वार्षिक प्रतिवेदन
ANNUAL REPORT
2000 - 2001









गोवा में स्थित भा. कृ. अनु. प. अनुसंधान समूह
(भारतीय कृषि अनुसंधान परिषद्)
एला, ओल्ड गोवा - 403 402

भाकृअनुप
ICAR

ICAR RESEARCH COMPLEX FOR GOA
(Indian Council of Agricultural Research)
Ela, Old Goa - 403 402 INDIA

वार्षिक प्रतिवेदन
ANNUAL REPORT
2000 - 2001

भाकृअनुप
ICAR



गोवा में स्थित भा.कृ.अनु.प. अनुसंधान समूह
(भारतीय कृषि अनुसंधान परिषद)
एला, ओल्ड गोवा 403 402.

ICAR RESEARCH COMPLEX FOR GOA
(Indian Council of Agricultural Research)
Ela, Old Goa - 403 402, INDIA

Published by :

P. G. Adsule
Director (Acting)
ICAR Research Complex for Goa
Ela, Old Goa - 403 403, India

Grams : RESEARCH, VELHA GOA
Fax : 0832 - 286249
Phone : 0832 - 286181, 284678, 284679 (O)
0832 - 411607 (R)
E-mail : icar@goa1.dot.net.in

Compiled and edited : **P. G. Adsule & J. R. Faleiro**

Hindi Translation : **E. B. Chakurkar & S. B. Barbuddhe**

Compilation &
Technical Assistance : **Sidharth Marathe**

Printed at : **Rahul Offset Printers**
Merces - Goa. Ph : 235141

: CONTENTS :



		PAGE
1.	Preface by Director	1
2.	Executive Summary	2
3.	Introduction	9
4.	Research Achievements	13
5.	Technology Assessed and Transferred	113
6.	Education and Training	114
7.	Awards and Recognition	120
8.	Linkage and Collaboration	121
9.	Other Projects	122
	General / Miscellaneous	
10.	List of Publications	123
11.	List of Approved Ongoing Projects	129
12.	Consultancy, Patents, Comercialisation of Technology	130
13.	Meetings of RAC, SRC, Management Committee, etc.	131
14.	Participation in Conferences, Meetings, Workshops, Symposia etc.	135
15.	Workshops, Seminars, Summer Institutes, Farmers, Day etc. Organised by the institure.	138
16.	Distinguished Visitors	139
17.	Personnel	143
18.	Any other relevant information	145
19.	Summary in Hindi	148

1. PREFACE BY DIRECTOR

Goa is a tiny coastal State, located in the konkan tract of Western India. Agriculture has been closely associated with the life of the people in the State and with its growing population and booming tourism industry there is a constant demand to produce more cereals, friuts, vegetables, flowers, meat, milk and fish. Several Agro- tourising projects are also in the offing in the State giving a new dimension to agriculture as an enterprise.

The ICAR Research Complex for Goa, which is a multidisciplinary research Institute is mandated to cater to the agricultural research and education needs of the Goa State besides extending its findings to the farming community through its Krishi Vigyan Kendra.

Since its inception in the Goa in April, 1976, as a Research Centre and its subsequent upgradation as an independent Institute during April,1989, the ICAR Research Complex for Goa through its technologies has stood by the farming community in the State enhancing the production of various farm commodities. The identification of superior rice varieties, including short and medium duration, scented, hybrid and salt tolerant varieties, introduction of suitable groundnut and cowpea varieties for rice based cropping systems, identification and release of high yielding cashew selection (Goa-1), collection and maintenance of the popular and rare Goan mango varieties in the germplasm bank of the Institute, evoloving suitable cocnut based cropping models, devising suitable pest management stratergies for field and horticultural crops, standardising a comphrensive rabbit rearing technology package, livestock disease investigation , rearing poultry on indegenously available waste litters, formulation of feeds for ornamental fish, integrated farming system technologies are some of the major contributions of the Institute.

With the Natural Resource Management Division of the Council, New Delhi now looking after the activities of the Institute, the ICAR Research Copmlex for Goa is poised to take a major leap in the new millenium with a thrust on coastal agriculture research with the sustainance of the ecosystem. Besides the 25 Research Projects of the Institute there are at present six research projects under the National Agricultural Technology Project (NATP) with a budget of Rs 133 lakhs. Though, the first NATP programme was initiated only during 1999 but it has made a significant impact in the field.

It gives me indeed an immense pleasure to publish this annual report for the year 2000-01, which will be useful to the researchers, planners, administrators and members of the farming comminity both within and outside the State of Goa.

P.G.ADSULE

2. EXECUTIVE SUMMARY

The ICAR Research Complex for Goa, is the only Institute of its kind in the State o Goa catering to the Research needs in the field of Crop Science, Horticultutre, Animal scienc and Fisheries. Beside Research, the Institute transfers technologies to the farming communit of the State, through its Krishi Vigyan Kendra. Following are the highlights of the Researc Projects of the Institute and TOT programmes of the KVK, for the year 2000-2001.

2.1 CROP SCIENCE

Among the 12 short duration rice varieties evaluated during Kharif 2000, the variet Triguna (IET-12875) had the highest yield of 5.46 t/ha followed by Krishna Hamsa (5.16 t ha) over Jyoti (4.75 t/ha) as the local check variety..

In another trial comprising of 11 medium duration varieties, variety 4063 yielded 5.3 t/ha as compared to local check Jaya (4.97 t/ha). All the other varieties were found to yiel lesser than Jaya.

In the Basmati rice trial, evaluation of eight varieties showed that the variety IET - 13549 out yielded others yielding 5.26 t/ha followed by others.Culture IET-15390 (4.9 t/ha) and IET-14191 (4.76 t/ha) were found to be superior to the Pusa Basmati-1(4.33 t/ha).

Among the evaluation of 12 hybrids during Kharif, 2000 'Sahyadri' had the highes yield level of 6.76 t/ha followed by DRRH-1 (6.4 t/ha) and PAC-6201 (6.1 t/ha). The control varieties Jaya and Jyoti in this trial yielded 5.23 t/ha and 4.83 t/ha respectively.

In a trial on screening and management of salt tolerant rice varieties, to have rice plants growing in high salinity level it was observed that there was reduction in the root length, tertiary roots and increase in the ratio of weight of root to the shoot.

Under evaluation and management of high yielding varieties of sugarcane, it was observed that the treatment of 300,150:150:10 Kg N,P,K and Zn gave the maximum ratoon sugarcane yield of 92.7 t/ha and 82.0 t/ha in sugarcane varieties viz CO 7527 and CO 90009, respectively.

In a trial on rice based farming systems, recycling of paddy straw (2 t/ha) along with mushroom spent substrate (1 t/ha) in rice continued to show an increased trend in both grain yield (4.59 t/ha) and the straw yield (5.36 t/ha). Among the rice based cropping systems, rice-cowpea (variety V-118) system yielded consistently higher rice grain equivalent yield (7.77 t/ha) under residual moisture situations as compared to rice -brinjal system (8557 kg/ ha) under protective irrigated conditions. However, the soil organic carbon build up was better with the recycling of FYM to rice @ 10 t/ha and rotation with groundnut. Further, the integration with mushroom production @ 1000 bags/ha added additional component productivity to the tune of 4.95 t/ha equivalent rice grain yield.

Among the seven high yielding forage grass varieties/hybrids tested under the trial on coconut based farming systems, the Hybrid Napier PBN-16 and DHN-3 consistently showed better performance in terms of green forage yield, dry forage yield and the tillers per clump. Further, intercropping with perennial forage legume *Centrocema* was also moderately compatible with these Hybrid Napiers. The grass intercropping in coconut with dairy unit has added additional net returns to the tune of Rs.7000/cow/year with additional employment potential of 70 man days/cow/year. Further, recycling through FYM and coconut compost of the system with the grass intercropping helped to build up the soil organic matter content to a level of 1.44 per cent OC as compared to 1.17 per cent in control.

NATP Project on management of Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Oliv. using food baited pheromone traps, revealed a high incidence of RPW throughout Goa. On an average 26.03 weevils were captured per trap during the period. RPW was most active in the State during the period of September to November while it was least active during May to June. It was observed that for mass trapping programmes the recommended trap density of 1trap/ha. can be reduced effectively to 1 trap/3ha., without impairing weevil captures. Weevil captures were not impaired even when the coconut petiole food based bits kairomone releasing bait was not replaced in the trap for one month. However, water in the trap had to be replenished if traps were not serviced beyond 15 days. Vertical preference for trap heights indicated that highest weevil captures of 30.4 weevils per trap was recorded when traps were placed at a height of 1.0m from the ground.

Laboratory reared monsoon and winter broods of pheromone trap captured weevils indicated that young, gravid and fertile female weevils were attracted to the pheromone traps. Thus, pheromone trapping of RPW is beneficial as it suppresses the build up of RPW in the field. Different kairomone-releasing food baits indicated that dates gave the highest captures of 14.33 per trap, at par with sugarcane (12.33) and the freely available coconut petiole (11.66). Oil palm fruit when used in pheromone traps had a repelling effect on RPW. The field life of the costly pheromone lure (Ferrolure +, 800mg) can be extended upto seven months by setting traps under shade and retaining the sachet in the silver foil packing, by making longitudinal slits for slow release of the chemical into the environment. Spatial distribution of RPW in coconut plantation showed that the pest was of highly aggregated charecters and followed the negative binomial pattern of distribution. Hence, plantations in the vicinity of heavily infested palms are most prone to RPW attack and need immediate protection from the pest to avoid the spread.

Field studies of reaction of different rice varieties to major insect pests during Kharif 2000, showed that there was more incidence of gall midge in the short duration rice varities and gall midge in hybrid rice varieties.

Studies on the reaction of local cashew selections to tea mosquito bug (*Helopeltis antonii),* revealed that Karapur-1 recorded the lowest average damage score of 1.25 (13%) while Dhave-1 had the highest score of 3.27 (33%). It was also observed that VTH-164/1 recorded the least cumulative shoot damage score of 1.25.

Testing pheromone traps for rhinoceros beetle (*Oryctes rhinoceros),* revealed that traps were not very effective in trapping the pest. On an average only 6.67 beetles per trap were caught in a period of three months. Considering the high cost of the lure, low beetle captures and non-lethal nature of the pest, trapping rhinoceros beetle with pheromone lures is not an economic viable proposition.

Monitoring the incidence of Mango fruit fly (*Dacus dorsalis)* in mango, revealed that the incidence of the pest was the highest during April to June while it was the least active during November and December.

2.2 HORTICULTURE

In an Ad-hoc Project entitled "Collection of cashew germplasm in Goa and establishment of germplasm," five new accessions viz. Sattari-1(CD-80-9), Sattari-2 (CS-80-9), Sattari-3 (CS-80-10), Sattari-4 (CS-80-11) and Sattari-5(CS-80-12) were identified and added to the germplasm collection.

Metroglyph analysis of germplasm accessions based on average nut weight and nut yield per tree showed that two accessions viz. Valpoi - 5 and Bardez - 9 were the solitary clusters to form extreme groups (Groups I and XV) representing the distant genetic relationship in respect of mean weight of nuts and nut yield per tree.

In a project on survey, collection and evaluation of plantation crops and spices, Goa-1 (Balli-2) cashew selection, from among the local accessions, continued to show promising performance by recording 4.01 kg of raw nuts per tree (at 2 m x 2 m spacing) during the season with a cumulative yield of 25.16 kg/tree at the age of 11 years. Shelling per cent was 31.24. Action has alredy been initiated for the notification of this selection by the Union Agricultural Ministry.

Among the introduced accessions viz. H-1600 and H-1608 recorded nut yield of 5.86 and 4.13 kg per tree, respectively.

Evaluation of oilpalm hybrids (D x P) under Goa conditions revealed that 35 D x 291P and 18 D x 32 P showed significantly higher Fresh Fruit Bunch yield performance by recording more than during 2000-2001 season.

In a project under NATP entitled "Integrated Nutrient management of palm based cropping/farming system", organics were compared with inorganics both for forage grasses and coconut. It was observed that application of 100 per cent inorganics alone has resulted in relatively higher plant height, tillers per clump, number of leaves per plant, leaf length and width, inter-nodal length and forage grass yield (29.62 t/ha/harvest) and was followed by another treatment of 50 per cent organics + 50 per cent inorganics (29.18 t/ha/harvest) while the minimum growth and yield parameters were recorded in plots receiving 100 per cent organics alone (28.23 t/ha) in NB-21 Hybrid Napier grass. However, the treatments were statistically on par with each other. The growth and yield parameters of *Centrocema* followed a similar trend.

In another project on survey, collection, conservation and evaluatin of fruits available/ grown in agro-forest areas of Goa, four types of rose apple, two types of bread fruit, two types of jack, three species of *Garcinia* and three varieties of amla were added to the Institute germplasm during this period.

In a trial on collection, conservation and evaluation of vegetable crops in Okra, 13 high yielding strains were collected from different vegetable growing areas of Goa during the period of work.

In a project on collection and evaluation of flower crops, local germplasm of marigold (8 varieties), jasmine (6 varieties) and crossandra (4 varieties) were collected. Eight improved varieties of gladiolus were collected from IIHR Bangalore.

Under a project on Post harvest management technologies for fruits available/grown in agroforestry areas of Goa region, survey work was undertaken to collect the traditional convenient processed food products prepared from the agricultural food produce available in the region. The products were further evaluated for their physico-chemical and storage life attributes. Most of the products had storage life of upto six months with traditional receipes and packing. However, a lot of scope exists for improving the overall quality of the product and storage life. Studies on extending the shelf life of indeginous friuts viz. Bread fruit and bimbli, it was observed that the storage life could be extended without much loss of weight and freshness to eight days and five days in case of bread fruit and bimbli, respectively at ambient temperature by packing them in 0.4 mm LDPE bags with 0.5 per cent ventillation.

Studies on storage of raw bread fruit pieces in brine solution, revealed that after six months of storage there was not much change in organoleptic attributes viz. colour, texture and flavour besides, chemical parameters like T.S.S and acidity.

2.3 ANIMAL SCIENCES

To encourage pig rearing by the farming community under NATP programme, an experimental low cost feed was formulated replacing wheat bran with dried Cashew Apple Waste (CAW) to the extent of 20 per cent. The trials conducted on local x Yorkshire crossbred pigs to study the suitability of CAW as feed substitute, indicated that there was no adverse effect on the feed intake and growth rate of the animals when CAW was incorporated at this level. Average dry matter digestibility was 70.78 per cent and 73.90 per cent in case of experimental and control groups, respectively, while the daily weight gain was 167.70 g and 168.35 g for the experimental and control groups, respectively. Cost of feed per kg was reduced to the extent of 17 per cent (Rs.1.20/kg).

With a view to develop low cost feed for rabbit, two experimental diets were formulated by incorporating Brewery Dried Grain waste (BDG) or cashew apple waste to the extent of 25 per cent level in rabbit feed. Feeding trial conducted on 18 young crossbred rabbits recorded the average daily weight gain of 17.87 g, 15.06 g and 15.84 g for control, CAW

and BDG diet respectively indicating that Brewery grain waste can be used as substitute for wheat bran in rabbit feed to reduce the feed cost by Rs. 1.45 per kg.

To study the effect of high energy diet on performance of lactating rabbit, Jaggery was incorporated as high-energy source. Rabbit Does supplemented with 10 g of jaggery for 5 days before the expected date of kindling daily till 10 days post kindling had improved kit survival rate of young ones from 45 to 80 per cent.

As part of the survey of the prevailing diseases in the state of Goa , a total of 25 milk samples were collected from crossbred cows from field cases to identify the major causative organisms of mastitis. Out of these, 15 samples were from clinical cases of mastitis. *Staphylococcus aureus* and *Streptococcus sp.* were found to be the major causative organisms. Other pathogens isolated were *Pseudomonas sp., Listeria* sp. and *Escherichia coli*. Isolates were found to be sensitive to gentamicin, norfloxacin, chloramphenicol, ampicillin-cloxacillin and pefloxacin.

Two outbreaks, reported in the State one each of Foot and mouth disease and Ehrlichiosis among cattle were investigated and measures recommended for their control. A total of 3.13 per cent blood samples from cattle revealed positivity for brucellosis.

To identify the source of contamination in market meat, 37 samples of fresh meat and meat products were collected and processed for total plate counts for mesophiles and psychrophiles, yeast and mould counts and for *Salmonella* detection. In fresh meat, the counts were 10.45×10^4 cfu/g for mesophiles, less than 10^3 cfu/g for psychrophiles and 1.1×10^4 cfu/g for yeast and moulds. In meat products the mesophilic counts were 7.5×10^4 cfu/g.

A feeding trial conducted with commercial broilers to see the effect of feeding brewery dried grain (BDG) with or without kemzyme supplementation on the performance of broiler indicated that broiler chicks fed with 4 per cent BDG and 1.0 g/ Kg Kemzyme performed equally as that of control chicks in respect of body weight and feed conversion efficiency. However, there was no significant difference among the various treatments for the relative weight of carcass traits and relative weight of organs except the weight of abdominal fat. The relative weight of abdominal fat did not follow a definite trend. The chicks fed with BDG had less abdominal fat deposit than the control chicks. Kemzyme supplement to the diet containing 8 per cent BDG significantly reduced the abdominal fat in chicks

2.4 FISHERIES

Under the project on rice-freshwater integration studies, additional rice varieties were tested for their suitability for the combination, in two locations. The rice variety Vytilla-5 was found to be the best, giving a yield of 3 t/ha with 180 cm plant height during kharif. Vytilla-5 also recorded a yield of 5 t/ha with a plant height of 124 cm during rabi.

Under the project on low cost fish feed formulation, the four ornamental fish feeds were tested on gourami for the growth performance. Feeds based on chicken liver meal and squid meal, gave results statistically on par in case of all nutritional indices compared to the commercial diets viz. brine shrimp flake and tubifex worm. Formulated fish feeds were many fold chepaer in cost as compared to the commercial ones.

The formulated feeds for carp starter and ornamental fish were tested for storage life and water stability. When kept in airtight plastic containers, the feeds were found to retain the quality for one year without any deterioration. About 70 per cent and 50 per cent of the carp feed pellets retained their original shape after 30 minutes and 60 minutes of immersion in little agitated water respectively, whereas the ornamental fish feeds were water stable only up to 30-45 minutes. The protein leaching percentage of the carp starter feeds and ornamental fish feeds varied from 8.63 to 14.97 per cent and 8.12 to 13.58 per cent, respectively, after one hour.

In a trial on the use of probiotics containing different levels of *Lactobacillus* sp. on *Labeo rohita* fry, the growth performance, nutrient utilisation and carcass composition was found to be the best at the probiotic supplement level of 5.0 g (3.0 billion *Lactobacillus* viable CFU)/kg of basal diet (40.00 % C.P.). However, the enzyme based probiotic feed supplement gave the best reults at the level of 3 g.

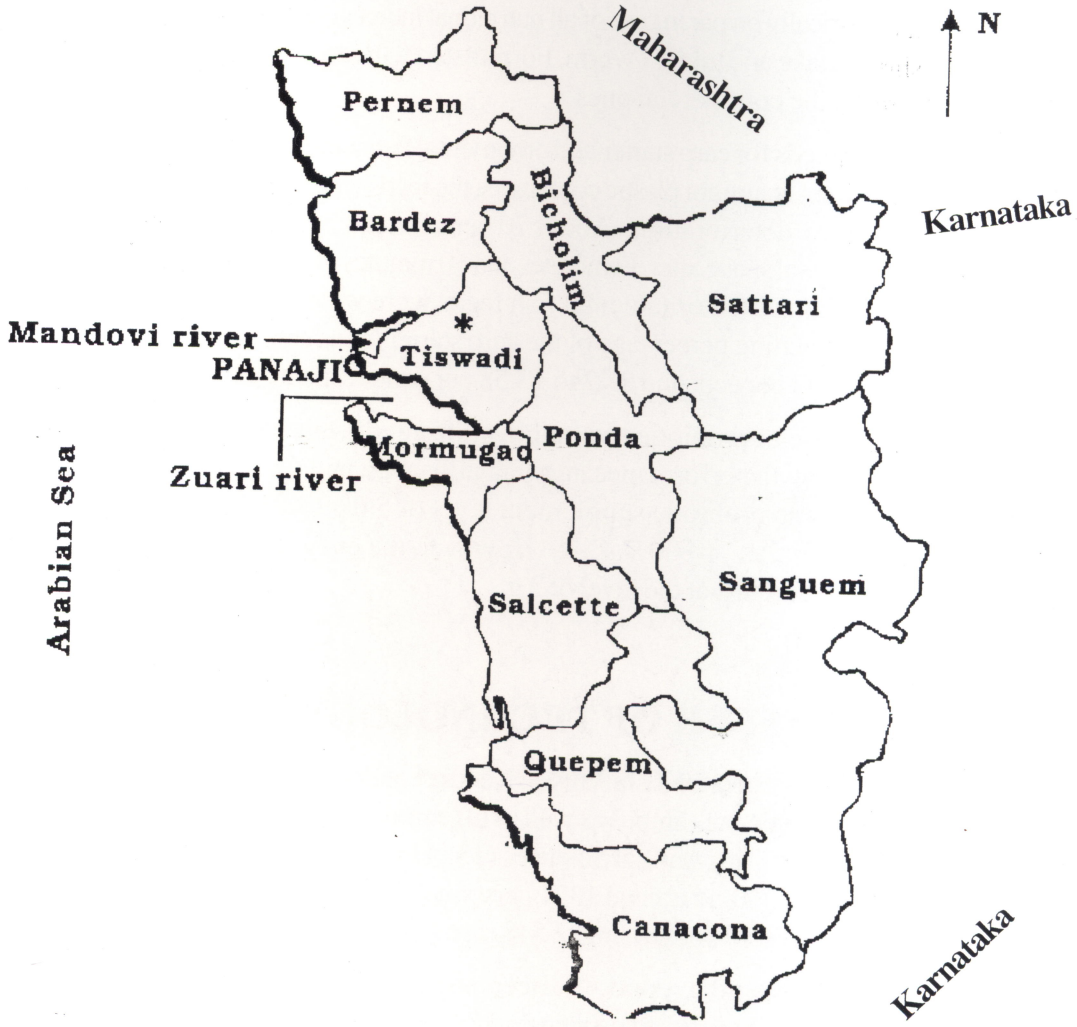
2.5 TRANSFER OF TECHNOLOGY

During the period of report, Krishi Vigyan Kendra conducted 85 need based vocational training programmes both on the campus as well as off campus in various disciplines viz.Crop Science (16), Horticulture (18), Animal Sciences (13), Home Science (22), Plant Protection (13) and Agril. Extension (8) and trained 1321 personnel drawn from the practicing farmers, rural youth and Extension staff comprising of 548 men (41.48 %) and 773 women (58.52 %).

During the year under the report, fourteen popular articles, and one each research article and technical reprots besides, two extension folders were published. Twenty four radio talks and three television talk were broadcast/telecast by All India Radio/Doordarshan, Panaji,Goa for giving latest update technologies relating to the production of plantation / horticulture and field crops. During the period, 1051 progressive farmers visited to this Institute for getting assistance in various forms from the Centre.

On Farm testing trials were conducted on 13 farmers fields covering 2.6 hectares to find the solutions to the problems related to agriculture. Beneficiaries selected under on farm testing, were drawn almost equally form the men and women groups.

During the year, 22.9 hectares (oilseeds: 11 ha + cereals : 11.9 ha) area was covered under the front line demonstrations on 73 farmers fields.



* ICAR Research Complex for Goa, Old Goa

Fig. 1. Map of Goa indicating talukas and neighbouring states.

3. INTRODUCTION

The coastal State of Goa situated along the Konkan tract is bounded by Arabian Sea and the States of Karnataka and Maharashtra (Fig-1). It has a warm humid and equanimous coastal climate which is ideally suited for all kinds of agricultural activities viz; annual crops, plantation crops, horticultural crops, livestock enterprises and fish farming. Due to increasing labour costs, cultivation of field crops especially rice is becoming unprofitable. The farmer of the State are, therefore, increasingly taking up to Horticultural crops with emphasis on mixed farming where in farming system research including rearing of animals and fish, and watershed management is gaining importance. Goa also does not have agricultural university or any other agency to look after the specific agricultural research needs of the state.

The Indian Council of Agricultural Research, New Delhi, therefore, established the ICAR Research Complex for Goa in April 1976. To begin with, the Complex was under the administrative and technical control of Central Plantation Crops Research Institute, Kasaragod. After functioning at different Government farms in the state, it was finally shifted to its present location at Ela, Old Goa in 1982. In oredr to intensify further the transfer of technology and to impart grassroot level vocational training to the local farming community, a Krishi Vigyan Kendra was established at the research Complex in 1983.

Keeping in mind the evergrowing needs of agricultural research, educatuin and extension of the State of Goa, the ICAR, New Delhi upgraded the Research Complex to a full fledged Institute in April, 1989. The Research Complex carries out applied as well as basic research in crop sciences, horticulture, animal husbandry and fisheries science. In all, the Research Complex has 53.37 ha land of which 33.67 ha was acquired during 1987. The Institute is headed by the Director, who is supported by 20 Scientists from different disciplines on research side and also other 23 technical, 18 administrative and 33 supporting staff, making the total staff strength of the Complex to 95. Besides one Scientific, 11 technical, 2 administrative and 2 supporting staff function under the KVK of the Institute.

The research activities are carried out through 25 ongoing research projects distributed in crop sciences, horticulture animal sciences and fisheries sections of the Institute. Technologies are imparted to farmers through both on campus and off campus training programmes organised by the KVK of the Institute. Further, special training programmes, field demonstrations and Kisan melas are also organised from time to time to intensify the transfer of technology process. During this year also the Institute was previlaged to be a coperating centre for six National Agricultural Technology Projects in Horticulture, Animal Science, Agricultural Entomology and Soil and Water Conservation and centre for IVLP.

3.1 MISSION

The Institute was started with a mission to achieve, "the introduction and improvement of all potential crops and various species / breeds of livestock, their production and scientific exploitation of various auatic resources for improving fish production"

3.2 MANDATE

Based on the local requirements and priorities, the mandate of the Institute is as follow

1. To conduct strategic and applied research on potential agricultural and horticultu crops, livestock and fisheries for improving productivity and postharvest manageme
2. To disseminate improved technology developed
3. To act as a centre for training in updated technologies
4. To collaborate with national and international Institutes / agencies in developing a transferring new technologies
5. To generate nucleus planting material
6. To provide consultancy services, and
7. To act as a repository of information on Western Ghat Agriculture System.

The research and the extension activities are carried out through a network of three discipli based divisions and a Krishi Vigyan kendra (KVK). Different Committiees viz; Institu Management Committee, research Advisory Committee, Scientific Research Council a Scientific Advisory Committee help the Management for the smooth functioning of the Institut

3.3 ORGANISATIONAL SETUP

The Director heads the technical and the administrative unit of the Institute. The resear and the extension activities are carried out through a network of discipline based sections a a Krishi Vigyan Kendra (Organisational Chart detailed in Fig-2). Different Committees mentioned in the Institute mandate help the management for smooth functioning of the Institu

3.4 FINANCIAL STATEMENT

Expenditure incurred on various accounts of both the Institute and KVK is presented table 1.

Table 1. Abstract of expenditure in (Rs in lakhs) for the year 2000-2001.

Sr. No	Head	Institute		KVK
		Non plan	Plan	Non plan
1.	Establishment charges	73.57	15.66	18.01
2.	Travelling allowances	1.79	1.79	0.48
3.	Other charges	30.68	30.32	2.22
4.	Works	3.82	7.65	—
5.	One time catch up grant			
	a) Replacement of equipments	—	13.33	—
	b) Renovation of old building	—	9.63	—
	TOTAL	**109.86**	**78.38**	**20.71**

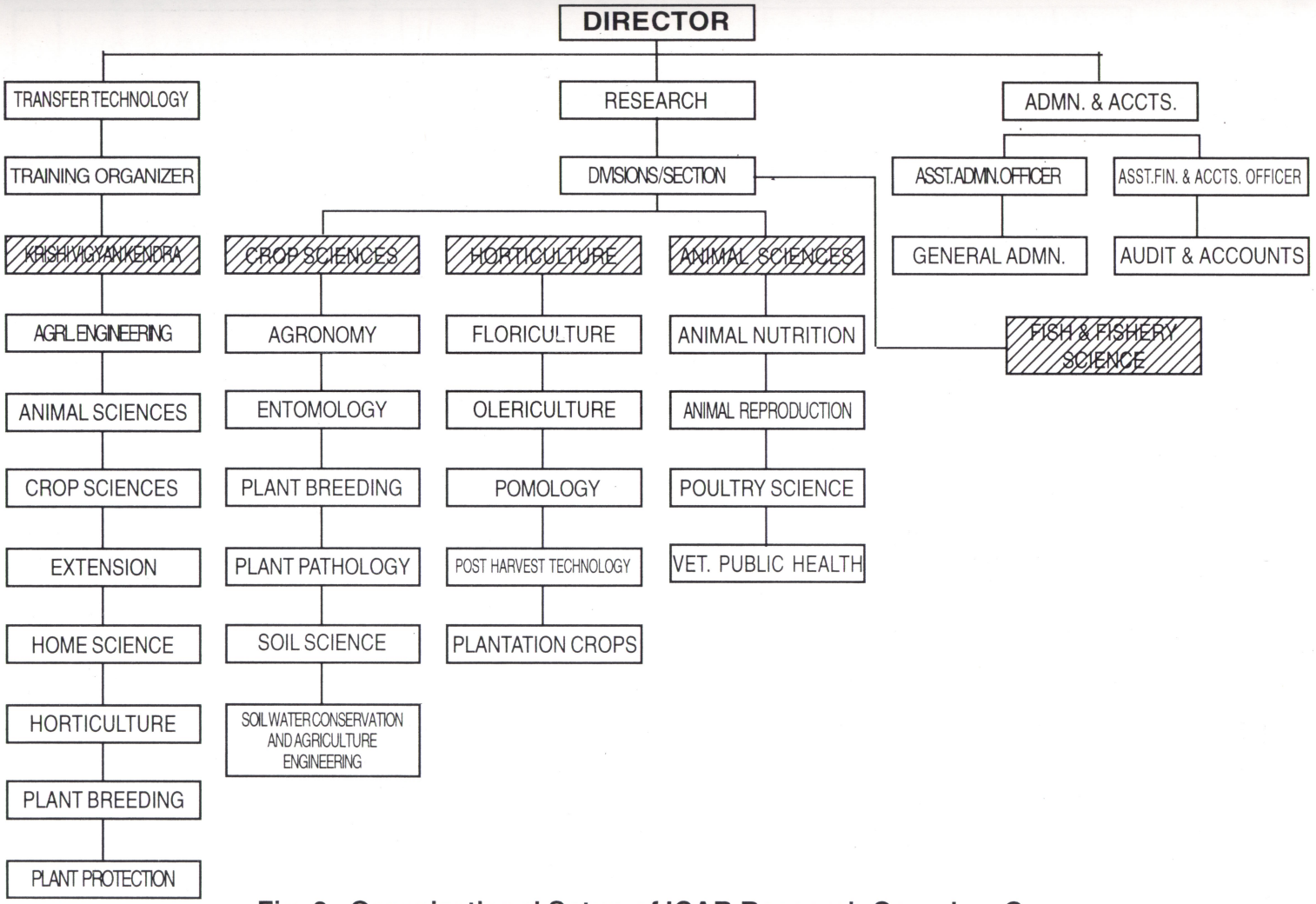


Fig. 2. Organizational Setup of ICAR Research Complex, Goa

3.5 STAFF POSITION

Staff position of the Institute and Krishi Vigyan kendra is presented in tables 2 and 3 respectively.

Table 2. Staff strength of the Institute.

Category	Sanctioned posts	Posts filled	Posts vacant	No of SC.	No of OBC
1. **Director** (RMP)	1	--	1	--	--
2. **Scientific**					
Principal Scientist	2	1	1	1	--
Sr. Scientist	4	2	2	1	--
Scientist	14	15	--	2	2
	21	18	4	4	2
3. **Technical**	23	17	6	3	1
4. **Administrative and Accounts**	18*	10	8	1	-
5. **Supporting staff**	33	31	2	4	3
Total	**95**	**76**	**20**	**12**	**6**

RMP - Research Management Position.

* Inclusive of two post under the AICRP (Pigs) sanctioned in September, 2001.

Table 3. Staff strength of Krishi Vigyan Kendra.

Category	Sanctioned posts	Posts filled	Posts vacant	No of SC.	No of OBC
1. **Scientific**					
(Training Organizer)	1	--	1	--	--
2. **Techinical**					
Training Associates	6	6	--	2	--
Training Assistants	1	1	--	--	--
Farm Manager	1	--	1	--	--
Computer Programmer	1	--	1	--	--
Driver	2	2	--	1	--
3. **Administrative**	2	2	--	--	--
4. **Supporting staff**	2	4	--	1	--
Total	**16**	**16**	**3**	**4**	**--**

4. RESEARCH ACHIEVEMENTS

4.1 CROP SCIENCE

4.1.1. Evaluation of short, medium, fine grained/ scented rice varieties and rice hybrids in Goa.

(HR Prabhudesai, JR Faleiro and R Ramesh)

Rice is the main cereal crop occupying an area of 54,000 ha and contributes to about 42 per cent of the total net sown area of the state. Project aims to find out alternative high yielding varieties to replace the traditionally cultivated varieties viz. "Jaya" and "Jyoti" and also diversification into high value fine grain varieties of basmati types and also into hybrid rice technology which has shown to break the yield barriers of the traditional varieties. The later two aspects were incorporated into the main project from the year 1993-94 and the work was continued during the year.

All these trials were laid out in Randomised block design with three replications each with a net plot size of $10m^2$. All the plots were maintained as per the technical details provided by the DRR, Hyderabad. All the standard agronomic practices specified for each of the group were followed. A fertilizer dose of 80:50:50 kg/ha NPK for short duration, 100:50:50 kg /ha for medium as well as basmati group and a higher dose of 120: 50: 60 kg NPK /ha for hybrids was applied in doses.

Obersvations in repect of the yield contributed by the physiological characters like plant height (cm), earhead length (cm), number of productive tillers, panicles/m^2, number of filled grains/panicles, 1000 grain weight(g) and plot yield (kg) was recorded alongwith other miscellaneous data such as grain type, days for 50 per cent flowering and straw yield.

During the kharif season, trials were laid out in the four categories namely short, medium, scented and hybrid group. Among the 12 short duration rice varieties evaluated, the variety Triguna (IET-12875) out yielded others recording a yield of 4.26 t/ha followed by Krishna Hamsa (IET-9219) and the check variety "Jyoti" which yielded 4.08 t/ha and 3..42 t/ha, respectively. (Table 4)

Table 4. Data on yield and physiological characters of short duration rice varieti during Kharif, 2000.

Variety	Earhead length (cm)	Panicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
IET-16825	21.6	581	82.2	27.2	2.48	MS
IET-16826	17.4	572	78.2	23.8	2.93	MS
IET-16827	21.4	534	116.4	26.5	3.23	SB
IET-16828	20.6	512	69.2	25.1	2.76	SS
IET-16829	21.3	576	104.4	26.3	2.86	MB
IET-16830	20.6	702	118.2	26.9	3.65[b]	LB
IET-16831	23.4	610	87.0	27.4	2.87	MB
IET-16832	21.8	564	90.4	25.8	3.41	MB
Gautam	22.0	615	93.8	26.7	3.28[b]	MB
Krishna Hamsa	24.0	684	74.0	26.2	4.08[a]	LS
IR-64	22.2	598	93.6	28.4	3.63[a]	MS
Triguna	24.6	567	106.2	26.4.	4.26[a]	LS
Jyoti (Check)	21.6	589	112.8	27.2	3.42[b]	MS
CD (P=0.01)	1.38	32.6	3.64	2.12	1.63	

LS : Long slender, MS : Medium slender, SS : Small slender,
LB : Long bold, MB : Medium bold, SB : Small bold

In the 11 medium duration varieties evaluated during the season, the coded variet 4001 yielded 4.53 t/ha as compared to the local check "Jaya" which recorded a yield of 4.1 t/ha. All other varieties recorded yields below the check variety. (Table 5)

Table 5. Data on yield and physiological characters of medium duration rice varieties during Kharif, 2000.

Variety code	Earhead length (cm)	Panicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
4001	23.2	554	123.8	33.4	4.06[b]	LB
4002	24.4	606	112.6	36.2	4.13[b]	MB
4003	25.6	589	109.8	34.5	4.43[a]	LB
4004	23.8	637	112.6	34.1	3.93	LS
4005	24.0	593	121.4	36.6	4.04	LS
4007	25.6	548	96.8	35.3	3.83[b]	MB
4008	23.8	580	113.6	36.3	4.33[a]	MB
4009	21.6	517	124.4	35.8	3.26	SB
4010	25.8	644	111.5	34.9	4.06	MB
4011	25.6	544	136.0	33.7	4.53[a]	LS
Jaya (check)	24.2	621	120.4	36.4	4.97[ab]	LB
CD (P=0.01)	2.31	27.8	2.17	3.19	3.12	

LS : Long slender, LB : Long bold, MB: Medium bold, SB : Small bold

In the basmati group, among the eight varieties evaluated, the variety IET-15390 outyielded (4.90 t/ha) the other varieties as against the National check variety Pusa Basmati-1 (4.33 t/ha) (Table 6).

Table 6. Data on yield and physiological characters of Basmati rice varieties during Kharif, 2000.

Variety	Earhead length (cm)	Pannicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
Karnal local	32.8	624	104.8	20.3	3.33	LS
IET-13549	30.6	581	122.4	21.6	3.26	LS
IET-15392	34.5	661	113.6	19.4	4.10[b]	LS
IET-15390	29.4	725	139.6	18.5	4.90[ab]	LS
IET-15391	34.2	628	112.4	19.4	4.16[a]	LS
IET-13548	30.3	581	99.6	21.4	3.00	LS
IET-14131	28.4	469	85.7	22.0	3.20	LS
P.Basmati(check)	33.6	688	125.5	19.4	4.33[a]	LS
CD (P=0.01)	2.31	27.6	2.47	1.79	0.74	

LS : Long slender.

In the trial on evaluation of 12 rice hybrids, the variety Sahyadri once again recor the highest yield of 7.65 t/ha followed by DRRH-1 (7.15 t/ha) and KRH-2 (6.89 t/ha) wh were found to be statistically superior to the local checks viz Jyoti (3.82 t/ha) and Jaya (5 t/ha) (Table 7).

Table 7. Data on yield and physiological characters of Hybrid rice varieties duri Kharif, 2000.

Variety	Earhead length (cm)	Pannicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
ADTRH-1	25.6	452.4	138.7	26.4	4.32	MS
APHR-2	24.2	474.8	129.6	25.4	4.80^{bc}	SS
CNRH-3	23.8	526.3	120.5	26.3	5.36^{b}	MS
CORH-2	22.6	539.4	125.6	24.9	5.05^{b}	LB
DRRH-1	23.6	588.2	167.3	25.6	7.15^{a}	LS
KRH-2	26.3	569.8	152.4	26.6	6.89^{a}	LS
NSD-2	25.0	478.6	130.3	24.8	4.16	MS
PSD-1	23.7	469.8	128.6	24.2	4.23	MB
Sahyadri	28.8	596.4	173.5	27.3	7.65^{a}	MS
PAC- 6201	26.8	559.7	159.4	26.4	6.32^{a}	SS
PHB-71	23.0	428.9	119.6	27.6	4.16	SB
Jaya	24.7	389.7	140.5	28.6	5.68^{b}	LB
Sasyashri	23.0	328.4	118.5	25.8	4.00	MS
Triguna	25.0	477.9	143.8	26.4	4.73^{c}	LS
Jyoti (check)	22.6	389.2	110.8	26.2	3.82	MS
CD (P=0.01)	3.76	31.3	17.9	1.69	2.37	

LS : Long slender, MS : Medium slender, SS : Small slender,
LB : Long bold, MB : Medium bold, SB : Small bold

Table 8. Data on yield and physiological characters of short duration rice varieties during Rabi, 2000-01.

Variety	Earhead length (cm)	Pannicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
IET-16825	24.4	602	97.8	26.8	3.46[b]	MS
TET-8886	23.6	576	103.5	27.6	3.40[b]	LS
IET-16827	21.0	503	110.8	28.2	3.86[a]	LS
IET-16828	23.2	625	126.8	26.7	4.23[a]	MS
IET-16829	25.8	572	109.0	28.2	3.16	MS
IET-16830	23.6	591	100.8	26.4	3.40[b]	MS
IET-9240	24.4	578	116.4	27.1	3.95	MS
IET-16832	21.8	512	89.2	26.7	3.15	MS
Gautam	24.0	655	116.8	28.4	4.10	MB
Krishna Hamsa	26.4	688	136.8	27.4	4.23[a]	LS
IR-64	23.2	618	110.6	28.3	3.83	MS
Triguna	25.2	720	136.7	26.6	4.45[a]	LS
Jyoti (check)	23.6	589	112.8		3.32[b]	MS
CD (P=0.01)	1.78	27.6	3.07	1.79	1.93	

LS : Long slender, MS : Medium slender,
LB : Long bold, MB: Medium bold.

Study the field reaction of different rice varieties to major insect pests (Kharif, 2000)

During kharif, 2000 the incidence of gall midge, *Orseolia oryzae* and leaffolder, *Cnaphalocrocis medinalis* was recorded in four different groups of rice varieties viz, short duration, medium duration, hybrids and scented varieties at 30,45,60 and 75 Days After Transplanting (DAT).

The reaction of different rice varieties to gall midge and leaffolder is presented in Table 9. It was also seen that the incidence of gall midge and leaffolder was below the economic injury level. However, the incidence of gall midge and leaffolder was comparatively more in the short duration and hybrid rice varieties, respectively (Figures 3 and 4).

Table 8. Data on yield and physiological characters of short duration rice varieties during Rabi, 2000-01.

Variety	Earhead length (cm)	Pannicles/ m^2	Filled grains/ pannicle	1000 grain weight (g)	Yield (t/ha)	Grain type
IET-16825	24.4	602	97.8	26.8	3.46[b]	MS
TET-8886	23.6	576	103.5	27.6	3.40[b]	LS
IET-16827	21.0	503	110.8	28.2	3.86[a]	LS
IET-16828	23.2	625	126.8	26.7	4.23[a]	MS
IET-16829	25.8	572	109.0	28.2	3.16	MS
IET-16830	23.6	591	100.8	26.4	3.40[b]	MS
IET-9240	24.4	578	116.4	27.1	3.95	MS
IET-16832	21.8	512	89.2	26.7	3.15	MS
Gautam	24.0	655	116.8	28.4	4.10	MB
Krishna Hamsa	26.4	688	136.8	27.4	4.23[a]	LS
IR-64	23.2	618	110.6	28.3	3.83	MS
Triguna	25.2	720	136.7	26.6	4.45[a]	LS
Jyoti (check)	23.6	589	112.8		3.32[b]	MS
CD (P=0.01)	1.78	27.6	3.07	1.79	1.93	

LS : Long slender, MS : Medium slender,
LB : Long bold, MB: Medium bold.

Study the field reaction of different rice varieties to major insect pests (Kharif, 2000)

During kharif, 2000 the incidence of gall midge, *Orseolia oryzae* and leaffolder, *Cnaphalocrocis medinalis* was recorded in four different groups of rice varieties viz, short duration, medium duration, hybrids and scented varieties at 30,45,60 and 75 Days After Transplanting (DAT).

The reaction of different rice varieties to gall midge and leaffolder is presented in Table 9. It was also seen that the incidence of gall midge and leaffolder was below the economic injury level. However, the incidence of gall midge and leaffolder was comparatively more in the short duration and hybrid rice varieties, respectively (Figures 3 and 4).

Table 9. Cummulative damage per m² in rice varieties due to leaffolder, *Cnaphalocrocis medinalis* and gall midge, *Orseolia oryzae* in Goa during Kharif, 2000.

Short duration varieties	Cummulative damage/m²		Medium duration varieties	Cummulative damage/m²		Hybrid varieties	Cummulative damages/m2		Scented varieties	Cummulative damage/m²	
	G.M.	L.F.		G.M.	L.F.		G.M.	L.F.		G.M.	L.F.
IET-16825	0.25	5.25	4001		3.25	ADTRH-1	0.50	7.25	Pusa basmati	0.75	3.50
IET-16826	1.00	4.00	4002		2.00	APHR-2	0.00	5.50	Karnal local	1.25	3.25
IET-16827	0.00	6.00	4003		3.25	CNRH-3	1.00	7.00	IET-13549	1.25	3.75
IET-16828	1.00	4.00	4004		2.50	CORH-2	0.50	5.25	IET-15392	0.25	2.50
IET-16829	5.25	5.00	4005	0.25	4.00	DDRH-1	0.00	5.25	IET-15390	1.00	3.50
IET-16830	1.50	5.25	4007	0.25	2.25	KRH-2	0.25	7.50	IET-13548	0.25	3.75
IET-16831	0.75	4.25	4008	0.75	3.25	NSD-2	0.25	4.75	IET-15391	1.50	4.25
IET-16832	0.00	4.50	4009		3.00	PSD-1	0.25	6.75	IET-14131	0.50	3.50
Gautum	1.75	4.75	4010		4.50	Sahyadri	0.00	6.75			
Krishna Hansa	0.75	8.00	4011		2.25	PA-6201	0.25	6.75			
IR-64	0.25	5.75	Jaya		3.00	PHB-71	0.50	5.50			
IR-12875	1.75	5.75				Jaya	0.00	5.75			
						Sasyasri	0.50	6.50			
						IET-12875	0.25	6.75			
						Jyoti	0.00	6.50			

G.M. = No.of silver shoots/m²

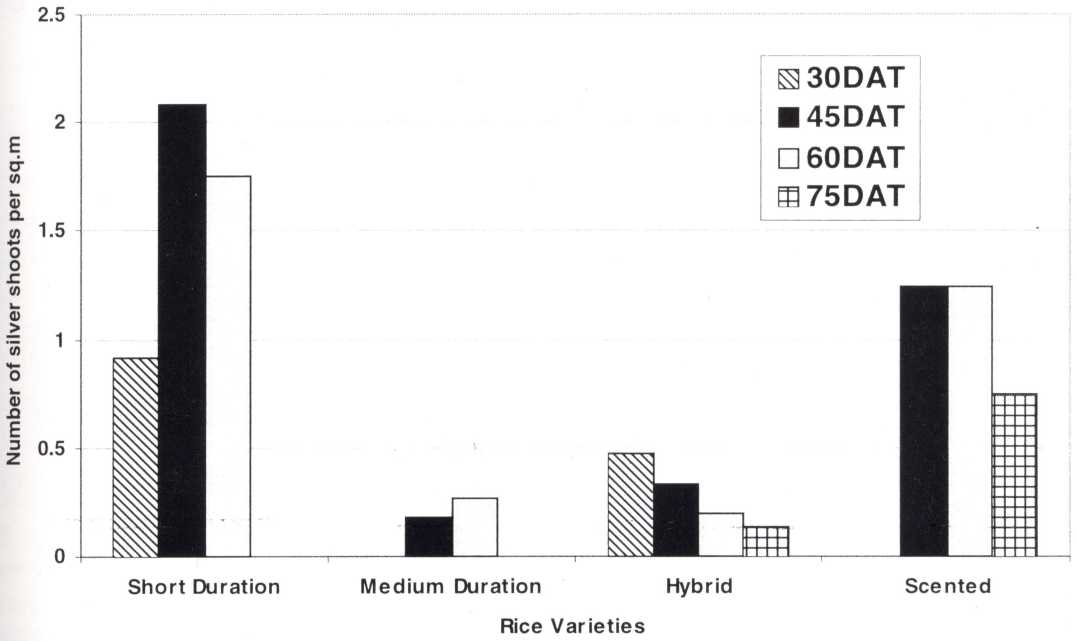


Figure 3. Incidence of gall midge, *Orseolia oryzae* on rice varieties in Goa (Kharif, 2000).

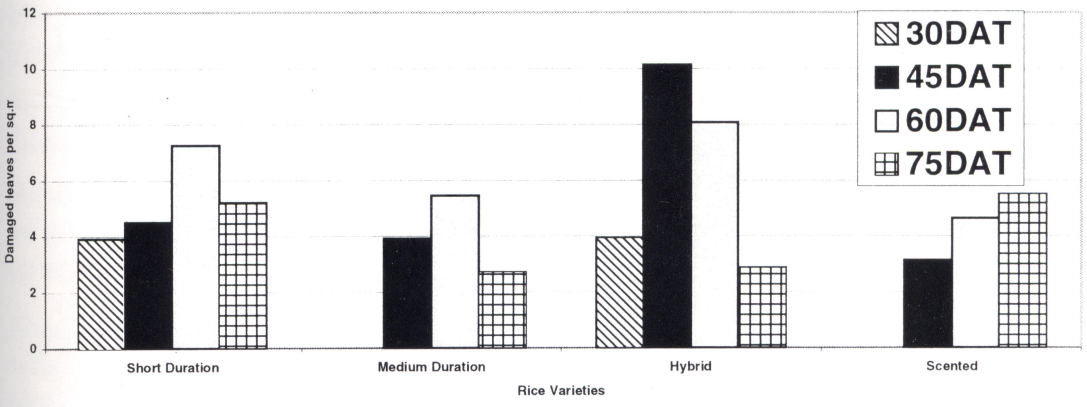


Figure 4. Incidence of leaffolder, *Cnaphalocrocis medinalis* on rice varieties in Goa (Kharif, 2000)

G.M. = No.of silver shoots/m^2
L.F. = No.of folded leaves/m^2

4.1.2. Screening and Management of salt tolerant rice varieties in Goa.

(H.M.Wasnik)

To study salt tolerance in rice, field experiments were conducted on rice varieties viz CSR-10,CSR-27 and Korgut during the kharif, 2000 at three different locations a Ela,Carambolim and Chodan. The physico-chemical properties of the soils of the differen locations are given in table 10. The quality of the ground water at different intervals selecte from the sampling sites of the soil samples showed an increase in the salinity levels in th month of October as compared to the previous months of August and september at all th locations. The maximum salinity in term of E.C.3.20 dS/m in the ground water was recorde at Chodan where higher concentration of sodium (24.56 me/l), Chloride (26.86 me/l) an SAR value of 29.86 obtained. These were the main factors found responsible for high salinit in the water presented in table 11.

In the root studies of the salt tolerant rice in these soils, it was found that there wa reduction in the root length, less number of tertiary roots and increase in the weight of root t shoot ratio, in the rice plants growing at higher salinity level. A root damage of four per cen with 30 per cent reduction in yield of Korgut was also noticed when grown at a salinity leve of E.C.3.20 dS/m. (Table 12).

Table 10. Physico-chemical properties of the soil at different locations under study

Nutrient	Ela	Carambolim	Chodan
pH (1:2.5)	5.95	4.84	6.94
E.C.(dS/m)	0.09	0.36	1.06
Organic Carbon (g/kg)	14.10	7.70	6.30
Available N (kg/ha)	241	257	244
Available P (kg/ha)	34	7.16	6.3
Available K (kg/ha)	112	102	807
Available Ca (kg/ha)	650	170	370
Available Mg (kg/ha)	192	367	850
Available Na (kg/ha)	46	225	950
Available S (kg/ha)	152	109	20
DTPA extractable Fe (mg/kg)	25.51	24.60	19.28
DTPA extractable Mn (mg/kg)	12.50	9.59	7.90
DTPA extractable Zn (mg/kg)	1.49	1.07	0.75
DTPA extractable Cu (mg/kg)	7.53	4.00	2.80
Hot water extractable B (mg/kg)	0.34	0.39	0.30
Water extractable Chlorides (mg/kg)	105	311	1330

Table 11. Quality of ground water at different intervals of soil samples at sampling sites. (August to October, 2000)

	Ela			Carambolim			Chodan		
Parameters	Aug	Sept	Oct	Aug	Sept	Oct	Aug	Sept	Oct
pH	4.14	5.70	5.88	4.57	6.59	7.02	7.00	7.34	7.37
E.C .(dS/m)	0.10	0.15	0.15	0.24	0.29	0.42	0.85	3.0	3.20
Na (me/l)	0.10	0.22	0.27	0.97	1.39	2.78	11.57	24.13	24.56
Mg (me/l)	0.25	0.20	1.30	0.15	0.12	0.34	0.20	1.06	1.11
Ca (me/l)	0.40	0.56	1.20	0.10	0.13	0.20	0.25	0.33	0.38
K (me/l)	0.15	0.21	0.23	0.03	0.03	0.05	0.35	0.55	0.59
HCO_3 (me/l)	0.10	0.11	0.16	0.15	0.25	0.35	0.38	0.70	0.76
Cl (me/l)	0.45	0.63	1.11	1.20	2.40	4.20	7.06	26.28	26.86
SO_4 (me/l	0.20	0.30	0.50	1.06	1.16	1.57	1.20	1.81	2.03
S.A.R.	0.10	0.16	0.17	3.08	4.20	5.68	24.4	29.0	29.30

Table 12. Effect of soil salinity on root development and yield of salt tolerant rice varieties.

	Ela			Carambolim			Chodan		
Parameters	CSR-27	CSR-27	Korgut	CSR-27	CSR-27	Korgut	CSR-27	CSR-27	Korgut
Root length (cm)	33	26	40	34	36	32	23	22	21
No. of Tertiary roots	224	218	232	221	94	212	106	76	97
No. of Damaged roots	0	0	0	0	0	0	0	0	4
Root weight (gm/plant)	0.9	1.40	1.0	2.8	1.1	1.1	1.9	0.60	0.9
Shoot weight (gm/plant)	15.2	18.60	7.6	33.0	11.5	13.5	4.9	4.40	10.5
Ratio of Root : Shoot	0.06	0.07	0.06	0.08	0.09	0.08	0.39	0.14	0.09
Yield (t/ha)	4.50	4.0	2.0	4.0	3.90	2.0	2.20	2.10	1.50

4.1.3. Evaluation and Management of high yielding varieties of Sugarcane.

(H.M.Wasnik)

To study the nutritional requirements in sugarcane for second year ratoon management, a field experiment was carried out during 2000-2001 at the Institute farm. The soil samples (0-25 cm) indicated pH 5.97,E.C.0.10 dS/m, available nutrients contents of 197 kg N,6.39 kg P,168 kg K,176 kg Ca,141 kg Mg, DTPA extractable 25.83 kg Fe,29.48 kg Mn,2.93 kg Zn,4.27 kg Cu and 0.55 kg hot water extractable Boron per hectare respectively. The experiment consisted of eight treatment combinations with two varieties of sugarcane viz. CO 7527 and CO 90009 with 250:125:125, 300:150:150 kg N:P:K/ha and 250:125:125:10, 300:150:150:10 kg N:P:K:Zn/ha respectively, replicated thrice in a Randomised Block Design.

Results of the experiment revealed that there was significant increase in the growth parameters and yield of sugarcane due to different treatments, however the application of 300 kg N,150 kg P,150 kg K and 10 kg Zn per hectare recorded more cane height, individual cane weight, cane girth, Brix, recovery and cane yield (86.2 t/ha) with 19.0 per cent Brix and 8.5 per cent sugar recovery in CO 7527 ratoon crop. Also a yield of 82.6 t/ha with 18.5 per cent Brix and 8.3 per cent sugar recovery was recorded in CO 90009 ratoon crop (Table 13).

Table 13. Mean growth and quality parameters of sugarcane varieties as influenced by different levels of Nitrogen, Phosphorus, Potassium and Zinc application.

Treatment (kg/ha)	Height (m)	Weight (kg)	Girth (cm)	Brix (%)	Yield (t/ha)	Recovery (%)
CO - 7527						
250N,125P,125K	2.60	1.50	1.80	8.20	52.0	8.30
250N,125P,125K,10Zn	2.63	1.58	1.85	18.50	70.0	8.35
300N,150P,150K	2.67	1.60	2.00	18.70	75.5	8.45
300N,150P,150K,10Zn	2.70	1.70	2.10	19.00	86.2	8.50
CO - 90009						
250N,125P,125K	2.50	1.50	1.85	18.30	51.0	8.15
250N,125P,125K,10Zn	2.55	1.55	1.90	18.40	62.0	8.20
300N,150P,150K	2.58	1.60	1.95	18.45	70.0	8.25
300N,150P,150K,10Zn	2.60	1.65	2.0	18.50	82.6	8.30

4.1.4. Rehabilitation of mine reject soils for crop production.

(HM Wasnik, BL Manjunath, AR Desai and S Mannivanan)

To develop technologies for management of mine reject soils, project cost estimates were prepared for formal discussion with mine owners. The company accepted the project proposal and agreed to provide necessary help. Forestry species namely Acacia auriculiformis and Casuarina equisetifolia were planted in double rows at two meter spacing in zigzag manner. The seedlings were irrigated periodically. The peripheral line was raised by making bunds along the border to avoid sideward movement of water from top surface. Partial levelling, wherever necessary was carried out for laying out and planting of cashew grafts and forage crops.

In order to develop a cropping model involving multi-species for the dump yards of mine reject soils including land development through soil and water conservation a multi-disciplinary strategy was planned by assessing the actual situation .The plan included Sylvi component on the border at a regular intervals, cashew and forage grasses in the inter spaces involving contour and periferal bunding, partial levelling, contour straggered trenching and formulation of bench terraces. Acacia and Casuarina planted at the border were maintained and initial studies show that the survival rate of Acacia auriculiformis is better as compared to Casuarina.

With a view to know the effect of different amendments on the crop establishment in the mine reject soils, four organic manurial treatments including control were imposed viz. pressmud, farm yard manure and poultry manure. Initial studies show that poultry manure application has favoured plant growth both in terms of its survival. Grass species viz. Hybrid napiers PBN-16 and NB-21 have also been planted to cover the berms in the laidout bunds and trenches to stabilise the soil and enhance production. Graded bunds were formed in the experimental area while, straggered trenches of 3.0 x 0.3 x 0.45 m were excavated in the remaining area of the plot.

To provide an ecological site stability in terms of a diverse vegetative cover and in order to establish the mine areas with suitable horticultural species for mine dump yard soils, about four hundred pits were dug at a spacing of 5x5 meter in one hectare and filled with 10 kgs. of F.Y.M. 200 cashew grafts (Vengurla-4) and 200 mango grafts (50 each of Amarapalli, Hilario, Ball and Mussarat) were planted on the onset of monsoon 1996. It was observed that there was 80 per cent survival of cashew grafts. The survival of mango grafts was initially 80 per cent during 1996-97,which gradually decline to 15 per cent during 2000-01. The cashew grafts were 2.0 to 2.6 meters in height, with 5to 13 branches, with canopy spread of 4.34 to 15.53 sq.meters and 76 leaves per twig, on an average. The nutrient content of the cashew leaf was 15.9 g N, 5.5 g P,8.0 g K, 1.1 g Ca, 1.0g Mg, 208 mg Fe, 96 mg Mn, 14 mg Zn, 12 mg Cu and 16 mg B/kg dry matter respectively.

Mango grafts were 0.60 to 1.0 m in height with 3 to 11 branches, with a cann spread of 0.12 to 0.74 sq. meter and 16 leaves per twigs, on an average. The nutrient con in mango leaf was 10.2 g N, 7.7g P, 5.0 g K, 1.0 g Ca, 1.2g MG, 211mg Fe, 314 mg Mn mg Zn, 13mg Cu and 26 mg B/ Kg dry matter respectively. A well branched cashew g yielded 40 fruits per plant on an average with bold cahew kernel weighing 8.10 g and contai 12.5 g N, 6.5 g P, 11.5 g K, 2.4 g Ca, 3.7 g Mg, 3.0 g Fe, 1.7 mg Mn, 0.46 mg Zn, 0.3 Cu and 0.3 mg B/Kg dry matter. The cashew apple contained 13.6 g N, 9.8 g P, 17.5 g 9.5 g Ca, 2.0 g Mg, 2.5 g Fe, 0.9 mg Mn, 0.2 mg Zn, 0.6 mg Cu and 0.3 mg B/Kg dry ma

The soils under cashew, mango and mine pits had a pH of 6.55, 6.35 and 6.45 with corresponding electrical conductivity of 0.062, 0.036, 0.030 dS/m, respectively. The availa soil nutrients content in Kg/ha were 144,47,84 N, 8.24, 8.14, 7.75 P, 61, 114,59 K, 7 575, 1672 Ca, 418, 535, 545 Mg, DTPA Extractable 17.07, 9.50, 9.17 Fe, 22.18, 18. 20.79 Mn, 0.68, 1.30, 0.53 Zn, 0.40, 0.33, 0.18 Cu, 0.53, 0.48, 0.44 B content for s under cashew, mango and mine pits respectively.

Mine pit water recorded a pH 6.88, Electrical conductivity 0.015 dS/m and milliequival litre of 0.50 Ca, 0.10Mg, 1.80 HCO 3,2,40 chlorides, 0.41 SO_4 0.031 SAR and 0.20 M Ca content.

4.1.5. Rice based farming systems.

(BL Manjunath)

The experiment was continued during the year in a Split-plot design with three replicati in Jyothi rice variety during kharif. The main plot treatments included comparison of recyc manurial resources from integrated enterprise viz. recycled FYM (M_1), recycled poultry man (M_2), recycled paddy straw with mushroom spent substrate

(M_3) which were compared with the control (M_0). All the plots were uniformly fertili @ 80: 50: 50 Kg NPK/ ha. The sub-plot treatments included comparison of four commo followed rice based cropping systems in Goa viz. rice-groundnut, rice-cowpea, rice-bri under protective irrigated conditions as per the local practice and rice-sunhemp with the ri fallow system as control under residual moisture situations.

The potentially recyclable by-products/residues from rice and rice based cropp system were quantified and feasibility of maintaining an integrated mushroom unit using resources available within the system was worked out, so as to ascertain the sustainabilit the system.

Effect of recycled manures and cropping systems on succeeding rice

The effect of recycled manurial resources and preceeding rice based crops on subsequent rice crop in terms of grain and straw yield is presented in table 14.

PLATE-1 Crop Science



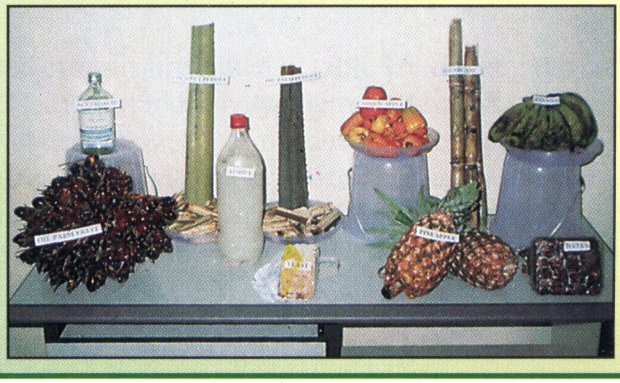
"Pusa Basmati"
a high value aromatic
rice variety for Goa.



Variation in cowpea
varities of Goa.



A view of groundnut
trial during rabi
at the Institute farm.



Different food baits
evaluated for use
in red palm weevil
pheromone traps.

Table14. Yield of grain and straw with the different sources of mannure and cropping system.

Cropping systems / manurial resources	Grain yield (Kg/ha)					Straw yield (Kg/ha)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
Rice – Fallow	4230	4039	4134	4917	4330	5883	5015	4902	6076	5467
Rice – Groundnut	3855	4789	5143	5065	4713	5290	5694	5789	6474	5812
Rice – Cowpea	4635	3747	4876	3866	4281	5390	4618	5439	4149	4899
Rice – Brinjal	4904	4093	4172	5150	4655	5777	4094	5135	6155	5290
Rice – Sunhemp	3523	5153	3505	3956	4034	4424	5661	4801	3935	4705
Mean	4229	4364	4426	4590	4402	5353	5016	5213	5358	

	Main plot	Sub Plot	Interaction
'F' test	NS	NS	NS

Rice grown under recycled paddy straw with mushroom spent substrate in 2:1 ratio consistently recorded highest productivity of 4.59 t/ha among the treatments. The treatment recorded 8.5 per cent higher grain yield over no recycled manure. The increase in grain yield was also coupled with increase in straw yield (5358 Kg/ha). The increased vegetative growth in terms of higher leaf production and plant growth with profuse tillering enhancing the photosynthetic surface resulted in increased number of panicles per unit area along with panicle length having more number of filled grains per panicle resulted in consistently better performance of the treatment.

Among the sequential crops, groundnut was found to have influenced the productivity of rice to an extent of 8.8 per cent in grain yield and 6.3 per cent in straw yield over rice – fallow sequence. This may be attributed not only due to the crop rotation effect of the legume but also due to the turning in of about 2.4 tonnes of groundnut hull having narrow C:N ratio after its harvest which resulted in increased plant height and higher dry matter production in succeeding rice crop.

Performance of rice based crops

Data on the performance of rice based crops is presented in table 15. Among the cropping systems tried, rice-brinjal system yielded more productivity in terms equivalent yield. The increase was 98, 25, 10 and 81 per cent over rice-fallow, rice-groundnut, rice- cowpea and rice- sunhemp systems respectively. Higher increase in the yield in case of brinjal was due to the bigger size and more number of fruits per plant. Within rice-brinjal system, recycling of paddy straw with mushroom spent substrate yielded 14.2 per cent higher productivity over control.

Table 15 : Rice grain equivalent yield (Kg/ ha) in different rice – based cropp systems.

Cropping System / recycled Manure	M_0	M_1	M_2	M_3	Mean
Rice – Fallow	4230	4039	4134	4917	4330
Rice – Groundnut	5662	7042	7703	7024	6858
Rice – Cowpea	7483	7992	9286	6317	7770
Rice – Brinjal	8716	7828	7734	9950	8557
Rice – Sunhemp	4295	5839	4118	4684	4734
Mean	6077	6548	6595	6578	6450

	Main Plot	Sub plot	Interaction
"F" Test	NS	*	NS
C.D. (P = 0.05)	--	1477.4	--

M_0 : No recycled manure + recommended NPK
M_1 : Recycled FYM + recommended NPK
M_2 : Recycled Poultry Manure + recommended NPK
M_3 : Recycled Paddy straw + recommended NPK + Mushroom spent substr

Rice-cowpea system seems to be a better option for residual moisture situations. T combination yielded 79 per cent higher equivalent grain yield over rice –fallow system. E duration coupled with compact branching of the cowpea variety V-118 accomodates m plant population per unit area. Further, better root system establishment in the early stage crop growth helped to extract more moisture from the subsurface layers of soil resultin increased productivity.

Effect of recycled manures and cropping systems on soil fertility

Data on Effect of recycled manures and cropping systems on soil fertility is presente table 16. In situ incorporation of paddy straw along with mushroom spent substrate over t years had beneficial cumulative effect on soil fertility. Analysis of soil after rice harvest indica that the organic carbon content of soil in these plots was better as compared to cont Pooled data showed that on an average these plots had higher organic carbon to the exten 0.05 to 0.08 per cent over no recycled manure and recycled poultry manure respectiv suggesting that recycling of crop residues ensured recovery of major proportion of the nutrie by the crop from the soil. The beneficial effects were also due to the carbon di-oxide enrichm of the lower atmosphere which is known to improve the nitrogen fixation.

Table 16. Soil fertility paramaters as influenced by recycled manurial resources in rice and rice based cropping systems.

Treatments	Soil reaction (pH)	E.C (ds m^{-1})	Organic carbon (%)
After rice crop			
M_0	5.80	0.071	1.33
M_1	5.79	0.088	1.48
M_2	5.83	0.093	1.34
M_3	5.74	0.081	1.38
Mean	5.79	0.083	1.38
No recycled manure + Recommended NPK			
After Rice-Fallow	5.72	0.116	1.32
Rice-Groundnut	5.53	0.270	1.32
Rice-Cowpea	5.58	0.200	1.44
Rice-Brinjal	5.87	0.079	1.26
Rice-Sunhemp	5.81	0.125	1.29
Mean	5.70	0.158	1.33
Recycled FYM + Recommended NPK			
After Rice-Fallow	5.80	0.250	1.17
Rice-Groundnut	5.63	0.215	2.19
Rice-Cowpea	5.65	0.315	1.13
Rice-Brinjal	5.99	0.089	1.32
Rice-Sunhemp	5.70	0.145	1.26
Mean	5.75	0.203	1.47
Recycled Poultry Manure + Recommended NPK			
After Rice-Fallow	5.80	0.114	1.44
Rice-Groundnut	5.64	0.220	1.38
Rice-Cowpea	5.49	0.340	1.32
Rice-Brinjal	5.98	0.077	1.32
Rice-Sunhemp	5.87	0.125	1.29
Mean	5.76	0.175	1.25
Recycled Paddy straw + mushroom spent substrate + Recommended NPK			
After Rice-Fallow	5.69	0.118	1.32
Rice-Groundnut	5.56	0.220	1.41
Rice-Cowpea	5.61	0.240	1.38
Rice-Brinjal	5.84	0.073	1.29
Rice-Sunhemp	5.76	0.113	1.17
Mean	5.69	0.153	1.31

Performance of Integrated farming systems

Data on performance of integrated farming systems is presented in table 17. Pool data over the years on the system productivity indicated that rice-brinjal + mushroom+ poult recorded the highest total system productivity (19568 Kg/ha) followed by rice-cowpea mushroom + poultry. The contribution of poultry component in these systems was to an exte of 28 to 34 per cent to the total system productivity. Inclusion of mushroom production in t system enhanced the total productivity of the system by 20 to 23 per cent.

Table 17. Productivity (Rice Grain Equivalent Yield) of Integrated Farming systems during 2000-01.

Farming System		System Productivity (Kg ha^{-1})			System productivit Kg/ha^{-1}
FS_1	Rice cropping alone	4330	-	-	4330
FS_2	Rice – Groundnut + Mushroom + Poultry	6857	6060	4950	17867
FS_3	Rice – Cowpea + Mushroom + Poultry	7770	6060	4950	18780
FS_4	Rice – Brinjal + Mushroom + Poultry	8558	6060	4950	19568
FS_5	Rice – Sunhemp + Mushroom + Poultry	4733	6060	4950	15743

4.1.6. Coconut based farming systems.

(BL Manjunath)

The farming system trial in coconut involving identification of a profitable forage gras along with a forage legume (*Centrocema*) mixture was tried on a thirteen year old plant spaced at 7.5 x 7.5 m in Benaulim coconut garden. The trial included comparison of seve high yielding forage grass hybrids/ varieties viz. Guinea, Setaria, PBN-16, DHN-1, DHN-2 DHN-3 and NB-21 with an inter crop of *Centrocema,* a forage legume suited for the locatio in 1:1 ratio. A control treatment was maintained without any inter cropping of forage grass Each of these grasses were grown around coconut palms leaving a basin of 1.8 m radius fo coconut and were replicated thrice. Recommended package of practices were followed bot in forage grasses and the coconut .

Performance of forages

Data on performance of forages is presented in table 18. Among the forage gras varieties tried, PBN-16 and DHN-3 hybrid napiers performed better during both the years o

experimentation in terms of green and dry forage yields. These hybrids recorded 27.1 and 16.2 per cent higher green forage yield over the control, hybrid NB-21. Better performance of these two hybrid napiers could be attributed to their increased tillering more than 52 per cent over NB-21, higher leaf width, reduced inter-nodal length, better leaf to stem ratio and higher dry matter content as compared to NB-21.

Table 18. Green forage yield of different forage grass varieties / hybrids (t/ha) at different stages of harvest.

Forage grass variety/hybrid	Green forage yield (t/ha)				
	I Harvest	II Harvest	III Harvest	IV Harvest	Total yield
Guinea	12.74	8.18	8.85	16.89	46.66
Setaria	7.82	6.05	7.20	8.86	29.93
PBN-16	28.62	15.29	10.93	15.82	70.66
DHN-1	19.50	12.80	7.11	18.55	57.96
DHN-2	16.35	12.38	14.08	18.67	61.48
DHN-3	27.17	14.34	9.63	16.74	67.89
NB-21 (control)	19.14	13.10	10.37	17.84	60.45
'F' Test	**	**	**	NS	**
SEm ±	2.22	1.09	0.82	-	4.10
C.D. (P = 0.05)	6.82	3.35	2.51	-	12.63

In general, the yield levels of the legume were low due to the higher shade that prevailed under grass cropping. The photosynthetically active radiation received on legume canopy varied from 5.5 to 34.6 per cent of the open height conditions depending on the forage variety and its stage of growth.

Data on total yield of grass and legume as intercrop in coconut is presented in table 19. The forage mixture yield followed a similar trend as that of forage grasses, as the quantity of forage legume harvested was less in comparison to forage grasses. PBN-16 with *Centrocema* mixture, yielded significantly higher forage yield during both the years of experimentation in terms of both green and dry forage yield. DHN-3 + *Centrocema* was another better mixture for increased yields particularly as green forage yield PBN-16 combination recorded 27 per cent more yield as compared to the locally popular hybrid napier NB-21 combination.

Table 19. Yield of grass and legume (t/ha) as inter crops in coconut at different stages of harvesting.

Intercropped forage grass	Grass + legume mixture yield (t/ha)				
	I Harvest	II Harvest	III Harvest	IV Harvest	Total yiel
Guinea + Centro	12.95	8.58	8.96	17.23	47.72
Setaria + Centro	8.15	6.49	7.44	9.79	31.87
PBN-16 + Centro	29.02	15.83	11.13	16.11	72.08
DHN-1 + Centro	19.80	13.21	7.30	18.23	58.55
DHN-2 + Centro	16.47	12.52	14.18	19.13	62.31
DHN-3 + Centro	27.33	14.52	9.80	17.03	68.70
NB-21 + Centro (control)	19.29	13.29	10.49	18.18	61.25
'F' Test	**	**	**	NS	**
SEm ±	2.21	1.01	0.83	-	3.87
C.D. (P = 0.05)	6.80	3.11	2.54	-	11.92

The increased yields of PBN-16 with *Centrocema* were mainly due to the better tille of the hybrid napier which recorded 52.6 per cent higher tillering over NB-21 right from first harvest. Further, higher leaf width, reduced inter nodal length, better leaf to stem ratio higher dry matter content have contributed for the increased yield.

In general, the forage yields were lower during winter months (third harvest) which m be due to the winter dormancy exhibited by the forage grasses as well as due to the l transmission of photo synthetically active radiation on the grass canopy which ranged fr 23.1 to 23.4 per cent of the open light conditions under coconut canopy during winter peri However, the yields were much higher from February onwards which may be due to higher intensities of photo synthetically active radiation received during the period wh ranged from 27.1 to 36.6 per cent of the open light conditions.

Effect of forage intercropping on soil fertility

Although the effect of forage crops inter cropping on soil pH and EC were not signific there appeared to be continuous built up of soil organic matter compared to initial level w inter cropping. The increase in the organic matter content of soil may be due to the higher r biomass of inter cropped forages decayed in the soil along with the shed leaves of both gr and legume and addition of recycled compost. The increased recyclable biomass in s environment probably stimulated for higher soil microbial biomass which ultimately resulte increased organic carbon content (Table 20).

Table 20. Soil fertility changes after intercropping of forage grass varieties / hybrids with *Centrocema*.

Treatments	Soil reaction (pH)	E.C. (dsm^{-1})	Organic carbon %
Guinea + Centro	5.59	0.085	1.40
Setaria + Centro	5.57	0.091	1.37
PBN-16 + Centro	5.65	0.081	1.49
DHN-1 + Centro	5.69	0.075	1.32
DHN-2 + Centro	5.55	0.139	1.55
DHN-3 + Centro	5.60	0.120	1.50
NB-21 + Centro	5.81	0.059	1.43
Mean	5.64	0.093	1.44

Economics of coconut based integrated farming systems

In the present study, the gross returns from an hectare of coconut garden was on an average Rs. 18370/year. However, the gross returns increased 197 per cent over mono cropping when forage crops were inter-cropped. Further, when two milching cows were added to the system, a mean gross returns of Rs. 94870/year which is nearly five times of pure cropping of coconut was obtained. The higher gross returns with inter-cropping were mainly due to the high yielding nature of the hybrid napiers inter-cropped. Further, good milk yield from dairy throughout the year with continuous supply of green forage resulted in higher gross returns (Table 21).

Table 21. Economics of a coconut based farming system in a hectare of garden for an year.

Component	Mean gross returns (Rs/ha/year)	Mean cost of maintenance (Rs/ha/year)	Mean net returns (Rs/ha/year)	B:C
Coconut alone	18370	12150	6225	0.51
Coconut + grass	61450	27080	34370	1.27
Coconut + grass + dairy	109150	60620	48530	0.80

The cost of cultivation was increased by 138.6 per cent by inter-cropping forage cr compared to mono cropping. The cost of maintenance to integrate a unit of two milchi cows was almost doubled (Rs. 62535/ha/year) compared to coconut + forage crops int cropping. The higher cost with dairy integration was due to the establishment costs includi feed and labour.

Mono cropping of coconut was found to be non-remunerative with the return Rs. 6225/ha/year. However, with inter-cropping, the net returns substantially increased Rs 34370 /ha/year. Further, with the integration of dairy having two milching cows gave retu of Rs 48530 /ha/year. High yielding nature of hybrid napiers used for inter-cropping coupl with on-farm generation of inputs in terms of feed for cattle and manure for the crop resulted higher net returns.

The benefit-cost ratio was found to be higher for inter-cropping of forage cro compared to all the others as the hybrid napiers used were multi-cut (perennial) high yieldi ones with least maintenance costs (Table 21).

4.1.7. Hydrologiocal investigations on soil and water conservation measures under cashew crop.

(S Manivannan and AR Desai)

The above project was proposed to predict runoff, soil loss and suggest suitable bo soil and water conservation measures. Based on the detailed topographical survey of t experimental area, the countour map of the area was prepared at 1meter vertical interv Further, the experiment area was divided into large sized runoff plots and the followi conservation measures were followed.

T_1 — Continious Contour Trenching + Vegetative Barrier.
T_2 — Staggered Contour Trenching + Vegetative Barrier.
T_3 — Crescent shaped trenches + Vegetative Barrier.
T_4 — Vegetative Barrier alone.
T_5 — Control.

Goa-1, a cashew selection was planted at 6 x 6 m spacing as a main crop with int crops viz, local cowpea and DMH-2 maize. Combination of *Stylosanthus scabra* and *Sign basilisk* grasses were planted on the surface of excavated soil as vegetative barrier to suppo the mechanical measures.*Glyricidea maculata* was planted as live hedge at 50 cm spacir followed by stylo and basilik grasses. Runoff and soil loss will be measured from next seas after installation of gauging stations.

4.1.8. Management of Red Palm Weevil (RPW) Rhynchophorus ferrugineus Oliv. using food baited pheromone traps.

(JR Faleiro and HRC Prabhu)

Study the locational distribution of RPW in Goa

Data collected on the locational distribution of RPW in Goa is presented in table 22. During the year under report, forty food baited pheromone (Ferrolure) traps set during the previous year in various coconut plantations throughout Goa were serviced at fortnightly intervals when, the food bait (coconut petiole) and insecticidal solution containing 10g carbofuran 3G in 1L water was replaced and also a count of the trapped weevils was recorded. A monthly analysis of trap captured weevils indicated that the captures were female dominated and that the pest was severe and active throughout Goa. On an average 26.03 weevils were captured per trap during the period

Seasonal activity of RPW

Seasonal activity of RPW is presented in figure 5. The pest was most active during Sep-Nov. 2000 and least active during May- June, 2000, indicating that the weather conditions influenced the activity of the pest. A similar trend in the activity of the pest was also noticed in the previous year (1999-2000).

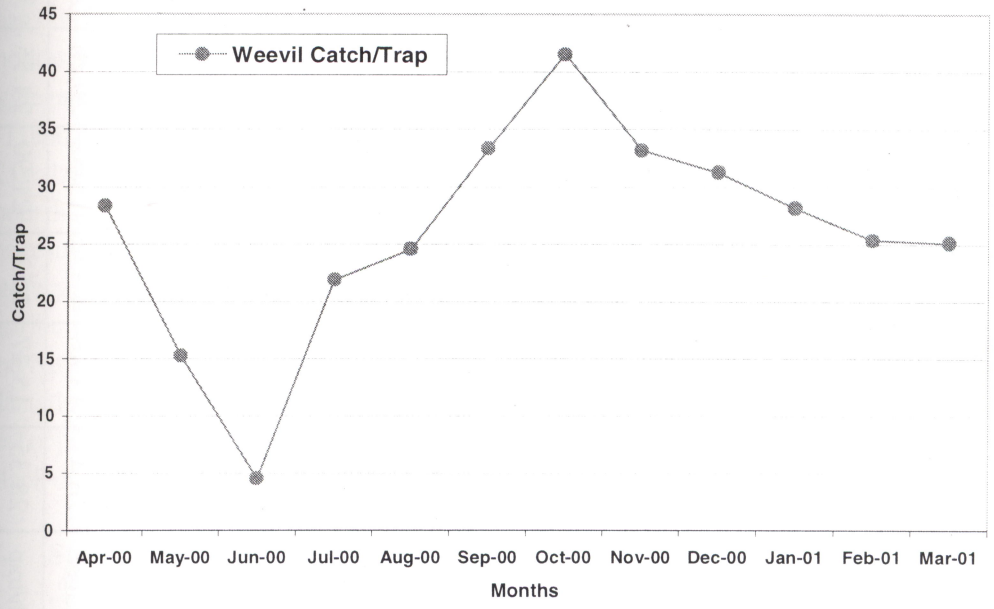


Figure 5. Seasonal Activity of Red Palm Weevil, *Rhynchophorus ferrugineus* Oliv. in coconut plantations of Goa from April, 2000 to March, 2001.

Table 22. Weevil catch per pheromone trap in different Talukas of Goa. (April 2000 to March 2001)

Talukas	April 2000	May 2000	June 2000	July 2000	Aug 2000	Sept 2000	Oct 2000	Nov 2000	Dec 2000	Jan 2001	Feb 2001	March 2001	Ave. 2001
North													
Tiswadi	34.66	13.66	1.00	38.33	60.66	79.00	82.00	39.00	89.66	42.33	46.33	25.33	45.99
Bardez	41.80	23.00	9.20	36.60	26.60	42.00	51.00	45.20	20.40	19.20	23.00	25.60	30.33
Pernem	13.33	11.66	1.00	35.33	30.66	28.66	24.00	22.66	7.00	8.66	19.66	23.33	18.83
Bicholim	22.00	3.66	4.33	18.33	12.33	32.33	33.00	29.33	20.33	22.66	10.00	18.66	18.91
Sattari	35.33	30.00	3.00	20.00	24.00	24.66	21.00	7.33	19.33	23.66	19.33	60.67	24.03
Average	30.38	17.77	4.35	30.52	30.35	40.05	43.23	30.65	30.06	22.82	23.59	30.12	27.82
South													
Mormugao	27.00	16.66	0.00	27.33	50.33	56.66	78.33	70.66	58.33	43.33	37.33	29.00	41.25
Salcette	26.71	10.00	4.57	14.14	20.00	30.28	49.43	52.00	54.42	44.71	36.57	30.14	31.08
Canacona	23.66	6.33	13.00	10.00	12.00	5.66	4.66	9.66	4.00	50.33	26.33	24.33	15.83
Quepem	28.00	13.66	4.33	22.00	10.66	16.66	18.33	20.66	15.33	19.66	13.00	11.33	16.14
Sanguem	21.25	11.75	0.75	15.50	16.50	21.75	34.25	17.25	19.50	7.75	15.75	8.00	15.83
Ponda	33.66	30.66	5.33	6.00	13.66	30.33	46.00	23.00	15.33	17.66	21.33	18.00	21.75
Average	26.47	13.86	4.52	15.52	20.26	27.30	40.22	35.00	32.08	32.08	26.65	21.35	24.61

Average	28.47	13.86	4.32	15.32	20.26	27.30	40.22	35.00	32.08	32.08	26.65	21.35	24.61
Catch/trap	28.35	15.27	4.52	21.90	24.55	33.30	41.50	33.15	31.23	28.15	25.35	25.08	26.03

Spatial distribution pattern of RPW in coconut plantations

Studies on spatial distribution of the pest population serves as a basis for decision making to implement management tactics in the field and is one of the most important ecological properties of a species. Insect populations are known to follow three distinct distribution patterns viz.a) binomial, uniform or regular b) random or poisson and c) negative binomial, aggregated or clumped. However, there is no information on the spatial distribution pattern of RPW. Data on weevil captures between August, 1999 and July, 2000 from the 40 pheromone traps under the surveillance programme as mentioned before was used to work out the spatial distribution of RPW in Goa.

Spatial distribution of RPW was known by calculating different dispersion parameters. The distribution pattern was further confirmed by working out the dispersion indices. Results pertaining to different dispersion parameters and also the dispersion indices are presented below:

1. The variance was always greater than the mean, suggesting aggregative nature of distribution of RPW population in the field. Further, the dispersion parameter 'K' and accurate 'K' were less than eight, indicating that RPW population followed the negative binomial series. The statistic T in this study was found to be less than all the corresponding monthly standard errors of T signifying aggregation or clumping of the population.

2. The aggregated nature of RPW in coconut plantations of Goa was further confirmed by calculating the indices of dispersion. The variance to mean ratio in this study was greater than one for all months suggesting aggregation. The observed Cole's index values for all the months were greater than the values of maximum regularity and randomness suggesting aggregation. David Moore's Index values were also found to be greater than maximum regularity (-1) and randomness (0), confirming the contagious nature of RPW. Reciprocal of exponent K i.e. 1/K is also a measure of clumping of individuals. In this study the values of 1/K were more than zero for all the months thereby suggesting aggregation of RPW population. From the results presented above it is clear that RPW population in coconut plantations of Goa is aggregated and follows the negative binomial distribution pattern. Clumped or aggregated distribution patterns were observed when RPW population was highly active between October and November and also during the periods of low activity between May and June. Hence, plantations in the vicinity of gardens infested by RPW, need to be protected from this dreaded pest of palms by taking up prophylactic control measures as such gardens are prone to repeated attack due to the aggregated spatial distribution pattern of the pest.

Standardise trapping density

Data on the weevils captured under the different trap densities is presented in the figure 6. In any pheromone trapping programme it is essential to have an optimum density of

traps in the field, so as to obtain a good catch of the pest. For mass trapping programm RPW, involving food baited pheromone (Ferrolure +) traps, a trap density of 1trap/ recommended. A trial was laid out in Sanguem, Goa involving six treatments, wherein densities ranging from 2traps/ha to 1trap/5ha were evaluated. Results presented in F indicate a possibility of lowering the recommended trapping density of 1trap/ha to 1trap/ thereby economizing on the use of the costly pheromone lure.

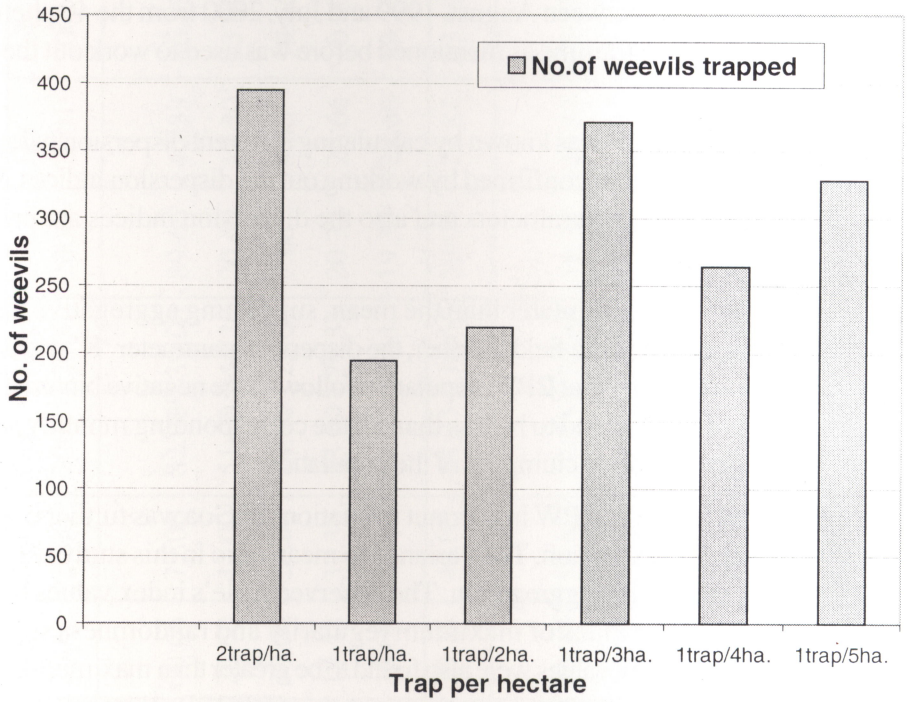


Figure 6. Number of weevils captured under different trap densities (April 2000-March 2001)

Standardise trap protocols for trapping RPW (Ideal Trap)

During the year under report, various trap components viz. trap surface, longevit the food bait and height of trap placement, were evaluated to assess their impact on we captures. In all these field experiments the standard four window (1.5 x 5cm) five litre capa plastic bucket traps were used. Each trap was loaded with a new 800mg Ferrolure + sa hung to the inner side of the bucket lid which also contained 250g of food bait (coc petiole) immersed in 1L insecticide solution containing 10g of Carbofuran 3G. All traps w serviced at fortnightly intervals when, the food bait and insecticidal solution was replaced also a count of the trapped weevils was recorded. Within a given experiment, treatments w separated by a distance of at least 25m.

a) Trap surface (Two traps each, with and without jute-sack at three sites)

In order to evaluate the influence of trap surface (with and without jute sack) on the weevil captures, traps were set at three different sites in Goa. The experiment was conducted between 11.4.2000 to 26.5.2000. The catch per trap indicated that weevil captures were almost at par and traps with sack captured 18.50 (±6.86) weevils, while those without jute sack captured 16.50 (±7.93) weevils. Thus trap surface did not significantly influence weevil captures.

b) Longevity of Kairomone-releasing food bait

During the period under report, a four week trial to evaluate the longevity of food bait was conducted in November' 2000 at four locations of Goa. This trial had six treatments wherein the food bait (coconut petiole) in the trap was replaced after 5, 10, 15, 20, 25 and after 30 days. Results are presented in figure 7 and showed that weevil captures were not impaired even when the food bait was not replaced for one month. However, water in the trap had to be replenished if traps were not serviced beyond 15 days.

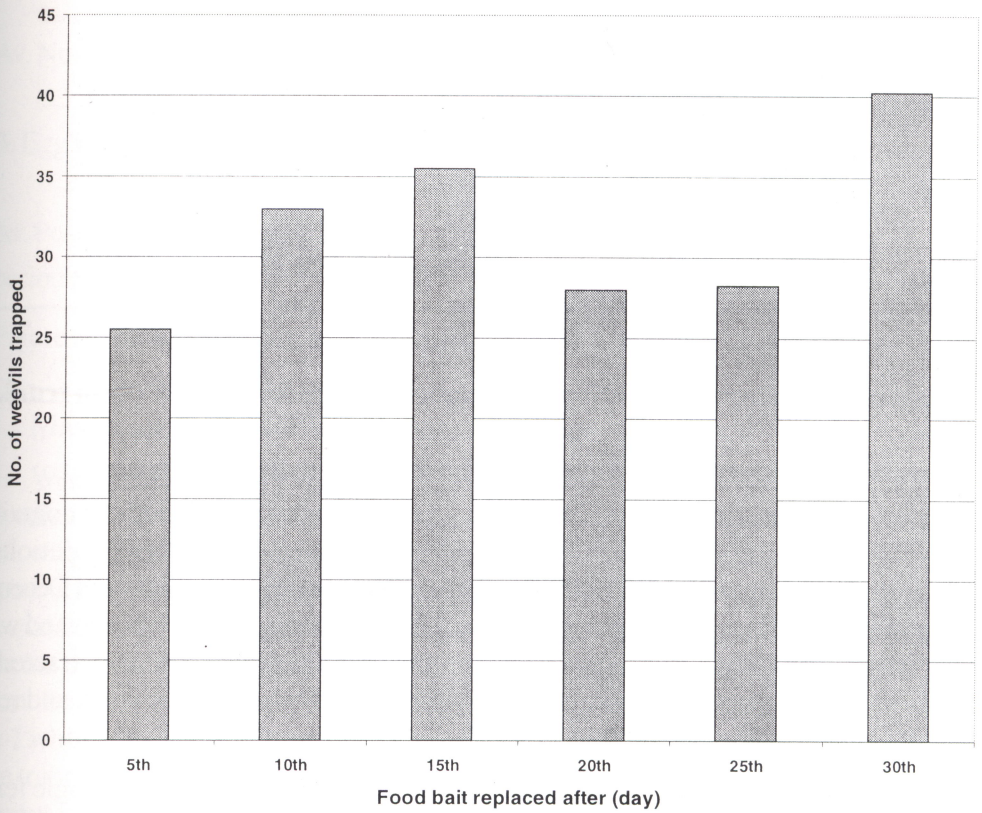


Fig. 7. Weevil captures in relation to replacement of food bait in pheromone trap.

c) Height for trap locations on the palm

In order to determine the optimum height for setting pheromone traps in the f evaluation of traps were undertaken at five levels of height, wherein traps were set at level and at 0.5, 1.0, 1.5 and 2.0m above the ground, along the trunk of the palm. T was carried out simultaneously for four weeks at five locations between September and 2000. Data on this trial is presented in figure 8. Highest weevil captures of 30.4 wee trap was recorded when traps were set at 1.0m height.

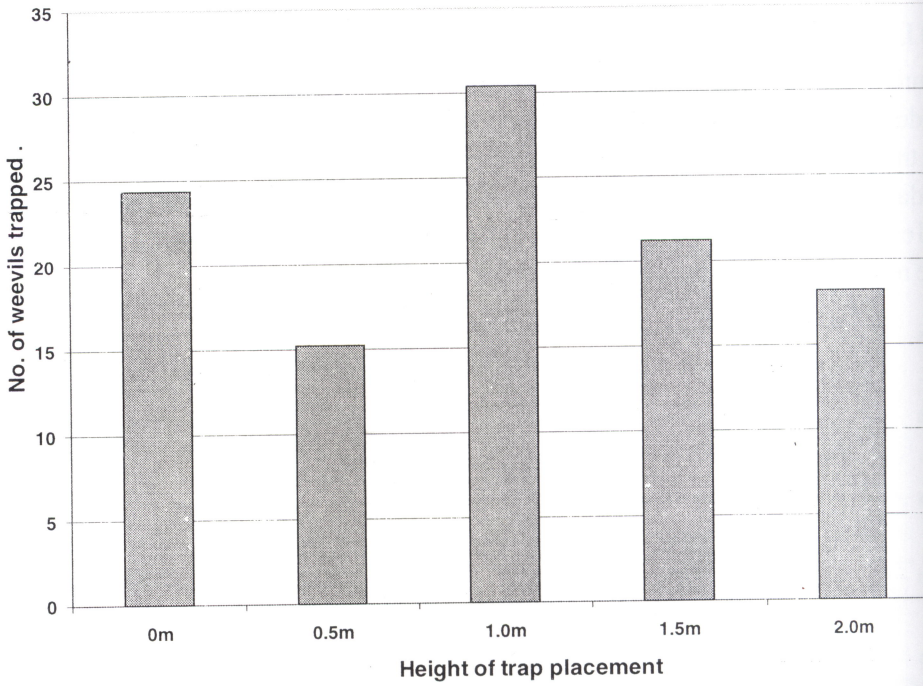


Fig. 8. Weevil captures in relation to the height of the trap on the palm tr

Assesment of reproductive status of captured weevils in the trap

Four window bucket traps of 5 litre capacity without the insecticide but co ferrugineol based pheromone lure (800 mg) and kairomone releasing coconut pe (250g) were set in the farm of the ICAR Research Complex for Goa during July and D 2000 to collect and evaluate the longevity and reproductive status of the monsoon ar broods of RPW emerging from coconut plantations of Goa. Adult weevils attra captured in the above traps were collected every day over a period of one week ar in the laboratory on coconut petiole.

Captured adult weevils in the trap were divided into two sets viz. (i) a singl caged individually and confined to a celibate life (Set-I) and (ii) a female caged toge a trap captured male partner (Set-II). Five replications were maintained in each se

Data on biological parameters of captured weevils is presented in table 23. The average life span of female weevils in Set-I for the monsoon and winter broods was 75.4 and 87.4 days, respectively. While, in Set-II for monsoon and winter broods female weevils lived for 55.4 and 87.4 days, respectively. Further, in Set-I the average egg lay was 207.2 and 171.4 while in Set-II, 315.2 and 281.00 eggs were laid by the monsoon and winter broods, respectively. The egg hatch in Set-I was lower as compared to Set-II for both the monsoon and winter broods. This shows that the female weevils attracted to the pheromone traps during the monsoon and winter season were young, fertile and gravid. The male weevils in Set-II lived for more than two months.

Table 23: Biological Parameters of captured Red Palm Weevils *Rhynchophorus ferrugineus* Oliv in the trap.

PARAMETERS	FEMALE ONLY		FEMALE + MALE	
	Monsoon Brood	Winter Brood	Monsoon Brood	Winter Brood
Av.Life span (days)	75.4 (±6.23)	87.4 (±3.47)	55.4 (±3.39)	87.4 (±3.94)
Av. No. of eggs laid	207.2 (±34.34)	171.4 (±44.89)	315.2 (±14.22)	281.00 (±32.39)
% Egg Hatch	66.90 (±16.94)	41.54 (±15.00)	88.78 (±2.60)	69.47 (±1.97)
Av. Post ovipositional period (days)	5.4 (±1.53)	4.8 (±1.24)	3.25 (±0.61)	3.2 (±1.32)

Figures in parentheses are standard errors

Mass trapping of RPW in infested gardens

Weevil infested two gardens were mass trapped during the year. In Site-I (Farm of Mr. Vidyadhar Mallya – 10ha.) the Mass Trapping Programme (MTP) was started in September 1999, with a trapping density of 0.5traps/ha. A new site (Farm of Mr. Angelo Barreto – 5ha.) was brought under the MTP during November, 2000 where a trapping density of 1trap/ha. was maintained. Data on weevil captures in MTP is presented in table 24. It is significant to point out that the incidence of RPW in Site-I has considerably declined during the year under report. Between September, 1999 to March, 2000 a total of 510 weevils were captured in Site-I while, during the entire year between April, 2000 to March, 2001 only 460 weevils were trapped. In Site-II the weevil activity was high as 1075 weevils were captured from this coconut plantation in a short span of only five months. In both the gardens no new RPW infestations were reported after MTP was initiated.

Table 24. Weevil captures using pheromone traps in Mass Trapping Programmes. (April, 2000 to March, 2001)

Sr. No.	Months	Number of weevils captured	
		Site-I (10ha. – 0.5traps/ha.)	Site-II (5ha. – 1trap/ha.)
1	April 2000	140	-
2	May 2000	70	-
3	June 2000	15	-
4	July 2000	25	-
5	August 2000	9	-
6	September 2000	19	-
7	October 2000	47	-
8	November 2000	41	220
9	December 2000	39	255
10	January 2001	9	240
11	February 2001	NIL	179
12	March 20001	46	181
	TOTAL	460	1075

Evaluation of different food attractants to use as food baits in pheromone traps

A replicated field trial using the standard four window bucket trap was laid at the farm of ICAR Research Complex, Old-Goa to study the weevil capturing potential of different food baits when used along with Ferrugineol based pheromone lures. Details of the treatments are mentioned in table 25. In each trap a quantity of 250g of the food bait (coconut petiole, oil palm petiole, oil palm fruit, dates, cashew etc) was used along with 10g of Carbofuran 3G dissolved in 1L of water. However, in traps containing toddy, 250ml of the same was used to which was added 750ml water. In some treatments 5g of yeast and/or 5 ml of Acetic Acid was also used. Traps were serviced fortnightly when the food bait and insecticide solution was replaced. Observation on weevil captures was recorded at weekly intervals and reported in table 25.

Table 25. Red Palm Weevil, *Rhynchophorus ferrugineus* Oliv. captures in pheromone (Ferrolure +) traps containing different food baits.

Sr. No.	Treatments	Average catch per trap
1	Coconut Petiole	32.66
2	Toddy (250ml – made to 1L with water)	24.66
3	Sugarcane pieces	49.33
4	Oil Palm Petiole	17.33
5	Oil Palm Fruit	7.33
6	Pineapple pieces	27.00
7	Dates	62.00
8	Plantain	31.66
9	Toddy + Yeast (5g) + Acetic Acid (5ml) + Coconut Petiole	37.66
10	Yeast (5g) + Coconut Petiole	26.00
11	Cashew Apple	19.00
12	Control	10.00
	CD (P=0.05)	13.73

From Table 25 it can be seen that dates recorded the highest average weevil catch of 62.00 weevils per trap which was statistically superior to all the other food baits evaluated and was followed by sugarcane (49.33). Although, coconut petiole ranked fourth (32.66 weevils) it was the best food bait, considering its cost and availability. Oil palm fruit had a negative effect on the weevil captures as the fruit in the trap containing insecticide solution got putrefied and repelled the attracted weevils as can be seen from the data presented above where higher weevil captures were obtained in the control which had no food bait as compared to oil palm fruit.

Studies on the longevity of pheromone lure (Ferrolure +)

The pheromone lure (Ferrolure +) is costly and has to be used judiciously without impairing the trapping efficiency. The life of the costly lure can be extended in the field by setting the traps in shade under canopy of trees/palms. In order to extend the field life of these lures further, since July, 2000 the pheromone sachet was retained in the original silver foil cover, to which two longitudinal cuts were made for the release of the lure into the environment. It may be noted that prior to July 2000, Ferrolure + sachets of 700mg were supplied. However, the manufacturer supplied lures of 800mg after July, 2000. In order to measure the amount of pheromone in a given lure at different intervals, the quantity of pheromone intact in a sachet was assessed by visual observation using the following grade index. For the quantity of lure remaining intact between two score values, then a score value in decimal was assigned to that sachet. If for example 90 per cent of the pheromone was intact, a score 3.60 was assigned.

GRADING INDEX

Score Values	Status of pheromone lures
4	100% of the pheromone intact (New lure)
3	75% of the pheromone intact
2	50% of the pheromone intact
1	25% of the pheromone intact
0	No pheromone left (Spent sachet)

The average per cent pheromone remaining intact was measured using the formu Y/n x 25, where Y is the total of the assigned scores obtained in a batch of n lures observe Twenty five is the constant factor obtained by dividing 100 by 4, which represents a new lur Accordingly, pheromone lures in the monitoring programme were graded since January, 200 and the results obtained on various aspects of lure longevity under the agroclimatic condition prevailing in Goa are presented in table 26.

Table 26. Longevity of Ferrolure + in coconut plantations of Goa during Janauar 2000 to March, 2001.

Sr. No	Month	Lure Inact (%)	Lure Released (%)	Amount Released (mg)	Average Daily Release (mg/day)	Average Monthly Weevil Catch/Trap
1	January 2000 *	94.45	5.55	38.85	1.30	33.82
2	February	90.95	3.50	24.50	0.82	30.82
3	March	87.22	3.73	26.11	0.87	25.45
4	April	52.38	34.84	243.88	8.13	30.88
5	May	32.20	20.18	141.26	4.71	17.17
6	June	7.65	24.55	171.85	5.73	4.35
7	July **	97.94	2.06	16.48	0.55	21.90
8	August	96.20	1.74	13.92	0.46	24.55
9	September	95.21	0.99	7.92	0.26	40.05
10	October	88.05	7.16	57.28	1.91	41.50
11	November	77.33	10.72	85.76	2.86	33.15
12	December	51.48	25.85	206.80	6.89	31.23
13	January 2001	30.70	20.78	166.24	5.54	28.15
14	February 2001***	99.50	0.50	4.00	0.13	25.35
15	March 2001	96.74	2.76	22.08	0.74	25.08

*New Lure (Ferrolure + 700) ** New Lure (Ferrolure + 800) ***New Lure (Ferrolure + 800)

It is significant to point out that the lures (Ferrolure + 700mg) set at the end of December, 1999 were active in the field for six months and were replaced only in June, 2000 when 7.65 per cent of the pheromone was intact (Table 26). Subsequently, Ferrolure + 800mg (covered in silver foil) set in the field at the end of June, 2000 remained active for seven long months and were replaced at the end of January, 2001. These lures could have easily continued in the field for at least another month but were replaced to make sure that the weevil monitoring programme does not suffer. From Figure 8 it is evident that there was no relationship between the average daily release of pheromone and the monthly weevil captures. Even at very low average daily release of 0.13mg/day, during February, 2001 a medium weevil catch of 25.35 weevils was obtained. Similarly, with a high release of 5.73mg per day during June 2000 a monthly catch of only 4.35 weevils was obtained (Fig 9). This indicates that the lure is capable of maintaining the trapping efficiency at very low release rates. Further, the release of pheromone into the environment and RPW captures by pheromone traps are related to the prevailing weather conditions.

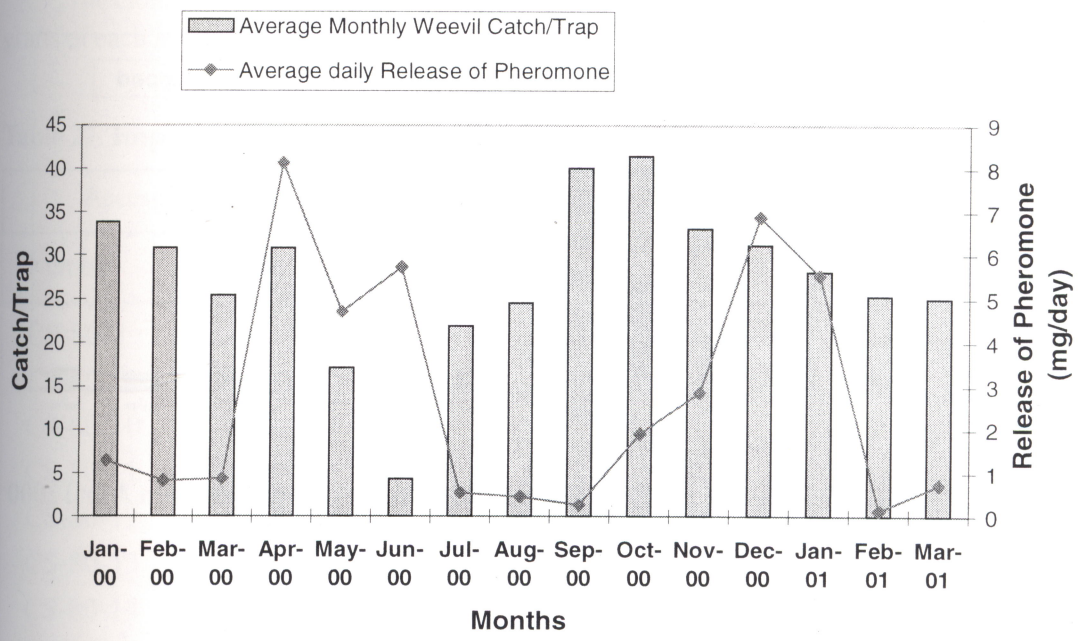


Figure 9. Monthly weevil catch per trap and release of pheromone (mg/day) between January, 2000 and March, 2001.

Testing pheromone traps for rhinoceros beetle, *Oryctes rhinoceros* was undertaken according to the decision in the SRC. Accordingly three traps (one vane trap and two bucket traps) were set in the farm of Institute during December 2000. Weekly observations were recorded on the number of beetles captured between December 2000 and March 2001. In all only 20 beetles were caught during this period. Considering the high cost of the lure and low beetle captures besides the non-lethal nature of the pest, trapping rhinoceros beetle with pheromone lures was discontinued since it was not a viable proposition.

Since June 1999, the incidence of mango fruit fly, *Dacus dorsalis* was monitored in the germ plasm mango block in the ICAR farm at Old-Goa using a fruit fly trap containing Methyl eugenol, the attractant. During the year under the report, a total of 1679 fruit flies pest were trapped. From Figure it is evident that the incidence of the pest was high during the fruit maturity period i.e April to June. In particular, the late varieties that mature during the onset of the monsoons in June are most vulnerable to fruit fly attack. The incidence of the pest was, however, low during November-December, 2000. A similar trend was seen during the previous year of 1992-2000.

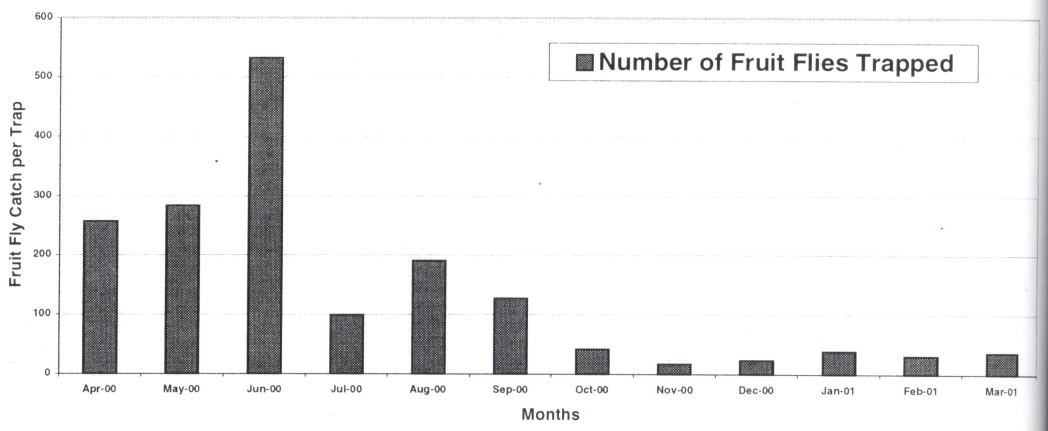


Figure 10. Trap captures of Fruit Fly, Dacus dorsalis in Mango between April 200 to March 2001.

4.2 HORTICULTURE

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

(AR Desai and RB Dalvi)

Five new accessions viz, Sattari-1 (CS-80-8), Sattari-2 (CS-80-9), Sattari-3 (CS-80-10), Sattari-4 (CS-80-11) and Sattari-5 (CS-80-12) were identified and added to the germplasm collection. The salient features of these new accessions are presented in table 27. Most of the accessions have very bold nut size with excellent kernel of 28 - 33 per cent, meeting the export market. With omission of a few accessions identified earlier and addition of some new accessions, the total germplasm collection has reached to 90 accessions which is presented in table 28.

The clonal germplasm bank of 90 accessions was established in Institute's Farm. Four grafts of each accession were planted at spacing of 6m X 6m.

Table 27. Important characters of newly added accessions.

Accessions		Approx. tree age (yrs)	Nut. yield (kg./tree)	Av. nut wt. (g)	Shelling (%)	Av. apple wt (g)
Number	Name					
CS-80-8	Sattari-1	15	8.0	10.8	32.96	151
CS-80-9	Sattari-2	18-20	10.0	9.86	28.26	148
CS-80-10	Sattari-3	10	6-7	11.12	31.34	156
CS-80-11	Sattari-4	15-17	8-10	11.14	31.61	113
CS-80-12	Sattari-5	12-15	8.0	9.8	30.00	129
CS-80-13	Keri –1	20-25	30.0*	8.67	32.29	129
CS-80-14	Keri-2	20-25	10-12	11.14	30.77	64.67
CS-60-13	Ashley-1	>35	15-20*	8.13	30.17	89.67
CS-60-14	Raia-1	10-12	10.0	7.1	29.41	121.33
CS-60-15	Raia-2	12-15	6-7	10.0	31.03	78.4

* Estimated Yield

Table 28. Zone-wise distribution of germplasm accessions.

Zone	Number of accessions reported earlier	Number of accessions rejected	Number of accessions added	Total number of accessions
Bardez	11	-	-	11
Bicholim	5	-	-	5
Ponda	4	2	-	2
Tiswadi	8	3	-	5
Cancona	22	-	-	22
Salcette	12	-	3	15
Quepem	9	-	-	9
Sattari	7	-	7	14
Sanguem	3	-	-	3
Pernem	4	-	-	4
Total	85	5	10	90

The classificatory analysis of 70 germplasm accessions based on average nut weigh and nut yield per tree, scattered the accessions in to 15 clusters is presented in fig. 11. I general there was a negative trend line, among the accessions for the above two character Two accessions namely Valpoi –5 (No-70) and Bardez – 9 (No-6) were the solitar clusters to form extreme groups (Groups I and XV). These represented the distant genet relationship in respect of mean weight of nuts and nut yield per tree. Other groups namel XII, XIII and XIV also consisted of only one accession each viz, Tudal – 4 (N0-42 Tiswadi – 3 (No-21)and Valpoi – 4 (No-69) respectively, which were distinctly away fro other clusters in terms of nut weight and nut yield per tree, but possessed higher total inde scores in the range of 15 - 16. The promising groups identified in the present study wer - cluster IV with 9 accessions, cluster V with 8 accessions, cluster VI with 4 accession cluster VIII with 3 accessions and cluster XI with 11 accessions.

In group IV, the accessions had the yield range from 15 to 18 kg/tree with averag weight of nuts ranging from 7.2 to 8.13 g. Ashley-1 (No-55) and Bardez-6 (No-4) wer prominent in this group with the highest index score of 16 points followed by SB-2 (No 24, Malwada-2 (No-37) and Pernem-2 (No-83) with total index score of 15 each Flowering intensity, Number of rachis per inflorescence and shelling percentage wer

Total number of accessions
11
5
2
5
22
15
9
14
3
4
90

ge nut weight
in fig. 11. In
wo characters.
the solitary
istant genetic
roups namely
- 4 (N0-42),
ly away from
er total index
nt study were
4 accessions,

with average
(No-4) were
y SB-2 (No-
of 15 each.
entage were

ICAR Research Complex for Goa
Library
Acc. No. .....

important ultimately in contributing to nut yield per tree, which varied from 15 to 18 kg in this group.

Eight accessions with nut yield potential in the range of 18.6 to 21 kg per tree and average nut weight in the range of 8.08 to 9.44 g got clustered to form group V. Khola-3 (No-39) and Khola-1 (No-29) were the important accessions with total index score of 19 and 17 respectively. Characters such as flowering intensity, number of rachis per inflorescence, number of flowering laterals, shelling percentage and average kernel weight were prominent in contributing to the higher index score in this group.

Group VI was identified for the accessions with very bold nuts and higher yield ranging from 8.5 to 11.01 g and 14.4 to 18.0 kg per tree, respectively. Kholker-1 (No-57) and Sanguem –2 (No-81) were prominent accessions in this group with higher index score of 17 each, due to maximum contribution by number of nuts per panicle, shelling percentage, flowering intensity and number of lowering laterals per m^2 canopy.

On the other hand, Tiswadi-2 (No-20) and Kholker-4 (No-63) were identified as promising accessions with 16 index score each in group VIII. Similarly, Group XI had accessions with very bold (10.02g) to ultra-bold nut size (12.55g) and yield potential varying from 12.8 to 18.0 kg per tree. The promising accessions were Sarvan-3 (No-12) with total index score of 16 and Valpoi-1 (No-67), Valpoi-2 (No-68), Sarvan-1 (No-44) and Pernem-4 (No-85) with total index score of 15 each (Table 29 and 30).

The other clusters namely VII, IX and X were observed to be below the trend line which could be useful in crop improvement programmes for widening the genetic base (Fig. 11).

The promising accessions were planted in 8 pilot scale demonstration plots 4 each in South Goa and North Goa for simultaneous evaluation of the accessions besides the germplasm bank established in Institute's Farm.

A cashew competition was organised at Valpoi in Sattari taluka on 18th April 2000 in collaboration with Sahyadri Nature club, Valpoi and Zonal Agriculture Office. The aim of competition was to locate and identify the useful potential germplasm for further utilization, which facilitated the scientists to visualize the cross section of the variability in cashew in that zone and identify potential genotypes for further evaluation studies.

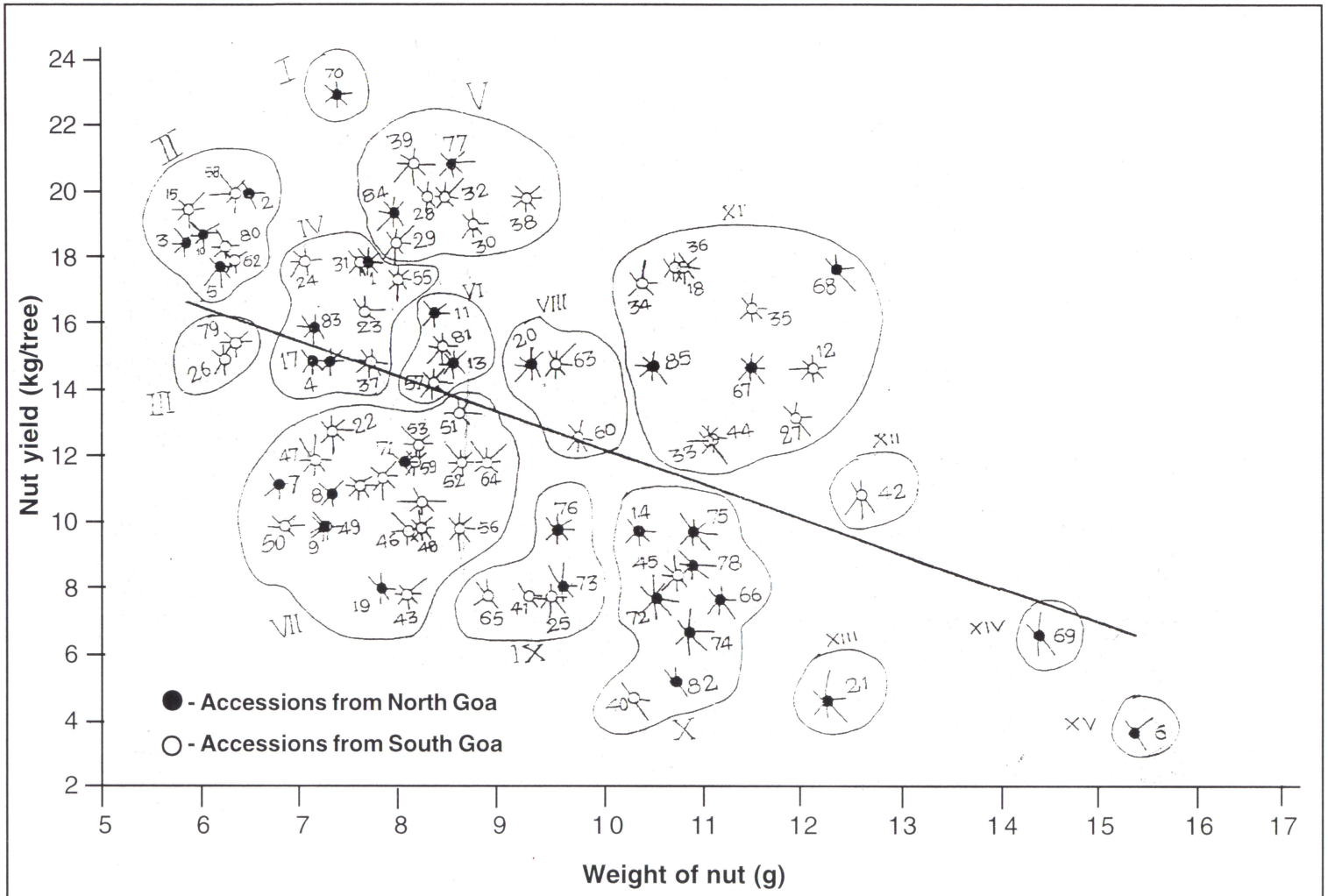


Fig. 11. Metroglyph analysis showing the scatter diagram of cashew germplasm accessions based on nut yield / tree and the average weight of nut.

Weight of nut (g)

Fig. 11. Metroglyph analysis showing the scatter diagram of cashew germplasm accessions based on nut yield / tree and the average weight of nut.

Table 29. Promsing accessions in important groups with index scores.

S. No.	Name of accession	Wt. of nut(g)	Nut yield (kg/tree)	Wt. of apple (g)	No. of nuts per pannicle	Shelling (%)	Wt. of kernel (g)	Flowering intensity (%)	No. of flowering laterals / m^2 cannopy
Group IV									
4	BARDEZ-6	7.46	15.00	99.00 (2)	5.73 (2)	28.07 (2)	1.58 (1)	73.72 (2)	25.25 (2)
37	MALWADA-2	7.87	15.00	100.57 (2)	1.73 (1)	29.89 (2)	2.57 (2)	62.14 (2)	24.25 (2)
55	ASHLEY-1	8.13	17.50	89.60 (2)	5.60 (2)	30.17 (2)	2.67 (2)	80.00 (3)	17.50 (2)
83	PERNEM-2	7.30	15.50	110.40 (2)	2.60 (1)	27.40 (1)	2.00 (2)	76.41 (3)	20.25 (2)
Group V									
29	KHOLA-1	8.11	18.60	98.00 (2)	6.20 (2)	29.00 (2)	2.20 (2)	92.75 (3)	32.00 (3)
39	KHOLA-3	8.28	21.00	100.90 (2)	2.40 (1)	30.91 (3)	2.61 (2)	76.08 (3)	29.12 (3)
Group VI									
57	KHOLKHER-1	8.51	14.40	136.50 (2)	7.60 (3)	31.80 (3)	2.46 (2)	63.08 (2)	23.50 (2)
81	SANGUEM-2	8.60	15.00	100.14(2)	1.40 (1)	28.45 (2)	2.06 (2)	74.84 (3)	29.75(3)
Group VIII									
20	TISWADI-2	9.51	15.00	123.57 (2)	4.46 (2)	25.91 (1)	2.28 (2)	71.18 (2)	31.50 (3)
63	KHOLKHER-4	9.76	15.00	106.00 (2)	7.40 (3)	27.90 (2)	2.19 (2)	66.96 (2)	17.25 (2)
Group XI									
12	SARVAN-3	12.33	15.00	115.60 (2)	2.60 (1)	28.50 (2)	2.51 (2)	68.46 (2)	22.25 (2)
44	SILVA-1	11.33	12.80	75.00 (1)	1.93 (1)	28.27 (2)	2.32 (2)	66.66 (2)	16.00 (2)
67	VALPOI-1	11.71	15.00	106.00 (2)	5.00 (2)	28.21 (2)	3.17 (3)	57.57 (2)	14.25 (1)
68	VALPOI-2	12.55	18.00	114.33 (2)	1.86 (1)	28.35 (2)	3.23 (3)	58.61 (2)	16.50 (2)
85	PERNEM-4	10.74	15.00	91.33 (2)	3.80 (1)	27.31 (1)	3.29 (3)	73.63 (2)	20.25 (2)

Values in parentheses are Index scores.

4.2.2. Collection and evaluation of plantation crops and spices.

(AR Desai, DG Dhandar, SP Singh, VY Gaonkar and JR Faleiro)

Cashew

Under this project, the cashew germplasm of 76 accessions was maintained evaluation studies continued during the period of work. Among the local accessions, G (Balli-2) cashew selection continued to show promising performance by recording 4.01k raw nuts per tree (at 2m x 2 m spacing) during the season with the cumulative yield of 3 kg /tree at the age of 11years and kernel recovery of 31.24 per cent. Data is presente table 30. Other local accessions viz, IA Farmagudi, Mardol-5, Malorem, Buipal-1 and Lout showed the consistent trend for bold nut size varying from 8.5 g to 12.0g during the last t seasons. However, nut yield performance was very poor when compared to Balli-2.

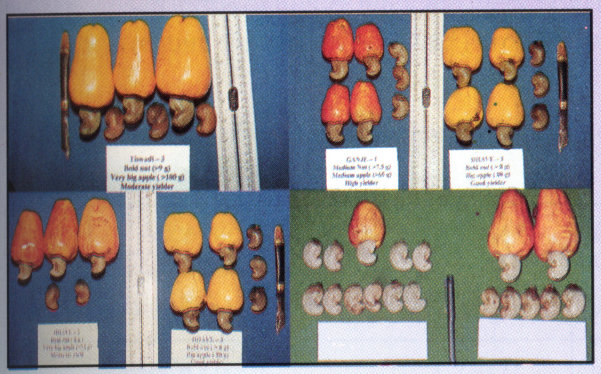
Table 30. Performance of local cashew accessions at 2m X 2m spacing.

Accessions	Nut yield (kg/tree)			Av. Nut weight (g)			Shelling (%)			Av. Apple Weigh		
	98-99	99-00	00-01	98-99	99-00	00-01	98-99	99-00	00-01	98-99	99-00	
I A F' gudi	0.25	<1	0.38	8.5	8.58		28.6	28.1	28.5	55.8	61.0	6
Mardol-5	0.15	<1	<1	9.01	9.33	10.06	-	-	28.6	50.5	86.5	1
Balli-2*	4.55	3.7	4.01	7.67	7.9	7.6	28.9	29.8	31.2	64.1	78.1	6
Buipal-1	-	<1	<1	-	12.0	10.0	-	-	26.8	-	66.7	5
Malorem	<1	<1	<1	9.2	10.0		-	-		-	97.5	
Loutlim	0.16	<1		10.0	8.9		-	-		65.5	57.5	
Nanora-2			1.1			4.9			28.2			3

*Cummulative yield for 11 years : 31.24 kg/tree at 2m X 2m spacing.

In another evaluation trial of local accessions including Balli-2 and V-4 as checks, 9 of 10 accessions started yielding during the period of report and the data is presente table31. The accession GCC-94/8 recorded a maximum nut yield of 0.55 kg per tree follo by GCC-94/10 (0.305 kg/tree) as compared to local check Balli-2 (0.285kg/tre) and (0.31 Kg/tree). The starting yield level of the accessions ranged from 0.12kg/tree in G 94/4 to 0.55 kg/tree in GCC-94/8. Such accessions as GCC-94/3, GCC-94/8, GCC-9 and GCC-94/10 were observed to be of very bold nut types with nut weight in the rang 9.2 g (GCC-94/2) to 9.52 g (GCC-94/3). In other accessions too, the average nut we

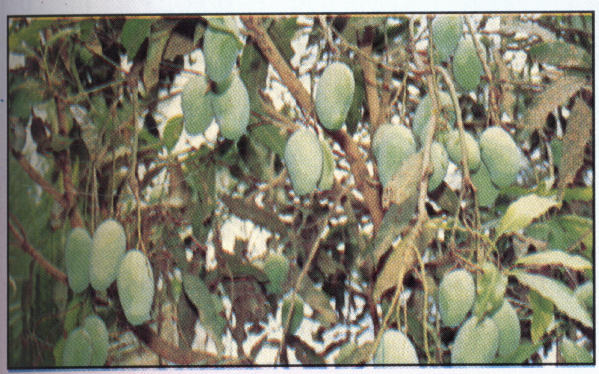
PLATE-2 Horticulture



Promising local cashew accessions from Goa.



Popular indigenous fruits of Goa.



"Amrapali" a hybrid mango variety with heavy bearing in Goa.



Variation in breadfruit - A popular vegetable in Goa.

was more than 8 g. In almost all the accessions, the apple size was observed to be bigger than the checks – Balli-2 and V-4. In general, the accession GCC-94/8 showed the most promising initial results in terms of higher nut yield, very bold nut size and bigger apple size. However, these results require the support of higher kernel recovery for which studies are under progress.

Table 31. Initial performance of local cashew accessions during 2000-01 and their characteristic features.

S. No.	Accessions/variety		Nut yield (kg/tree)	Av. Nut wt.(g)	Av. Apple wt.(g)	TSS (0^0B)	Apple skin colour
	Number	Name					
1	GCC-94/1	Ganje –1	NA	8.2	68	12.7	Red
2	GCC-94/2	Ganje –2	0.255	9.2	86.18	11.9	
3	GCC-94/3	Backle-1	NA	9.25	80.56	11.8	Red
4	GCC-94/4	Karapur-1	0.12	8.03	85.4	11.4	Red
5	GCC-94/5	Karapur-2	0.16	8.00	75.18	12.3	Yellow
6	GCC-94/6	Dhave –1	—	—	—	—	
7	GCC-94/7	Dhave –2	0.21	7.6	89	13.1	Red
8	GCC-94/8	Dhave –3	0.55	9.35	78.83	12.6	Yellow
9	GCC-94/9	Paikul –1	0.15	8.9	98.0	13.13	Red
10	GCC-94/10	Balli-1	0.305	9.25	98.18	13.4	Yellow
11		Balli-2	0.285	8.05	72.56	12.8	Yellow
12	V – 4		0.310	7.94	60.1	12.5	Red

NA = Complete yield not available,

* = First mean nut yield of unequal number of trees.

Date of planting – 1994 through 1997 ; Spacing = 8m X 8m

Screening of local accessions for TMB

Eleven local accessions along with V-4 as check were scored for reaction to tea mosquito bug and the data is presented in table 32. The accessions differed significantly with respect to incidence of tea mosquito bug during the season of report. There was highest shoot damage in GCC-94/6 and the lowest in GCC-94/4. However, these values were 15.7 and 16.5 in V-4 and Goa-1, respectively.

was more than 8 g. In almost all the accessions, the apple size was observed to be bigger than the checks – Balli-2 and V-4. In general, the accession GCC-94/8 showed the most promising initial results in terms of higher nut yield, very bold nut size and bigger apple size. However, these results require the support of higher kernel recovery for which studies are under progress.

Table 31. Initial performance of local cashew accessions during 2000-01 and their characteristic features.

S. No.	Accessions/variety		Nut yield (kg/tree)	Av. Nut wt.(g)	Av. Apple wt.(g)	TSS (0^0B)	Apple skin colour
	Number	Name					
1	GCC-94/1	Ganje –1	NA	8.2	68	12.7	Red
2	GCC-94/2	Ganje –2	0.255	9.2	86.18	11.9	
3	GCC-94/3	Backle-1	NA	9.25	80.56	11.8	Red
4	GCC-94/4	Karapur-1	0.12	8.03	85.4	11.4	Red
5	GCC-94/5	Karapur-2	0.16	8.00	75.18	12.3	Yellow
6	GCC-94/6	Dhave –1	—	—	—	—	
7	GCC-94/7	Dhave –2	0.21	7.6	89	13.1	Red
8	GCC-94/8	Dhave –3	0.55	9.35	78.83	12.6	Yellow
9	GCC-94/9	Paikul –1	0.15	8.9	98.0	13.13	Red
10	GCC-94/10	Balli-1	0.305	9.25	98.18	13.4	Yellow
11		Balli-2	0.285	8.05	72.56	12.8	Yellow
12	V – 4		0.310	7.94	60.1	12.5	Red

NA = Complete yield not available,

* = First mean nut yield of unequal number of trees.

Date of planting – 1994 through 1997 ; Spacing = 8m X 8m

Screening of local accessions for TMB

Eleven local accessions along with V-4 as check were scored for reaction to tea mosquito bug and the data is presented in table 32. The accessions differed significantly with respect to incidence of tea mosquito bug during the season of report. There was highest shoot damage in GCC-94/6 and the lowest in GCC-94/4. However, these values were 15.7 and 16.5 in V-4 and Goa-1, respectively.

Table 32. Reaction of local cashew accession from Goa to Tea Mosquito Bug, *Helopeltis antonii* (2000 – 01).

S.No.	Accessions	Mean score of shoot damage*		
		2000	2001	Cummulative
1	GCC-94/1 (Ganje-1)	1.67 (2.30)	1.53 (1.83)	1.60 (2.01)
2	GCC-94/2 (Ganje - 2)	1.29 (1.17)	1.56 (2.00)	1.44 (1.59)
3	GCC-94/3 (Bakhle – 1)	1.73 (2.50)	1.34 (1.30)	1.55 (1.92)
4	GCC-94/4 (Karapur –1)	1.40 (1.50)	1.32 (1.25)	1.36 (1.38)
5	GCC-94/5 (Karapur – 2)	1.44 (1.67)	1.46 (1.63)	1.45 (1.65)
6	GCC-94/6 (Dhave –1)	1.71 (2.50)	1.94 (3.27)	1.83 (1.83)
7	GCC-94/7 (Dhave –2)	1.59 (2.05)	1.66 (2.30)	1.63 (2.18)
8	GCC-94/8 (Dhave –3)	1.77 (2.72)	1.91 (1.17)	1.26 (1.94)
9	GCC-94/9 (Paikul –1)	1.80 (2.90)	1.81 (2.79)	1.81 (2.84)
10	GCC-94/10 (Balli-1)	1.49 (1.97)	1.37 (1.40)	1.44 (1.969)
11	Balli-2	1.39 (1.50)	1.65 (2.23)	1.53 (1.87)
12	V – 4	1.39 (1.50)	1.57 (2.00)	1.49 (1.75)
	CD (P=0.05)	NS	0.29	NS

* Mean shoot damage calculated by grading six plants per replication on a scale of 0-1(where a scoreof one indicates 10 per cent shoot damage.

Data transformed using $\sqrt{X+0.5}$ where X indicates mean shoot damage per six pl within replication.

Figures in parentheses indicate average score values, NS = Non Significant.

Introduced accessions

Performance of the introduced cashew accessions / hybrids is given in table 33. An introduced accessions, there was highest nut yield in H-1600 followed by H-1608 and 1610.

During the period, a new block of Scion bank of Goa - 1 cashew variety was establi in Institute farm and the production of nucleus planting material of this variety was take

Table 33. Performance of introduced cashew accessions at 2m X 2m spacing.

Accessions	Nut yield (kg/tree)			Av. nut weight (g)			Shelling (%)			Av. apple weight (g)		
	98-99	99-00	00-01	98-99	99-00	00-01	98-99	99-00	00-01	98-99	99-00	00-01
Hb-1600	3.21	7.06	6.36	7.6	6.7	6.32	28.0	27.8	27.6	59.2	45.1	56.5
Hb-1608	2.99	3.71	3.66	7.45	6.08	6.71	27.6	-	28.0	67.6	48.7	43.6
Hb-1610	-	0.20	<1	-	8.13	9.37	-	-	-	43.6	-	60.0
HB-1598	0.95	2.12	1.7	6.03	5.85	5.6	28.8	28.1	27.9	57.0	49.1	35.5
VTH-59/2	1.49	2.21	1.94	7.1	7.24	6.96	27.5	27.4	28.7	54.1	60.1	52.1
VTH-30	-	-	1.06	-	-	9.29	-	-	28.1	-	-	44.4
VTH-125	-	-	1.3	-	-	5.4	-	-	-	-	-	65.6
M-26/2	-	-	1.89	-	-	6.7	-	-	-	-	-	small

Spices

Evaluation trial of five black pepper varieties viz, Panchami, Pournami, Sreekara, Subhakara and P-24 was initiated and maintained. Multiplication of seed rhizomes of introduced turmeric varieties namely RCT-1 (NEH Region), Prabha, Pratibha (from IISR, Calicut) and Sudarshan from (Karwar) was taken up for further evaluation trial.

4.2.3. Evaluation of Oil palm (DxP) hybrid combinations under Goa Conditions.

(AR Desai, K Ramchandradu and Priya Devi)

Data on evaluation of five oil palm hybrids of Dura x Pissifera combinations, is presented in table 34. It was observed that the hybrids differed significantly with respect to palm girth, number of fresh fruit bunches per palm and fresh fruit yield per palm during the season 2000-2001. The hybrid 35D x 291P recorded the highest fresh fruit bunch yield of 122.35 kg/palm mainly because of the higher number of fresh fruit bunches per palm with average bunch weight of 8.64 kg, followed by the hybrid 18D x 32P. However, cumulative yield from 1995-96 to 2000-01 did not differ significantly among the hybrids. Numreically, 82D x 266P recorded the higher fresh fruit bunch yield of 297.40 kg followed by 35D x 291P (294.42 kg/per palm).

Table 34. Growth and Fresh Fruit Bunch (FFB) yield of oil palm hybrids.

S.No.	Hybrid combinations	Height (m)	Girth (m)	FFB Yield (2000-2001)		Average wt. of bunch (kg)	Cummilative yield (from 1995-96 to 200	
				No of FFBs	Total yield (kg/palm)		No. of FFBs	Total F yield (kg/palm
1	82D X 266P	7.10	2.61	11.23	82.41	7.33	52.69	297.4
2	124D X 266P	7.08	2.64	8.76	58.84	6.71	50.76	240.3
3	18D X 32P	7.26	2.56	10.69	82.82	7.74	44.00	247.5
4	35D X 291P	7.23	2.59	14.15	122.35	8.64	53.00	294.4
5	65D X 111P	7.20	2.41	10.07	66.23	6.57	46.76	216.4
	CD (P=0.05)	NS	0.124	2.92	24.29		NS	NS

4.2.4. Survey collection, conservation and evaluatio of fruit crops.

(SP Singh, DG Dhandar and VY Gaonkar)

Mango being an important crop of the state, the Institute has over the years colle and evaluated over 80 local mango varieties. During the year under report the performan 13 hybrid mango varieties introduced from other parts of the country is reported here u

Observation recorded on the growth performance of hybrid varieties is present table 35. The variety HB-56 recorded the maximum height of 5.00 m, while also regist the higest stem girth and cannopy spread.

Table 35. Growth performance of Hybrid Mango varieties introduced at Instit

S. No.	Name of varities (m)	Height of plants (m)	Girth peropheri of main stem (m)	Spreading of plant	
				ExW (m)	NxS (
1	KxB	3.25	0.40	3.23	3.23
2	Ratna	3.90	0.60	4.50	3.70
3	HB-56	5.00	1.15	7.30	7.05
4	HB-45	4.55	0.74	5.50	4.80
5	HB-151	3.70	0.75	5.50	4.40
6	HB-87	4.30	0.76	6.40	6.75
7	Arka Puneet	3.30	0.52	4.18	4.03
8	Arka Aruna	3.43	0.54	4.03	4.20
9	Arka Anmol	4.45	0.521	3.41	2.76
10	Amrapalli	3.75	0.66	3.80	3.77
11	Neelgoa	4.40	0.91	7.05	6.00
12	HB-117	2.35	0.33	2.57	2.75
13	Mallika	2.90	0.36	2.90	3.10

Observations recorded on fruit and yield parameters reveal that the hybrid Arka Aruna yielded the heaviest fruit each weighing on an average 866.67 gm. (Table 36) It is also relevant to mention that the under the agro climatic condition prevaling in Goa, Amrapalli performed consistantly well showing strong resistance to insect pests with highly satisfactory fruit quality. However, Arka Aruna was severly infested by fruit fly.

Table 36. Yield and Yield related characters of different introduced hybrid varieties of mango.

S.No.	Name of varieties	Weight of fruit (gm)	Leangth of fruit (cm)	Girth of fruit (cm)	Width of fruit (cm)	Skin weigth (gm)	Stone weigth (gm)	Length of stone (cm)	Girth of stone (cm)	Width of stone (cm)
1	HB-56	429.33	9.84	9.52	7.49	112.00	37.33	7.68	4.56	1.88
2	HB-45	503.33	10.96	8.97	8.27	84.00	50.66	8.19	4.07	2.25
3	Ratna	356.67	10.51	8.69	7.11	80.00	38.67	7.4	4.50	2.12
4	HB-157	141.33	8.47	5.55	4.98	62.67	24.67	7.04	3.12	2.11
5	HB-87	302.67	9.80	7.61	6.24	48.67	51.33	7.81	4.02	2.51
6	Arka Aruna	866.67	13.72	10.32	8.66	170.00	66.67	10.05	4.55	2.37
7	Amrapalli	322.00	11.82	7.30	6.49	57.33	37.33	10.28	4.04	1.98
8	HB-117	176.00	9.00	6.45	5.70	50.00	22.00	7.33	3.86	1.56

In the new mango block of this institute, more than 350 plants of local mango varieties and some other introduced varieties were planted in May-June 2000, at 4 x 4 spacing in a square system. Of these, 40 varieties were planted for evaluation and maintenance of germplasm. Among these, plant height ranged between 0.30 m and 1.88 m in Matekia and Sacaradin, respectively. Girth of the main stem also ranged between 0.05 m to 0.15 m in Hilario, Namdev and Salgadin, respectively. Spreading of plants towards ExW ranged between 0.10 m to 0.51 m in variety Papel and Munda Mozambique (Table 37). Spreading of plants towards NxS also ranged between 0.10 m to 0.65 m in the same varieties i.e. Papel and Munda Mozambique, respectively.

Table 37. Initial growth performance of different mango varieties in New Block Year 2000-2001.

S.No	Name of varieties	Height (m)	Girth of stem (m)	Spreading of plants	
				ExW(m)	NxS(m)
1	MDCH-1	1.76	0.14	0.98	1.09
2	STH-1	1.25	0.15	1.20	0.80
3	Bemcardo	1.15	0.10	0.58	0.56
4	Cardozo Mankurad	0.96	0.09	0.55	0.46
5	Fig Musarat	0.25	0.07	0.38	0.26
6	Akno Malgesh	0.48	0.11	0.28	0.20
7	Tokio	0.85	0.07	0.30	0.25
8	Barreto	0.65	0.06	0.29	0.29
9	Hilario Namdev	0.69	0.05	0.12	0.13
10	T.C.C	1.20	0.07	0.23	0.30
11	Munda Moxambique	1.05	0.07	0.51	0.65
12	Alampur Benesan	0.88	0.07	0.35	0.48
13	St. Anthony	1.23	.09	0.41	0.51
14	Salgadin	1.21	0.15	0.40	0.45
15	Thimoz	0.56	0.08	0.40	0.35
16	Mankurad	0.40	0.07	0.15	0.15
17	Monterio	1.15	0.08	0.35	0.38
18	Sacaradin	1.08	0.09	0.37	0.55
19	Papel	0.50	0.06	0.10	0.10
20	Eadzo	0.91	0.08	0.31	0.19
21	Cruz Fernandin	1.25	0.09	0.30	0.34
22	Rotto	0.99	0.09	0.30	0.32
23	Karel Branca	0.90	0.09	0.48	0.50
24	Bardez Mussarat	0.71	0.07	0.35	0.29
25	Bemcorad	0.70	0.07	0.34	0.42
26	Margaroza	0.42	0.08	0.26	0.36
27	Chimoth	0.45	0.07	0.15	0.20
28	Sensation	0.63	0.06	0.28	0.18
29	Desi Ambo	0.88	0.07	0.30	0.33
30	Madame	0.55	0.07	0.23	0.28
31	Sensation 2	0.75	0.07	0.25	0.23
32	Japoa	1.15	0.11	0.42	0.52
33	D'Silva	0.80	0.07	0.28	0.28
34	Matekin	0.30	0.09	0.36	0.32
35	Darbate	0.40	0.08	0.20	0.15

36	Jose	1.10	0.07	0.20	0.27
37	Dourado	1.00	0.07	0.23	0.28
38	Neelam	1.10	1.11	0.43	0.42
39	Sakrino	0.58	0.08	0.31	0.19
40	Kala alphonso	1.30	0.09	0.42	0.55
41	Black Culas	0.79	0.11	0.27	0.31
42	Jarmone	0.85	0.06	0.13	0.18
43	Bishop	0.93	0.07	0.28	0.27

4.2.5. Survey, collection, conservation and evaluation of fruit crops available/grown in agro forest areas of Goa.

(S Priya Devi, AR Desai, M Thangam, PG Adsule and Sunetra Talauliker)

Work in the project was initiated in August, 2000. Information on all the under-exploited fruits of Goa and their season of flowering was gathered and reported in table 38.

Table 38. Information on indigenous fruits of Goa with reference to season of flowering.

Sl.No.	Fruit name	Botanical Name	Family	Season of Flowering
1	Adam's fruit	*Mimusops kauki*	Sapotaceae	Nov-Dec
2	Ambada	*Spondias pinnata*	Anacardiaceae	April-Jun
3	Bimbla	*Averrhoa bilimbi*	Oxalidaceae	July-Sep, Nov-Dec
4	Bread fruit	*Artocarpus altilis*	Moraceae	Jan-Feb, Jul-Aug
5	Carambola	*Averrhoa carambola*	Oxalidaceae	April-Aug, Sep-Oct
6	Chivra	*Grewia micrococus*	Meliaceae	Nov., Mar-April
7	Churna	*Zizyphus rugosa*	Rhamnaceae	Feb-Mar
8	Jack	*Artocarpus heterophyllus*	Moraceae	May-June, Sep-Oct
9	Jagomas	*Flacourtia jagoma*	Flacourtiaceae	Jun-July
10	Jamun	*Syzygium cumini*	Myrtaceae	Mar-April
11	Karonda	*Carrisa caranda*	Apocyanaceae	Feb-Mar
12	Kokum	*Garcinia indica*	Guttiferae	Feb-Mar
13	i)Rose Apple	*Syzygium jambos*	*Myrtacease*	*Mar-April*
	ii) Wax Jambu	*Syzygium samarangense*	,,	,,
	iii) Malay Rose Apple	*Syzygium malaccense*	,,	,,

Market Survey and Physico-Chemical analysis of fruits

Information on the availabilities of different fruits was collected by visiting the marke and is presented in table 39. Market survey information covered the source of fruits an physiological analysis in the laboratory.

Promising trees of different fruit types have been identified viz. bread fruit, ros apple, sweet carambola, ambada in Balli, Rose apple and sour carambola in Old Go Rose apple in Ponda and Jamun in Vagator, Maina, Karmali, Neura and Divar. Th outstanding trees identified have been tagged. In all, 19 accessions of jamun identified th observations on fruit charecteristics were made and are furnished in tables 40 and 4 Among the jamun accessions F1 and V6 recorded highest fruit weights of 13.67g an 12.40g respectively, whereas the highest pulp percentage of 84.55 was recorded in F followed by 77.22 (V2). The highest TSS of 26.8°Brix was observed in NA1, followe by N2 (26.0°Brix) and N1 (25.8°Brix).

Table 39. Physico-Chemical parameters of various fruits collected during the perio

S. No.	Name of Fruit	Type/ Source	Fruit Wt. (g)	Length (cm)	Girth (cm)	Pulp (%)	Seed (%)	TSS (°Brix)	Acidity (%)
1	Rose apple	Light Pink Big size	55.94	5.66	4.82	81.59	18.41	5.6	0.47
	i) Malayan apple	Light green	60.4	8.46	5.08	83.44	16.56	3.8	0.36
	ii) Wax jambu	Seedless	40.8	4.56	3.98	100	-	4.8	0.12
2	i) Carambola	Sweet	96.6	11.94	2.78	99.1	0.9	6.6	0.29
	ii) Carambola	Sour	75.6	9.28	2.38	99.0	1.0	3.8	2.4
3	Bimbla	Soft ridged	12.12	5.3	1.80	100	-	3.8	2.8
4	Jagoma	Small, round	5.94	2.2	1.80	92.58	7.42	18.2	0.56
5	Chara	Small, round purple	1.22	1.88	1.56	66.21	33.79	21.4	0.48
6	Adam's fruit	Brown, Oval	12.6	4.72	8.18	60.55	39.45	23.0	0.13
7	Karonda	Round, purple	2.75	1.3	1.2	95.21	4.79	14.4	1.15

visiting the markets
source of fruits and

iz. bread fruit, rose
mbola in Old Goa,
a and Divar. The
mun identified the
tables 40 and 41.
hts of 13.67g and
as recorded in F1
in NA1, followed

during the period.

TSS (°Brix)	Acidity (%)
5.6	0.47
3.8	0.36
4.8	0.12
6.6	0.29
3.8	2.4
3.8	2.8
18.2	0.56
21.4	0.48
23.0	0.13
14.4	1.15

Table 40. Physico-chemical parameters of different Jamun fruit accessions collected during the period.

S. No.	Name	Source	Fruit Wt. (g)	Fruit Length (cm)	Ft. Circum Ference (cm)	Pulp (%)	Seed (%)
1	NA1	New Area (Old Goa)	3.42	3.31	5.23	66.27	33.73
2	NA2	New Area Farm (Old Goa)	3.76	3.63	5.81	65.68	34.32
3	D1	Divar	7.79	4.13	6.94	73.91	26.09
4	V1	Vagator	10.20	4.50	9.82	73.68	26.32
5	V2	Vagator	8.80	4.40	6.44	77.22	22.78
6	V3	Vagator	10.20	4.56	6.70	69.80	30.20
7	V4	Vagator	10.80	4.68	7.14	64.89	35.11
8	V5	Vagator	9.40	4.08	6.84	74.44	25.56
9	V6	Vagator	12.40	4.96	7.54	78.49	21.51
10	M1	Maina	5.80	3.89	5.41	68.97	31.04
11	M2	Maina	6.40	3.86	5.40	69.82	30.18
12	M3	Maina	5.20	3.87	5.28	73.08	26.92
13	K1	Kermali	7.20	4.02	6.32	71.67	28.33
14	N1	Neura	4.00	3.42	5.40	60.00	40.00
15	N2	Neura	4.27	3.67	5.21	68.09	31.91
16	N3	Neura	4.80	3.81	5.46	62.50	37.50
17	F1	Farm	13.67	5.26	7.96	84.55	15.45
18	DN1	Divar- Norva	4.98	3.67	5.47	60.74	39.23
19	DN2	Divar- Norva	5.03	3.87	5.43	58.57	41.43

Table 41. Chemical parameters of different Jamun fruit accessions collected during the period.

S. No.	Name	TSS ^{0}Brix	Acidity (%) in 100	Total Sugar (%)	Reducing Sugars (%)	Non-reducing Sugars (%)
1	NA1	26.8	0.96	24.250	0.019	24.231
2	NA2	14.6	0.75	13.180	0.008	13.172
3	D1	17.0	0.64	6.875	0.017	6.858
4	V1	14.2	0.78	13.125	0.003	13.122
5	V2	14.8	0.78	13.125	0.004	13.121
6	V3	12.0	0.78	11.625	0.004	11.621
7	V4	13.6	0.78	12.186	0.004	12.184
8	V5	15.0	0.59	13.250	0.004	13.246
9	V6	14.0	0.59	12.625	0.004	12.622
10	M1	13.0	0.64	8.125	0.011	8.115
11	M2	15.8	0.64	10.625	0.014	10.611
12	M3	12.4	0.64	9.375	0.017	9.358
13	K1	18.0	2.36*	17.375	0.015	17.360
14	N1	25.8	1.63	12.188	0.018	12.170
15	N2	26.0	1.28	25.310	0.015	25.295
16	N3	21.2	1.14	16.875	0.018	16.857
17	F1	15.0	0.96	12.830	0.009	12.823
18	DN1	22.8	1.31	18.290	0.017	18.273
19	DN2	23.8	1.47	18.830	0.002	18.828

* in 100 g of pulp.

Besides this, in order to enrich the institute germplasm, *Garcinia indica*, *G gammigatta*, *Spondias pinnata, Artocarpus altilis*, *A.. heterophyllus* and six varieties of *Phyllanthus emblica*, *Syzygium spp*, one variety of annona which comprise the indigenous fruits; commercial fruits like pomegranate and guava and also exotic fruits like mangosteen and durian planted during the previous year have got established in the field and put forth new flushes.

4.2.6. Collection, Conservation and Evaluation of Vegetable crops.

(M Thangam, K Ramachandrudu, R Ramesh and PG Adsule)

Evaluation trial in Bhendi

Seed material of twenty varieties of bhendi, which comprise of 13 local types from Goa and seven released varieties, were sown for preliminary evaluation trial. The details

regarding source and fruit characteristics of all the types (varieties) are presented in table 42.

The evaluation trial was taken up in Randomized Block Design (RBD) with three replications. Observations like germination percentage, number of days for flowering, number of days for harvest, individual fruit weight, fruit bearing height, fruit bearing node, fruit length, fruit circumference, internodal length, yield per plant and YVM incidence were recorded. The data on these parameters is presented in tables 43 and 44. DVR-1 variety recorded the highest germination percentage of 95.45% followed by Local type-3 (81.21%). The highest fruit weight of 31.38g was recorded in local type-4, followed by Local type-17 (29.92g).The observation on YVM incidence showed that DVR-1, Local type-1, 3,8,10,12 and 13 exhibited mosaic symptoms whereas Arka anamika, Parbhani kranti, DVR-2, Sel.10, VO-1, VRO-6, Local type-2, 4,5,6,7,9 and 11 were free from the incidence.

Table 42. Germplasm collections of bhendi and its source.

S. No.	Type/Variety	Source	Fruit characteristics
1.	Arka Anamika	IIHR	Green fruits, Five ridges
2.	Parbhani Kranti	Parbhani	Dark green fruits, pubescent, Five ridges
3.	DVR-1	IIVR, Varanasi	Green fruits, pubescent, Five ridges
4.	DVR-2	IIVR, Varanasi	Green fruits, pubescent, Five ridges
5.	Sel-10	-	Green fruits, pubescent, Six ridges
6.	Bo-1	-	Green fruits, pubescent, Six ridges
7.	VRO-6	-	Light green fruits, Five ridges
8.	Local type-1	Adnem	Light green fruits, Five ridges
9.	Local type-2	Shirodon	Dark green, pubescent, Five ridges
10.	Local type-3	Ponda	Light green fruits, Five ridges
11.	Local type-4	Chimbel	Light green, pubescent, Six ridges
12.	Local type-5	Ponda	Green fruits, pubescent, Six ridges
13.	Local type-6	Margao	Green fruits, pubescent, Six ridges
14.	Local type-7	Shirodon	Light green, pubescent, Nine ridges
15.	Local type-8	Margao	Green fruits, pubescent, Five ridges
16.	Local type-9	Shirodon	Light green, Seven ridges
17.	Local type-10	Mapusa	Green fruits, Five ridges
18.	Local type-11	Sanguem	Green fruits, pubescent, Five ridges
19.	Local type-12	Ponda	Green fruits, pubescent, Five ridges
20.	Local type-13	Karmali	Light green, pubescent, Seven ridges

Table 43. Observations on germination and morphological characters in Bhendi.

S. No.	Name of the Variety/type	Germination (%)	No. of days for flowering	No. of days for harvest	First fruit bearing height (cm)	First fruit bearing node (No.)	Internodal length (cm)
1.	Arka Anamika	51.58	41.00	54.33	19.10	3.33	7.62
2	Parbhani Kranti	75.15	38.66	48.66	24.11	3.11	13.53
3	DVR-1	95.45	39.00	48.00	23.27	3.11	10.49
4	DVR-2	68.48	38.66	48.00	17.78	2.89	10.66
5	Sel-10	69.39	40.00	48.66	15.31	2.56	9.46
6	Bo-1	71.82	40.33	49.66	18.74	2.55	7.90
7	VRO-6	78.18	40.66	48.00	22.14	3.56	9.54
8	Local type-1	60.00	40.33	48.66	25.38	3.55	10.36
9	Local type-2	14.21	40.33	52.66	21.29	3.22	8.94
10	Local type-3	81.21	38.66	48.00	23.44	3.33	10.22
11	Local type-4	45.76	43.33	53.00	30.55	3.78	10.20
12	Local type-5	63.33	37.33	49.66	25.67	3.33	11.38
13	Local type-6	78.79	40.00	49.66	22.19	3.22	8.32
14	Local type-7	41.51	40.00	49.66	26.13	3.22	11.41
15	Local type-8	69.39	40.00	49.66	19.39	3.00	9.01
16	Local type-9	25.76	41.33	50.66	17.50	2.78	9.14
17	Local type-10	33.03	43.66	51.00	23.07	3.56	8.33
18	Local type-11	32.62	42.33	51.00	24.57	3.78	10.17
19	Local type-12	78.79	40.00	48.66	19.11	3.67	10.75
20	Local type-13	50.00	42.33	51.66	38.12	4.48	11.54
	Sed	16.08	1.63	1.49	4.27	NS	1.36
	CD (P=0.05)	35.56**	3.29**	3.04**	8.65**	-	2.76*

Table 43. Observations on germination and morphological characters in Bhendi.

S. No.	Name of the Variety/type	Germination (%)	No. of days for flowering	No. of days for harvest	First fruit bearing height (cm)	First fruit bearing node (No.)	Internodal length (cm)
1.	Arka Anamika	51.58	41.00	54.33	19.10	3.33	7.62
2	Parbhani Kranti	75.15	38.66	48.66	24.11	3.11	13.53
3	DVR-1	95.45	39.00	48.00	23.27	3.11	10.49
4	DVR-2	68.48	38.66	48.00	17.78	2.89	10.66
5	Sel-10	69.39	40.00	48.66	15.31	2.56	9.46
6	Bo-1	71.82	40.33	49.66	18.74	2.55	7.90
7	VRO-6	78.18	40.66	48.00	22.14	3.56	9.54
8	Local type-1	60.00	40.33	48.66	25.38	3.55	10.36
9	Local type-2	14.21	40.33	52.66	21.29	3.22	8.94
10	Local type-3	81.21	38.66	48.00	23.44	3.33	10.22
11	Local type-4	45.76	43.33	53.00	30.55	3.78	10.20
12	Local type-5	63.33	37.33	49.66	25.67	3.33	11.38
13	Local type-6	78.79	40.00	49.66	22.19	3.22	8.32
14	Local type-7	41.51	40.00	49.66	26.13	3.22	11.41
15	Local type-8	69.39	40.00	49.66	19.39	3.00	9.01
16	Local type-9	25.76	41.33	50.66	17.50	2.78	9.14
17	Local type-10	33.03	43.66	51.00	23.07	3.56	8.33
18	Local type-11	32.62	42.33	51.00	24.57	3.78	10.17
19	Local type-12	78.79	40.00	48.66	19.11	3.67	10.75
20	Local type-13	50.00	42.33	51.66	38.12	4.48	11.54
	Sed	16.08	1.63	1.49	4.27	NS	1.36
	CD (P=0.05)	35.56**	3.29**	3.04**	8.65**	-	2.76*

rs in Bhendi.

t fruit uring ade No.)	Internodal length (cm)
33	7.62
11	13.53
11	10.49
89	10.66
56	9.46
55	7.90
56	9.54
55	10.36
22	8.94
33	10.22
78	10.20
33	11.38
22	8.32
22	11.41
00	9.01
78	9.14
56	8.33
78	10.17
67	10.75
48	11.54
S	1.36
-	2.76*

Table 44. Observations on physical parameters, yield and disease resistance in Bhendi.

S.No	Name of the Variety/type	Individual fruit weight (g)	Fruit length (cm)	Fruit circumference (cm)	Cummulative Yield per plant (g)	YVM incidence
1	Arka Anamika	21.84	18.65	6.66	129.23	Absent
2	Parbhani Kranti	24.45	14.96	7.11	181.41	Absent
3	DVR-1	23.22	16.81	6.31	154.54	Present
4	DVR-2	20.28	16.56	5.72	140.58	Absent
5	Sel-10	23.01	15.84	6.61	192.89	Absent
6	Bo-1	25.81	16.78	6.84	239.22	Absent
7	VRO-6	19.21	16.69	6.11	173.40	Absent
8	Local type-1	28.77	19.45	6.24	238.23	Present
9	Local type-2	19.75	12.88	6.01	164.57	Absent
10	Local type-3	22.68	16.70	6.08	170.86	Present
11	Local type-4	31.38	15.46	6.27	120.05	Absent
12	Local type-5	22.94	15.97	5.84	183.61	Absent
13	Local type-6	24.08	17.90	6.29	176.68	Absent
14	Local type-7	29.92	18.29	6.22	159.69	Absent
15	Local type-8	20.69	16.05	5.95	180.74	Present
16	Local type-9	27.19	17.14	5.92	131.09	Absent
17	Local type-10	21.01	15.04	6.03	159.75	Present
18	Local type-11	19.86	18.01	6.05	182.25	Absent
19	Local type-12	21.84	16.91	6.69	142.67	Present
20	Local type-13	25.84	17.92	7.16	197.68	Present
	Sed	NS	1.23	0.38	28.71	
	CD (P=0.05)	-	2.49**	0.76**	58.12**	

Preliminary seed production trial on Brinjal

A preliminary trial was undertaken in brinjal, which included nine local types and three released varieties. Selfing was effected in local types and seeds have been collected for large scale evaluation trial to be taken up in the ensuing rabi 2001-2002.

Seed material of brinjal (three varieties), tomato (one variety), vegetable cowpea (five local types and an improved variety) and pumpkin (one variety) were collected during this period. Further work on evaluation of varieties of these vegetables shall be taken up during coming year.

4.2.7. Collection and evaluation of flower crops.

(K Ramchndradu, M Thangam and P G Adsule)

An extensive survey was taken up in Goa to collect local germplasm of commerc flower crops. Six varieties of jasmine i.e three varieties of *Jasminum sambac*, two in *grandiflorum* and one in *J. auriculatum* were collected from mardol, Giri, Mangueshi, Karm and Corlim. While eight varieties of Marigold were collected from Panjim, Chimbel, Betho and Sanvordem. In Crossandra, four varities from Corlim, Divar and Karmali were collect The studies on characterization of above germplasm are in progress.

Eight improved varieties of gladiolus viz. Dhiraj, Darshan, Tilak, Aarti and Sindo from IIHR, Bangalore and American Beauty, Oscar and Sylvia from UAS, Dharwad ha been introduced and tried up under field conditions as preliminary trial and the performan was found satisfactory during October, 2000 to February, 2001.

4.2.8. Development of suitable agrotechniques for multistorey cropping system in Goa.

(SP Singh)

To find out suitable crop components in multistorey cropping system in Goa

In the coconut garden, three varieties of coconut have been used viz; Calangute, Benauli and DxT along with mango plant in the middle of 4 coconut and banana (Saldatti local variety Black pepper (variety Panniyur) has been used along with coconut basin. The yield and oth data of different crop component have been recorded.

Production potential of different components in the system (yield performanc of different crop components)

Among the coconut varieties, DxT gave the maximum yield of 357.00 in the year 199 2000 with an average number of 49.42 nuts per palm in the HDCM block. Variety Benaulim gav the total average yield of 292.25 nuts with an average of 39.99 nuts/palm in the same area. Amon the coconut varieties Calangute has given the minimum yield of 252.75 nuts as average of four row with an average yield of 38.51 nuts/palm in the HDCM Block in the year 1999-2000. Averag nut production was increased over the period of five years with a deceasing treed in the year 199 1997 and 1997-98. Even DxT gave the average nut yield of 40.45,32.67,31.57,49.67 and 49.5 over the period of five years from 1995-96 to 1999-2000. Among the mango varieties, Amrapal has given good yield of 381.00 Kg fruit from the HDCM Block, which was in an increasing tren because of better management of the Block. Several bunch of banana were harvested from th system. An average of 56 fingers of banana/bunch has been obtained with an average weight 4.22kg per bunch in the HDCM Block. Black pepper variety Panniyur also started fruiting an a yield of 250.00gm has been obtained from six yielding plants in the first year.

4.2.9. Post harvest management technologies for fruits available/ grown in agroforestry areas Of Goa region.

(PG Adsule, AR Desai, K Ramchandraddu, S Priya Devi and M Thangam)

Survey work was undertaken to collect the traditional convenient processed food products prepared from the agricultural food produce available in the region. The survey was confined to Goa region. Products were collected from the home and cottage scale food processing manufactures besides from the markets directly or through NGO's like "Mahila Groups", co-operatives and self help groups. By and large, the collected products covered were papad, pickles, spice mixtures, extruded products, halwa etc and details of their including source are presented in table 45.

Table 45. Type of traditional processed products and their source of collection.

SNo.	Type of product	Raw material used	Source
1.	Papads	Banana and urd dal	House hold manufacturer, Canacona, Goa.
2	Groundnut oil based pickles	Mango, Bittergourd Tamrind	Mapusa market, Indira Mahila Block Society, Mapusa, Goa.
3	Dried pickles / spice moisture	Okra, Cluster bean, chilli Bitter gourd, Naringa, Mango, Carombola, Bilimbi, Tendli	House hold manufacturer, Canacona, Goa.
4.	Sweet products like		
	Mango halwa	Mango	Muncipal market
	Guava halwa	Guava	Margao, Goa
	Mango leather	Mango	
5.	Dehydrated fruit Slices	Monkey jack, kokum	Muncipal market, Margao,Goa
6	Cakes	Sago(Shabu), Ragi, Ash gourd	House hold manufacturer, . Cancona, Goa
7.	Extruded Products (Vermicilli likeproducts)	Beaten rice (Poha), wheat, Sweet potato	House hold source Cancona, Goa

The products were further evaluated for their physico chemical and storage life attributes and details of which is presented in table 46. Most of the products were found to be packed by the candle sealing in LDPE bags with a thickness range of 0.2 mm to 0.6 mm except in few cases by electric sealing / staple pining. The products were in simple polypack except double polypack in pickles and sweet products. Moisture range in the product was found from 0.40 to 17.35 per cent while, the acidity range was 0.66 to 9.66 per cent. Most of the products had shelf life of more than six months but could be extended further by controlling moisture level in the product depending upon the type of product through better packaging and adding presevative chemicals in the products. Sealing by staple pin is to be avoided in view of its contamination with food products.

Table 46. Physico chemical analysis of traditional processed products.

Type & name of product	Wt. of product (g)	Thickness of LDPE bag used (mm)	Acidity (%)	Moisture (%)	Approx. storage life
Papads					
Banana papad	42	0.6 (C)	0.32	0.86	6 months
Udid papad	44	0.4 (C)	0.35	1.23	6 months
Oilbase pickles					
Mango pickle	206	0.4 (C)	9.64	17.35	> 6 months
Bittergourd pickle	129	0.3 to 0.4 (C)	3.87	10.31	6 months
Tamarind pickle	204	0.3 (C)	8.00	6.65	6 months
Sweet products					
Mango halwa	193	0.4 (C)	2.30	3.32	6 months
Guava halwa	270	0.2 to 0.5 (ES)	1.68	2.75	12 months
* Mango leather	193	0.3 (C)	-	-	< 6 months
Dried pickles					
Okra pickle	23	0.2 (C)	2.64	2.65	6 months
Cluster bean pickle	30	0.2 (C)	2.38	2.63	6 months
Bitter gourd pickle	25	0.2 (C)	1.18	1.87	6 months
Carambola pickle	28	0.2 (C)	7.34	0.82	6 months
Naringa pickle	49	0.2 (C)	6.55	1.02	6 months
Chilli pickle	34	0.2 (C)	3.24	0.66	6 months
Mango pickle	31	0.2 (C)	5.05	0.47	6 months
Bimbli pickle	31	0.2 (C)	5.76	0.87	6 months
Tendli pickle	31	0.2 (C)	2.55	1.00	6 months
Dried pulp slices					
Monkey Jack	29	0.4 (S)	8.12	0.45	12 months
Kokum rind	76	0.4 (S)	8.16	1.00	12 months
Cakes (To be fried)					
Sago cakes	35	0.3 (C)	0.06	0.40	6 months
Ragi cakes	35	0.2 (C)	0.81	0.40	6 months
Ashgourd cakes	47	0.3 (C)	2.12	2.52	6 months
Extruded products					
Poha	29	0.2 (C)	0.26	0.96	6 months
Sweet potato	27	0.3 (C)	0.65	1.06	6 months
Wheat noodles	29	0.2 (C)	1.92	1.23	6 months

* Spoiled within 6 months

LDPE : Low Density Polyethylene

ES : Electrical sealing

C : Candle sealing

S : Staple pin sealing

Physico chemical analysis of fruits like bread fruit, rose apple, star fruit (Carambola) and Bilmbi was undertaken besides their fresh storage life using LDPE bags at ambient and low temperature and the information is presented in tables 47 and 48.

Table 47. Physico chemical charecteristics of some locally grown fruits in Goa region.

Name of fruit	Av. Fruit Wt. (g)	T.S.S ^{0}B	Acidity (%)	Ascorbic acid (mg/100g)	Remarks
Bimbli (*Averrhoa bilimbi*)	12.12	2.96	1.28	—	Sour type
Star fruit (*A. carmbola*)	105.2	7.6	0.32	400	Sweet type
Star fruit (*A. carmbola*)		3.8	2.4	—	Sour type
Bread fruit (Artocarpus altilis)	584.0	7.0	0.13	45.05	Well matured fruit

Table 48. Storage life of locally available fresh fruits in LDPE bags.

Name of fruit	Storage conditions	Without LDPE bags (Control)		With LDPE bags		Remarks
		Duration of storage	PLW (%)	Duration of storage	PLW (%)	
Bilimbi	Ambient Temperature	5 days	17.5	5 days	6.62	LDPE with 0.5% ventilation.
Carambola (Sour type)	Ambient Temperature	4 days	22.22	4 days	8.24	LDPE with 0.5% ventilation.
Bread fruit	Ambient Temperature	2 days	21.01	8 days	4.57	Without ventilation.
	Low temp (Temp. at 4^{0}C)	8 days	16.23	8 days	2.35	Without ventilation.

Bilimbi fruits are delicate, small with average fruit weight of 12.12 g and acidic in taste (1.28%). Fresh fruits recorded a TSS of 2.96^0 B. These fruits with minimum PLW of 6.62 per cent had storage life of five days in LDPE bags of 0.4 mm thickness with 0.5 per cent ventilation under ambient conditions as against 17.5 per cent of PLW in control. Fresh, whole fruits were also stored in brine solution for further storage studies.

Bread fruit cannot be stored for more than two days at ambient temperature. Howev its shelf life cpould be increased to 8 days when stored in LDPE bags of 0.4 mm thickn with minimum loss in physiological weight of 2.35 per cent and 4,57 per cent under l temperature and ambient conditions respectively as against 21.01% of PLW under ambi conditions and without LDPE bags.

Two types of carambola fruits viz. Sweet type and sour type are available. Fruits sweet type are slightly bigger in size (105.20 gms) with higher TSS of 7.6^0 B, lower acid level of 0.32 per cent and ascorbic acid contents of 400 mg / 100 mg, whereas, fruits of so type were smaller in size with TSS of 3.8^0 B and acidity level of 2.40 per cent. Sour type fru recorded a minimum PLW of 8.24% when stored in LDPE bags of 0.4 mm thickness with 0 per cent ventilation under ambient conditions for 4 days as against the PLW of 22.22 per ce in case of fruits stored in ambient conditions (Control).

Roseapple

The fresh seedless roseapples which had an average individual fruit weight of 40.82 TSS of 4.8^0 B and acidity of 0.12% were subjected to storage study. These fruits could b stored upto 7 days in LDPE bags with 0.4 mm thickness having 0.5 per cent ventilation wi minimum PLW of 3.27 under refrigerated condition as against a maximum PLW of 21.68 control (unpacked fruits under ambient condition).

Studies on preparation of processed products from fruit and their evaluation

Storage of breadfruit pieces in brine solution

Fresh fruits were peeled, cut into cubes and stored in brine solution containing 5 % sa 0.5% acetic acid and 500 ppm SO_2 with or without blanching for periodical observations an interval of three months. After six months of storage, colour, texture and appearance of th stored cubes remained in good conditions. Further storage studies are under progress.

Organoleptic tests were also taken up at periodic intervals and the unblanched piece scored highest among others, while all the treatments were found acceptable qualitavely eve after six months.

Table 49. Changes in TSS and acidity during the storage of Bread Fruit pieces at different levels.

Parameter	Blanched storage		Unblanched Storage		F test	CD at 1 % or 5 %
	3 months	6 months	3 months	6 months		
TSS (^{0}B) fruit pieces	5.20	5.20	5.60	5.87	NS	——
Acidity (%) fruit pieces	0.33	0.33	0.34	0.32	**	0.152
Acidity (%) in brine	0.51	0.52	0.45	0.45	*	0.072

Storage of bread fruit pulp

Fresh fruits were peeled, cut into pieces and homogeneously pulped in mixer. Pulp, thus prepared was stored in bottles with or without blanching by adding 5% salt and preservatives, for periodical observations.

Storage of Carambola pulp

Pulp of sweet carambola was boiled, cooled and preserved by addition of presevatives. Fresh pulp without addition of any presevative has been stored in deep freeze for further storage quality.

Storage of rose apple pulp

The fruits were cut and made into pulp after the removal of seeds. Fresh and boiled pulp have been preserved in bottles after addition of preservatives (500 ppm SO_2). Further studies are in progress.

4.3 ANIMAL SCIENCE

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

(RNS Sundaram, EB Chakurkar and SB Barbuddhe)

Feeding is the major expenditure in the maintenance of rabbits under the cage rearing. With a view to identify the economic feeding practices, an experimental rabbit feed was formulated incorporating locally available agro wastes. Cashew Apple Waste (CAW), a seasonal by-product available from feni industry during summer months was incorporated in the feed at the level of 15 per cent and 30 per cent, as a substitute for wheat bran. Effect of incorporation of the agro-waste in rabbit diet was compared with control feed. A feeding trial was conducted for a period of 8 weeks in 18 crossbred rabbits (6x3). Data on ingredient composition and growth performance of the animals are presented in table 50 and figure 12.

Table 50. Feed ingredient composition and growth performance in rabbit.

Ingredient composition per cent	T1	T2	T3
Maize	40	40	40
Ground nut cake	20	20	20
Wheat bran	40	25	10
Dried cashew apple waste	0	15	30
Crude protien %	16.4	16.51	16.55
Crude fibre%	7.62	7.94	8.85
Average body Weight (g)	1653	2111.3	1757.7
Total Dry Matter intake /day (g)	102.29	129.88	116.66
Dry matter digestibility per cent %	66.56	67.75	66.29
Total Dry Matter intake /day /kg B Wt(%)	6.18	6.15	6.63
Feed Cost Rs./kg	6.8	5.93	5.08

level in

its under the cage
imental rabbit feed
pple Waste (CAW),
s was incorporated
wheat bran. Effect
h control feed. A
abbits (6x3). Data
presented in table

abbit.

	T3
	40
	20
	10
	30
	16.55
	8.85
	1757.7
	116.66
	66.29
	6.63
	5.08

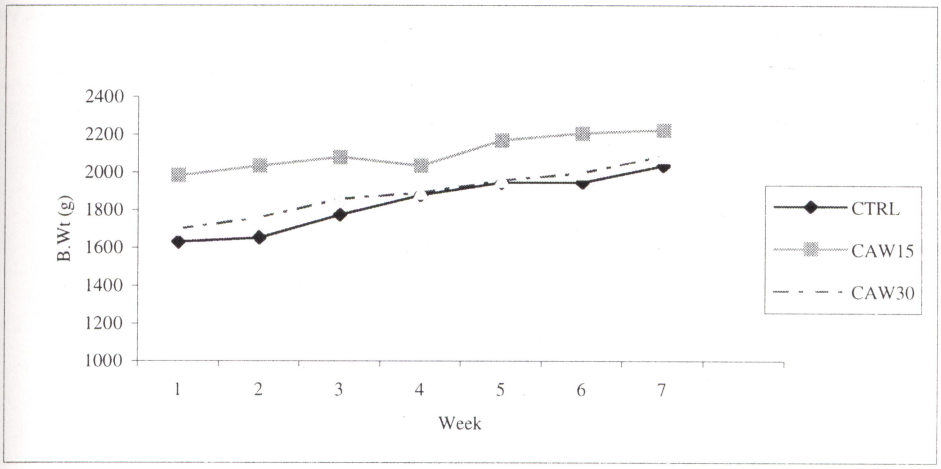


Fig12. Growth performance of rabbits at the different levels of CAW in the feed.

The level of crude fibre content of the feed was 7.62, 7.94 and 8.85 per cent in T_1 T_2 ad T_3 respectively. While the CP content of all the feeds was at the same level. Dry matter digestibility was found to be 66.20, 68.65 and 66.97 per cent for T_1 T_2 ad T_3 respectively indicating that there was no adverse effect on the digestibility by incorporating the CAW in the feed at 30 per cent. As a result of this studies, the feed cost was reduced from Rs 6.80 to Rs 5.08/kg.

Inanother trial, BDG and CAW were used separately at 25 per cent level in the formulation of economic rabbit feeds. Feeding trial was conducted for a period of 3 months in 18 young chinchilla crossbred rabbits. Data on feed intake and weight gain recorded during the trial are presented in Table 51 and figure 13.

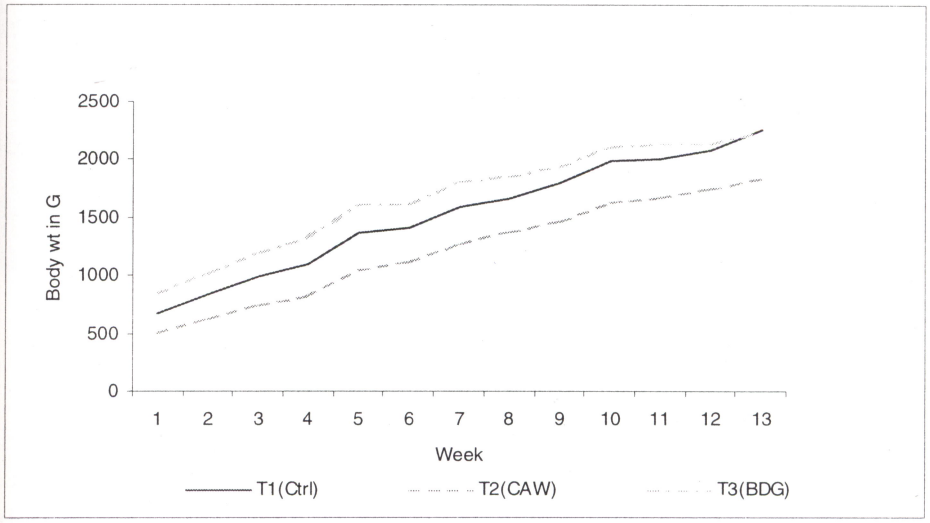


Fig13. Comparative performance of rabbits with CAW / BDG in low cost feed.

Table 51. Ingredient composition and growth performance in rabbit using CAW/BDG in rabbit feed.

Ingredient composition per cent	T1	T2	T3
Maize	40	40	40
Ground Nut oil Cake	20	20	20
Wheat Bran	40	15	15
Cashew Apple Waste	0	25	0
Brewery Dried Grain Waste	0	0	25
Crude Protein	16.4	16.52	18.9
Digestible Energy Kcal/kgfeed	3040	3000	2890
Initial Body.wt(g)	680	514	854
Final Body.wt(g)	2254	1840	2248
Average Daily Wt.Gain (g)	17.87	15.06	15.84
Total Dry Matter Intake (g)	102.07	98.89	112.83
Dry Matter Digestibility %	66.68	67.09	73.05
Dry Matter Iintake /kg wt(%)	5.05	5.35	5.01
Feed cost(Rs/kg)	6.80	5.20	5.35

Average daily weight gain was 17.87 g, 15.06 g and 15.84 g in control, CAW and BDG respectively. Per cent dry matter digestibility was 66.78, 66.09 and 73.05 in T_1, T_2 and T_3 respectively. While the feed intake /kg body weight was 5.05,5.25 and 5.17 per cent in T_1, T_2 and T_3 respectively, indicating that there was no adverse effect on digestibility when BDG was incorporated at 25 per cent in the concentrate feed.

4.3.2. Studies on existing diseases including zoonoses in Goa region and establishment of disease investigation laboratory.

(SB Barbuddhe, RNS Sundaram and BK Swain)

Mastitis

A total of 25 milk samples were collected from crossbred cows to test for mastitis. Out of these 15 samples were positive for clinical cases of mastitis. Out of the remaining 10 milk samples from cows tested by California mastitis test 50.0 per cent were positive for subclinical mastitis. The milk samples were processed for bacteriological examination. After enrichment

it using CAW/BDG

T2	T3
40	40
20	20
15	15
25	0
0	25
52	18.9
00	2890
14	854
40	2248
26	15.84
39	112.83
9	73.05
5	5.01
0	5.35

control, CAW and
73.05 in T_1, T_2 and
5.17 per cent in T_1,
tibility when BDG

g zoonoses
isease

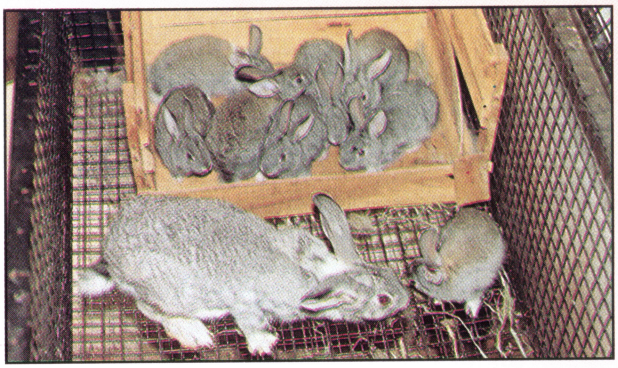
st for mastitis. Out
emaining 10 milk
tive for subclinical
After enrichment

PLATE-3 Animal Science



Investigation on the causes of mortality in pigs -Post mortem lesion of pyometra.

Improved litter size in rabbit (Soviet chinchilla) with high energy and protein diet.





Feeding trial with brewery dried grain in vencobb broilers.

Large white Yorkshire piglets under AICRP - Pigs for cross breeding programme.



of the milk samples with nutrient broth, the samples were streaked on nutrient agar to obtain single colonies. The isolated bacterial colonies were further characterized morphologically and biochemically to identify the genus/species of organisms. *Staphylococcus aureus* and *Streptococcus sp.* were found to be the major causative organisms. Other pathogens isolated were *Pseudomonas sp., Listeria* sp. and *Escherichia coli.*

After confirmation the isolates were subjected to antibiotic sensitivity. Some of the isolates revealed multiple antibiotic resistance. The isolates were found to be sensitive to gentamicin, norfloxacin, chloramphenicol, ampicillin-cloxacillin and pefloxacin.

Investigation of outbreaks

During the year, two outbreaks of diseases among cattle were investigated and measures recommended for their control.

1. Outbreak of Foot and Mouth disease (FMD) at Kulan in Bicholim taluka

On 18 th December 2000 an outbreak of FMD like disease was reported in a herd of 58 cross bred cattle at Kulan. The morbidity was 22.4 per cent. Epidemiological data on the outbreak was collected. The symptoms noticed were fever, profuse salivation, anorexia, erruption on tongue and palate, and hoof lesions. The animals were off-feed for two days. However, no deaths were recorded.

From the affected animals tongue epithelium and serum samples were collected for laboratory examination. The tongue epithelium was preserved in 50 per cent glycerol saline and was sent to Centre for Animal Disease Research and Diagnosis, Indian Veterinary Research Institute, Izatnagar for diagnosis and it was confirmed as FMD caused by ASIA 1 strain of the virus.

Control measures suggested

It was advised to the concerned organizations to separate the affected animals immediately considering the contagious nature of the disease. It was recommended to apply sanitizer on the floor of animals for at least a week. It was also advised to apply antiseptics on tongue and to administer supportive antibiotic treatment with the help of local veterinary doctor.

2. Investigation of outbreak in Quepem taluka

An outbreak of a disease showing symptoms of recumbency, subnormal temperature, swollen joints, salivation, in-coordination in gait was reported. The disease was observed in four buffaloes and three cows which included one death. The animals were earlier treated with Paracetamol and Enrofloxacin injection. Blood smears were collected for lab examination. On Leishmans staining, Rickettsia and *Ehrlichia* were seen. It was advised to treat the animals with high doses of oxytetracyclines.

Disease investigations

A total of 36 serum samples comprising 32 from cattle and four from goats were collected. Samples from cattle and goats were tested by Standard tube agglutination test and Rose Bengal plate test for *Brucella* antibodies. Of these 3.13 per cent samples from cattle were positive for brucellosis. However, none of the goat sera samples were positive for brucellosis.

A total of 52 and 42 animals were tested for Bovine Tuberculosis and Johne's disease respectively, during the year, as a part of disease investigation.

Others

i. Vaginal discharge

Two numbers of vaginal swabs were collected from cattle. The bacteria isolated were *Bacillus, Staphylococcus aureus,* and *Escherichia coli.* The organisms were sensitive to kanamycin and gentamicin.

ii. Feacal samples

Nine faecal samples were collected from cattle. All the samples from cattle were negative for parasitic infestations. Three samples were positive for *Escherichia coli*. The organisms were sensitive only to gentamicin and norfloxacin and resistant to ampicillin, oxytetracycline and chloramphenicol.

iii. Pus

Four samples of pus were collected from cattle. Three samples were positive for *Pseudomonas* sp. and one for a fungal culture. The bacteria were sensitive to chloramphenicol, gentamicin and oxytetracycline. The fungus was sensitive to nystatin.

4.3.3. Microbiological studies of meat and meat products.

(SB Barbuddhe and BK Swain)

The project was initiated with an aim to assess the microbiological quality of meat and meat products. Quality parameters viz, Total Plate Count (TPC) for mesophiles and psychrophiles, Yeast and Mould Count (YMC), and *Salmonella* sp. Were estimated.

A total of 37 samples consisting of 20 meat and 17 meat products were processed for TPC for mesophiles and psychrophiles, YMC and for *Salmonella* detection. The meat samples were collected from the markets. In meat, the counts were 10.45×10^4 cfu/g for mesophiles, less than 10^3 cfu/g for psychrophiles and 1.1×10^4 cfu/g for yeast and moulds. In meat products the mesophilic counts were 7.5×10^4 cfu/g.

Typical bacterial colonies from agar plates were subcultured in broth for further morphological and biochemical confirmation. The organisms were stained by Gram's staining method and then checked for motility and catalase production. After initial confirmation the isolates were further subjected to biochemical tests, viz, MR-VP, nitrate reduction, citrate utilization, indole production, triple sugar iron agar, oxidase test and fermentation of sugars such as glucose, lactose, fructose, mannitol, sucrose, xylose. The pathogens were belonged to the genera/species *E. coli., Staphylococcus, Bacillus, Serratia, Kleibsiella, Alkaligens, Citrobacter, Proteus* and others Based on the morphological and biochemical characteristics.No *Salmonellas* were detected.

4.3.4. Evaluation of Brewery Dried Grain (BDG) with enzyme supplemantation in broiler diet.

(BK Swain, RNS Sundaram and SB Barbuddhe)

Brewery grain waste available as a by-product was collected from the local Brewery. It was then sun dried and proximate analysis was done as per AOAC (1990) and presented in table 52. Brewery Dried Grain (BDG) had 30.89 per cent crude Protein (CP) and 17 per cent Crude Fibre (CF). An experimental trial was conducted to identify a suitable low cost feed formula for broilers under local condition. Six experimental diets were prepared by inclusion of BDG at 4 and 8 per cent level with and without an commercial enzyme preparation (Kemzyme-HF) @ 1g/Kg feed. One hundred eighty day old broiler chicks used for the experiment were procured from local hatchery. They were weighed individually, wing banded and distributed randomly in to 18 groups on the basis of equal average body weight. Three groups were randomly assigned to each treatment. The feeding trial was conducted from 1st day to 42 days of age. Data on the weekly body weight gain and feed consumption were collected and feed efficiency values worked out and reported in table 53. At the end of the experiment three birds per treatment were bled and the serum was collected and stored under refrigeration till undertaken for biochemical analysis. Three birds from each treatment were slaughtered for recording of dressing percentage, cut up part yields viz. weight of breast, back, thigh, wings, neck, drumstick and organ weights. All these weights were expressed in terms of percentage of eviscerated weights and presented in table 54 and 55. Results indicated no significant difference among the various dietary treatments for the body weight gain after 42 days of age. However, numerically higher body weight gain was recorded in chicks fed 4 per cent BDG with Kemzyme @ 1.0 g/Kg feed. Higher (P£0.05) feed consumption was recorded in broilers fed diet incorporated with 8 per cent BDG with or without Kemzyme (1. 0 g/Kg feed) which was not different from those chicks kept on diet with 4 per cent BDG with or without Kemzyme (1.0 g/Kg feed). Chicks fed on diet containing 4 per cent BDG and Kemzyme (1.0 g/Kg feed) showed numerically better efficiency of feed utilisation which was comparable to that recorded in chicks fed control diet with or without Kemzyme. Poor feed efficiencies were recorded in chicks fed on diet having 8 per cent BDG with or without

Kemzyme supplementation. Enzyme supplementation to diet containing 4 per cent BDG v Kemzyme @ 1.0 g/Kg feed gave comparatively higher body weight gain and better f efficiency. Feeding of BDG at the level of 8 per cent with Kemzyme @ 1.0 g/Kg resulte significant reduction in abdominal fat. However, there were no significant differences am the values of various cut up parts and relative weights of various organs of broilers fe different levels of BDG with or without Kemzyme.

Table 52. Proximate composition of brewery dried grain.

Proximate constituents	(%) Composition
Dry matter	24.48 ± 0.35
Crude protein	30.89 ± 0.39
Ether extract	7.32 ± 0.11
Crude fibre	17.00 ± 0.30
Total ash	3.09 ± 0.03
Acid insoluble ash	1.37 ± 0.04

Table 53. Body weight gain, feed consuption and its efficiency affected by incorporation of BDG in broiler diet.

Treatments	Body wt. gain	Feed consumption	Feed efficiency
T1	1141.3	2723.0^{c}	2.386
T2	1158.8	2706.9^{c}	2.337
T3	1129.6	2793.2^{a}	2.432
T4	1168.7	2736.6^{bc}	2.373
T5	1135.9	2785.3^{ab}	2.439
T6	1129.0	2779.9^{ab}	2.430
SEM	12.25	16.48	0.0338

Means possessing different superscripts column wise did not differ (P≤0.05) significantly

Table 54. Reletive weights of carcass traits (% Evisc. Wt) as affected by incorporati of BDG in broiler diet.

Treatments	Evisc.wt	Thigh	Back	Breast	Drumstick	Wing	Neck	abd.fa
T_1	64.42	11.26	13.75	13.53	10.17	5.24	3.22	1.32
T_2	62.41	11.23	13.79	13.57	9.28	4.72	3.28	1.122
T_3	60.91	11.43	12.84	11.98	9.23	4.75	3.25	0.943
T_4	61.68	11.33	12.01	14.32	9.39	5.08	3.29	1.006
T_5	64.36	10.96	12.13	13.80	9.41	5.31	3.72	1.147
T_6	63.44	10.62	11.90	13.88	9.75	5.66	3.69	0.89
SEM	1.196	0.364	0.568	0.878	0.365	0.286	0.314	0.07

Means possessing different superscripts in a column differ significantly (P≤0.01)

Table 55. Reletive weights of organs (% Evisc. wt) as affected by inclusion of BDG in broiler diet.

Treatments	Liver	Heart	Gizzard	Spleen	Bursa of Fabricius	Giblets
T_1	2.697	0.577	2.457	0.172	0.172	5.745
T_2	2.656	0.664	2.297	0.175	0.184	5.617
T_3	2.810	0.674	2.640	0.171	0.178	6.123
T_4	2.490	0.615	2.491	0.168	0.168	5.596
T_5	2.765	0.539	2.604	0.180	0.195	5.909
T_6	2.550	0.620	2.534	0.178	0.205	5.703
SEM	0.147	0.040	0.107	0.005	0.012	0.153

4.3.5. Influence of brewery dried grain on the performance of Rhode Island Red (RIR) chicks.

(BK Swain and RNS Sundaram)

An experiment was conducted to find out the effect of feeding Brewery Dried Grain (BDG) at the level of 0,10,15 and 20 per cent on the performance of Rhode Island Red (RIR) chicks and the data is presented in table 56. Results indicated that there was no significant difference among the body weights and feed efficiency of birds fed on 0 to 20 per cent BDG replacing ground nut cake and wheat bran. However, significantly higher feed consumption was recorded in birds fed on control diet and that containing 15 per cent BDG. Results further revealed that BDG could be incorporated at a level of 20 per cent in chick ration without any adverse effect on their growth and feed efficiency.

Table 56. Performance of Rhode Island Red (RIR) chicks by feeding of brewery dried grain (BDG).

Treatments	Body wt. gain	Feed consumption	Feed efficiency
T_1 (Control)	685.3	2797.5^{a}	4.086
T2 (10 % BDG)	658.6	2693.7^{b}	4.090
T_3 (15 % BDG)	678.7	2746.8^{ab}	4.060
T_4 (20 % BDG)	683.4	2715.0^{b}	3.975
SEM	8.297	22.067	0.049

Means possessing different superscripts column wise differ ($P \leq 0.05$) significantly.

4.4 FISHERY SCIENCE

There are two ongoing projects under the Fisheries mega project entitled, 'Introducti and evaluation of technology package for culture and propagation of appropriate fish an shellfish species under Goa conditions'. The two projects cover the aspects of 'Rice freshwater prawn integration' and 'Formulation of economic fish feeds utilizing locally availab feed ingredients'.

4.4.1. Rice - Fresh water prawn integrated culture.

(S Subramanian and KN Mohanta)

With the main objective of increasing the income potential of rice cultivation by integratin fresh water prawn (*Macrobrachium rosenbergii*) as a high value component, the studie were taken up to help the farmer to sustain the rice cultivation and increase income from th rice fields. The main difficulties experienced in this integration are the raising of two rice crop in the face of sudden inundation and long retention of stagnated water in the field and survival of the small sized prawn seeds in the rice field situation.

Two evaluation trials, one at the Institute and another at farmer's field, were laid ou during Kharif, 2000, with four rice varieties viz,Vyttila-1, Vyttila-3, Vyttila-5 and Jyothi, under the stagnant water situation. In both the locations, Vyttila-5 performed better with yield o over 3.00 t/ha and over 180 cm plant height. However, during rabi, 2000-01 trial, conducte in the Institute, Jyothi topped the yield with 6.2 t/ha and a plant height of 87.8 cm compare to Vyttila-5 which yielded 5.0 t/ha and a plant height of 124 cm. Trial conducted at the farmer field also gave similar results with Vyttila-5 topping the yield. Details of rice yield and plan height, which are the two characters of prime importance to be considered for the integrate system, for the kharif and rabi crops during the period under report, are furnished in tables 5 and 58. It may be noted that during Kharif, 2000, there was no significant difference amon the yields of all the four varieties tested. However, for plant heights Vyttila 3 and 5 wer significantly different from that of Vyttila-1and Jyothi.

Only a few juveniles of freshwater prawn, *Macrobrachium rosenbergii* (about 15 m size) could be procured from CIFE, Mumbai, which were pre-reared to 25-30 mm size i Netlon cages fixed in the field and stocked in the field. The prawns attained individual growt of up to 150 g (20-25cm), though survival was poor which may be either due to mortality o escape from the field as they are known to crawl out of the system. Further refinement required to get better survival and to sustain growth of freshwater prawn in the system.

Table 57. Performance of selected rice varieties under the rice-freshwater prawn integration during kharif, 2000.

Rice variety	Plant height (cm)	Yield (t/ha)
Vyttila - 1	165.8	2.95
Vyttila - 3	187.6	3.10
Vyttila - 5	187.8	3.15
Jyothi	86.8	2.53
Design - RBD		
F Test	**	NS
CD (P=0.05)	11.91	—

Table 58. Performance of selected rice varieties under the rice-freshwater prawn integration during the rabi, 2001.

Rice variety	Plant height (cm)	Yield (t/ha)
Vyttila - 1	123.2	3.50
Vyttila - 3	121.8	4.10
Vyttila - 5	124.4	5.00
Jyothi	81.8	6.20

4.4.2. Formulation of low cost feed for fish and prawn, using locally available feed ingredients.

(KN Mohanta and S Subramanian)

Feed is one of the most important components in aquaculture production and the economics production mainly depend on the cost of feed. Use of locally available conventional and nonconventional feed ingredients in the formulation of nutritionally balanced feeds, is one the best alternative to reduce the cost and sustain the production. With this objective, three carp starter feeds and four ornamental fish feeds were formulated and tested under the project earlier, for growth performance on different fish species. In the year under report, the formulated feeds were tested for keeping quality, water stability and protein retention under water immersion with mild aeration. The ornamental feeds formulated and tested on gold fish earlier was tested on gourami during the current year. Diet improvement through supplementation of these feeds with probiotic and enzyme-probiotic combination, was also tested.

1. Keeping quality, water stability and protein leaching of formulated feeds

The formulated Carp Starter Feeds (CSF) and Ornamental Fish Feeds (OFF) were observed to be without any quality deterioration when kept in airtight plastic containers for

twelve months. About 70 and 50 per cent of the CSF pellets under water immersion wit mild agitation, retained their original shape after 30 and 60 minutes, respectively, whereas th OFF were water stable up to 30 to 45 minutes, under similar conditions. The protein leachin percentage of the CSF and OFF varied from 8.63 to 14.97 per cent and 8.12 to 13.58 pe cent, respectively, as shown in table 59.

Table 59. The protein leaching percentage of formulated carp starter feeds and ornamental fish feeds.

Feed code	Protein content (%)			Protein leaching (%) after 60 min
	Initial	30 min	60 min	
CSF-1	32.08	30.20	29.31	8.63
CSF-II	31.72	28.87	28.00	11.72
CSF-III	31.38	28.43	26.68	14.97
OFF-I	40.50	37.18	35.00	13.58
OFF-II	40.00	38.50	36.75	8.12
OFF-III	40.40	38.06	36.31	10.12
OFF-IV	40.15	37.62	35.87	10.66

2. Testing of four formulated ornamental fish feeds on gourami

Four fresh ornamental fish feeds having approximately 40.00 Per cent Crude Protei and 4,000 cal/g energy levels (calculated) were formulated. The growth performance of gourami fry, *Trichogaster trichopterus* using these formulated feeds along with two commercial feeds viz, brine shrimp flake and tubifex worm (as controls) were studied in a 30 days laboratory trial. The fish were fed at five per cent of their body weight. The results obtained are presented in table 60.

Table 60. Growth performance of gourami, *Trichogaster trichopterus* on feeding formulated and commercial ornamental fish feeds.

Nutritional parameters	T-1	T-2	T-3	T-4	T-5	T-6
Food Conversion Ratio (FRE)	1.92^{b}	2.16^{a}	2.18^{a}	1.83^{b}	1.93^{b}	1.87
Specific Growth Rate (SGR)	4.17^{abc}	3.52^{c}	3.66^{bc}	4.23^{ab}	4.10^{abc}	4.61^{a}
Protein Efficiency Ration (PER)	1.30^{a}	1.16^{b}	1.14^{b}	1.34^{a}	1.28^{a}	1.32^{a}
Percent Weight Gain (PWG)	210.79^{ab}	159.81^{c}	169.40^{bc}	214.51^{a}	206.79^{ab}	230.06^{a}
Cost of feed	88.75	58.70	226.30	147.85	1100.00	3500.00

Mean values for the components with common superscript are not significantly different (P ≤0.01), within the same row. * Commercial feed diets.

T - 1 : Chicken liver based T - 2 : Prawn meal based T - 3 : Mussel meal based
T - 4 : Squid meal based T - 5 : Brine shrimp flake T - 6 : Tubifex worm

From table 60, it is evident that the two feeds based on chicken liver meal and squid meal, were statistically on par in case of all nutritional indices as compared to that of two commercial feed. However, the cost of commercial feeds were in the range of Rs.1100 - 3500/kg, while the cost of formulated feeds based on chicken liver and squid meal was Rs 88.75 and 147. 85/Kg, respectively.

3. Effect of probiotic feed supplement on the growth performance of rohu *(Labeo rohita)* fry

In an effort to improve the carp starter feed, a probiotic supplement containing *Lactobacillus* sp. @ 600 billion CFU/kg of product was added to a prepared basal carp feed (approximately 40.00 % C.P. and 4.11 Kcal/g energy) at 0.0 (control), 1.0, 3.0, 5.0 and 10.0 g/kg levels and tested on *Labeo rohita* fry for growth performance. The diets were designated as D-1 (control), D-2, D-3, D-4 and D-5, respectively in the experiment. Results obtained are presented table 61.

Table 61. Growth performance of rohu fry fed on probiotic supplemented diets.

Nutritional parameter	Experimental diet				
	D-1 (0.0 g)	D-2 (1.0 g)	D-3 (3.0 g)	D-4 (5.0 g)	D-5 (10.0 g)*
Per cent Weight Gain (PWG)	197.28 ^{b} (± 4.695)	191.06 ^{b} (± 3.445)	189.67 ^{b} (± 4.747)	237.39 ^{a} (± 4.085)	221.48^{a} (± 8.310)**
Food Conversion Ratio (FCR)	1.50 ^{abc} (± 0.037)	1.63 ^{a} (± 0.088)	1.58 ^{ab} (± 0.039)	1.25 ^{d} (± 0.027)	1.34 ^{cd} (± 0.047)
Specific Growth Rate (SGR)	3.62 ^{bc} (± 0.052)	3.46 ^{c} (± 0.113)	3.53 ^{c} (± 0.054)	4.05 ^{a} (±0.040)	3.88 ^{ab} (±0.086)
Condition Factor (K)	1.00 ^{a} (± 0.031)	1.00 ^{a} (± 0.038)	0.96 ^{a} (± 0.018)	1.03 ^{a} (± 0.015)	0.90 ^{a} (± 0.015)
Protein Efficiency Ratio (PER)	1.64 ^{bc} (± 0.045)	1.53 ^{c} (± 0.083)	1.56 ^{c} (± 0.038)	1.96 ^{a} (± 0.034)	1.83 ^{ab} (± 0.063)

Mean values for the components with common superscript are not significantly different (P≤0.05), within the same row.

Figures in the parentheses indicate probiotic dosages* and standard error**.

twelve months. About 70 and 50 per cent of the CSF pellets under water immersion with mild agitation, retained their original shape after 30 and 60 minutes, respectively, whereas the OFF were water stable up to 30 to 45 minutes, under similar conditions. The protein leaching percentage of the CSF and OFF varied from 8.63 to 14.97 per cent and 8.12 to 13.58 per cent, respectively, as shown in table 59.

Table 59. The protein leaching percentage of formulated carp starter feeds and ornamental fish feeds.

Feed code	Protein content (%)			Protein leaching (%) after 60 min
	Initial	30 min	60 min	
CSF-1	32.08	30.20	29.31	8.63
CSF-II	31.72	28.87	28.00	11.72
CSF-III	31.38	28.43	26.68	14.97
OFF-I	40.50	37.18	35.00	13.58
OFF-II	40.00	38.50	36.75	8.12
OFF-III	40.40	38.06	36.31	10.12
OFF-IV	40.15	37.62	35.87	10.66

2. Testing of four formulated ornamental fish feeds on gourami

Four fresh ornamental fish feeds having approximately 40.00 Per cent Crude Protein and 4,000 cal/g energy levels (calculated) were formulated. The growth performance of gourami fry, *Trichogaster trichopterus* using these formulated feeds along with two commercial feeds viz, brine shrimp flake and tubifex worm (as controls) were studied in a 30 days laboratory trial. The fish were fed at five per cent of their body weight. The results obtained are presented in table 60.

Table 60. Growth performance of gourami, *Trichogaster trichopterus* on feeding formulated and commercial ornamental fish feeds.

Nutritional parameters	T-1	T-2	T-3	T-4	T-5	T-6
Food Conversion Ratio (FRE)	1.92^{b}	2.16^{a}	2.18^{a}	1.83^{b}	1.93^{b}	1.87
Specific Growth Rate (SGR)	4.17^{abc}	3.52^{c}	3.66^{bc}	4.23^{ab}	4.10^{abc}	4.61^{a}
Protein Efficiency Ration (PER)	1.30^{a}	1.16^{b}	1.14^{b}	1.34^{a}	1.28^{a}	1.32^{a}
Percent Weight Gain (PWG)	210.79^{ab}	159.81^{c}	169.40^{bc}	214.51^{a}	206.79^{ab}	230.06^{a}
Cost of feed	88.75	58.70	226.30	147.85	1100.00	3500.00

Mean values for the components with common superscript are not significantly different (P ≤0.01), within the same row. * Commercial feed diets.

T - 1 : Chicken liver based T - 2 : Prawn meal based T - 3 : Mussel meal based
T - 4 : Squid meal based T - 5 : Brine shrimp flake T - 6 : Tubifex worm

From table 60, it is evident that the two feeds based on chicken liver meal and squid meal, were statistically on par in case of all nutritional indices as compared to that of two commercial feed. However, the cost of commercial feeds were in the range of Rs.1100 - 3500/kg, while the cost of formulated feeds based on chicken liver and squid meal was Rs 88.75 and 147. 85/Kg, respectively.

3. Effect of probiotic feed supplement on the growth performance of rohu *(Labeo rohita)* fry

In an effort to improve the carp starter feed, a probiotic supplement containing *Lactobacillus* sp. @ 600 billion CFU/kg of product was added to a prepared basal carp feed (approximately 40.00 % C.P. and 4.11 Kcal/g energy) at 0.0 (control), 1.0, 3.0, 5.0 and 10.0 g/kg levels and tested on *Labeo rohita* fry for growth performance. The diets were designated as D-1 (control), D-2, D-3, D-4 and D-5, respectively in the experiment. Results obtained are presented table 61.

Table 61. Growth performance of rohu fry fed on probiotic supplemented diets.

Nutritional parameter	Experimental diet				
	D-1 (0.0 g)	D-2 (1.0 g)	D-3 (3.0 g)	D-4 (5.0 g)	D-5 (10.0 g)*
Per cent Weight Gain (PWG)	197.28 ^{b} (± 4.695)	191.06 ^{b} (± 3.445)	189.67 ^{b} (± 4.747)	237.39 ^{a} (± 4.085)	221.48^{a} (± 8.310)**
Food Conversion Ratio (FCR)	1.50 ^{abc} (± 0.037)	1.63 ^{a} (± 0.088)	1.58 ^{ab} (± 0.039)	1.25 ^{d} (± 0.027)	1.34 ^{cd} (± 0.047)
Specific Growth Rate (SGR)	3.62 ^{bc} (± 0.052)	3.46 ^{c} (± 0.113)	3.53 ^{c} (± 0.054)	4.05 ^{a} (±0.040)	3.88 ^{ab} (±0.086)
Condition Factor (K)	1.00 ^{a} (± 0.031)	1.00 ^{a} (± 0.038)	0.96 ^{a} (± 0.018)	1.03 ^{a} (± 0.015)	0.90 ^{a} (± 0.015)
Protein Efficiency Ratio (PER)	1.64 ^{bc} (± 0.045)	1.53 ^{c} (± 0.083)	1.56 ^{c} (± 0.038)	1.96 ^{a} (± 0.034)	1.83 ^{ab} (± 0.063)

Mean values for the components with common superscript are not significantly different (P≤0.05), within the same row.

Figures in the parentheses indicate probiotic dosages* and standard error**.

Data presented in table 61 revealed that PWG, FCR, SGR and PER are significantly better ($P<0.05$) in diet D-4 and D-5 than other diets. As there was no significant difference between D-4 and D-5, the diet D-4 is considered best among all the diets, as it gave the best results for all the nutritional parameters tested. The comparison between initial and final carcass composition of rohu fry before start and after feeding the test diets, is given in table 62.

Table 62. Carcass composition of the rohu fry before and after feeding probiotic supplemented feeds.

Constituent	Carcass composition (% Dry Matter basis)					
	Initial value (%)	Final value of fish fed with test diet (%)				
		D-1 (0.0g/kg)	D-2 (1.0g/kg)	D-3 (3.0g/kg)	D-4 (5.0g/kg)	D-5 (10.0g/kg)
Crude protein	58.25	61.75	63.50	64.75	65.25	64.75
Ether Extract	21.00	22.00	22.00	24.00	26.00	24.00
Crude fibre	1.30	1.20	0.86	0.93	0.78	0.84
Ash	13.20	14.00	14.00	13.00	13.00	15.00
Moisture	75.68	74.00	73.50	72.80	73.80	73.60

Figures in parentheses indicate g of probiotic/kg of basal diet.

There was an apparent increase in final carcass crude protein and crude ether extract levels in all fish groups fed with experimental diets including control when compared with the initial levels. However, the rate of increase was maximum in diet D-4. The carcass moisture content in all the treatments ranging from of 72.8 to 74.0 per cent which was also observed to be lower than the initial value of 75.68 per cent.

From the study it may be concluded that growth performance of rohu, *Labeo rohita* fry wa thes best at the probiotic supplement level of 5.0 g/kg when compared with other levels and control. Economics on the use of probiotic was worked out and it was found that probiotic supplement @ 5.0g/kg of basal feed, would increase the feed cost by about Rs.3.70/ kg from Rs.15.65 to 19.35/kg. However, the growth of the rohu fry was found to be three times more than the initial weight at 5 per cent level of probiotic inclusion in diet D - 4, giving 40 per cent more weight gain as compared to control diet.

4. Effect of enzyme-probiotic supplemented feeds on the growth performance, nutrient utilisation and carcass composition of rohu (*Labeo rohita*) fry

A commercial enzyme- probiotic feed supplement SpectraLac of Neospark make and costing Rs.1.15/g was obtained form the market. Each kg of product contained enzymes Amylase : 3,00,00,000 units, Hemicellulase : 17,82,000 units, Cellulase : 39,60,000 units,

Protease : 1,00,00,000 units, Lipase : 16,50,000 units, Betagluconase : 34,980 units and probiotic bacteria (*Lactobacillus* sps.) at the concentration of 300 billion viable Colony Forming Unit (CFU). This enzyme-probiotic supplement was added to the basal diet having 35.27 per cent of Crude Protein, at 0.0 (control), 1.0, 3.0, 5.0 and 10.0 g/kg levels thus preparing five experimental feeds. They were designated as D-1, D-2, D-3, D-4 and D-5, respectively. The details of growth performance of rohu fry, at the end of one month experimental duration, are furnished in table 63.

Table 63. Growth performance of rohu fry on feeding enzyme-probiotic supplemented feeds.

Nutritional parameter	Experimental diet				
	D-1 (0.0 g)	D-2 (1.0 g)	D-3 (3.0 g)	D-4 (5.0 g)	D-5 (10.0 g)*
Percent Weight Gain (PWG)	82.413 ^{b} (± 2.297)	74.303 ^{b} (± 1.422)	112.396 ^{a} (± 4.873)	81.960 ^{b} (± 3.515)	79.766 ^{b} (± 3.492)**
Food Conversion Ratio (FCR)	2.127 ^{ab} (± 0.058)	2.357^{a} (± 0.044)	1.635^{c} (± 0.093)	1.852 ^{bc} (± 0.084)	1.749 ^{bc} (± 0.0002)
Specific Growth Rate (SGR)	1.716 ^{b} (± 0.035)	1.585 ^{b} (± 0.22)	2.140 ^{a} (± 0.067)	1.708 ^{b} (±0.053)	1.674 ^{b} (±0.056)
Condition Factor (K)	0.983 ^{a} (± 0.013)	0.901^{c} (± 0.010)	0.965 ^{ab} (± 0.008)	0.927^{bc} (± 0.005)	0.972 ^{a} (± 0.011)
Protein Efficiency Ratio (PER)	1.336 ^{bc} (± 0.036)	1.204^{c} (± 0.023)	1.752 ^{a} (± 0.107)	1.620 ^{ab} (± 0.0002)	1.620 ^{ab} (± 0.000)

Mean values for the components with common superscript are not significantly different in PWG, FCR, PER, SGR ($P \leq 0.01$) and K ($P \leq 0.05$) within the same row.
Figures in the parentheses indicate probiotic dosages* and standard error**

It was found that the growth performance was the best in the group fed with diet D-3 when compared to other diets. The final carcass composition of the fry after completion of experiment was evaluated and data presented in table 64.

Table 64. Carcass composition of rohu fry fed on enzyme- probiotic supplemented diets.

Constituent	Carcass composition (% Dry matter basis)					
	Initial value (%)	Final value of fish fed with test diet (%)				
		D-1	D-2	D-3	D-4	D- 5
		(0.0g/kg)	(1.0g/kg)	(3.0g/kg)	(5.0g/kg)	(10.0g/kg
Crude protein	53.62	61.25	63.00	64.75	61.25	57.75
Ether Extract	16.00	20.00	18.00	20.00	19.00	18.00
Crude fibre	1.30	1.10	0.88	0.90	0.87	0.84
Ash	11.00	13.00	12.00	11.00	13.00	14.00
Moisture	75.50	75.10	74.60	74.80	73.90	74.40

* Figures in parentheses indicate g of probiotic/kg of basal diet.

It was observed that use of enzyme-probiotic feed supplement had no adverse effe on carcass composition of the fish as the final carcass moisture content, crude protein, eth extract and crude fibre in all treatments are numerically better than the initial values.

It is concluded from the present study that three g enzyme-probiotic feed supplem (equivalent to about 0.9 billion CFU of *Lactobacillus* bacteria, Amylase : 90,000 uni Hemicellulase : 5,346 units, Cellulase : 11,880 units, Protease : 30, 000 units, Lipase : 4,9 units and Betagluconase : 105 units) /kg of basal feed level gave the best growth performanc nutrient utilisation and carcass composition of the *Labeo rohita* fry. Economics of using enzym probiotic feed supplement was also worked out. It was found that enzyme-probiotic fe supplement at the level of 3.0 g/kg basal feed, would increase the feed cost by Rs.3.45/k from Rs.15.90 to Rs.19.35/kg. But the growth was found to increase twice from g initi weight to g final weight than the initial weight at 3.0 g/kg enzyme-probiotic feed supplem level, which resulted in 30 per cent more weight gain than the group fed with control die Under field and farming conditions, the enzyme-probitic supplement is expected to be mor economical, due to natural productivity of the culture system.

4.5 TRANSFER OF TECHNOLOGY

Krishi Vigyan Kendra (KVK) is a project of the ICAR to test and transfer of agricultural technologies to bridge the gap between the production and productivity and also to increase self employment opportunities among the farming communities. In order to achieve these goals, the Krishi Vigyan Kendra carried out the following activities during 2000-2001.

- Organising vocational training programme in agriculture and allied enterprises.
- On-farm testing in farmer's fields in crop production, horticulture, livestock production, fisheries, etc.
- Front line demonstrations on major cereal crops, oilseeds and pulses and other enterprises related to agriculture.
- In-service training of field level extension officials.

4.5.1. Training and other activities

(VY Gaonkar, HR Prabhudesai, SM Talaulikar, AV Nirmale, HR Chidananda Prabhu, VS Sakharkar, KK Metar).

During the period of report, the KVK conducted 84 need based vocational training programmes both on the campus as well as off campus in various disciplines like Crop Science, Horticulture, Animal Sciences, Home Science, Plant Protection and Agril. Extension and trained 1296 personnels in two categories viz., practicing farmers /farm women and rural youth. The whole group comprised of 512 maleand 784 female. The details of the vocational training courses conducted in different disciplines are provided in table 65.

Table 65. Vocational training programmes conducted in Agriculture and allied enterprises.

Sl. No.	Title of the Course	No.of courses conducted			No.of participants		
		On Campus	Off campus	Total	Male	Female	Total
I.	**CROP SCIENCE**						
A.	Practicing farmers and farm women						
1.	Technology for hybrid and basmati rice	2	1	3	44	11	55
2.	Vermiculture bio - technology	4	1	5	28	56	84
3.	Groundnut production technology	1	3	4	69	27	96
	SUB TOTAL - A	7	5	12	141	94	235

SI. No.	Title of the Course	No.of courses conducted			No.of participants		
		On Campus	Off campus	Total	Male	Female	Total
B.	Rural youth						
1.	Composting techniques	1	1	2	18	7	25
2.	Low cost farm implements	2	-	2	20	-	20
3.	Operation and maintenance of Power tiller, tractors and other farm machinery	1	-	1	8	-	8
	SUB TOTAL - B	4	1	5	46	7	53
	TOTAL (A + B)	11	6	17	187	101	288
II.	**HORTICULTURE**						
A.	Practicing farmers and farm women						
1.	Coconut based cropping system	2	-	2	14	6	20
2.	Nutrition gardening	2	-	2	5	32	37
3.	Improved cultivation practices for vegetables	-	1	1	24	8	32
4.	Improved cultivation practices for fruit crops	-	1	1	5	21	26
5.	Floriculture.	2	-	2	13	6	19
	SUB TOTAL - A	6	2	8	61	73	134
B.	Rural youth						
1.	Grafting techniques and nursery management	5	-	5	15	46	61
2.	Mushroom cultivation	2	2	4	26	17	43
	SUB TOTAL - B	7	2	9	41	63	104
	GRAND TOTAL (A+B)	13	4	17	102	136	238

.of participants	
Female	Total
7	25
-	20
-	8
7	53
101	288
6	20
32	37
8	32
21	26
6	19
73	134
46	61
17	43
63	104
136	238

SI. No.	Title of the Course	No.of courses conducted			No.of participants		
		On Campus	Off campus	Total	Male	Female	Total
III.	**PLANT PROTECTION**						
A.	Practicing farmers & farm Women						
1.	Pest of rice	1	-	1	-	6	6
2.	Pest management in plantation crops	1	-	1	6	4	10
3.	Pest management in fruit crops	1	-	1	4	2	6
4.	Pest management in vegetable crops	-	2	2	11	16	27
5.	Pest management in cashew	-	1	1	-	17	17
6.	Weed management	1	-	1	7	3	10
	SUB TOTAL - A	4	3	7	28	48	76
B.	Rural youth						
1.	Apiculture	2	-	2	5	10	15
2.	Spawn production	3	-	3	3	24	27
	SUB TOTAL - B	5	-	5	8	34	42
	GRAND TOTAL (A+B)	9	3	12	36	82	118
IV.	**ANIMAL SCIENCES**						
A.	Practicing farmers & farm Women						
1.	Pig rearing	2	-	2	32	4	36
2.	Dairy animal management	-	1	1	6	2	8
3.	Enrichment of karad hay	-	1	1	4	1	5
4.	Backyard poultry farming	-	1	1	18	3	21
	SUB TOTAL – A	2	3	5	60	10	70
B.	Rural youth.						
1.	Broiler farming	2	-	2	28	27	55
2.	Layer farming	1	-	1	13	2	15
3.	Rabbit farming	1	-	1	-	11	11
4.	Aquarium management	2	-	2	23	6	29
	SUB TOTAL - B	6	-	6	64	46	110
	TOTAL (A + B)	8	3	11	124	56	180

SI. No.	Title of the Course	No.of courses conducted			No.of participants		
		On Campus	Off campus	Total	Male	Female	Total
V.	**HOME SCIENCE**						
A.	Practicing farmers and farm Women						
1.	Low cost nutritious recipes	4	5	9	-	170	170
2.	Mushroom receipes	-	4	4	-	91	91
3.	Child care	-	1	1	-	26	26
	SUB TOTAL - A	4	10	14	-	287	287
B.	Rural youth						
1.	Home scale food preservation	3	-	3	-	30	30
2.	Income generating activities for housewives	4	-	4	-	43	43
	SUB TOTAL - B	7	-	7	-	73	73
	GRAND TOTAL (A+B)	11	10	21	-	360	360
VI.	**AGRIL. EXTENSION**						
B.	Rural youth						
1.	Panchayat Raj System	-	2	2	47	3	50
2.	Leadership development	-	2	2	7	44	51
3.	Organisational climate	-	2	2	9	2	11
	SUB TOTAL - B	-	6	6	63	49	112
	GRAND TOTAL (I+II+III+IV+V+VI)	52	32	84	512	784	1296

In service training of field level extension officials

During the year under the report, the KVK conducted seven in-service training programmes for field level extension officials in various disciplines like Horticulture, Plant Protection, Animal Sciences, Home Science and Agril. Extension and trained 110 participants comprising of 86 men and 24 women. The details of the in-service training programmes conducted for field level extension officials are furnished in table 66.

f participants	
Female	Total
170	170
91	91
26	26
287	287
30	30
43	43
73	73
360	360
3	50
44	51
2	11
49	112
784	1296

service training
Horticulture, Plant
d 110 participants
ing programmes

Table 66. In service training programmes conducted for field level extension officials.

SI. No.	Title of the Course	No.of courses conducted			No.of participants		
		On Campus	Off campus	Total	Male	Female	Total
	Horticulture						
1.	Plantation crops	1	-	1	14	4	18
	Plant Protection						
2.	Integrated pest management	1	-	1	16	1	17
	Animal Scinces						
3.	Dairy animal management	1	-	1	10	-	10
4.	Integrated farming system	-	1	1	33	-	33
	Home Science						
5.	Food preservation	1	-	1	-	19	19
	Agril.Extension						
6.	Use of audio visual aids	1	-	1	7	-	7
7.	Training and Technology Transfer	1	-	1	6	-	6
	TOTAL	6	1	7	86	24	110

Table 67. Farm advisory services and extension programmes.

SI. No.	Particulars	No.of programmes	No. of farmers covered	Male	Female	SC/ ST
1.	Scientific visit to farmers field	38	468	279	189	51
2.	No. visits by farmers to KVK	80	1054	500	554	105
3.	Field days	1	90	40	50	10
4.	World food day	1	30	-	30	-
5.	Women in agriculture day	1	25	-	25	-
6.	Kisan mela	1	100	48	52	19
7.	Farmers meetings	38	555	337	218	90
8.	Exhibitions	01	100	48	52	19

Table 68. Other extension activities.

Sr. No	Activities	Numbers
1.	Radio talks (broadcasting)	11
2.	TV coverages (telecasting)	3
3.	News paper coverages	8
4.	Popular articles published	13
5.	Research articles published	3
6.	Technical reports published	1
7.	Extension folders published	3
8.	Training notes published	10
9.	KVK staff deputed for training / seminar / workshop	4

Bench Mark Survey

Bench mark survey was conducted in Chopde and Maulinguem villages sitiuated in North Goa district. Out of 330 occupied residential houses, 100 house hold respondents were interviewed through an interview schedule.

Out of the 100 farm families surveyed with a population of 532, 269 are male (50.56%) and 263 are female (49.44%). 65 and 35 per cent of surveyed families had nuclear and joint family system, respectively. Average number of members in one family was 5.32. 38 and 62 per cent of the families had family members ranging from 1 to 4 and above four, respectively. 71, 24 and five per cent of the respondents belonged to Hindu, Buddhist and Chirstian religion, respectively. Majority of the houses were electrified and average number of rooms of dwelling house was three. One fourth of the farm families were using gas as a source of cooking fuel. However, three fourth of the respondents were using wood as a source of cooking fuel.

Educational status of rural youth was critically analyzed and the data revaled that only two out of 100 students enrolled for education will be in a position to complete graduation. 42 and 37 percent of the respondents were cultivating rice and horticultural crops, respectively. Only ten per cent of the respondents take two rice crops in a year (Rice – rice – fallow). Source of livelihood of 17 per cent of the respondents was dairy. 17 per cent of the farm families were landless labourers. Majority of the farmers depend on monsoon. 67 and nine per cent of the families possessed television and radio sets, respectively. Whereas, 20 per cent of the respondents were having their own conveyance. 18 per cent of the respondents in the surveyed villages subsribed newspapar for reading purpose.

Majority of the farmers and farm women stated that they are willing to attend a training courses on pest management in rice, pest management in cashew and income generating activities for house wives.

Nursery Activities

During the year, the following planting material was prepared to supply the beneficiaries under various schemes and for the general sale to the farmers. The detailed account is given in table 69.

Table 69. Planting materials prepared and supplied during 2000-01.

Sr. No	Planting materials	Quantity
1.	Cashew grafts	4411
2.	Mango grafts	1287
3.	Coconut seedlings	1604
4.	Arecanut seedlings	8000
5.	Others	3000
	TOTAL	18302

4.5.2. On farm testing.

(VY Gaonkar, HR Prabhudesai, AV Nirmale, HR Chidananda Prabhu, VS Sakharkar, KK Metar).

On Farm Testing (OFT) was conducted on 13 farmers field's by covering an area of 2.60 hectares to find solutions to the problems related to agricultural development. Out of 13 beneficiaries selected under on farm testing, six (46.15%) were men and seven (53.85%) were women. Six (46.15%) beneficiaries belonged to scheduled castes / tribes as per the details given in table 70.

Table 70. Details of on farm testing.

Particulars	Subject areas						Total
	Crop Science	Horti.	Animal Science	Home Science	Agril. Extn.	Plant Protect.	
Areas in hectares	0.4	0.2	-	-	-	2	2.6
No.of farmers	6	1	5	-	-	1	13
Male	4	1	-	-	-	1	6
Female	2	-	5	-	-	-	7
SC/ST	1	-	5	-	-	-	6

A. Testing of Eight row paddy dry seeder

In the second OFT, a eight row dry paddy seeder developed by the DRR, Hyderabad was demonstrated and tested in the farmers field conditions during the kharif season. The seeder is a low cost implement which aims at cutting down the cost towards the raising of rice nursery as well as the labour cost incurred in transplanting. The demonstration was conducted at Collem village in Sanguem taluka during the Kisan Mela function held on 23/3/2001.

The demonstration unit had 3 treatments in order to collect relevant data not only the saving in time and labour by virtue of the use of the implement but also compare the other traditional systems of rice planting in vogue in the said village namely

- Broadcasting of pre-germinated seed in puddle conditions
- Transplanting of rice seedlings
- Use of eight row dry seeder

The area of demonstration admeasuring 1500m^2 having each treatment of 500m^2 was selected and all the planting operations carried out and the time and labour requirement for each operation was recorded. Results are presented in table 71 and 72.

Table 71. Results of the OFT on 8 row paddy seader at Collem village.

Treatment	Area (ha)	Labour		Time taken (hrs)	Wages Rs
		Men	Women		
Broadcasting of pre-germinated seed in puddle condition	1	5	2	16	460
Transplanting of rice seedlings	1	2	60	8	3600
Use of 8 row dry seeder	1	2	1	12	540

Table 72. Saving due to use of drum seeder (Amount in Rs./ha) and rotary weeder.

Input / Operation	Drum Seeder	Broadcasting	Transplanting
Seed	625	625	625
Land Preparation	2750	2750	2750
Nursery Preparation	-	-	600
Transplanting/ sowing/Broadcasting	540	460	3600
Weed management	300	500	1200
Manures and Fertilizer application	3550	3550	3550
TOTAL	7765	7260	12325
Saving by use of drum seeder per ha. Rs.		4560	5065

DRR, Hyderabad
kharif season. The
s the raising of rice
ion was conducted
on 23/3/2001.

nt data not only the
compare the other

ment of 500m^2 was
ur requirement for

llage.

Time taken (hrs)	Wages Rs
16	460
8	3600
12	540

d rotary weeder.

g	Transplanting
	625
	2750
	600
	3600
	1200
	3550
	12325

5065

Table 73. Extent of increase in returns due to drum seeding (Rs./ha).

Income / Parameter	Drum Seeder	Broadcasting	Transplanting
Income @ Rs 5000/t	22150	16350	20800
Fodder Yield [t/ha]	4.00	3.00	4.00
Income @ Rs.1000/t	4000	3000	4000
TOTAL	26150	19350	24800

Increase in returns : Rs. 6800.00 over broadcasting
Rs. 2350.00 over transplanting
Overall profit by use of drum seeder over transplanting Rs. 6910.00

B. Testing of Polythene mulching technology in groundnut

In the third OFT, the technology of Polythene mulching was tested at Amthane village in Bicholim taluka under irrigated farming situations in early Feb planting during summer in Jl-24 variety with two treatments viz; Sowing without polythene mulch and Sowing with polythene mulch.

The total area covered during the year was 0.4 ha comprising of the two treatments. All the agronomic practices recommended for conventional groundnut cultivation (T1) and the polythene mulching technology (T2) were followed .

Salient findings and Observations under Polythene mulched groundnut are presented below :

1. The germination higher by three days.
2. The flower initiation was early by four days.
3. The flower initiation and subsequent pod formation was higher.
4. Minimize weed growth.
5. The number of supplementary irrigations given to mulched and non-mulched plots were six and 11 respectively leading for water saving to the extent of 90 per cent.
6. Early maturity of crop by five days.

4.5.3. Front line demonstrations.

(VY Gaonkar, HR Prabhudesai, HR Chidanand Prabhu, VS Sakharkar and KK Metar)

Front Line Demonstrations (FLD) was organised on 22.9 ha covering 73 farmers comprising of 54 males and 19 females. Ten farmers were from SC and ST category.

A. Front line demonstrations on cereals

The objective of this FLD was to show the impact of new technology as against the traditional variety/practice in the area. During both kharif and rabi seasons of the year 2000-2001, an area of 11.9 ha was was cultivated with the following rice groups.

Short duration.....	Triguna , Krishna Hamsa, IET- 8886	7.0 ha
Basmati	Pusa Basmati, IET-15390, IET-15392	1.0 ha
Hybrid rice.....	Sahyadri	3.9 ha

Each demonstration had 4 components to know the most ideal technology package under the farming situation. The componenets are listed below:

T1... Farmer's variety with his traditional cultural practice
T2... Farmer's variety with improved practice
T3... New variety with farmer's practice
T4... New variety with improved practice.

Table 74. Details of frontline demonstrations on cereals (Rice).

	Kharif, 2000	Rabi, 2000-2001
Area coverage (ha)	4.5	6.4
Villages covered	St.Cruz, Taleigao, Sangolda, Curtorim	Verna, Nogoa Chiraknali
Varieties used		
Short duration	Triguna , Krishna Hamsa, IET- 8886	Triguna , Krishna Hamsa, IET- 8886
Basmati	Pusa Basmati, IET-15390, IET-15392	IET-9240, IET-15996
Hybrid	-	Sahyadri
No. of beneficiaries	11 [M 9 F2]	13 [M 11 F 3]

The results of the FLD given in table 75 showed that during kharif, the highest yield among the short duration varieties demonstrated was at Utorda with variety Triguna yielding 4.25 t/ha.

The overall farmer's yield with his own variety (T1) was 2.35 t/ha which was increased to 2.68 t/ha by use of improved practice with the same variety(T2).

By introduction of a promising variety with farmer's practice (T3), the yield was found to increase to 3.20 t/ha whch was further increased to 3.67 t/ha by use of improved practice (T4).

Table 75. Component wise yield (t/ha) of rice varieties under multilocational testing during kharif, 2000 under Front-line demonstrations on cereals.

Village	Area (ha)	Variety	Yield (t/ha)				% Increase of T_4		
			T_1	T_2	T_3	T_4	T_1	T_2	T_3
Loutulim	0.2	Pusa Basmati	2.35	2.60	3.00	3.24	37.87	27.61	8.00
Chorao	0.2	IET-15390	2.15	2.35	2.80	3.10	44.18	31.91	10.71
St Cruz	0.5	Triguna	2.45	2.75	3.65	4.15	69.38	50.90	13.69
Utorda	0.5	Triguna	2.60	3.20	3.70	4.25	63.46	32.81	20.37
Porvorim	0.5	IET-11768	2.15	2.48	3.00	3.75	74.41	51.20	25.00
Sangolda	0.6	IET-15996	2.20	2.52	2.85	3.25	47.73	28.97	14.04
	0.3	Triguna	2.65	2.84	3.86	4.30	62.26	51.41	11.40
	0.3	IET-15390	2.55	2.75	2.90	3.00	17.65	09.09	03.45
	0.1	IET-15391	2.30	2.62	2.80	3.25	41.30	24.05	16.07
Taleigao	0.2	Triguna	2.40	2.85	3.45	4.00	66.67	40.35	15.94
	0.1	IET-9240	2.15	2.60	3.30	3.85	79.07	48.08	16.67
	0.1	Krishna Hamsa	2.30	2.70	3.10	3.80	65.22	40.74	22.58
Soccoro	0.5	Krishna Hamsa	2.35	2.60	3.20	3.75	59.57	44.23	17.19
Curtorim	0.2	IET-15391	2.50	2.75	3.10	3.45	38.00	25.46	11.29
Calangute	0.2	Krishna Hamsa	2.20	2.65	3.40	3.85	75.00	45.28	13.24
	4.5	Mean	2.35	2.68	3.20	3.67	56.12	33.55	13.74

The FLD results during kharif further indicated that the demonstrated technology could bring about an overall yield increase to the tune of 56 per cent over farmer's traditional practice. Similarly it also seen that the traditional yield level could be increased by 33.55 per cent by adopting improved cultivation practice alone. Further, the percentage increase by use of promising variety with farmer's practice along with improved package was only 13.74 per cent.

During Rabi (Table 76), the highest yield among the short duration varieties was at Chiraknali village with variety Triguna yielding 4.35 t/ha.

The overall farmer's yield with his own variety (T1) was 2.36 t/ha which was increased to 2.66 t/ha by use of improved practice with the same variety (T2).

Table 76. Component wise yield (t/ha) of rice varieties under multilocational testing during Rabi 2000-2001 under Front-line demonstrations on cereals.

Village	Area (ha)	Variety	Yield (t/ha)				% Increase of T_4		
			T_1	T_2	T_3	T_4	T_1	T_2	T_3
Verna	0.2	IET-15996	2.40	2.75	3.20	3.85	60.40	40.00	20.31
	0.2	IET-15998	2.20	2.50	2.80	3.65	65.90	46.00	30.35
	0.3	IET-13549	2.30	2.62	2.80	3.25	41.30	24.05	16.07
Nagoa	0.2	IET-9994	2.60	2.75	3.20	4.00	53.84	45.45	25.00
	0.3	IET- 9976	2.54	2.68	3.10	3.30	29.92	23.13	06.45
	0.4	Krishna Hamsa	2.70	3.00	3.20	4.20	55.55	40.00	31.25
Chiraknali	0.4	Triguna	2.10	2.45	3.30	4.35	107.14	77.55	31.81
	0.5	Krishna Hamsa	2.30	2.60	3.00	3.85	67.39	48.07	28.33
	0.6	IET-9240	2.45	2.65	2.85	4.25	73.46	60.37	49.12
	0.4	IET-8886	2.10	2.42	2.60	4.10	95.23	69.42	57.69
	3.5	Mean	2.37	2.64	3.01	3.90	65.01	47.40	29.63
Overall Mean of Kharif and Rabi			2.36	2.66	3.10	3.78	60.56	40.47	21.68

By introduction of promising variety with farmer's practice (T_3), the yield was found to increase to 3.10 t/ha whch was further increased to 3.78 t/ha by use of improved practice (T_4).

The FLD results further indicated that during the course of experimentation ,the demonstrated technology could bring about an overall yield increase to the tune of 60.56 per cent over farmer's traditional practice. Similarly it also showed that the traditional yield level could be increased by 40.47 per cent by adopting improved cultivation practice alone. It was also seen that the percent increase by use of promising variety along with farmer's practice and improved package was only 21.68 per cent.

B. Front line demonstrations on oilseeds

The programme has been successfully implemented in an area of 11 ha comprising of Sangolda (2ha) and Nodora and Revoda villages (9ha) of Bardez taluka covering 49 beneficiaries comprising of 34 males and 15 females (Table 77).

ational testing
n cereals.

ncrease of T_4	
T_2	T_3
40.00	20.31
46.00	30.35
24.05	16.07
45.45	25.00
23.13	06.45
40.00	31.25
77.55	31.81
48.07	28.33
60.37	49.12
69.42	57.69
47.40	29.63

40.47 21.68

eld was found to
proved practice

mentation ,the
ne of 60.56 per
tional yield level
ice alone. It was
rmer's practice

a comprising of
ka covering 49

Table 77. Basic information on selected villages under FLD on groundnut during rabi, 2000-01.

Village	Area (ha)	No of farmers			Variety	Farming situation	Previous crop	Cropping rotation
		M	F	Total				
Nadora	7.5	28	6	34	Jl-24 & DH 3-30	Residual moisture	Rice	Rice-Veg-G.nut
Revoda	1.5	2	5	7	Jl-24 & DH 3-30	Residual moisture	Rice	Rice fallow - chillies
Sangolda	2.0	4	4	8	Jl-24 & DH 3-30	Residual moisture	Rice	Rice-G.nut - Pulses
TOTAL	11.0	34	15	49				

Each demonstration was laid out in a contiguous area to involve maximum farmers and to have a better impact of the technology. The selected farmers were exposed to PRA tools and problem cause tree was drawn to identify and then prioritise their existing problems relating to Groundnut cultivation. After prioritising the problems, technical intervention points were decided based on the existing problems.

The beneficiaries were imparted skill oriented training in some of the aspects like mechanical shelling, seed treatment etc. and critical inputs were supplied to them.

Based on the existing problems faced by the farmers, the FLD were laid out comprising of four components viz;

1. Farmer's seed with his traditional practice
2. Improved seed with farmer's method of cultivation
3. Improved seed with technology recommended by KVK
4. Use of pesticide for pod borer management.

The crop was monitored at regular intervals and the results are presented in Table 78.

Table 78. Component and variety wise Yield (q/ha) of Groundnut crop under FLD in three villages during Rabi 200-2001.

Village	Area (ha)	JL-24				DH-3-30				Local		% Increased Yield			
												JL-24		DH-3-30	
		1	2	3	4	1	2	3	4	1	2	1	2	1	2
Nadora	7.5	13.5	17.2	21.6	22.5	12.8	18.3	23.6	24.3	11.4	14.2	60.0	25.5	84.3	28.9
Revoda	1.5	12.7	15.4	19.8	21.2	11.8	17.8	21.6	22.4	12.3	13.8	55.9	28.6	83.5	21.3
Sangolda	2.0	14.5	17.6	23.8	24.5	16.6	19.2	22.5	23.6	14.8	16.4	64.1	35.2	35.5	17.2
Mean		13.6	16.7	21.7	22.7	13.7	18.4	22.6	23.4	12.8	4.8	60.0	29.7	67.7	22.4

From table 78, the following inferences can be drawn:-

- The variety supported by the recommended package of practices could bring abou an increase in yield upto 60 per cent and 67 per cent Jl-24 and Dh-3-30 respectively
- The highest yields for Jl-24 was recorded in Sangolda village (24.5 q/ha) while in case of Dh-3-30 the highest yield of 24.3 q/ha was recorded at Nadora village.
- The maximum yields were however recorded in case of component four i.e (Full package of practice + Management of pod borer).
- The FLD results further indicate that the overall per unit productivity levels in the selected villages could be increased by 63.85 per cent over farmer's traditiona practice of groundnut cultivation and to around 26.05 per cent by only changing the variety or by use of quality seed.
- The results also showed the superiority of variety Dh-3-30 in terms of higher yield

C. Front line demonstration on hybrid rice

During the year 2000-2001, the Directorate of Rice Research, Hyderabad sanctioned a target of four hectares to transfer the technology of Hybrid rice which was earlier tested at the ICAR Research Complex Goa since 1997-98. The basic information of these demonstrations are presented in table 79.

Table 79. Basic information of Frontline Demonstrations on Rice Hybrids in Goa during Rabi 2000-2001.

Taluka	Village	Area (ha)	Beneficiaries			Variety		Collaboating Agency
			M	F	Total	Check	Hybrid	
Quepem	Chiraknalli	2.0	5	1	6	Jaya/Jyoti	Sahyadri	CADA
Salcete	Nagoa	1.4	2	2	4	Jaya/Jyoti	Sahyadri	DA
	Verna	0.5	2	-	-	Jaya/Jyoti	Sahyadri	DA

CADA : Command Area Development Authority

DA : Directorate of Agriculture

The results indicated the potential to more than double the existing rice yield of the best variety traditionally grown in the locality and also the potential to yield three and a half times if the production of Hybrid variety is also supported by the relevant technology package (Table 80).

Table 80. Performance Rice Hybrid "Sahyadri" under Front-line demonstrations in Goa (rabi 2000-2001).

Village	Area (ha)	Yield (Kg/ha)			Addn. Yield (kg/ha) over		Inc. (%) in Yield of hybrid over	
		Jaya	Jyoti	Sahyadri	Jaya	Jyoti	Jaya	Jyoti
Nagoa	1.4	3658	3020	6275	2617	3255	71.54	107.7
Verna	0.5	3075	2850	6080	3005	3230	97.72	113.3
Chiraknali	2.0	2436	2325	4885	2449	2560	100.53	110.1
Mean		3056	2731	5746	2690	3015	89.93	110.3

The results showed that Sahyadri has a distinct edge over the traditionally cultivated varieties viz; Jaya and Jyoti. The highest demonstration yield was obtained at Nagoa village (6275kg/ha).

The analysis of data collected indicated that overall an additional yield of 2690 kg and 3015 kg/ha over Jaya and Jyoti respectively could be harvested, which correspond to an overall yield increase of 89.93 per cent and 110.3 per cent over Jaya and Jyoti respectively inferring that the Hybrid rice technology if adopted by the farmer has the capacity to double the existing yield levels of the rice farmers in the state, which would break the yield barrier in traditional varieties and also enable the State to wipe the present rice deficit existing in the state.

Overall Cost Benefit Analysis of Hybrid rice in Front-line demonstrations

Parameters	Traditional Variety		Hybrid variety
	Jaya	Jyoti	Sahyadri
Grain Yield (kg/ha)	3056	2731	5746
Straw yield (kg/ha)	3000	2500	4500
Income from grain +straw (Rs)	18280	16155	32230
Cultivation Cost (Rs)	15200	15200	15800
Net income (Rs)	3080.0	955.00	16430.00
Benefit : Cost ratio	1 : 1.20	1 : 1.06	1 : 2.03

4.6 NATIONAL AGRICULTURAL TECHNOLOGY PROJECT

4.6.1. Strategies for enhancing the productivity of pigs for the farming community.

(RNS Sundaram and SB Burbuddhe)

In continuation of the earlier years programme, during the year existing piggery unit was modified and provision was made to accommodate 20 more adult pigs for conducting experimental trial. Provision was also made for individual housing of pigs for experimental feeding trial. The equipments viz: Bomb calorie meter and Fibre extraction unit which are approved for the project, were procurred during the year.

With a view to identify an economic feed for pigs which can be adopted in the field an experimental feed was formulated with dried Cashew Apple Waste (CAW) replacing wheat bran at 20 per cent level. Feeding trials were conducted for a period of 75 days in two groups of local x landrace (2 X 6) crossbred animals to study the suitability of CAW as feed substitute. The result is presented in table 81. Average dry matter digestibility was 70.78 percent in case of experimental vis vis 73.90 per cent for control group. Daily weight gain was 168.35g and 167.70g for control and experimental group, respectively. There was no adverse effect on growth rate and feed intake in experimental group with 20 per cent CAW in the diet. Cost of feed per kg was worked out at Rs. 7 for control as against of Rs. 5.8 for experimental feed.

Table 81. Low cost feed formulated for the trial (Parts/100).

	Control feed	Experimental feed
Maize	30	30
Ground nut cake	25	25
Wheat bran	45	25
Cashew apple waste	0	20
Crude protein (%)	16.62	16.30
Crude fibre (%)	7.30	8.23
Average daily weight gain (g)	168.35	167.70
Dry matter digestability (%)	73.90	70.78
Crude fibre digestibility (%)	37.82	50.34

Brewery waste, a by-product, available in the local breweries, was also used as feed ingredient. Dried brewery grain waste has 18.5 per cent crude protein and 19.6 per cent crude fibre. A low cost feed was formulated incorporating the byproduct at 20 per cent level, as replacement for wheat bran. Feeding trial was conducted with nine cross breed piglets for a period of 90 days. Comparative growth performance was recorded for the three test rations and the results of growth performance are presented in table 82.

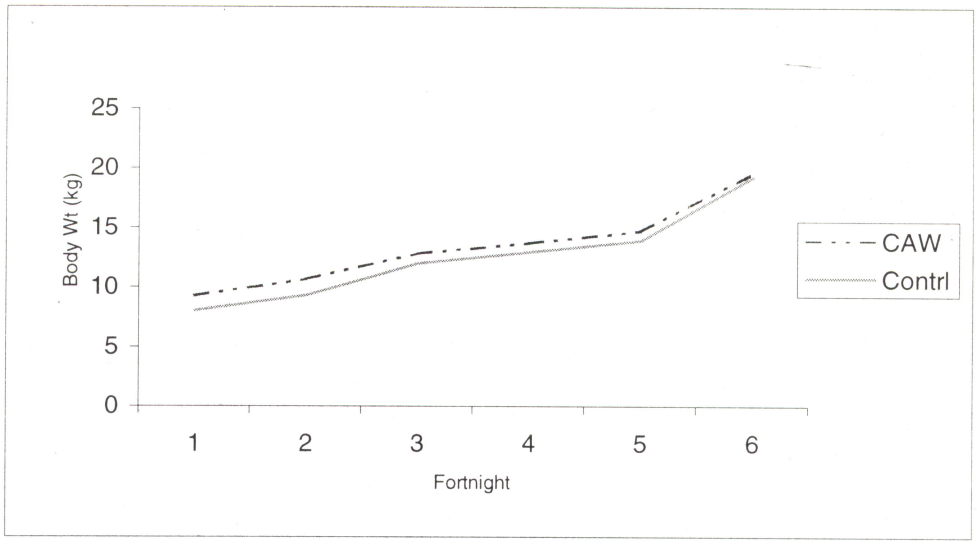


Fig 14. Comparative growth performance of pigs using as CAW feed.

Table 82. Ingredient composition and growth performance of piglets with CAW/BDG in the feed.

Ingredient Composition (%)	T1	T2	T3
Maize	30	30	30
Ground nut cake	25	25	25
Wheat bran	45	20	20
Brewery dried grain	0	0	25
Cashew apple waste	0	25	0
Crude protein (%)	16.62	16.30	17.50
Crude fibre (%)	11.14	14.70	12.05
Initial body weight (kg)	18.50	13.66	17.88
Final body weight (kg)	35.83	30.82	35.50
Feed consumed/kg weight gian	4.93	4.98	4.84
Average dry weight gain (g)	188.40	186.59	192.03

Preliminary study indicated that the incorporation of Brewery Dried Grain waste (BDG) at 20 per cent level has no adverse effect on growth. The average daily weight gain with control, CAW and BDG incorporated feed was 188.40g,186.59g and 192.03g respectively. Feed consumed per kg weight gain by T_1,T_2 and T_3 group was 4.93,4.98 and 4.84 kg, respectively.

The causes of piglet mortality were investigated. In all 13 bacterial isolates were recovered from dead pigs during the year. Septicemia, enteritis and pneumonia, which are infectious in origin were identified as the major cause of mortality.

4.7 COMPLETED PROJECTS

4.7.1. Studies on reproduction aspects of meat animals to improve the fertility and fecundity Later on renamed as "Adoption of improved techniques to increase fertility and fecundity in pigs and rabbits"

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

To make livestock industry more profitable, particularly in meat producing livestock, it is necessary to monitor reproductive management. In this particular project attempts were made to adopt modern techniques for augmenting fertility and fecundity and to get maximum number of young ones per animal per year.

Pigs

During the first year, selection of breeding stock, production of litters and standardization of analytical techniques were completed. The sows of pure Yorkshire breed were selected for breeding from different age groups and parity. These sows were bred with bore of the same breed. Data on litter size at birth and weaning was recorded. The average litter size at birth was 7.70 which declined to 4.0 at weaning. Average birth weight was 800 gms.

Sows and gilts of different breeds were bred at different postpartum period ranging from 29 days to 229 days. No difference was observed in litter size in two consecutive farrowings.

Seventeen gilts and sows of different breds viz. Yorkshire, Yorkshire crosses and Landrace crosses were studied for litter size at birth and weaning when they were bred after natural estrous, estrous induced by prostaglandin and estrous induced by prostaglandin plus Pregnant Mare's Serum Gonadotropin (PMSG). Results indicated that litter size at birth and weaning was 6.5and 6.0 when it was a natural estrous. It was 5.5and 4.5 when estrous was induced with prostaglandin and litter size was 9.2 and 7.2 when estrous was induced with a combination of prostaglandin plus PMSG. In sows there was no adverse effect on litter size at birth and weaning, when estrous was artificially induced within18-30 days after farrowing.

Rabbits

Rabbit does of different breeds i.e. Soviet Chinchilla, New Zealand White and Gray Giant were bred from different age groups and parity. A total of 19 kindling were studied for this purpose during 1993-94. Litter size at birth and birth weight was recorded .Average litter size at birth in Soviet Chinchilla, New Zealand White and Gray Giant was 4.0, 4.5 and 5.5 respectivly. Average birth weight was 39.13, 41.5 and 42 in Soviet Chinchilla, New Zealand White and Gray Giant breeds, respectively. It was observed that fecundity increased from 2.0 to 7.0 when breeding male was changed.

Litter size was studied by mating after prostaglandin treatment. Six rabbits group were injected with 0.1ml prostaglandin. All rabbits exhibited estrous (acceptance of male). After mating, five rabbits delivered with an average litter size of 4.00.

Litter size in rabbits was recorded by mating them on the day of kindling. In rabbit, does mated on the day of kindling or within 24 hours after kindling the average litter size increased and there was no reduction in survival of kits. By increasing the remating interval i.e.15 to 45 days there was no increase in average litter size.

An improvised Artificial Vagina (AV) for rabbit semen collection was developed employing cheap and easily available cheap materials.

Breeding of rabbits artificially by collecting semen through AV yielded successful results and the technique has been standardized.

Thirty semen samples were collected from two breeding bucks (New Zealand White and Soviet Chinchilla one each). After collecting, semen samples were evaluated for motility, total sperm count and live/ dead sperm count before and after dilution. Motility of sperm was better in New Zealand White than that of Soviet Chinchilla when diluted with sodium citrate-egg yolk diluter. Neat semen showed motility only for thirty minutes at room temperature where as diluted semen showed motility for sixty minutes. Diluted semen when preserved in refrigerator it showed motility for 48 hours. Total sperm count was 35x 10 6 in New Zealand White and 32x 10 6 in Soviet Chinchilla. Dead sperm count was 15 to 20 percent in these breeds.

An attempt was made to super ovulate three rabbit does and two fertilized ova (Eight celled embryos) were collected and examined under zoomsterio microscope. From single rabbit doe, 26 young ones were obtained in a short period of eight months by matting the doe on the day of kindling.

An ancillary work was carried to study comparative efficacy of benzyle benzoate and ivermectin for treating of Ear mite in rabbits. It was observed that ivermectin was better as compared to benzyl benzoate treatment for controlling ear mites in rabbits.

Studies on estrous induction was done using chlomiphene citrate, prostaglandin F2 in rabbit and sows. Copper sulphate solution 0.1 percent at the rate of 1 mg/kg body weight was injected intravenously in rabbits. Favourable results were observed.

For ascertaining normal values of the herd blood biochemistry, blood serum glucose was estimated by using Foli Wu method in rabbits and pigs. It was 90.32 mg /100 ml of blood and 131.93 mg /100ml for rabbit and pig, respectively. Blood serum protein was estimated using Biuret method which was found to be 5.09 gm percent and 5.07 gm per cent in rabbit and pigs, respectively.

Biochemical composition of rabbit blood serum in pregnant and lactating does was studied. It was observed that calcium and phosphorous was low in subfertile rabbits. Effect of various factors viz. sex, breed, age and weight on blood biochemistry was studied. It was

observed that age had a significant effect on phosphorus level. Oral calcium supplimentation a week before and after kindling improved kit survival rate as well as serum calcium levels of pregnant and lactating does.

An attempt was made to improve kit survival by feeding "jaggery' to the lactating does from the day of kindling for a period of ten days. Jaggery is a rich source of energy as well as important minerals like calcium and phosphorous which are essential for lactation. Results of this trial were promising. A total of 46 kindling were studied consisting of control and treatment groups. Control group consisting of six animals showed average litter size of 4.33 at birth and 2.00 at weaning i.e. survival of 46 per cent, where as group fed with jaggery (35 kindling) showed 4.88 average litter size at birth and 4.02 litter size at weaning, indicating 82.4 per cent kit survival.

4.7.2. Use of neem based pesticide in the eradication of weed and predatory fishes.

(S Subramanian, Mani Chellappan, KN Mohanta)

Objectives

1. Categorization of weed fishes in freshwater culture ponds with particular reference to Goa region.
2. To work out the effectiveness and lethal levels of different neem based pesticides containing Azadirachtin, against the target fishes.
3. Trials to determine the efficacy of the neem products in the control of weed fishes and working out their economics.

Introduction

In pond culture system, it is important to eradicate all the other fishes excepting the candidate species so that the expected production level is achieved. Weed fishes (both minnows and carnivorous fishes) making entry into the culture ponds, not only upset the stocking density but also utilize the space and food materials intended for the candidate fish species, there by reducing the overall productivity. The common fish poisons like mohua oil cake are either difficult to get or the poisonous effect on their application lasts for a long time delaying the fish stocking. Though, application of ammonia is effective in killing unwanted fishes in ponds, special applicator is required for its use. The release of ammonia by mixture of lime and ammonium sulphate is difficult due to the non-availability of ammonium sulphate. Many of the fish poisons already available are difficult to get in Goa. By finding out the efficacy and effective concentration of neem based pesticides in eradicating the weed fishes of pond, an alternative can be found to solve the above problems faced, which would help in achieving the pond productivity.

Considering the above aspects, use of neem based pesticides are safer, readily available and easy for application. It does not require any special applicator. They also degrade with in a short period, making early stocking of pond with culturable fishes, easier.

As a pre-runner, it becomes essential as to know the common weed and carnivorous fish species which may be present in the culture ponds.

It also becomes essential to determine the efficacy of the neem cake and the neem based products and the level of Azadirachtin contained in them, in killing the target fishes under laboratory and field conditions.

The project is aimed at identifying a purified neem product containing Azadirachtin, for the control or eradication of unwanted weed fishes of the freshwater culture system, whose application would be easy, economical and eco-friendly without any detrimental effect to the environment.

International Status

Of late the use of biological products in the control of pests has been gaining importance the entire world over as these products create less harm or no harm to the ecosystem or environment. In this context, neem products have been tested for its ingredients and Azadirachtin was identified to be one of the principal ingredients, which is very effective in the control of many insect pests of important crops. Though neem based products have not been tested much for its effect on fishes, some work has been already done in using the neem products in the control of fishes like Rainbow trout, Blue Gill Sunfish and Guppies, with reasonable success.

National Status

In India, though many have tested the efficacy of Azadirachtin containing products in the control of crop pests, no work has so far been carried out in testing the neem based pesticides in the control or eradication of weed and carnivorous fishes of the freshwater culture environment.

Methodology

Freshwater culture pond fishes were identified and categorized as minnows, cat fishes and air-breathers. As Azadirachtin affects the gill of the fish and inhibits breathing of dissolved oxygen in the water, both the concentration of Azadirachtin and concentration of the products at which 50 per cent and 100 per cent mortality was occurring, were assessed, for different target groups. Initially, the effective range was identified and subsequently the exact concentrations were worked out. Field efficacy of the identified product was evaluated subsequently.

Aplochelus sp., *Mystus* sp. and *Heteropneustes* sp. were selected as target fishes representing minnows, cat fish and air breathers, respectively. While neem cake was tested as

such, achook and bioneem were tested for their product concentration and Azadirachtin levels contained in them. Achook and bioneem contained 0.03 per cent of Azadirachtin as the active ingredient. Based on the efficacy of the different products, the identified products were tested in the field. The same were repeated for another neem product, neemazal which contained 1 per cent Azadirachtin as active ingredient. The optimum effective dose and economics were also worked out.

Results and Discussions

Weed fishes of freshwater culture system

In a survey to identify carnivorous and weed fishes of freshwater culture system, fourteen species falling under ten genera were identified as under:

1. *Aplocheilus* spp. (2 species)
2. Rasbora daniconius
3. Danio aequipinnatus
4. Gambusia affinis
5. Chela cabuca
6. *Punctius* spp. (4 species)
7. *Anabas* sp.
8. *Heteropneustes* sp.
9. Clarias batrachus
10. *Mystus* sp.

Evaluation on the effect of neem based pesticides

Biopesticides are preferred over other pesticides as they degrade in nature and are ecofriendly. Neem based pesticides containing Azadirachtin as the active ingredient, were studied under this project, for control/eradication of unwanted weed and predatory fishes of freshwater culture system.

Neem oil cake

In a preliminary trial, neem oil cake was tried at 10, 50, 100, 200 and 500 ppm level in the control of *Heteropneustes* sp. It was seen that none of the above concentrations were effective. Neem oil cake was, however, effective in killing the fish at a high concentration of 1000 ppm within 5 hours. As neem oil cake was effective only at higher levels of product concentration, other products such as achook, bioneem and neemazal were tried, subsequently.

Azadirachtin containing neem products

Achook

Achook containing 0.03 per cent (300 ppm) of Azadirachtin as the active ingredient, was tested for its effect in the control of *Aplocheilus* sp., in lab trials. It was found that achook was effective at the concentration of 0.011 ppm of Azadirachtim (37.5 ppm Achook). In another set of experiments, achook was found effective in killing *Mystus* sp. and

Heteropneustes sp. within 3 $^{1}/_{2}$ and 6 $^{1}/_{2}$ hours at the Azadirachtin concentrations of 0.015 ppm (50 ppm achook) and 0.060 ppm (200 ppm achook), respectively. The effect of achook on the three test fish species are depicted in figures 15,16 and 17.

Bioneem

Bioneem containing 0.03 per cent (300 ppm) of Azadirachtin as the active ingredient, was found effective in killing both minnow and catfish. In the three sets of lab trials conducted with bioneem at Azadirachtin concentrations ranging from 0.001 to 0.200 ppm, on *Aplocheilus* sp. and *Mystus* sp. Bioneem was found effective in killing both the species in 5 to 6 hours, even at the low concentration of 0.005 ppm (Fig.18 & 19). Trials on the effect of bioneem (containing 0.03 per cent Azhadirachtin as the active ingredient) on *Heteropneustes* sp. was repeated with lesser dilutions ranging from 0.0025 to 0.0150 ppm of Azadirachtin(8 to 50 ppm of bioneem), after initial trials to find out its effective range. The trials indicated that the lowest concentration of 0.0025 ppm of Azhadirachtin, could give 50 per cent mortality in nine hours and 100 per cent mortality in 13.30 hours after application. However, the earliest 100 per cent mortality occurred in one hour at the concentration of 0.075 ppm of Azadirachtin (250 ppm of Bioneem). A repeat trial with Bioneem on *Heteropneustes* sp. confirmed that at 0.0025 to 0.0150 ppm of Azadirachtin was effective in killing the fish within 9 to 13 $^{1}/_{2}$ hours duration (Fig 20).

Azadirachtin, the active ingredient in the neem products, inhibit the intake of dissolved oxygen at the gills, which can be seen from the swollen condition of the gills in the fish killed with bioneem.

With this, neem cake, Achook and Bioneem were tested on three types of fishes. The lowest concentrations obtained in the lab trials were not effective when tested in the field. Economics of application was also calculated.

Neemazal

Another neem based pesticide, Neemazal containing 1.0 per cent EC, was tested for its efficacy in killing *Aplocheilus* sp. It was found that neemazal was effective only in higher doses i.e. 5.0 and 10.0 ppm of product concentration (0.05 and 0.10 ppm Azadirachtin), being the lowest effective concentration for 50 and 100 per cent mortality levels, killing the fish within 20-26 hours and not at lower concentrations as compared to Bioneem. Therefore, Neemzal was not tested on other species.

Ecomomics

Comparative economics of various neem products tested namely neem cake, Achook, Bioneem and Neemazal were worked out and detailed in table 83. It may be seen from the table that bioneem is the most effective neem based pesticide killing all the three test species at 8 ppm product concentration (0.0025 ppm Azadirachtin) between 7 to13 hours. The quantity of neem pesticide required at the lowest effective concentration per ha of application is 85 litres in case of Bioneem and 50 litres for Neemazal. Therefore, both of them are uneconomical for application.

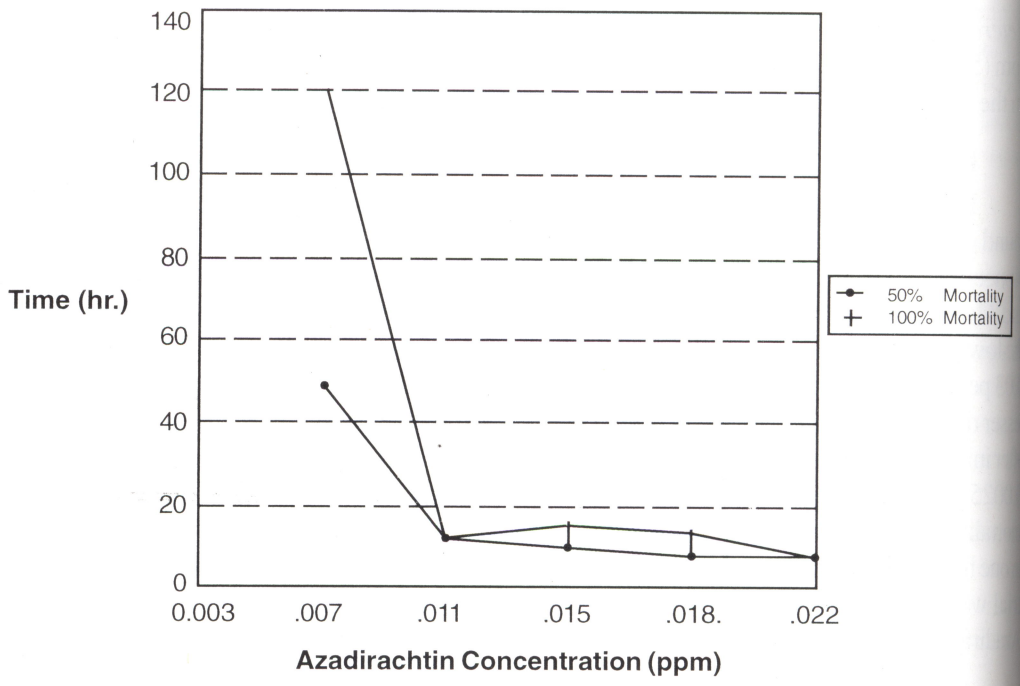


Fig 15. Effect of Achook on eradication on *Aplocheilus* sp.

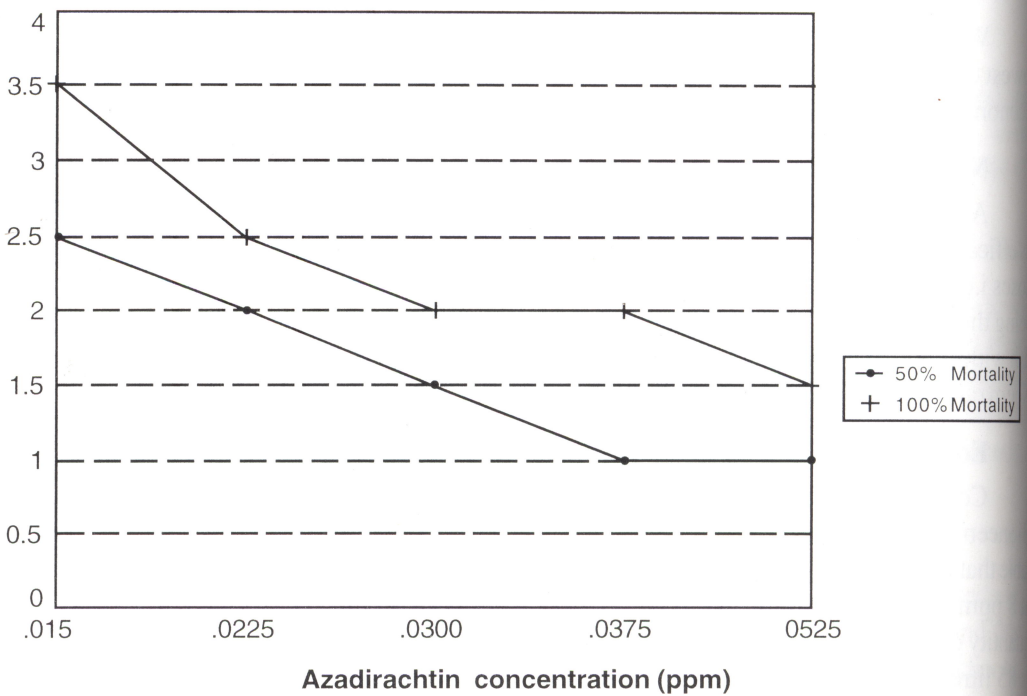


Fig 16. Effect of Achook on eradication on *Mystus* sp.

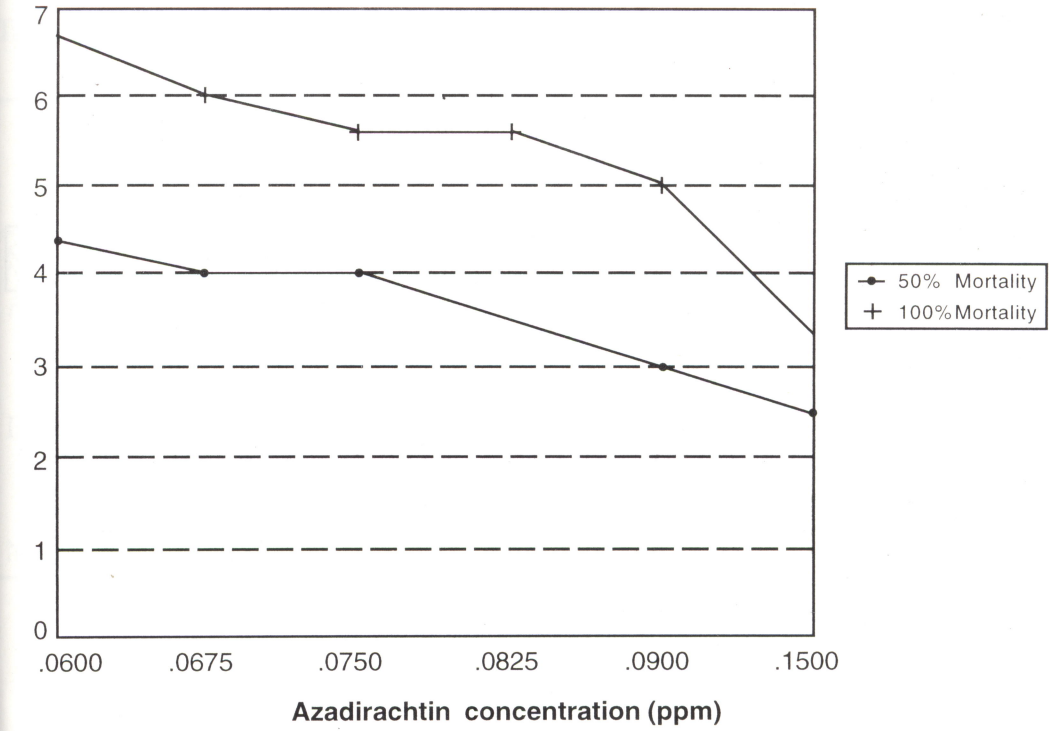


Fig 17. Effect of Achook on eradication on *Heteropneustes* sp.

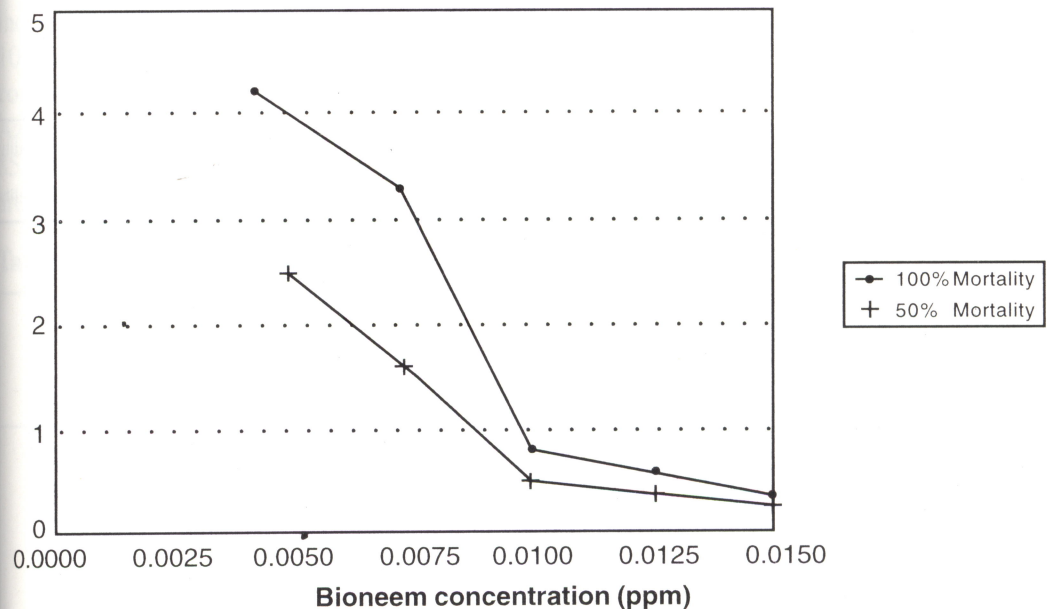


Fig 18. Effect of Bioneem on eradication of *Aplocheilus* sp.

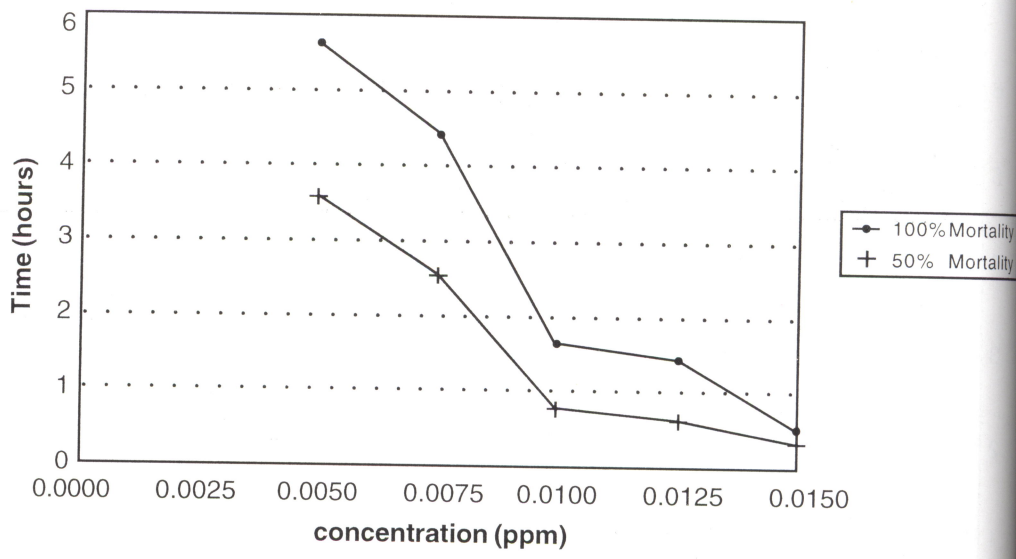


Fig 19. Effect of Bioneem on eradication of *Mystus* sp.

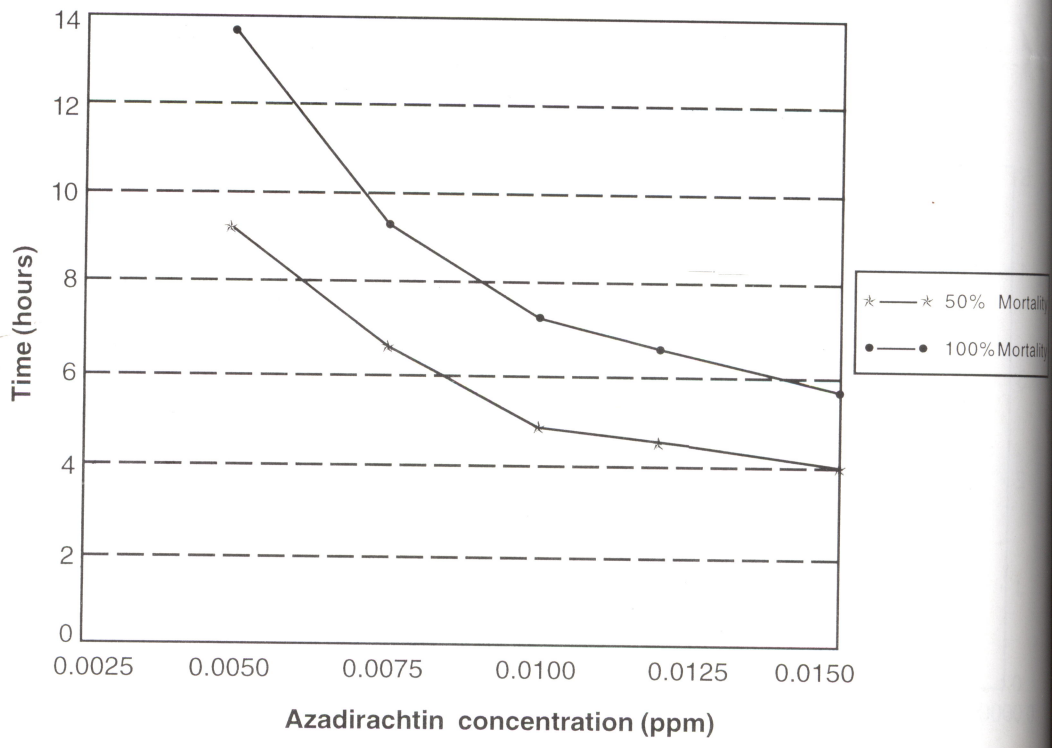


Fig 20. Effect of Bioneem on the mortality of *Heteropnetustus sp*.

Table 83. Effect of neem based pesticides on three groups of fishes with economics of application.

Neem pesticide	Azadirachtin Content (EC) (%)	Cost/ kg or l (Rs.)	LEC of 100% mortality			Quantity (kg or l) required/ha	Cost /ha (Rs.)
			Time (hour)	Product conc.(ppm)	Azadirachtin conc.(ppm)		
Neem cake	–	5.00	A-05.00	1000.0	-	10,000	50,000
Achook	0.03	200.00	A-12.00	37.5	0.011	375	75,000
			M-03.30	50.0	0.015	500	100,000
			H-06.30	200.0	0.060	2000	400,000
Bioneem	0.03	250.00	A-07.00	8.0	0.0025	85	21,500
			M-08.00	8.0	0.0025	85	21,500
			H-13.00	8.0	0.0025	85	21,500
Neemazol	1.00	780.00	A-20.00	5.0	0.0500	50	39,000

A – *Aplocheilus* sp. M – *Mystus* sp. H – *Heteropneustes* sp.

Residual effect in the medium

In another trial, the duration for which the effect of neemzal lasts in the medium, was tested with *Aplocheilus* sp. as the test fish. It was found that the residual effect of neemzal lasted for 15 days in killing the fish and no such effect was noticed on 20th day and afterwards even at the concentration of 0.2 ppm Azadirachtin (20 ppm product concentration). Table 84 indicates the effect of nemmazal on *Aplocheilus* sp. for the product concentrations of 0, 5, 10 and 20 ppm on the day of application and after 5,10,15 and 20 days. A similar trial conducted for Bioneem indicated that the residual effect lasted for more than 20 days for the Azadirachtin concentration of 0.015 ppm (50 ppm product concentration), as shown in table 85. The water quality parameters were also analysed for the above two trials and the ranges are indicated in table 86 and 87 for neemzal and bioneem, respectively.

Table 84. Duration of residual effect of Neemazal in the medium with *Aplocheilus* sp.

Days	Neemazal concentration (ppm) (Azadirachtin concentration ppm)			
	0	5 (0.050)	10 (0.100)	20 (0.200)
0 (day of application)	S	M	M	M
5	S	S	M	M
10	S	S	M	M
15	S	S	M	M
20	S	S	S	S

S : Survived M : Mortality

Table 85. Duration of residual effect of Bioneem in the medium with *Aplocheilus* sp.

Days	Bioneem concentration (ppm) (Azadirachtin concentration ppm)			
	0	25 (0.0075)	50 (0.015)	100 (0.030)
0 (day of application)	S	M	M	M
5	S	S	M	M
10	S	S	M	M
15	S	S	M	M
20	S	S	M	M
25	S	S	S	S

S : Survived M : Mortality

Table 86. Range of water qualtity parameters during the trial on the effect of Neemazol at different concentration on *Aplocheilus* sp.

Parameters	Neemazal concentration (ppm) (Azadirachtin concentration ppm)			
	0	5 (0.050)	10 (0.100)	20 (0.200)
pH	6.50	6.00-6.50	6.00-6.50	6.00-6.50
Temp.(^{0}C)	26.30-28.50	26.10-28.50	26.20-28.30	27.70-28.30
Alkalinity (m mol/l)	0.50-1.20	1.00-2.00	0.80-1.70	0.80-1.30
DO (ppm)	3.26-4.64	3.13-3.90	2.14-3.70	2.13-4.05
Ammonia NH_3 (ppm)	0.50	0.50	0.50-1.00	0.50-1.50
Nitrite (ppm)	0.05-1.00	0.00-1.00	0.00-0.50	0.00-0.50
Nitrate (ppm)	10.00-75.00	10.00-75.00	10.00-75.00	10.00-75.00

Table 87. Range of water qualtity parameters during the trial on the effect of Bioneem at different concentration on *Aplocheilus* sp.

Parameters	Bioneem concentration (ppm) (Azadirachtin concentration ppm)			
	0	25 (0.0075)	50 (0.015)	100 (0.030)
pH	6.50	6.50	6.00-6.50	6.00-6.50
Temp.(^{0}C)	25.80-28.20	25.80-28.20	25.80-28.30	25.80-28.30
Alkalinity (m mol/l)	0.80-1.20	0.80-1.20	0.80-2.60	0.90-2.60
DO (ppm)	3.26-4.64	2.49-3.72	2.30-3.71	1.40-2.81
Ammonia NH_3 (ppm)	0.00	0.00-1.00	0.00-3.00	0.00-3.00
Nitrite (ppm)	0.05-0.50	0.00-1.00	0.00-0.50	0.00-0.05
Nitrate (ppm)	75.00	75.00	50.00-75.00	75.00-100.00

5. TECHNOLOGY ASSESSED AND TRANSFERRED

The Krishi Vigyan Kendra attached to the Institute functions as an extension unit for the assesment of relevant technologies both within the campus and in the farmers field and their transfer through development Departments of the State.

So far, the Institute has identified, standardised and field tested various technologies in different crops, species and farming systems, which are ready for transfer to the farmers. Out of these, many technologies have already found a place in the farmers field either through the Krishi Vigyan Kendra or various development agencies. During the year under report, following technologies were given emphasis for transfer ;-

1. Technology for Basmati and fine grained scented rice.
2. Salt tolerant high yielding rice varieties for Khazan lands.
3. Technology for rice based cropping systems.
4. Technology for groundnut production under residual moisture conditions.
5. Management technology for sweet potato weevil.
6. Technology for rejuvenating unthrifty cashew trees through top working.
7. High yielding local cashew selections like Balli-2.
8. Grafting techniques for cashew and mango.
9. Production technologies for cashew, mango, cocnut and arecanut.
10. Technology for year round cultivation and spawn production for *Pleurotus florida* and *Pleurotus sojorcaju* mushrooms.
11. Technology package for meat rabbit production.
12. Technology for enhancement of broiler and layer production.

6. EDUCATION AND TRAINING

As Goa does not have an Agricultural University, the Institute is shouldered with the responsibility of education and training in the field of Agriculture. The Krishi Vigyan kendra of the Institute also renders training and academic assistance to students of the Goa University to a limited extent.

Trainings conducted / Lectures delevered

During the year under the report Scientist and KVK faculty have delivered regular lectures and conducted training programmes on various topics as indicated below :

1. " Recent advances in horticulture" for rural youth at Pilar Society on April 10th, 2000. (VY Gaonkar).
2. " Construction and maintenance of freshwater fish pond" for fish farmers and extension workers organised by Fisheries Department, Government of Goa on May 23rd, 2000. (KN Mohanta)
3. "Fish based Integrated Farming Systems" for fish farmers and extension workers organised by Fisheries Department on May 24th , 2000. (S Subramanian)
4. " Pest management in coconut, cashew, mango and spices" for Krishi Mela farmers organized by Zonal Agriculture Office, Bicholim on June 14th, 2000. (JR Faleiro)
5. " Improved cultivation practices for spices" for Kisan Mela farmers organized by Zonal Agriculture Office, Bicholim on June 15th, 2000. (VY Gaonkar)
6. "Improved cultivation practices for spices" for Kisan Mela farmers organized by Zonal Agriculture Office, Ponda on June 16th, 2000. (VY Gaonkar)
7. "Potential of vermiculture biotechnology" for farmers organised by Bank of India, Collem on August 16th, 2000. (HR Prabhudesai)
8. "Role of vermiculture technology in solid waste management" for trainees in training organised by PES College of Arts and Science, Farmagudi on August 18th, 2000. (HR Prabhudesai)
9. "Rice varieties and Basmati technology" for farmers organised by Dena Bank, Goa Velha on August 18th, 2000. (HR Prabhudesai)
10. "IPM in rice" for State Agriculture Officers organized by Directorate of Agriculture, Government of Goa under Integrated Community Development Programme at FTC, Old Goa on August 24th, 2000. (JR Faleiro)

11. "Agronomic practices in rice" for State Agriculture Officers organized by Directorate of Agriculture,Government of Goa under at FTC, Old Goa on August 24th, 2000. (BL Manjunath)

12. "Integrated weed management in rice" for State Agriculture Officers organized by Directorate of Agriculture,Government of Goa under at FTC, Old Goa on August 25th, 2000. (BL Manjunath)

13. "Scope and potential of vermiculture" for NSS unit volunteers organised by Carmel College, Nuvem Goa on August 26th, 2000. (HR Prabhudesai)

14. "Wonder mango varieties of 21st Centuary" for Botany students organised by UGC at Goa University on August 31st, 2000. (SP Singh)

15. "Fisheries programmes of ICAR Research Complex for Goa" for First Year B.Sc. students from College of Arts and Science, Ponda on September 12th, 2000 (KN Mohanta).

16. "Biological control – a vital component of IPM programmes" for Students of Biotechnology organized by Dempo College of Arts and Science, Panjim on September 28th, 2000. (JR Faleiro)

17. " IPM in important horticultural crops of Goa" for Nursery men at KVK, Old Goa on October 10th , 2000. (JR Faleiro)

18. "Improved cultivation practices for coconut" for Kisan Mela farmers organized by Zonal Agriculture Office, Ponda on October 19th, 2000. (VY Gaonkar)

19. " Importance of nutrition" for trainees in training programme organised by National Co-operative Union , Panjim and Workers Traing Centre, Ponda at Farmagudi on November 16th, 2000. (S Talaulikar)

20. "Plant protection in coconut, cashew and banana" for Kisan Mela farmers organized by Zonal Agriculture Office, Bicholim on November 16th, 2000. (JR Faleiro)

21. "Improved cultivation practices for spices" for Kisan Mela farmers organized by Zonal Agriculture Office, Valpoi on November 17th, 2000. (VY Gaonkar)

22. " Pest management in coconut" for farmers organised by Lions club of Avdem paroda at Goa Horticultural Show on November 18th, 2000. (JR Faleiro)

23. "Recent advances in horticulture" for unorganised workers meeting organized by Workers Education Centre at Farmagudi on November 20th, 2000. (VY Gaonkar)

24. "Mechanical cultivation of paddy" for Kisan Mela farmers organised by Zonal Agriculture Office, Sanguem at Collem on November 23rd , 2000. (HR Prabhudesai)

25. "Recent advances in crop improvement in plantation crops" for agriculture officers at State Level Collaborative Course on Plantation Crops at KVK, Old Goa on November 27th, 2000. (AR Desai)

26. " Mushroom World" for trainees at training organised by Goa State Horticultural Corporation on November 28th, 2000. (HRC Prabhu)

27. " IPM in Plantation Crops" for agriculture officers at State Level Collaborative Course on Plantation Crops at KVK, Old Goa on November 28th, 2000. (JR Faleiro)

28. " Spawn production" for trainees at training organised by Goa State Horticultural Corporation on November 30th, 2000. (HRC Prabhu)

29. "Information on dairy industry and breeding and reproductive management of dairy animals" for Zoology teachers organised by Goa University, Bambolim on December 19th, 2000. (EB Chakurkar)

30. "Cultivation of Oyster mushroom" for the mushroom trainees organized by Horticulture Development Corporation at Panaji on December 21st, 2000, January 1st, 30th and March 13th, 2001. (VY Gaonkar)

31. "Quality control of milk, egg and meat in relation to dairy and poultry farming" to the Students of Department of Zoology , Goa University on December 21st ,2000. (SB Barbuddhe)

32. " Diseases of pulses and groundnut" for trainees at training organised by FTC, Department of Agriculture, Old Goa on January 2nd, 2001. (HRC Prabhu)

33. "Cultivation of Groundnut" and "Cultivation for pulses" for village level workers organised FTC, Deprtment of Agriculture, Old Goa on January 2nd and 18th 2001. (HR Prabhudesai)

34. "Breeding of pigs" for trainees at KVK, Old Goa on January 3rd, 2001. (EB Chakurkar)

35. " Improved cultivation practices for arecanut, spices, banana, organic horticulture" for Gram Sevaks at KVK, Old Goa on Janauary 4,5,9 and 25th, 2001. (VY Gaonkar)

36. " Disease management aspects in coconut , arecanut and black pepper" for Gram Sevaks organised by FTC, Department of Agriculture at Ela, Old Goa on January 5th 2001. (R Ramesh)

37. " IPM in Plantation crops" for Village level workers organised by FTC, Depertment of Agriculture, Old Goa on Janauary 5th, 2001. (JR Faliero)

38. " Disease management aspects in vegetables, banana and mango" for Gram Sevaks organised by FTC, Department of Agriculture at Ela, Old Goa on January 8th 2001. (R Ramesh)

39. "Cultivation of Pineapple for trainees in the Refresher's Training Course for Village level workers organised by FTC, Department of Agriculture at Ela, Old Goa on January 10th 2001. (AR Desai)

40. "Varietal improvement in cashew and latest in cashew resaerch in Goa" in State Level Seminar held at FTC, Ela, Old goa on janauary 15th , 2001. (AR Desai)

41. " Water management in rice" for Agriculture Assistants organised by Department of Agriculture at FTC, Old Goa on Janauary 16th, 2001. (BL Manjunath)

42. "Improved cultivation practices for cashew" for Agriculture Assistants organised by Department of Agriculture at FTC, Old Goa on Janauary 18th, 2001. (VY Gaonkar)

43. "Pest and disease of cashew and their managemnt" for Agriculture Assistants organised by Department of Agriculture at FTC, Old Goa on Janauary 18th, 2001. (HRC Prabhu)

44. "Food processing" for trainees in traing programme organised by SISI, Margao on January 22nd, 2001. (S Talaulikar)

45. "Diseases of poultry and their control" for farmers at KVK on Janauary 25th, 2001. (SB Barbuddhe)

46. "Micro irrigation" for rural youth at KVK on January 22nd, 2001.(BL Manjunath)

47. "Aquarium - Fabrication and Management"- Two training programmes of two days each conducted for youths and small entrepreneurs, through KVK during January 29-30th. 2001 and March 2-3rd, 2001. (S Subramanian, KN Mohanta and AV Nirmale).

48. "Diseases of pig and their control" for farmers at KVK on February 2nd, 2001. (SB Barbuddhe)

49. "Meat inspection technology and other laboratory techniques" training imparted to Veterinary Officers of Disease Investigation Laboratiry, Department of Animal Husbandry and Veterinary Services, Government of Goa during February 13-17th, 2001. (SB Barbuddhe)

50. "Mushroom receipes" for trainees in training progremme organised by Institute of Ship Building Technology, Vasco at Corlim Panchayat on February 14th, 2001. (S Talaulikar)

51. "Importance of nutrition" for members of Mahila Mandal organised by Goa State Womens Federation, Panjim at Taligaon on February 14th, 2001. (S Talaulikar)

52. "Minor irrigation schemes with special refrence to Goa" for Final Year students (Civil Engg) organised by Government Polythecnic, Panjim on February 21st, 2001. (S Manivannan)

53. "Nutritious receipes" for trainees in training programme organised by Institute of Ship Building Technology, Vasco at Kumbarjuha Panchayat on February 28th, 2001. (S Talaulikar)

54. "Harvesting and Processing of spices" for progressive farmers at workshop on spices organised by Department of Agriculture and Spice Board at Gavane and Sanguem on February 27 and 28th, 2001 respectively. (VY Gaonkar)

55. "High yielding forage grasses for dairy" for Veterinary Assistants at KVK on March 8th, 2001. (BL Manjunath)

56. "Prevention of diseases and maintenance of hygiene at farm" for Veterinary Assistants at KVK on March 9th, 2001. (SB Barbuddhe)

57. "Breeding problems and their solutions" for Veterinary Assistants at KVK on March 9th, 2001. (EB Chakurkar)

58. " Fish culture possibilities in Goa" for fish cultivators of Mormugao Taluka, organised by the Community Polytechnic wing of the Institute of Ship Building Technology, Vasco, on March 13th, 2001 (S Subramanian).

59. "Field crops in irrigated command area" for farmers organised by Command Area Development Authority at Cacoda and Quepem on March 15th, 2001. (HR Prabhudesai)

60. "Use of fertilizers in high / low pH soils" for Field level officers of KRIBHCO organised by KRIBHCO at Panjim on March 15th , 2001. (BL Manjunath)

61. "Integrated farming systems for irrigated command areas" for farmers organised by CADA at Karapur, Sanquelim on March 16th, 2001. (SP Singh)

62. "Integrated plant nutrient system" for Field level officers of KRIBHCO organised by KRIBHCO at Panjim Goa on March 16th, 2001. (HR Prabhudesai)

63. "Farmer- Expert interaction" for Kissan Mela farmers organised by KVK, Old Goa on March 23rd, 2001. (JR Faleiro)

Training Programmes

Discipline	Title of training course
Crop Science	Basmati rice production Resource re-cycling and composting Integrated nutrient management Pulses and oilseed cultivation Rice based cropping systems Vermicomposting, NADEP composting Biofertilizers in crop production Polythene mulch technology in groundnut
Horticulture	Coconut based cropping systems Kitchen gardening, Mushroom cultivation Cashew production technology Improved cultivation practices for vegetables Improved cultivation practices for fruit crops Propogation techniques in important hort. Crops Rose cultivation, Vegetable production
Home Science	Low cost nutritional recipes Recipes for mushroom preparation Child care and preparation of weaning mixture Diet counselling, Bakery and crafts Methods of food preservation
Plant protecion	Integrated Pest Management in rice, fruit, vegetable and plantation crops Storage pests and their management, Apiculture Mushroom spawn production Plant protection equipments, Bioagents in plant protection
Animal science	Backyard and poultry keeping Piggery as an enterprise Rabbit rearing, Broiler rearing
Fishery Science	Integrated fish farming system comprising rice-fish Duck-fish, Poultry-fish combination Composite fish culture Brackishwater fish farming, Aquarium mamagement
Agril. Extension	Leadership development, Organizational climate Panchayat Raj System in Goa, Use of audio-video aids Training and trasnfer of technology

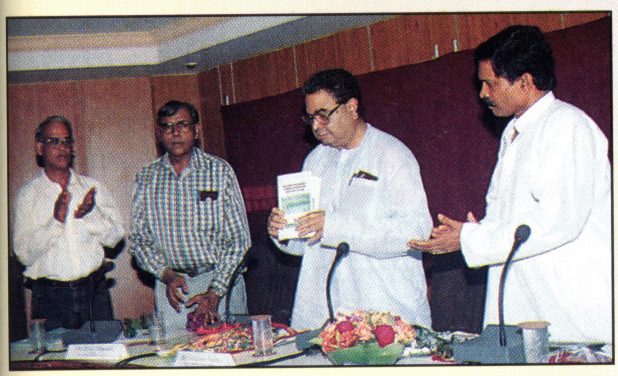
The duration of the above training programmes varied from 2 to 5 days

7. AWARDS AND RECOGNITION

* Shri. R.Ramesh Scientist (Pl. Pathology) was awarded Ph.D degree in Plant Pathology by the Tamil Nadu Agricultural University, Coimbaotore.

* Dr. A.V.Nirmale, Training Associate (Animal Science) was awarded Masters Degree in Veterinary Science by University of Agricultural Sciences, Dharwad.

PLATE-4 General



Dr.Devendra Pradhan, Hon`ble union Minister of state for Agriculture, Animal husbandry and DARE, releasing an Institute publication in the presence of shri Shripad Naik , Hon`ble union Minister of state for Agriculture and Co-operation.



Shri Ramrao Desai, Hon`ble Minister of Agriculture Govt. of Goa inagurating the Kisan Mela at the institute held on 23rd March 2001 along with Smt. Nirmala Sawant, local MLA.



Dr,R.S.Paroda Secretary, DARE and Director General, ICAR, releasing a tecnical bulletin in the presence of Dr,S.L. Metha, DDG, Educational, ICAR and other digniteries.



Dr, A.G. Sawant , Chairman, Research Advisory Committee addressing the inaugral session of the RAC metting.

8. LINKAGE AND COLLABORATION

Institute maintains a close collaboration with State Departments of Agriculture, Animal Husbandry and Veterinary Services, Fisheries, Rural Development Agencies, Horticulture Development Corporation and Goa Chamber of Commerce of the State to identify areas of research and prioritise its programmes. The Institute is also involved in programmes of mutual intrest with these departments/ organisations through the joint meeting, training and extension activities. While finalising Research programmes of the Institute the expertise and experience of specialists from other relevant ICAR Institutes, neighbouring Agricultural Universities and Goa State Development Departments are obtained in major meetings and committees arranged for this purpose. The Institute has identified areas of Inter Institutional Collaborative Research with the University of Agricultural Sciences, Dharwad, in which infrastructural and manpower facilities available under both the organisation would be utilised for common research programmes. To accrue the benefits in the field of research and education the Institute also collaborates with Goa Universitry and Konkan Krishi Vidhyapeeth, Dapoli.

In various State Level Committees constituted by the Government of Goa, the Institute has been nominated as a participant member. There exists a close and reciprocal involvement in various programmes conducted by agencies like NABARD, State Development Departments, CADA, Sanjeevani Sugar Factory, Central Integrated Pest Management Centre, Banks, Co-operatives, Mahila Mandals, private nurseries, Panchayats, SISI, NGO's, colleges etc,.The Institute participates in the Agricultural Programmes of All India Radio and Doordarshan, Panaji Centre and has also combined Research and Technology Transfer Programmes with Baba Atomic Research Centre, Mumbai, Coconut Development Board, Kochi and Government Polytechnic, Panaji.

9. OTHER PROJECTS / PROGRAMMES

1. Institute has six NATP Projects, one each in Entomology, Soil and Water Conservation Engineering, Horticulture, and Transfer of Technology and two in Animal Science. The titles of the projects are given below:-

   A. Development of IPM technology for palm based production system.

   B. Development and evaluation of soil and water conservation measures and land use systems for sustainable crop production in western ghats of coastal region.

   C. Integrated nutrient managemnt of palm based cropping/farming system for sustained productivity under coastal ecosystem.

   D. Institute Village Linkage Programme (IVLP) for Technology Assessment and Refinement (TAR) in coastal agro eco-system of North goa district of Goa.

   E. Stratergies for enhancing the productivity of pigs for the farming community.

   F. Animal health information system through monitoring and surveillance.

2. An Adhoc project on " Collection of cashew germplasm in Goa and establishment of germplasm bank " has been under way from 1997-98 for four year period. Salient achivements and the research details of the project has been furnished under the horticulture project in the report.

3. As per the guidelines, a project on Front Line Demonstration in oilseeds is being carried out at the Institute, the details of the project is furnished under transfer of technology project in the report.

4. A cessfund project on Technology evaluation and impact assesment in rice and groundnut is being taken up under KVK. The details are given under transfer of technology project in the report.

LIST OF PUBLICATION

A) RESEARCH ARTICLES

A V, Faleiro J R, Al-Shuaibi M A and Prem Kumar T.(2000) A stratergy to manage Palm weevil *Rhynchophorus ferrugineus* Oliv. on Date Palm *Phoenix dactylifera* Its sucessful implementation in Al- Hassa, Kingdom of Saudi Arabia. *Pestology*. 12): 23-30.

e S B, Malik S V S, Bhillegaonkar K N, Prahlad Kumar and Gupta L K. (2000) ation of *Listeria monocytogenes* and anti-listeriolysin O detection in sheep and s. *Small Ruminant Research*. 38(2): 151-155

i S P, Malik S V S, Banu Rekha G and Barbuddhe S B.(2000) Detection of anti- olysin O and *Listeria monocytogenes* in experimentally infected buffaloes (*Bubalus alis*) *Tropical Animal Health and Production* (In Press).

and Dhandar D G (2000) Variation in physico – chemical and morphogenetic racters of some mango varieties of Goa. *Acta horticulturea* Vol.1, 509 : 243-249.

Dhandar D G, Mathew P A Gaonkar V Y and Leebu Babu (2000) "Goa-1", a cashew variety for Goa. Accepted for publication in *J. Plantation Crops*.

R and Rangnekar P A. (2001) Ovipositional preference of red palm weevil, nchophorus *ferrugineus* Oliv. to coconut cultivars. *Indian Coconut Journal*. mmunicated)Faleiro J R, Ashok Kumar J and Rangnekar P A. (2001) Spatial ribution of red palm weevil, *Rhynchophorus ferrugineus* Oliv. eoptera : Curculionidae) in coconut plantations. Crop Protection, U.K. (Accepted)

an S, Ramaswamy K and Sundarraman S. (2000) Comparision between Green and Curve number runoff predictions. *Journal of Applied Hydrology*, XII (1&2), -24.

N and Rao K J.(2000) Comparative performance of three types of larval diets in production of giant freshwater prawn and a trial partial or complete substitution of shrimp. *Journal of Aquaculture in Tropics*, 15(2) (2000) : 146 – 152.

N.(2000) Development of giant freshwater prawn broodstock. NAGA, CLARM Quarterly Journal, 23 (3) : 18-20.

Pawar D D, Malik S V S, Bhillegaonkar K N and Barbuddhe S B. (2000) Effect of nisin and its combination with sodium chloride on survival of *Listeria monocytogenes* added to raw buffalo meat mince. *Meat Science* 56(3): 215-219.

Swain B K and Johri T S. (2000) Effect of supplementation of combinations of different levels of selenium and vitamin E on relative weight of some organs and serum enzyme level in broilers. *Indian J. Poultry Science*, 35(1):66-69

Swain B K, Johri T S and Majumdar S. (2000) Effect of supplementation of vitamin E Selenium and their combinations on the performance and immune response of broilers.*British Poultry Science* 41(3):287-292.

Swain B K, Johri T S, Swain P and Shrivastav A K.(2000) Effect of supplementation of different combinations of some selected nutrients on the performance and immune response of broilers. *Indian J. Poultry Science* (In Press).

Swain B K, Johri T S and Dash B B.(2000) Effect of supplementation of different combinations of methionine and choline on some biochemical parameters and organ weights in broilers. *Indan J, Anim. Prod. & Mngt.* (Communicated).

Swain B K, Johri T S, Majumdar S and Shrrivastav A K.(2000)Influence of dietary vitamin A on some biochemical parameters and organ weights of broiler chickens. *Indian J, Anim.Nutr.* 17(2):137-140.

Swain B K, Sundaram R N S, Nirmale A V and Barbuddhe S B.(2000)Effect of rearing broilers using different types of litter materials on slaughter charecteristics and biochemical parameters. *Indian J. Vety. Res.* (Accepted)

Swain B K, Sundaram R N S, Barbuddhe S B and Nirmale A V.(2000)Influence of cage and deep litter rearing system on the performance of broilers. *Indian Vety. J.* (Accepted)

(B) PAPER PRESENTED AT THE SEMINARS / WORKSHOPS / SYMPOSIA

Barbuddhe S B, Chakurkar E B, Swain B K and Sundaram R N S (2001) Caprine mastitis among goats in Goa region. Abstract of paper presented at National Symposium on "Animal health and production in new Millenium and Indian Veterinary Congress" held at Ludhiana on February 22-23, 2001.

Barbuddhe S B, Swain B K, Chakurkar E B and Sundaram R N S. (2001) Studies on microflora of pork and pork products in Goa. Proceedings of the 88th session of Indian Science Congress, New Delhi, Janauary 3-7,2001.

r D G and Desai A R (2000) Constraints and needed stratergy for cashew in Goa. esented in the 5th National seminar on cashew with the theme on "Indian cashew in e New Millenium – Vision 2020.

R, Dhandar D G, Leebu Babu and Dalvi R B (2000) Classificatory analysis of some shew germplasm accessions of Goa. Presented at the International Conference on lantation Crops PLACROSYM-XIV, Hyderabad, December 12-15, 2000.

J R and Rangnekar P A (2000) Sex ratio of pheromone trap captured red palm evil, *Rhynchophorus ferrugineus* Oliv. in coconut plantations of Goa. Presented at e International Conference on Plantation Crops PLACROSYM-XIV, Hyderabad cember 12-15, 2000.

R and Rangnekar P A. (2001) Location specific and seasonal activity of red palm evil, *Rhynchophorus ferrugineus* Oliv. in coconut plantations of Goa. Presented in tional Conference : Plant protection – new Horizons in the millenium organised by tomological Research Association, Udaipur, February 23-25, 2001.

nan S, Ramaswamy K and Rajendran R (2000) Effects of surface water supplies on und water regime of Cauvery Sub – basin. XIX annual convention and Seminar on tional Watershed Development with a special theme on Deccan Trap Hyderogeology, d at Maulana Azad College, Aurangabad during December 16 -18, 2000.

h B L and Sundaram R N S. (2001) Performance of legume forages as inter crops coconut. In proceedings of Agricultural Sceiences Section of 88th Session of ian Sceince Congress organised at IARI, New Delhi, January 3 - 7, 2001.

K N and Rao K J. (2000) Use of three types of diet and maintenance of suitable ure management practices for synchronous larval progression and metamorphosis iant freshwater larval rearing trials". Accepted for publication in the proceeding of National Workshop on aquaculture of freshwater prawns held on February 8 - 9, 0 at College of Fisheries, Muthukur, Nellore.

K N and Subramanian S. (2001) Effect of probiotic supplement on growth formance, nutrient utilisation and carcass composition of *Labeo rohita* fry. Presented e National Conference on fish and Fisheries : Challenges in the Millennium, March 15, 2000, Osmania University, Hyderabad.

Manjunath B L, Barbuddhe S B, and Dias S M F (2000) Coconut based integrated ming system for sustained productivity under coastal ecosystem. Paper presented at rnational Conference on Plantation Crops, PLACROSYM XIV, Hyderabad during cember 12-15, 2000. pp.54.

Subramanian S, Faleiro J R, Manjunath B L and Mohanta K N. (2001) Improved technology package for rice fish integration in low lying rice fields. Proceedings of the 88th session of the Indian Science Congress, New Delhi, January 3-7, 2001. Section I : Agricultural Sciences. abstract no. 6:7.

Sundaram R.N.S., Chakurkar E.B., Barbuddhe S.B.and Sharmila.L. (2001). Cashew apple waste – A potential feed resource for pig. Abstr.P.124. Annual Conference and National Symposium, Indian Veterinary Congress, Feb 22-23, at PAU, Ludhiana, Punjab and presented a paper.

Sundaram R N S, Chakurkar E B, Barbuddhe S B, and Sharmila L. (2001) Cashew apple waste : a potential feed resource for pigs. *Ibid.*

Swain B K, Sundaram R N S , Barbuddhe S B and Nirmale A V.(2000) Effect of feeding brewery dried grain with enzyme supplement on the performance, carcass traits and organ weights of broilers. Abstract of the paper presented at National Symposium on "Challenges to poultry industry in the new Millenium" at Chennai during October 12-14, 2000.

(C) POPULAR ARTICLES

Manivannan S and Shanthi R (2000) Water: a challenge in the 21st Centuary, Kisan World 27(5), pp 40-41.

Manivannan S, Shanthi R and Sundarraman S (2000) Water users role in tank command areas, Kisan World 27(8), pp 28-29.

Mohanta KN and Subramanian S (2000) Design and management of ornamental fish farm, Indian Farmers Digest, March, 2000, pp.25-30.

Mohanta K N and Subramanian S (2000) Water quality requirement for giant fresh water prawn, Seafood Export Journal. Vol.XXXI.No.5, May 2000, pp. 7-9.

Prabhu H R C (2000) Campaign against nutty pests. Gomantak Times on 28.07.2000.

Prabhu H R C (2001) Know more on the art of Bee Keeping. The Navhind Times on 07.02.2001.

Prabhudesai H R (2000) Vermiculture in Goa neglected – I Herald on 10.05.2000.

Prabhudesai H R (2000) Vermiculture in Goa neglected – II Herald on 11.05.2000.

Prabhudesai H R (2000) Vermiculture in Goa neglected – III Herald on 13.05.2000.

Prabhudesai H R (2000) Role of organics in modern agriculture Tarun Bharat on 03.07.2000.

Prabhudesai H R (2000) New horizons in rice research Tarun Bharat on 03.07.2000.

Prabhudesai H R (2000) Polythene mulching technology in groundnut Tarun Bharat on 03.07.2000.

sai H R (2000) Freedom from hunger I The Navhind Times on 24.10.2000.

sai H R (2000) Freedom from hunger II The Navhind Times on 28.10.2000

sai H R (2000) Hybrid rice seed production I Gomantak on 29.06.2000.

sai H R (2000) Hybrid rice seed production II Gomantak on 30.06.2000.

sai H R (2000) Groundnut production technology Tarun Bharat on 03.07.2000.

and Sundaram R N S (2000) Influence of nutrition on the meat quality of chickens. ltry Punch, 16(12): 69-74.

and Sundaram R N S (2001) Use of animal protein feed source in poultry feeding. ltry Line (Communicated).

) REVIEW ARTICLES

N, Subramanian S and Nirmale A V (2000). Use versatility of chitin and chitosan iew. *Agriculture Reviews*. (Accepted)

and Johri T S.(2000). Importance of methionine and choline supplementation of on the performance of broilers – A review. *Poultry Adviser*, 33(4): 21-25.

and Sundaram R N S.(2001). Role of biotechnology in poultry nutrition. *Poultry* h (Comminicated).

BOOK CHAPTERS

(2001) Cashew variety form ICAR Complex for Goa. In : Cashew- Varietal th of India (Edts. M.Abdul Salam and E V V Bhaskara Rao) Directorate of Cashew Cocoa Development, Cochin.

G and Desai A R (2001) Cashew Scenerio in Goa - An invited article for including publication Cashew Industry in India proposed to be released in National seminar shew by Directorate of Cshew and Cocoa Development, Cochin.

REPORT / BULLETINS / TECHNICAL FOLDERS / MISC. PUBLICATIONS

arch Complex for Goa (2000) Annual report 1999-2000, Eds. Dhandar DG, e PG and Faleiro JR 125 p.

ICAR Research Complex for Goa (2000) Newsletter Volume – II (No1 and 2) Eds. Adsule PG and Barbuddhe SB.

Krishi Vigyan kendra (2000) Annual Report 1999-2000 and Action Plan 2000-2001. Eds. Sakharkar VS and Gaonkar VY.

Sudaram RNS, Barbuddhe SB and Chakurkar EB (2000) Rearing Pigs- a subsidiary enterprise for farmers – Extn folder No 23.

Subramanian S, Manjunath BL and Mohanta KN (2000) Rice-Fish integrated farming systems for low-lying fields – Extn folder No 24.

Gaonkar VY and Dhandar DG (2000) Krishi Vigyan Kendraze Kariayakram – Extn folder No 25.

Chidananda Prabhu HR and Desai PG (2001) Bud root management in coconut palm – Extn folder No 26.

(G) RADIO TALKS

- "Plant protecion in cashew" on 04-04-2000. V Y Gaonkar.
- "Land preparation for Kharif rice" on 21-05-2000. H R Prabhudesai.
- "Selection of seed and seed treatment" on 28-05-2000. H R Prabhudesai.
- "Uprooting of seedling and transplanting" on 04-06-2000. H R Prabhudesai.
- "Aftercare, interculture and plant protection" on 18-06-2000. H R Prabhudesai.
- " Disease management in Banana" on 22-08-2000. H.R.C.Prabhu.
- "Raising seedlings for Rabi vegetables" on 29-09-2000. H R Prabhudesai.
- "Raising rabi Paddy nursery" on 24-11-2000. H R Prabhudesai.
- "Groundnut productuion technology" on 16-12-2000. H R Prabhudesai.
- "Irrigate cashew for high yields " on 29-01-2001. V Y Gaonkar.
- "Improved cultivation practices for cashew" on 18-02-2001. V Y Gaonkar.

(H) DOORDARSHAN PROGRAMMES

- "Use of cultar in mango" on 08-08-2000. V.Y.Gaonkar
- "Softwood grafting in cashew" on 07-11-2000. V.Y.Gaonkar
- "Budding techniques in roses" on 09-02-2001. V.Y.Gaonkar

LIST OF APPROVED ONGOING PORJECTS

rop Sciences

valuation of short/medium, fine scented and hybrid rice varieties.
reening and mamagent of salt tolerent rice varieties.
valuation of high yielding varieties of sugarcane.
habilitation of mine reject soils for crop production.
ce based farming systems.
conut based farming systems.
drological investigations on soil and water conservation measures under cashew crop.
nagement of red palm weevil Rhynchophorus ferrugineus Oliv. using food baited eromone traps.

orticulture

rvey, collection and evaluation of plantation crops and spices.
luation of oilpalm hybrids (DxP) combinations under Goa conditions.
rvey, collection, conservation and evaluation of fruit crops.
rvey,collection,conservation and evaluation of fruits available / grown in agroforest as of Goa.
llection, conservation and evaluation of vegetable crops.
llection and evaluation of flower crops.
ndardization of agrotechniques for horticultural crops.
st harvest management technologies for fruits available / grown in agro forest areas of a.

imal Science

luation of varying energy and protein level in rabbit diet for better performance.
dies on existing diseases including zoonoses in Goa region and establishment of disease stigation laboratory.
crobiological studies of meat and meat products.
formance of commercial broilers under different feeding and rearing systems in Goa ditions.

shery Sciences

e-freshwater prawn integration.
mulation of low cost feed for fish and prawn, using locally available feed ingredients.

ansfer of Technology

ining and other activities.
nt line demonstrations.
farm testing.



12. CONSULTANCY, PATENTS COMMERCIALISATION OF TECHNOLOGY

The ICAR Research Complex for Goa plays a vitol role in the State to support a wide range of agricultural enterpirses by rendering farm advisory and consultancy services through its specialised pool of Scientific and Technical manpower. The experts of various disciplines working in the Institute are often sought by the farmers of Goa to provide on the spot solutions to a wide range of problems in various disciplines of Crop Sciences, Horticulture, Animal Sciences and Fisheries.

Besides providing technical knowhow to the farmers of Goa, planting material produced at the Institute is always in high demand. Seeds of fine grain, scented and hybrid rice were distributed to the farmers through the State Agriculture Departments. Also, grafts, seedlings and rooted plant cuttings of various horticultural crops viz. cashew, mango, coconut, ornamentals and mushroom spawn were multiplied and sold at the Institute during the year.

MEETING OF RAC, SRC, MANAGEMENT COMMITTEE, ETC. OF THE INSTITUTE

(A) RESEARCH ADVISORY COMMITTEE

The research priorities of the Institute were critically examined and achievements in the light of local agricultural requirements and thrust areas identified, by the Research Committee constituted for the Institute, in its third meeting held on 15-16th May, 2000 conference hall of the Research Complex. The current Research Advisory Committee ed by the Council for 3 years w.e.f 10-3-1998 consisted the following members.

Dr. A. G. Sawant Ex-Vice-Chancellor, Konkan Krishi Vidhyapeeth, Dapoli, Ratnagiri.	- Chairman
Dr. M. Mahadevappa Vice-Chancellor, University of Agricultural Sciences, Dharwad.	- Member
Dr. V. R.P. Sinha Ex-Director, Central Institute of Fisheries Education Mumbai.	- Member
Dr. M. K. Nair Ex-Director, Central Plantation Crops Research Institute Kasaragod, Kerala.	- Member
Dr. U. V. Sulladmath Ex-Head & Professor, Department of Horticulture, University of Agriculture Science, Bangalore.	- Member
Dr. P. M. Puntambekar Ex-Dean, Bombay Veterinary College, Mumbai.	- Member

7) Dr. D. G. Dhandar - Member
Director,
ICAR Research Complex for Goa,
Ela, Old Goa.

8) Dr. P. S. Pathak - Member
Asst. Director General (Agro Forestry),
ICAR, Krishi Bhavan,
New Delhi.

9) Dr. S. Subramanian - Member Secretary
Principal Scientist (Fishery Science),
ICAR Research Complex,
Ela, Old Goa - 403 402.

(B) SCIENTIFIC RESEARCH COUNCIL

The suggestions made by the Research Advisory Committee were taken as guidelines for scrutinising the ongoing research projects and finalisation of technical programmes of each project by the Scientific Research Council of the Institute. The 11th Annual Scientific Research Council meeting of the Institute was held on 21-22nd July, 2000 in the conference hall of the the Research Complex. The meeting comprised of six sessions which included the inagural session, four technical session and the plenary session.

The technical sessions of the meeting were guided by Dr. D.G.Dhandar, Director of the Institute, Dr. P.S.Pathak, ADG(AF), ICAR, New Delhi, Dr. K.J.Rao, Principal Scientist, CIFA, Bhubaneshwar, Shri. P.B.Hawaldar, Director, Directorate of Agriculture and Shri. S.V.Desai and Shri. P.P.Kumbhare, Dy. Directors of Agriculture also attended the meeting. The others who participated in the meeting were all project leaders and associates of the Institute.

The Scientific Research Council reviewed the progress made under various Research Projects for the year 1999-2000 before finalising the Technical Programmes of the ongoing research projects for the year 2000-2001. The members of the Council are as under.

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

2) Dr. P. S. Pathak - Member
Asst. Director General (AF)
New Delhi.

3) All Project Leaders - Member

4) Shri. B. L. Manjunath - Member - Secretary
Scientist. Sr. Scale
ICAR Research Complex for Goa
Ela, Old - Goa.

INSTITUTE MANAGEMENT COMMITTEE

Institute Management Committee constituted for financial and administrative guidence
itute, met twice in year on 23/7/2000 and 15/2/2001 and reviewed the progress of
tural development before approving the important financial and administrative
of the institute for the year. The composition of the committee is as follows :

Dr. D. G. Dhandar Director, ICAR Research Complex for Goa, Ela, Old Goa.	-	Chariman
Dr. P. S. Pathak Asst. Director General (AF) ICAR, Krishi Bhavan New Delhi.	-	Member
Dr. R. N. S. Sundaram Principal Scientist, ICAR Research Complex for Goa, Ela, Old Goa.	-	Member
Dr. S. Subramanian Principal Scientist, ICAR Research Complex for Goa, Ela, Old Goa.	-	Member
Shri. A. R. Desai Scientist Sr. Scale, ICAR Research Complex for Goa, Ela, Old Goa.	-	Member
Shri. Ram Avatar Parashar Assistant Finance & Account Officer, ICAR Research Complex for Goa, Ela, Old Goa.	-	Member, Secretary
Dr. P. G. Adsule Principal Scientist, ICAR Research Complex for Goa, Ela, Old Goa.	-	Special Invitee
Shri. M. S. Balbatti Farm Superintendent, ICAR Research Complex for Goa, Ela, Old Goa.	-	Special Invitee



(D) SCIENTIFIC ADVISORY COMMITTEE FOR KVK

The Scientific Advisory Committee of the Krishi Vigyan kendra, constituted with the representatives from both Government and Non-Government organisations and farmers, met on 24/7/2000 in the conference hall of the research Complex and reviewed the progreess of Transfer of Technology programmes of the Krishi Vigyan Kendra as per the modified norms of the council and approved the technical programmes for 2000-2001. Following are the members of the committee.

1)	Director, ICAR Research Complex for Goa	Chairman
2)	Director of Agriculture, Govt. of Goa.	Member
3)	Diretor of A. H. & V. S., Govt. of Goa	Member
4)	District Animal Husbandary Officer, Directorate of AH & VS, Govt. of Goa	Member
5)	Assistant Director (Training), FTC, Ela, Old Goa.	Member
6)	Shri. Vithal Benaulikar	Member - representative of small farmers
7)	Shri. Tatysaheb Shinde	Member - representative of big farmers
8)	Ms. Muriel D'Souza	Member - representative of farm women
9)	Fr. Luis	Member - Social worker (male)
10)	Mrs. Mangala Wagle	Member - Social worker (female)
11)	Mr. Sebi Fernandes	Member - representative of young farmers
12)	District Project Officer (Agriculture) RDA, Panjim.	Member
13)	Project Officer, NABARD, Panjim	Member
14)	Officer Incharge, Govt. Estuarine Fish Farm, Dhauji, Old Goa.	Member
15)	Officer Incharge, Nutrition Board, Directorate of Health Service	Member
16)	I / C Training Organiser, KVK, ICAR Research Complex for Goa, Ela, Old Goa.	Member Secretary

PARTICIPATION OF SCIENTISTS IN CONFERENCE, MEETINGS, WORKSHOP, SEMINAR, SYMPOSIUM, SUMMER SCHOOL ETC.

le Level seminar on "Preventing protein malnutrition in children below two years" anised by State Nutrition Board at panjim Goa on 7th April, 2000. **Prabhdesai HR**

II meeting of Regional Committee No VII held at Bhopal during 14-15th April, 2000. **ndar DG**

inar on "Poultry diseases and their control" organised by Goa Veterinary Association llaboration with Komarala group of feeds, Miraj and Mandovi Hatcheries, Ponda oa Intenational Centre, Dona Paula on 11th May, 2000. **Swain BK**

p meeting on recent advances in the management of coconut pests at CPCRI regional on, Kayangulam during 24- 25th May, 2000. **Prabhu HRC**

mer school on "Recent trends in diagnosis and control of important zoonoses and -borne infections" held at Division of Veterinary Public Health, IVRI, Izatnagar g 5-25th June, 2000. **Barbuddhe SB**

nar on Integrated Coastal and Marine Area Management Plan for Goa, organised epartment of Coastal and Marine area Management, Govt. of India, Chennai and rtment of Science, Technology and Environment, Govt. of Goa at Saligao on 8th June, for North Goa and at Margao on 9th June, 2000 for South Goa. **Subramanian S**

ng of the Fisheries project evaluation under AP Cess fund Scheme at ICAR, New during 16-17th August, 2000 and presented two projects on oyster and mussel e in Goa and Karwar coasts. **Subramanian S**

ational Consultation Seminar on Plant Protection in Horticultural crops organised R, Banglore from 17-19th August, 2000. **Prabhu HRC**

ction workshop on finalizing methodologies of the NATP funded project entitled elopment and evaluation of soil and water conservation measures and land use s under Western Ghats of Coastal region" at Centre Soil & Water Conservation rch & Training Institute: research Centre, Udhagamandalam, Tamil nadu, during , August, 2000. **Manivannan S**

- State level training cum workshop on "Extension Management" organised bu MANAGE, Hyderabad and Deprtment of Agriculture, Government of Goa during 25 – 29th August, 2000. **Prabhdesai HR**

- Review Workshop of Krishi Vigyan Kendra at Mysore organised by KVK, Suttur on 25-26th September, 2000. **Gaonkar VY**

- Institute Directors meeting held at NBPGR, New Delhi o during 10-12th October, 2000. **Dhandar DG**

- Workshop on Sustainable Fishery Management in Goa held at National Institute of Oceanography, Dona Paula, Goa during 11-12th October, 2000. **Subramanian S and Mohanta KN**

- XX Annual Conference and Symposium of the Indian Poutry Scienec Association held at TANUVAS, Chennai during 12-14th October, 2000. **Swain BK**

- Kisan Expo exhibition and Kisan mela at Agricultural College, Pune during 16-18th November, 2000. **Dhandar DG and GaonkarVY**

- Indian Convenction of Food Scientists and Technologists on Modern Trends and Perspectives in Food Packaging for 21st Century organised by Association of Food Scientists and Technologists (INDIA) and Central Food Technical Research Institute, Mysore during 22 - 24th November, 2000. **Adsule PG**

- National Workshop on packhouses for pineapples and oranges of the AFST(I) held at Guwahati on 2nd December and at Agratala on 4th December, 2000. **Adsule PG**

- International Conference on Plantation Crops (PLACROSYM-XIV), held at Hyderabad during 12-15th December, 2000. **Dhandar DG, Singh SP, Faleiro JR and Desai AR**

- Seminar on Horticultural crops of Konkan and Goa organised by CAPART, New Delhi at Rajapur on 23rd December, 2000. **GaonkarVY**

- 88th Session of Indian Science Congress "Food, Nutrition and Environmental Security" held at IARI, New Delhi during 3-7th Janauary , 2001. **Dhandar DG, Subramanian S, Manjunath BL, Barbuddhe SB and S Priya Devi**

- National Symposium on Fishery Technologies and their Commercialisation, held at Central Institute of Fisheries Education during 11-12th January, 2001.**Mohanta KN**

- Summer school on "Techniques in Entomological Research" organised by Center for Advanced Studies in Entomology, TNAU, Coimbatore during 18th Janauary – 7 February, 2001. **Faleiro JR**

nal Organic Conference organised by Institute for Integrated Rural development t Bidkin, Aurangabad during 21 – 24th January, 2001. **Prabhudesai HR**

ner school on "Emerging concepts in commercial poultry housing and management" ised by Veterinary College and Research Institute, Namakkal, Tamil Nadu during February, 2001. **Swain BK**

annual conference of IAAVR and National Symposium on "Animal Health and ction in Mew Millenium" and Indian Veterinary Congress, held at Ludhiana during d February, 2001. **Sundaram RNS and Barbuddhe SB**

al Conference on Plant Protection – New Horizons in the millenium Organised by nological Research Association, Udaipur during 23-15th February, 2001. o **JR**

ng for the Fish cultivators of Mormugao Taluka, organised by the Community chnic wing of the Institute of Shipbuilding Technology, Goa, on 13th March, 2001 livered a lecture on Fish culture possibilities in Goa. **Subramanian S**

ar on "Increasing fertilizer use efficiency" organised by KRIBHCO, Pune at Panjim March, 2001. **Manjunath BL**



15. WORKSHOPS, SEMINARS, MEETINGS, FARMERS AND FIELD DAY, ECT, ORGANISED BY THE INSTITUTE

- ICAR Research Complex for Goa along with its KVK sucessfully hoisted the visits of Minister of State for Agriculture, Government of India, Shir. Hukum Narayan Yadav on 5th April, 2000 and Dr. Debendra Pradhan and Shri Sripad Naik on 4th November, 2000.
- ICAR Research Complex for Goa organised a Workshop on all India Co-Ordinated Research Project on Pigs at the Institute on 17-18th March, 2001. Dr. S.C.Chopra, ADG(AP&B), DR. K.M.Bujrbarauh, Director, NRC Mithun and Dr. G.L.Kaul, P.C, AICRP on Pigs guided the workshop.
- Krishi Vigyan Kendra, ICAR Research Complex for Goa organised Krish Mela on the 23rd March, 2001 at the Institute Shri Ramarao Dessai Honourable Minister for Agricultutre, Government of Goa was the Chief Guest and Smt Nirmala sawant, local MLA was the Guest of Honour.
- ICAR Research Complex for Goa sucessfully organised the Pre Kharif Interface meeting with development Departments on 4th May, 2000 and the Pre Rabi Interface meeting with the Development Departments on the 23rd September, 2000.
- ICAR Research Complex for Goa in collaboration with Sahaydri Nature Club, Valpoi and Zonal Agriculture Office, Sattari organised a cashew competition at Valpoi on 18th April, 2000 with Shri Venktesh Dessai, Honourable Minister for Panchayat and Rural development being the Chief Guest.
- ICAR Research Complex for Goa celebrated the Hindi Day on 21st, September, 2000 at the Institute Premises with Shri. S.R.Bajpai, Director Goa Metreological Department being the Chief Guest.
- Krishi Vigyan Kendra, ICAR Research Complex for Goa celebrated the World Food Day at the Institute on 16th, October,2000.
- Krishi Vigyan Kendra, ICAR Research Complex for Goa celebrated the women in Agriculture Day on 6th December, 2000 with Mrs Amol Morajkar, Director of Women's Co-operative Bank being the Chief Guest.
- Krishi Vigyan Kendra, ICAR Research Complex for Goa organised a State level Collaborative Training Programme on Plantation Crops at the Institute from 27th November to 1st december, 2000 for the officers of State Department of Agriculture.

DISTINGUISHED VISITORS

Visiting Dignitary	Date of Visit
L.HUKUM NARAYAN YADAV ster of State for Agriculture(AHD and DARE), mment of India.	05-04-2000
DEBENDRA PRADHAN ster of State for Agriculture(AHD and DARE), mment of India.	04-11-2000
L.SHRIPAD NAIK ster of State for Agriculture & Co-operation, mment of India.	04-11-2000
L.RAMARAO DESSAI, ter for Agriculture, mment of Goa.	23-03-2001
PRATAPSINGH RANE, er, Goa Legislative Assembly mment of Goa.	07-08-2000
RAMAKANT ANGLE er of Parliament (Lokh Sabha) mment of India	04-11-2000
EDUARDO FALEIRO er of Parliament (Rajya Sabha) mment of India	05-10-2000
NIRMALA SAWANT Government of Goa	23-03-2001
S.PARODA, AR and Secretary, DARE, elhi.	02-04-2000
L.MEHTA, Edn), ICAR, elhi.	02-04-2000

SHRI. GAYA PRASAD, Director (Personnel), ICAR, New Delhi.	13-07-2000
DR. P.S.PATHAK, ADG(AF), ICAR, New Delhi.	15-05-2000 & 21-07-2000
DR. B.S.CHOPRA, ADG (AP&B), ICAR, New Delhi.	17-03-2001
DR. B.N.CHOUDHARY, ADG(LLR), ICAR, New Delhi.	19-04-2000
DR. A.G.SAWANT, Chairman, ASRB, ICAR, New Delhi.	15-05-2000
DR. M.MAHADEVAPPA, Vice Chancellor, UAS, Dharwad.	15-05-2000
DR. H.P.SINGH, Horticulture Comissioner, Government of India.	03-01-2001
DR. P.RETHINAM, Chairman, Coconut Development Board, Kochi.	20-06-2000 & 03-01-2001
DR. J.C.KATYAL, Director, NAARM, Hyderabad.	03-07-2000
DR. J.L.KARIHALLO, Director, NRC on Finger Print, New Delhi.	07-09-2000
DR. K.M.BUJUBARAUH, Director, NRC on Mithun, Nagaland	17-03-2001
DR. G.L.KAUL, PC on AICRP, Pigs, Izzatnagar.	17-03-2001

M.K.NAIR, Director, CPCRI, argod.	15-05-2000
P.N.PUNTAMBEKAR, Dean, Bombay Veterinary College, mbai.	15-05-2000
U.V.SULLADMATH, Head, Horticulture Division, A, Banglore.	15-05-2000
H. R.P.SAROJ, er Secretary (GAC), R, New Delhi.	07-04-2000 & 04-11-2000
K.J.RAO, ipal Scientist, , Bhubaneshwar.	21-07-2000
P.K.SAMANTA, Co-ordinator, -VII, Bangalore.	24-07-2000
A.K.SIKHA, and Principal Scientist, WCRI Regional Research Station,	15-09-2000
J.ITNAL, or of Instructions, Dharwad.	19-12-2000
. GOSWAMI Division of Fruits and Hort.Technology, New Delhi.	18-06-2000
IJAY KUMAR, d Manager and Project Director, Finance and C-operation Ltd. elhi.	20-06-2000
EER BHADRAIH or of Extension, Dharwad.	19-04-2000



DR. K.D.KOKATE Director of Extension, KKV, Dapoli.	19-04-2000
DR. TAPESH PAWAR Director, Dept of AH&VS, Government of India, New Delhi	04-11-2000
SHRI. R.G.JOSHI, Director, Directorate of Agricultute, Govt. of Goa.	23-09-2000, 16-10-2000 & 04-11-2000
DR.H.K.MALVIYA Director, Department of AH&VS, Government of Goa.	17-03-2001
DR. V.J.THOMAS Ex. Director, Department of AH&VS, Government of Goa.	04-11-2000 & 30-11-200
SHRI. VERENCAR, Director, Directorate of Fisheries, Govt. of Goa.	04-11-2000
SHRI. S.R.BAJPAI Director, Goa Metereological Department, Panjim.	21-09-2000
SHRI. P.B.HAWALDAR, Ex-Director, Directorate of Agricultute, Govt. of Goa.	05-04-2000
SHRI. K.L.MANE Manager, Agril. Product, SBI, Pune.	06-01-2000

7. PERSONNEL

Name	Designation	Specialisation
nagerial		
Dhandar D.	Director (upto 22/01/01)	Horticulture
Adsule D.	Director (Acting) (From 23/01/01) & Principal Scientist & Head, Horticulture	Horticulture
ntific		
ramanian	Principal Scientist & Head, Fishery Science	Fishery Science
Sundram	Principal Scientist & Head, Animal Science	Animal Nutrition
Wasnik	Senior Scientist & Head, Crop Science	Soil Science
gh	Senior Scientist Horticulture	Horticulture
leiro	Scientist (Sr. Scale)	Agril. Entomology
anjunath .(Ag.)	Scientist (Sr. Scale)	Agronomy
sai .(Ag.)	Scientist (Sr. Scale)	Horticulture
akurkar Sc.	Scientist	Animal Reproduction
budhe	Scientist	Vet. Public Health
ohanta Sc.	Scientist	Fish & Fishery Science
ain	Scientist	Poultry Science
chandradu	Scientist	Horticulture



S Manivanan M. E. (Agri.)	Scientist	Agriculture Enggenering
R Ramesh Ph. D.	Scientist	Plant Pathology
M Thangam M. Sc. (Ag.)	Scientist	Horticulture
J Ashokkumar M. Sc. (Ag.)	Scientist	Computer Application
S Priyadevi M. Sc. (Ag.)	Scientist	Horticulture

Technical

MS Balbati M. Sc. (Ag.)	Farm Supdt. (T-7)	Agronomy
VD Kulkarni B. Sc. (Ag.)	Tech. Officer (T-5)	

KVK

VY Gaonkar, M. Sc. (Ag.)	Training Associate (T-7) & I/C KVK	Horticulture
HR Prabhudesai 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 M. V. Sc.	Training Associate (T-6)	Animal Science
HR Chindananda Prabhu M. Sc. (Ag.)	Training Associate (T-6)	Plant Protection
VS Sakharkar Ph. D.	Training Associate (T-6)	Agril. Extension
KK Metar	Tech. Officer (T-5)	

Administrative

Ram Avatar Parashar	Asst. Finance & Accounts Officer

ANY OTHER INFORMATION

) Training Attended

Shri. A. R. Desai, Scientist Sr. Scale (Horticulture) attended a training programme on "Computer Application in Agriculture" organised by NAARM, Hyderabad during June 20 - July 1, 2000.

Dr. D.G.Dhandar, Director of the Institute participated in the training on "Executive Development Programme in Agricultural Research Management" organised by NAARM, Hyderabad during July 15-18, 2000.

Dr. R.N.S.Sundaram, Principal Scientist (Animal Nutrition) attended a Training programme on "Agricultural research prioritization techniques organised by NAARM, Hyderabad during August 21-26, 2000.

Dr. J.R.Faleiro, Scientist Sr. Scale (Entomology) attended a National Training Course on "IPM of Rice" organised by National Centre for Integrated Pest Management, New Delhi during September 4-9, 2000.

Shri. A. R. Desai, Scientist Sr. Scale (Horticulture) attended a banner programme on "New dimensions of agriculture extension management" organised by MANAGE, at Panaji during September 25-29, 2000.

Shri. R. Ramesh, Scientsit (Pl. Pathology) attended and successfully completed a "Foundation Course for Agricultural Research service" at NAARM, Hyderabad from September 25 to December 22, 2000.

Shri. S. Manivannan, Scientist (S&WCE) attended a Training on GIS applications in Agriculture organised by NAARM, Hyderabad from November 6-16, 2000.

Shri M. Thangam, Scientist (Horticultutre) attended the 4th International training course on "Integrated production and processing technologies for sweet potato" organised by Central Tuber Crops Research Institute, Thiruvananthapuram from November 21-28, 2000.

Shri M. Thangam, Scientist (Horticultutre) attended the training course on "Protected cultivation in ornamental and vegetable crops" organised by Indian Institute of Horticultural Research, Bangalore from December 12-19, 2000.

Dr. B.K.Swain, Scientist (Poultry Science) attended a Training on India.admasEpitrak – the vaterinary epidomiological software, computer applications and A-B ELISA for Bovine Brucellosis and IBR conducted by the Project Directorate on Animal Disease Monitoring and Surveillance, Hebbal, Bangalore during January 3-10, 2001.

Dr. S.P.Singh, Sr. Scientist (Hort) attended a Training programme on Agricultural Research Priotization Techniques organised by NAARM, Hyderabad during Janauary 18-24, 2001.

Shri. B.L.Manjunath, Scirntist Sr. Scale (Agronomy) attended a Training on "Land use planning and watershed management in rainfed agriculture" conducted by TNAU, Coimbatore durimg January 23 – February 12, 2001.

(B) Transfers

Dr. D.G.Dhandar, Director of the Institute was relived and transferred from the Institute to the NRC, Oil Palm, Elluru on 22/01/2001.

(C) Promotions

Technical

Shri. K.K.Metar, Training Assistant T-4 was promoted to Technical Officer T-5 w.e.f 01-07-1994.

Shri V.D.Kulkarni, Farm Assistant T-4 was promoted to Technical Officer T-5 w.e.f. 01-01-2000.

Shri U.B.Pawar, Technical Assistant T-3 was promoted to T-4 w.e.f 01-01-2000.

Shri. Suresh Naik , Driver was promoted from T-3 to T-4 w.e.f 01-01-2000.

Shri Ankush Kambli JTA was promoted from T-2 to T-I-3 w.e.f 01-01-2000.

Shri. Edward Cresta, Stockman was promoted from T-2 to T-I-3 w.e.f 01-07-1997.

Administration

Shri. K.Yeshodharan, Sr. Clerk was promoted to Assistant w.e.f 16-11-2000.

Shri. Agosthino Fernandes, Sr. Clerk was promoted to Assistant w.e.f 30-01-2001.

Smt. M.Rita D'Silva, LDC was promoted to Sr. Clerk w.e.f 17-11-2000.

Miss Pratibha Revodkar, LDC was promoted to Sr. Clerk w.e.f 17-11-2000.

Under ACP scheme

Shri. Mario Fernandes, Stenographer was promoted to the Sr. Stenographer w.e.f 12-10-2000.

Smt. Prafulla Gadekar, Smt. Rekha Naik, Smt. Lalitha Gadekar, Smt. Pratidha Fodkar and Shri. Umesh Marcelkar SS.Gr.I were promoted to SS. Gr.II w.e.f 24-06-2000.

Shri. Vittal Porwar, SSGr.I was promoted to SS Gr.II w.e.f 08-07-2000.

Shri. Gokuldas Kaskar, SSGr.I was promoted to SSGr.Ii w.e.f 09-08-1999.

Month	Rainfall (mm)	Mean Temperature °C		Mean Relative Humidity (%)	Mean sunshine Hours/day	Average Wind speed (km/hr.)	Mean Soil Temperature °C
		Max.	Min.				
January	0.6	33.42	18.61	81.90	7.11	3.25	15.5
February	0.0	31.10	18.01	82.98	7.25	5.42	15.9
March	0.0	31.85	20.19	82.43	6.55	4.36	18.3
April	0.0	33.10	27.69	79.93	6.26	4.10	22.5
May	86.8	31.60	26.86	85.04	6.43	3.15	20.3
June	805.5	28.40	26.32	95.22	7.65	2.98	15.0
July	1125.0	28.11	25.13	95.97	7.27	3.44	13.6
August	562.6	27.82	25.08	95.97	7.18	2.96	14.4
September	151.4	29.74	25.27	93.99	6.87	2.16	14.5
October	76.0	31.00	25.51	94.50	7.38	1.32	14.8
November	5.6	34.19	22.74	84.03	7.16	1.38	14.5
December	1.4	33.17	17.84	77.46	6.88	1.43	12.4
Total/Mean	2814.9 *	31.12	23.3	87.5	7.00	3.00	15.9

* - Annual RAINFALL for the Year 2000.



19. प्रगति सारांश

कृषि अनुसंधान परिषद का यह परिसर गोवाा प्रदेश में अपनी तरह का एक ही सस्थान है. जो फसल, उद्यान, पशुपालन एवं मत्सपालन विज्ञान के क्षेत्र में अनुसंधान अवश्यकताओं की पुर्ती करता है । अनुसंधान के साथ साथ यह संस्थान अपनी कृषी विज्ञान केंद्र की माध्यम से गोवा प्रदेश के कृषक वर्ग को नई नई कृषि तकनिकों की जानकारी भी देता है ।

वर्ष 2000 - 2001 की दौरान इस संस्थान व इसकी कृषि विज्ञान केंद्र की उपलब्धीयाँ का विवरण इस प्रकार से हैं ।

19.1 फसल विज्ञान

कम अवधीवाली धानकी 12 किस्मोंका मुल्यांकन किया गया, उनमे से त्रिगुण (आय.ई.टी -12875) किस्मोंका सब से जादा 5.46 टन / है. उत्पादन हुआ. इस के बाद दुसरे और तिसरे स्थान पर कृष्णहिंसा (5.17 टन / है.) और गौतम (4 टन / है.) का रहा ।

इन सभी किस्मो ने स्थानीय किस्म ज्योती (4.75 टन / है.) ने जादा पैदावार दी।

एक अन्य प्ररिक्षण में मध्यम अवधि वाली 11 कीस्मों मे से किस्म 4063 (5.37 टन / है.) की पैदावार जया (4.97 टन / है.) से ज्यादा रही। अन्य सबी कीस्मों की पैदावर किस्म जमा से कम रही। बासमती धान की आठ किस्मों मे से आय इं टी 1349 की पैटावर अन्य किस्मों से ज्यादा रही।

आय ई टी 15390 (4.9 टन / हे.) और आय ई टी. 14191 (4.76 टन / हे) की पैदावार पुसा बासमती - 1 (4.33 टन / हे) से ज्यादा रही ।

एक अन्य परीक्षण में, खरीफ 2000 मौसम के दौरान, धान की बारह संकर प्रज्यातियों में से सहयाद्री (6.76 टन / हे.) की पैदावार डी. आर. आर, एच - 1 (6.4 टन /है.) और पीए सी - 6201 (6.1 टन / है.) से ज्यादा रही ।

लवण अवरोधी धान प्रजतीयों का परीक्षण मै ज्यादा लवण युक्त खेतीं मे पौधों के मूलों की लंबाई कम पायी गई। तथा मूल और शाखाँओं का अनूपात ज्यादा पाया गया ।

अधिक उत्पादन देनेवोले गन्नो कीं परिक्षण तथा व्यवस्थापन मे 300 किलो नाइट्रोजन, 150

न फॉस्फेट, 150 किलो , पोटाश और 10 किलोग्रॉम जिन्क डालनेपर अधीकतर पैदावार जो सी. ओ. 752 और सी. ओ. 90009 में क्रमश 92.7 टन /है. और 82 टन / है. रही।

ान से निकली हुई अनुपयोगी मृदा में अच्छी शाकाओं वाले चार साल पहले रोपीत कीये के पौदों से औसतम 8 – 10 ग्रॅम वाले 40 फल प्रति पौधा प्राप्त किए गये ।

नकी खेती पर आधारीत एक प्रयोग किया गया । ईस प्रयोग मे धान के पुआल को मशरूम वशेष के साथ दो एक के अनुपात मेमिलाकर खेतो मे डला गया । जिससे खरिप मौसम मे के पैदावार (4.49 टन / है) व पुआळ की पैदावार 5.36 ट/है. हुई। धान कि खेती पर फसल पध्दती मे लोबीय सबसे अच्छा पाया गया।

वशिष्ट नमीवाली खेती मे धान और बैंगन की खेती जो की जादा पायी गई। यह उपज मी मे हुई। लेकिन चारा उत्पादन के एक परिक्षण मे अधिक उपज देने वाले चाराघांस संकर का परीक्षण नारीथल फैधोंके बिचमे किया गया । पलहनीलारा सेंट्रोसीमा के साथ ती संकर नेपीअर के साथ अनुकुल रही ।

ीयल पौधों के बीच डेअरी प्रभागं और परस्पर खेती से रु. 6000 प्रति गाय प्रति वर्ष मुनाफा हुआ और उससे 60 दिन / गाय / वर्ष / का अतिरीक्ता रोजगार का निर्माण हो खेती से उपजित खादा और नारीयल कंपोस्ट का पुर्न उपयोग करले से और लारे की ती से सुदसें कार्बन द्रव्य 1.44 प्रतिशत पाया गया जबकी नियंत्रीत खेती मे कार्बन द्रव्य ात पाया गया ।

ीय कृषि प्रौधोगि की परियोजना अंतर्गत रे पाम वीतिल की रोकथाम हेतू केलोमेल और पदार्थ के साथ उपयोग किया गया. उस परीक्षण मे रेड पाम वितित की गतितिधीयाँ ा मात्रा है । उस अवधि के दौरान औसतम 26.03 विवित प्रति ट्रॅप पकडे गये । उस पाम वीवील की गीत विधीयाँ सितंबर से नवंबर तक सबसे ज्यादा और मई – जून मे ही । यह देखा गया की बहुसंखया में द्रकंग करने हेतू ट्रॅप का घानापान 1 ट्रॅप। हे. से हे. तक कम कीया जा सकता है। उसका वीविन कण्डा करने पर कोई असर नही यल पेटीअेल के साथ करोयोन छोडनेवाले साद्धा पदार्थ ट्रॅप तक माहिनो तक नहि. से वीविल की पकडपर कोई असर नहि हुआ। किंतु पानी गये तो ट्रॅप की अँपाईकी ंद से पह पाया गया. (30.4) वीतिल पकडे गये। मान्सुन तथा शितकाल में ब्रेरोमोन कडे गये विविल की प्रयोगशाला में पैदावार करने से पता चला की युवा, गर्थवती तथा विल फेरोमोन ट्रॅप की तरफ आकीर्षत हुये। तात्पर्थ की फेरोमोन ट्रॅप का इस्तेमाल

करने से रेड पाम वीविल की संख्यामें दो क्षेत्र में कमी आती है। विभीन्न फेरोमोन - छोडनेवाले खाद्यपदार्थो से पता चला की खजुर का इस्तमाल करने से सबसे जादा (4.33) प्रति ट्रॅप वीविल पकडे गये। जब कि गया (12.33) और आसानी से पायेजानेवाले नारीयल पेटीओल से (11.66) विविल पकडे गये। आँयल पाम कलका फेरोमोन ट्रॅप मे इस्तमाल करने से रेहपाय विविल पर घृणित परिणाम हुआ।

फेरोमोन ट्रॅप कि आयु छाया मे रखने से और चांदीका पर्ख इस्तमाल करने से सात महिने तक बढी। नारीयल कि बागानों मे रेडपाम विविल के क्षेत्रीय वितरण से पताचला कि, यह किडक समुह मे पाया जाता है और नकारात्मक बायनी मीथल प्रणालि दिखाता है। इसलीये अधिक मात्रा में बीमार पेड कि सानिध्य में होनीवाली बागातो मे रेडपाम विविल जादा आक्रमण करता है और इसके लिये इस्की रोकताम बहुत आवश्यक है।

धान क्षेत्रीय परीक्षणोसे पता चला कि गालमीज का प्रादुभाव खरिप मे कम अवधिवाले प्रजातियो मे अधिक रहा है।

काजुके स्थानिय प्रजामियोंका परिक्षण टी. मास्क्युटो किट के लिये किया गया। कारपार - 1 मे अवसतम नुकसान 13 पतिशत, वी टी एच - 164 / 1 मे 13 प्रतिशत तथा धावे - 1 मे सबसे जादा 33 पतिशत नुकसान पाया गया ।

रिनोसोर बीटल के फेरोमन ट्रॅप के परिक्षण मे उत्साहवर्धक परिणाम प्राप्त नही हुये। तीन महिनेकी अवधि मे अवसतम 6.67 किटक प्रति ट्रॅप पाये गये । किटकों द्वारा कम नुकसान, फेरोमन कि जादा किमत इसकारण आर्थीक दृष्टी कोणमे यह फायदेमंद नही लगता ।

आम मे फ्रुटफ्लय किटकका प्रादुर्भाव, नवंबरसे दिसंबर तक सबसे कम तथा अप्रैल से जुन तक सबसे जादा पाया गया ।

19.2 फल विज्ञान

काजु के स्थानिय प्रजातियोंका संकलन सम्बधी अस्थायी परियोजना के अंदर सत्तरी - 1 (सीडी - 80-9), सत्तरी - 2 (सी. एस 80-9), सत्तरी - 3 (सी. एस. - 80-11), सत्तरी 4 (सी. एस. - 80-11), सत्तरी - 5 (सी. एस. - 80-12) नामक पाँच प्रजातियोंका सकंलन किया गया।

मेट्रोलिफ चयन के द्वारा जनित द्रव्यो के परिक्षण मे औंसतम नट का वजन एंव नट सख्या के आधारपर वाळपई - ५ और बोर्दज - व इन दो प्रजातिमे अनुवंशिक संम्बध पाया गया ।

ली – 2 जो कि स्थानिय एसेसन्नस से चयन की हुई प्रजाति: हे लगातार अच्छे परिणाम के धिक औसंत उपज 4.01 कि, (2 मी 2 मी) दुरी मे अवांहनीय मौसम मे भी पाया गया । ट उपज 25.16 कि प्रति वृक्ष को 11 साल के अंदर प्रापत किया गया । केंप्रीय कृषी ने बाली – 2 की नामांकन की कार्यवाही शुरु कि गयी ।

ी लायी हुई जातियो (एवसेसन्स मे) एच – 1600, और एच – 1608 को प्रायोगिक श्रेत्र ा के लिए स्थापित लिया गया। औसत उपज 5.86 कि. और 4.13 प्रति पौंधा पाया गया।

ॅयल पाम की संकर किसमों के अध्ययन से यह ज्ञात हुआ की संकर 2 पि और 31 डी x 292 पि ने अधिक उत्पादन दिया जो वर्ष 2000 – 2001 के दौरान पाये न से अधिक था ।

ीय कृषि प्रौद्योगिकी परियोजना के अंतर्गत ताड पर आधारीत फसल पदधती में एकबदध बंध जिवात्मक और अजैव खादों की चारा फसल और ताडो में तुलना की गई । इसमें ात अजेव खादों का इस्तेमाल करने सें सबसे ज्यादा उँचाई, अधिक झुरमट प्रीत पौधा लँबाई और चौड़ाई, गाँठो की बीच लँबाई और उत्पादन पाये गये । इसके बाद उत्पादन त जीवात्मक और 50 प्रतिशत अजै खादोंका इस्तेमाल करने से पाया गया की / हे. अपज थी। सबसे कम वृद्धि और उपज 100 प्रतिशत जिवात्मक खादों का प्रयोग आ । इस प्रयोगोंमें एन बी – 21 संकर चारे का अध्ययन किया गया । सेंट्रोसेमा में भी इस ध्दि और उपप्त पाया गया।

अन्य परियोजना के अंतर्गत गोवा के कृषि – वन क्षेत्रों में पाये जानेवाले फलो का संकलन, र परिक्षण किया गया, जिसमें चार तरह मे रोज ॲपल दोतरह के ब्रेड़ फ्रुट, दो तरह के ीन तरह के कोकम और आँवला की तीन प्रजातीयों का संस्थान की बागों मे जोड़े गये।

ी फसलों के संकलन, संधारण तथा परिक्षण के अंतर्गत भेंडी की 13 अधिक फसल देने यॉं इकट्ठा की गई।

की संकलन तथा परिषेण के अंतर्गत झंडूकी स्थानिय प्रजातीयाँ, चमेली की 6 प्रजातिया ा की 4 प्रजातियाँ संकलित की गई। ग्लेडिओलस की 8 प्रगतिया आई. आई. एच. र से लाई गयी ।

अन्य परियोजना मे गोवा श्रेत्र के कृषिवनों में पायेजाने वाले / उगाये जाने वाले फलो बाद प्रबंध का अध्ययन किया गया । इसके अंतर्गत पारंपारिक तरिके से बनाये गये रिक्षण किया गया । इन पक्षार्थोका भौतिक – रहशहयीचकत्त या रखरखाब की आयु

का अध्ययन किया गया । अधिकतम पदार्थ छह माह तक पारंपारिक तरीको से बनाये थे और पैकटों में सुस्थिती में पाये गये । ब्रेड फ्रुट और बिंबली की रखरखाव की आयु 0.4 मीमी एल डी पी ई बॅगों मे 0.5 प्रतिशत हवा में क्रमश: आठ दिन और पाच दिन तक बढाई जा सकती है।

ब्रेड फुट के कच्चे तुकडे नमक की पानी रखने सें छह माह के बाद भी उनका रंग, बनावट और महक तथा रासायति घटक और अम्हलता में परिवर्तन नहीं पाया गया ।

19.3 पशु विज्ञान

किसानोंमे सुअर पालन को बढावा देने के उद्देशसे राष्ट्रीय कृषी प्रौद्योगिकी परियोजना के अंतर्गत एक कम मुल्यवाला परिक्षात्मक खादय बनाया गया। इस खादय मे गेंहूकी भुसे की जगह बीस प्रतिशत तक काजु के फल का निरुपयोगी सुखा हिस्सा इस्तेमाल किया गया । इसका परिक्षण देसी एकं यॉर्कशायर के संफर द्वारा उत्पादित सुअरो में करने पर यह ज्ञात हुआ कि यह परिक्षात्मक खादय से सुहरों की वृध्दी एवं भक्षण की मात्रा पर कोई बुरा असर नही हुआ । अवसतम रोजाना वजन मे वृध्दी 167.70 और 163.85 ग्राम क्रमश: परिधात्मक और नियंत्रीत समुहोंमे पायी गयी। इस तरह से खादय के मुल्य मे 17 प्रतिशत कमी कि गयी (रु 1.20 प्रतिकिलो)

खरगोश के लिये सस्ता खादय तयार करने हेतू दो परिधात्मक खादय, (बीजी डी) और काजु फलका सूखा निरुपयोगी हिस्सा 25 प्रतिशत तक इस्तेमाल किया गया। इसका परिक्षण 18 युवा संकरीत खरखोशो मे किया गया। अवसतम रोजाना वजन वृध्दी 17.87 ग्राम, 15.06 ग्राम और 15.84 ग्राम क्रमश: नियंत्रीत समुह, काजु फल का समुखा निरुपयोगि हिस्से का स्वाद्य और ब्रीवर्स ड्राइड ग्रेन (बी डी जी) खाद्य समुह मे पाया गया। इससे यह ज्ञात हुआ कि बी डी जी का इस्तेमाल गेंहु भुसे की जगह खरगोशों के भोज्य मे किया जा सकता है ।

अत्याधिक उजावाले भोज्यका खरगोशोमें परिणाम देखने हे तू गुढ का इस्तेमाल किया गया। मादा खरगोशमे प्रतिदिन 10 ग्राम गुढ प्रसुतिके 5 दिन पहले से लेकर प्रसुतिबाद 10 दिन तक देने से 45 से 80 पतिशतक बच्चे जिवीतरहे ।

रोग प्रबंधके संबंधी अध्ययनमे गायके दुध के 25, नमुने स्तनदाह परिक्षण हेतू इकठ्ठे किये गये । इनमे से 15 नमुने स्तन दाह से पिडीत गायो के थे । स्टॅफिलो कोकस और स्ट्रेप्टोकोकस नामक जिवाणू इसके प्रमुख कारण पाये गये । अन्च जिवाणू मे सिडोमोनास, लिस्टेरिया और इस्चेरिचिया पाये गये । यह जिवाणू जेंटामार्यासन, नार फलो कसासिन, कलोराम फेनिकाल, अम्पीसिलीन, फलोक झांसिलीन तथा पिक्लो कझसिन के प्रति संवेदशील पायेगये ।

स राज्य मे एक एमडी और इरले कियोसी से रोंग का फैलान पाया गया। इनका परिक्षण के रोगथाम हेतू किये गये।

जारों मे विक्रय हेतू रखे मांसो मे रोंणों के संक्रमीत जीवाणू का स्त्रोतज्ञात करने हेतू मांसके मुनोका प्रसंस्करण किया गया। मिजो किल की संख्या 10.45×10^4 सिएफ यु प्रति ग्राम यको किल की संख्या 10^3 सि एफ यु प्रति ग्राम पायी गयी। वाय एम सी की संख्या ^{4} सिएफ यु प्रति ग्राम पायी गई।

कुट पालन के अंतरर्गत व्यवसार्याक ब्रायलर मुर्गी यों मे बी दी जी का परिपुरण दो समुहों में ा। एक समुह मे सिकी द –1 बी डी जी और दुसरे समुह मे केमझाईम (1 ग्राम प्रति कीलो) परिपूरीत समुह और नियंत्रीत समुह मे वजन और खादय परिवर्तन कार्यधमता समान ीन मांसोकी अन्य घटकोंमे कोई फरक नही पाया गया सिवा पेट का मेद जादा रहा।

.4 मत्स्य पालन

न एवं झिंगो की समन्वीत योजना के अध्ययन के अंतर्गत वायटीला – 5 धानकी प्रजाती ी गयी। खरिपमें इसका उत्पादन 3 टन / है. और रबी मे 5 टन / है. रिकार्ड किया गया।

लागत के भोजनका निर्माण तहत चार सशोभित करने वाली मछलींया वृधीके लिये कि गयी। मुगीके यकृत और स्वीड पदार्थपर आधारित भोजन बाजारमे उपलब्ध खाद्यो किया दृष्टी से सभी गुणों मे समान पाया गया। निर्माण किये गये भोजन बाजार मे उपालब्ध सस्ते पाये गये।

स्टारटर और सुशोभीत करनेवाले मछलीयोंके किये निर्माण किये गये भोजनोंकी आयु तथा पानी मे स्थीरता का अध्ययन किया गया । हवाबंद डिब्बो में इन खाद्योंको क बीना नुकसान के रखा जा सकता है । कापस्टार्टर क्रमश: 30 मीनट और 60 मीनट पानी मे रखनेसे 70 प्रतिशत तक और 50 प्रतिशत तक मुल स्थितीय में पाये गये। भित करने वाली मछलियोका भोजन 30 – 45 मीनट तक स्थीर पाया गया। प्रथिनोंका तिशत, कार्प स्टारटर और सुशोभित मछली के खादयमें 8.63 से 14.97 प्रतिशत और 58 प्रतिशत एक घंटे बाद क्रमश: पाया गया।

योटीक पुरक (5 ग्राम प्रति कीलो) देने से लॅबीयो रोहिता मे वृध्दी, भोज्यउपयुक्तता की रचना सबसे अच्छी पायी गयी। लेकीन एन्झाईम पर आधारीत प्रोबायोटीक खादय म प्रति किलो) इस्तेमाल करने से अच्छे परिणाम पाये गये ।

19.4 तकनीकी हस्तांतरण

इस अवधी के दौरान कृषी विज्ञान केंद्र द्वारा 85 आवश्यकता अनुसार प्रशिक्षण कार्यक्रम परिसर मे तथा परिसर के बाहर विभीन्न विषयों के लियें आयोजित किये गये।

इन कार्यक्रमो में 132 प्रशिक्षणार्थीयोंने प्रशिक्षण प्राप्त किया। इन में 548 पुरुष और 773 महीलायें थी। इस दौरान 14 लोकप्रीय लेख, 1 शोध लेख और एक तकनिकी रिपोर्ट तथा दो विस्तार पत्रिकांए प्रकाशीत कीये गयें । चौबीस रेडीओ प्रसारण तथा 3 टेलीवीजन साक्षात्कार प्रसारित कीये गये।

इस अवधी में संस्थान मे 105 उन्नतशील किसान आये जिन्हे संस्थानकी गतविधीयोंके बारे में जानकारी दी गयी।

औनफार्म प्रदर्शन कार्यक्रम के अंतर्गत 13 किसानोंके रवेतों मे (2.6 हेकटर क्षेत्र मे) प्रयोग करके खेती संबंधीत मसलोंका हल किया गया।

फ्रंट लाईन प्रदर्शन कार्यक्रमके तहत 22.9 हेक्टर (तिलहन : 11 हेक्टर खादयान्न 11.9 हेक्टर) (73 किसांनों की भूमी मे) रवेती की गयी।