduction).

Dr. H. M. Wasnik

1. Life member of the Journal of Maharashtra Agricultural Universities, College of Argriculture, Pune, Maharashtra.

2. Member Secretary, Local Management Committee of Krishi Vigyan Kendra, ICAR Research Complex, Old Goa.

Shri P. A. Mathew

1. Life member for Indian Society for Plantation crops, CPCRI, Kasaragod, Kerala.

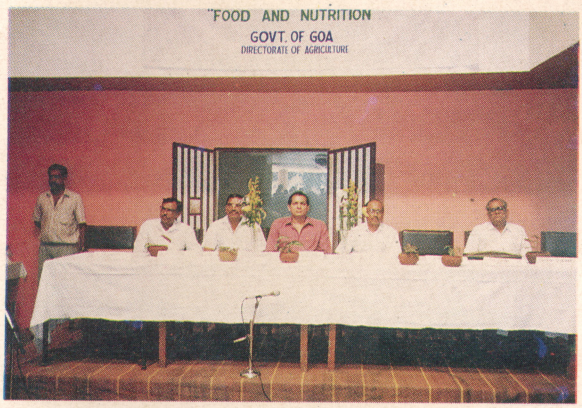
2. Life member of the Horticultural Society of India, New Delhi.

3. Life member of the Indian Society for Root crops, CTCRI, Trivandrum, Kerala.

4. Member, Agricultural Sub-committee of the Goa Chamber of Commerce and Industry, Panaji, Goa.

Shri. B. L. Manjunath

1. Life member for Indian Society of Weed Science.



Honourable Minister for Agriculture, Government of Goa, Shri Francisco Sardinha presiding over "World Food Day" celebration.

Deputy Director General (Horticulture), Dr. K. L. Chadha on a field visit to oilpalm plot.

Assistant Director General (Plantation Crops) Dr. P. Rethinam, delivering introductory remarks at the Fourth Annual Research Council meeting of the Institute.

The victorious football team of the Institute at the Inter-Institutional Sports Meet in Bhopal.

Dr. J. R. Faleiro

Member : Board of Studies (Zoology), Goa University.

Shri V. Y. Gaonkar

Member: Local Advisory Committe, All India Radio Panaji.

Shri H. R. Prabhudesai

Member Secretary : Sub-Committee for Sugarcane development, Govt. of Goa.

Executive Member : Botanical Society of Goa.

Member : Deccan Sugar Technologists Association (DSTA), Pune

5.9 Participation in Symposium/Seminar/ Workshop

Golden Jublee Symposium on Horticulture Research-Changing scenario, held at Bangalore between 24 to 28th May, 1993.
-D.G. Dhandar

Symposium on Biodiversity in Western Ghats - conducted by World Wild life Fund, Goa division from 15-31 January 1994 at National Institute of Oceanography, Dona Paula, Goa.
-S. Chander Rao, K.D. Patil and H.R. Prabhudesai.

National Symposium on Mushrooms, NCERT, Solan, Himachal Pradesh.
-S. Chander Rao.

Eleventh All India Co-ordinated Biennial Workshop on Palms. 1-3 September, 1993, held at the National Institute of Ocenography, Dona Paula, Goa.
-A.R. Bhattocharyya, R.N.S. Sundaram, S. Chander Rao, D.G. Dhandar, K.D. Patil, J.R. Faleiro, P.A. Mathew, H.R. Prabhudesai, B.L. Manjunath, V.Y. Gaonkar.

Seminar on Organic manures organised by Godrej Agrovet Ltd. and VNS Sales Corporation at Margao on 7th April 1993.
-P.A. Mathew, V.Y. Gaonkar.

Seminar on Paddy and Horticultural Crops at Amona on 18th April 93 organised by IFFCO.
-H.R. Prabhudesai, V.Y. Gaonkar.

All India Seminar on Sprinkler and Drip Irrigation organised by the Institution of Engineers at Hyderabad on 9-10, December 1993.
-B.L. Manjunath.

State level training cum Workshop on National Watershed Development Project for Rainfed Areas organised by Department of Agriculture, Govt. of Goa at Old Goa from 22-24, March 1994
-B.L. Manjunath, D.G. Dhandar, P.A. Mathew.

Seminar on "Strategies for increasing horticultural production by use of growth regulator organised by Konkan Krishi Vidyapeeth at Vengurla on 10.4.93
-D.G. Dhandar, P.A. Methew. V.Y, Gaonkar.

Seminar on "Paddy and horticultural crops" organised by KRIBHCO at Chinchinim on 25th May 1993.
-D. G. Dhandar V.Y. Gaonkar.

Seminar on Paddy and horticultural crops organised by RCF, at Bordem on 29th August 1993.
-V.Y. Gaonkar

Eleventh Annual Convention of ISSAR held at Calcutta from 25-12-93 to 28-12-93.
-A.R. Bhattacharyya.

5.10 Lectures delivered

Lectures on Diseases of Rice and their management (17.12.93, 20.1.94 and 15.2.94) and diseases of plantation crops and their management (13.12.93, 18.1.94 and 14.2.94) organised by Extension Training Centre of Directorate of Agriculture, Govt. of Goa.
-S. Chander Rao.

Lecture cum demonstration on "Mushroom spawn production and quality control" organised by Extension Training Centre of

Directorate of Agriculture, Govt. of Goa.
-S. Chander Rao.

Lecture on Spices cultivation (15.12.93) organised by Extension Training Centre of Directorate of Agriculture, Govt. of Goa.
-P. A. Mathew.

Lecture on "Coastal Agriculture - prospects and potentials with special reference to west coast region" (23.11.93) for Indian Forest Service Officers.
-D.G. Dhandar and S. Subramanian.

Lecture on "Important horticultural crops of Goa". (3.3.94) organised by NABARD.
-V. Y. Gaonkar.

Lecture on "Weed and weed Control". (21.2.94) organised by Department of Agriculture, Govt. of Goa.
S-atish Modak

Lecture on "Recent developments in horticulture". (8.9.93) organised by village Panchayat, Curtorim.
-V.Y. Gaonkar.

Lecture on "Improved cultivation practices for Cashew". (17.2.94) organised by Department of Agriculture.
-V.Y. Gaonkar.

Lecture on "Kitchen Gardening". (20.12.93) organised by Village Panchayat, Aldona.
-V.Y. Goankar.

Lecture on "Production technologies for Rainfed crops" (22.03.94) organised by Directorate of Agriculture, Govt. of Goa.
-B.L. Manjanath

5.11 Important meetings attended

Fourth Annual Research Councli meeting ICAR Research Complex for Goa, Old Goa. (17-18, july 1993)

-All Scientists, KVK Training Personnel, Farm Superintendent.

KVK Local Management Committeee meeting. ICAR Reseach Complex for Goa, Old Goa (17th June 1993).
-KVK Training Personnel, All Scientists, Farm Superintendent.

Annual Staff Research Council meeting, CPCRI, Kasargod (30th April-1st MAy 1993).
-S. Chander Rao.

Meeting on National Watershed Development Project for Rainfed Areas at Secretariate, Panaji (7th April 93 and 18th April 1993).
-D.G Dhandar P.A. Mathew, B.L.Manjunath.

Meeting of Goa Chamber of Commerce and Industry, Agriculture Sub Committee at Panaji. (27th October 1993 and 6th November 1993)
-P.A. Mathew.

Executive Committee meeting of Botanical Society of Goa.
-H.R. Prabhudesai.

Local Advisory Committee meeting of All India Radio, Panaji. (18 June 93, 7th September 93, 25th November 93 and 11th March 1994.
-D.G. Dhander, V.Y. Gaonkar.

Meeting on 'Integrated KVK Model' at Hanumanalatti, Karnataka'
-H.M. Wasnik and Training Associates.

Farmers club meeting organised by NABARD at Priol and at Shiroda on 20th October 1993 and 3rd March 1994.
-V.Y. Gaonkar.

5.12 Participation in Extension Oriented Programmes

Farmers Convention on modern irrigation systems organised by Krishi Vigyan Kendra at Old Goa on 9th February, 1994.
-All Scientists and KVK staff

World Food day celebrations on 16th October 1993 at Panaji.
-All KVK staff and Scientists.

Spices day organised by Spices Board at Ponda on 13th January, 1994.
-P.A. Mathew

Field day on groundnut frontline demonstration at Porvorim on 17th April, 1993.
-D.G.Dhandar, H.M. Wasnik, H.R. Prabhudesai.

"Kisan Mela" at Curtorim on 8th September, 1993.
-V.Y. Gaonkar.

"Kisan Mela" at Aldona on 20th December, 1993.
-V.Y. Gaonkar

Cashew Field day at Nanoda on 17 February, 1994
-D.G. Dhandar V.Y Gaonkar

5.13 PUBLICATIONS

1) Research articles

Mathew, P.A., Dhandar D.G. and Viraktamath B.C. (1993). Yield of Mangala areacnut in Goa. *Journal of Plantation Crops,. 21*:275-276.

Mathew, P.A., Nagabhushanam and Dhandar D.G. (1993). Multicropping trials in Coconut in Goa. Advances in Coconut Reseach and development, IBH publishing Co. Ltd. New Delhi, P 437-439.

Mishra P.K. Manjunath B.L, Rao J.V. and Subba Reddy G. 1993). Farm pond - A potential source for vegetable production. *Indian Journal of Dryland Agricultural Research and Development., 8*(2): 171-172

Modak S.B., Rai R.K. and Sinha M.N (1994). Effect of phosphorous and phospho bacteria on yield. N.P. Uptake and P balance in pigeonpea wheat sequence. *Annals of Agricultural Research, 15* : 36-40

Patil, K.D. Faleiro J.R. and Viraktamath B.C. (1993). Performance of medium duration rice varieties in western ghats *Indian Journal of Coastal Agricultural Research.*, Vol.II No. 1.

Sundaram R.N.S. and Bhattacharyya A.R.(1992.) Performance of exotic meat rabbit under tropical coastal climate condition. *Indian Journal of Animal Research, 26*(2): 109-110.

Wasnik, H.M. (1994). Performance of Rice varieties under coastal saline environmental stress at Goa. In *Plant productivity under environmental stress*. Edited by Karan Singh and S.S. Purohit, Agro-Botanical Publishers, Bikaner, India. pp 299-302.

ii) Paper Presented in Symposia/Seminar/ Worksop

Chander Rao S. and Patil K.D. (1994). Pesticides and its effect on Agro-eco Systems". Paper presented in the Symposium on Biodiversity in Western Ghats" organised by World Wild life Fund, Goa division at National Institute of Oceanography, Dona Paula, Goa. 15-30 January 1994.

Mathew P.A., Dhandar D.G. and Gaonkar V.Y. (1993). Varietal wealth of mangoes of Goa. Paper presented in "Golden Jubilee Symposium of Horticultural Research - Changing Scenario" Bangalore. 24-28, May 1993.

Manjunath B.L. and Dhandar D.G. (1993). Potential for Drip irrigation System in Goa. Paper presented in All India Seminar on Sprinkler and Drip irrigation organised by The Institute of Engineers, at Hyderabad. 9-10, December 1993.

Sundaram R.N.S. and Bhattacharyya A.R. (1993). Factors influencing production efficiency in rabbits under tropical coastal climatic conditions. Paper presented in 80th Session of Indian Science Congress at Panaji, 3-8 January 1993.

(iii) Popular articles:

Gaonkar, V.Y., Dhandar, D.G. and Mathew, P.A. " Improve your Cashew yield by Topworking". (Marathi) Gomantak Daily May 25, 1993.

Gaonkar, V.Y., Dhandar, D.G. and Mathew P.A. "Cultivation of Radish". (Marathi). Sahakar Surabhi September 1993.

Gaonkar, V.Y., Wasnik, H.M. and Dhandar

D.G. KVK at Farmers Service (Marathi). Sahakar Surabhi. November 1993.

Mathew, P.A., Dhanda,r D.G. and Gaonkar, V.Y. Goviasati ambachi naveen utkristh jat (Marathi), Tarun Bharat Daily, January 4, 1994.

Prabhudesai, H.R. Importance of interculture in Sugarcane (Part I & II). Gomontak Daily (Marathi) June 1, 1993.

Prabhudesai, H.R. Balanced fertilizer usage. (Marathi). Gomantak Daily, June 7, 1993.

Prabhudesai, H.R. Harvesting Nature's Biodiversity (English). The Navhind Times Daily, October 16, 1993.

iv) Reports, proceedings, books, folders, training notes

Bhattacharyya, A.R. (1993). Guidelines to maintain optimum fertility in crossbred cattle. Eds: N.S. Nair, R.N.S. Sundaram and S. Subramanian. Extension folder No. 3 : 6 P.

ICAR Research Complex for Goa (1993). Annual Report 1991-92.
Eds. S.Subramanian, J.R. Faleiro and H.R. Prabhudesai: 77 P.

Background information report for QRT of KVK. (1993)
Eds. H.R. Prabhudesai, V.Y. Gaonkar.

Prabhudesai H.R. (1993). Package of practices for sugarcane cultivation in Goa. Eds. D.G. Dhandar and S. Subramanian. Extension Bulletin No. 3. 20 P.

5.14 Trainings undergone

Training programme on Integrated KVK model organised by Transfer of Techonology projects (ICAR) at Hanumanahatti, Karnataka from 10-13, January 1994.
-Training Organiser & Training Associates.
Computer training programmeon computer application in livestock production at C.S.W.R.I. Avikanagar from 1-9, September 1993.
-R. N. S. Sundaram.

Orientation training programme for DIA'S at NBPGR organised by Directorate of Plant protection, Quarantine and Storage, Faridabad. 6-7, July 1993.
-S. Chander Rao.

5.15 participation in ICAR Zonal Sports meet.

A 12 member sports contingent of the Institute participated in Inter Institutional Sports meet (Zone-I) at CIAE Bhopal during the period 15 to 18th December,1993. This Institute was represented in football, volleyball and athleltics. The 12 member team was led by shri Edward Crasta and Dr. Avinash Nirmale was the Manager. In athletics Shri Anil Khandeparkar, SS Grade I secured third place in 800 mt running event. In football finals, our team defeated host Institute CIAE Bhopal (3-1) and won the trophy and qulified for All India Inter Zonal Sports meet

5.16 Promotions

Name	Promoted From	To	Date of Promotion
Ashok Gadekar	SS Gr.I	SS Gr.II	28-12-93
Ramesh Martonkar	SS Gr.I	SS Gr.II	28-12-93

5.17 Transfer and Deputations

Name and Designation	From	To	Date (w.e.f.)
I.Deputation:			
Dr. J.R. Faleiro Scientist (Sr. Scale)	ICAR Research Complex for Goa	Ministry of Agriculture Govt. of Saudi Arabia	8-11-1993
II Transfers:			
T.V. Ramachandran Superintendent (Accounts)	ICAR Research Complex, for Goa	CPCRI Kasaragod	15-7-1993
A.V.Sankarankutty Assistant Admn. Officer	ICAR Research Complex, for Goa	CPCRI Kasaragod	11-3-1994
Shri. C. Sukumaran Superientendent (Accounts)	Directorate of water Management Rahuri	ICAR Research Complex for Goa	21-3-1994

5.18 Weather data of Goa

Month	Temperature (°C)			Relative Humidity at (%)		Rainfall (mm
	Max.	Min.	Mean	5.30h	23.30h	
1993						
April	33.3	24.7	28.5	91	86	0.0
May	33.2	26.6	29.9	90	88	65.3
June	30.9	25.8	28.3	91	86	401.4
July	28.7	21.2	26.4	93	92	1333.1
August	29.4	24.3	26.8	93	89	367.3
September	29.3	23.8	26.5	95	92	210.5
October	31.1	24.0	27.5	94	92	168.9
November	33.6	23.3	28.4	79	81	2.0
December	32.3	21.3	26.8	79	80	9.8
1994						
January	32.5	20.9	26.7	83	76	0.0
February	31.4	20.8	26.1	84	75	0.0
March	32.3	24.9	28.6	89	79	0.0