वार्षिक प्रतिवेदन

ANNUAL REPORT 2001 - 2002



गोवा में स्थित भा.कृ.अनु.प. अनुसंधान समूह

(भारतीय कृषि अनुसंधान परिषद)

एला, ओल्ड गोवा - 403 402.

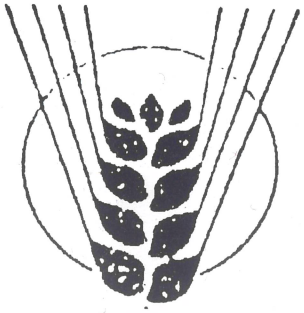
ICAR RESEARCH COMPLEX FOR GOA

(Indian Council of Agricultural Research)

Ela, Old Goa - 403 402, INDIA

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CONTENTS

		PAGE
1.	Preface by Director	1
2.	Executive Summary	2
3.	Introduction	8
4.	Research Achievements	12
4.1	Crop Science	12
4.2	Horticulture	36
4.3	Animal Science	54
4.4	Fishery Science	63
4.5	ARIS	66
4.6	Transfer of Technology	67
4.7	Extermally Funded Projects	76
4.8	Completed Projects	87
5.	Technology Assessed and Transferred	96
6.	Education and Training	97
7.	Awards and Recognition	102
8.	Linkage and Collaboration	103
9.	Other Projects	104
	General / Miscellaneous	
10.	List of Publications	105
11.	List of Approved ongoing Projects	110
12.	Consultancy, Patents, Commercialisation of Technology	112
13.	Meetings of RAC, SRC, Management Committee, etc.	113
14.	Participation in Conferences, Meetings, Workshops, Symposia etc.	117
15.	Workshops, Seminars, Summer Institutes, Farmers, Day etc. Organised by the institure	120
16.	Distinguished Visitors	122
17.	Personnel	125
18.	Any other relevant information	127
19.	Summary in Hindi	131

1. PREFACE BY DIRECTOR

Goa is a coastal state located along the Konkan tract of Western India. There is a constant demand to produce more food to meet the needs of the local population and also to cater to its increasing tourist population that visit the state every year.

ICAR Research Complex for Goa is a multidisciplinary Research Institute established in 1976 with a mandate to conduct Research on various aspects of Crop Science, Horticulture, Animal Science and Fisheries. The Institute has a Krishi Vigyan Kendra to cater to its Transfer of Technology Programme.

Over the years the Institute has generated several technologies for the benefit of the farmers in the State. 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, evolveing suitable coconut based cropping and farming system 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 our significant contributions.

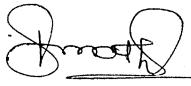
The KVK of the Institute has made a significant contribution in taking the findings of the Research Complex to the farming community of the State, through vocational and inservice training, on farm testing of programmes and Front Line Demonstrations. The recent success storties are the cultivation and demonstrations of hybrid rice and polythene mulch technology for groundnut. The Institution Village Linkage Programme (IVLP) has also made a significant dent by exposing the farming community of the adopted villages to proven farm technologies including hybrid rice, improved vegitable varieties, profitable rearing of backyard farm animals, integrated pest management etc,.

The Research Complex is well equiped with several sophisticated equipments and during the period under report has further strengthened its laboratories with the procurement of several equipments including atomic absorption sphectrophometer, ultra sonograph, Elisa reader, portable water analysis kit etc.

The Institure maintains a strong linkage with the Developmental Departments of the State and has collabritive programmes with the Departments of Agriculture, Animal Husbandary and Veterinary Services, Fisheries, Goa Chamber of Commerce, Goa University, etc,.

During November 2001, the Institute successfully organized a Symposium on "Post Harvest technologies for agricultural produce and prospects for the food processing industry in Konkan Region" at the International Centre, Dona Paula. The Staff of the Institute also made all arrangements during the year to host a National Conference on Costal Agricultural Research, which received tremendous response from various parts of the country. At present there are 31 on going Research Projects in the Institute. Besides, the Institute also has interesting programmes in six disciplines under the National Agricultural Technology Project. The mission of the Research Complex, its strategic location and contribution over the last two decades makes it ideally poised to takeup research pertaining to Costal Agro Ecosystem.

As the new Director of the Institute it gives me immense pleasure to present this annual report for the year 2001-2002. I am sure this report will serve as a valuable document for researchers, planners, administrators and members of the farming community both in Goa and out of the State, specially in the Coastal Agro Ecosystem.



V. S. KORIKANTHIMATH

2. EXECUTIVE SUMMARY

The ICAR Research Complex for Goa, is the only Institute of its kind in the State of Goa catering to the Research needs in the field of Crop Science, Horticulture, Animal Science and Fisheries. Beside Research, the Institute transfers technologies to the farming community of the State, through its Krishi Vigyan Kendra. Following are the highlights of the Research Projects of the Institute and Transfer of Technology programmes of the KVK, for the year 2001-2002.

2.1 CROP SCIENCE

Among the eight hybrid of rice evaluated during *kharif*, 2001, Sahyadri recorded the highest yield of 7.15 t/ha and was closely followed by the hybrid KRH-2 which recorded a yield of 6.87 t/ha. Both were significantly superior to the local check varieties of Jaya and Jyothi which yielded 5.72 t/ha and 4.68 t/ha, respectively.

In a trial pertaining to manurial treatment of four Basmati/ scented varieties, it was seen that application of vermicompost @ of 5 t/ha resulted in superior grain yields of 3.03 t/ha and 3.3 t/ha in Pusa Basmati and Indrayani, respectively. This treatment also resulted in the higher accumilation of 2-acetyl-1-pyroline content in the grain which is responsible for better aroma.

Fourteen short durations and seven scented rice varieties were evaluated for field reaction to leaffolder, *Cnaphalocrocis medinalis* and gall midge, *Orseolia oryzae* during *kharif,* 2001. IET- 16829 and IET – 16827 registered lowest cumulative attack of 1.00 damaged leaf and 2.25 silver shoots per m^2 for leaffolder and gall midge, respectively, in the short duration group. Among the scented varieties IET- 15392 and IET –13548 recorded the least cumulative infestation of 0.83 damaged leaves and 0.75 silver shoots per m^2 for leaffolder and gall midge, respectively.

The varities Triguna, IR-64 and IET- 16830 exhibited a moderate degree of field tolerance to blast leaf spot and sheath rot, respectively.

In vitro assays to study the antignostic effect of natural biocontrol pathogens revaled that *Trichoderma* and *Psuedomonus* species were effective in inhibiting the growth of *Pyricularia oryzae Helminthosporium oryzae* and *Sarocladium oryzae*.

In a trial on screening and management of salt tolerent rice varieties, it was observed that high salinity reduced the root length and number of tertiary roots. However, high salinity increased the weight of root to shoot ratio.

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:Zn gave the the maximum ratoon sugarcane yield of 75.3 t/ha with 19.1 per cent brix and 8.5 per cent sugar recovery in the variety CO-7527.

Cropping model trials involving multi species for mine reject soils showed that PBN-16 performed well in these soils, recording a yield of 10.66 t/ha for a single harvest. Further, it was seen that application of poultry manure in mine reject soils enhanced the per cent survival of cashew grafts.

In trials under the rice based farming system, it was observed that rotating groundnut with rice increased the grain yield of subsquent rice crop by over 5 t/ha. Also, rice grown under recycled paddy straw with mushroom substrate in 2:1 ratio consistantly regstered higher productivity (4.5 t/ha).

Among the different cropping systems tried, rice –brinjal system, registered the better productivit

level particularly under recycled FYM. It was also observed that rice-cowpea system was the best option under residual moisture sitiuation. Rice-cowpea rotation resulted in a 78 per cent higher productivity over rice fallow system. Pooled economic analysis revealed that integration of rice-brinjal with mushroom and poultry was highly economical with the best net returns of Rs 77,305 / ha.

During *kharif*, 2001 a protection / exposure spray schedule with 0.07 per cent endosulfan 35EC revealed that the damage to pigeon pea pods due to the borer complex could be minimized by protecting the crop at flowering.

Studies to monitor Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Oliv. activity in Goa using pheromone traps revealed that the pest was severe throughout the State. Pheromone trap captures showed that RPW was most active (32.50weevils per trap) during November, 2001 while the pest was least active (16.13 weevils per trap) during June, 2001.

A pheromone trap density of one trap for 2 -3 hectares of coconut plantation was found to be suitable for adopting in mass trapping programmes. The best weevil captures of 62 weevils per trap were obtained when dates were used as food bait in pheromone traps. Carbofuran 3G (0.05 %) was found to be most suitable for use in RPW pheromone traps.

Studies pertaining to the longevity of ferrugineol based RPW pheromone lure (ferrolure +, 800mg) showed that under the agro-climatic conditions prevailing in Goa, ferrolure + 800mg had a field life of six months, provided traps are set under shade of plant canopy.

Wilt disease in brinjal was diagnosed due to combined infection of fungus and bacterium. Laboratory experiments and field studies showed that use of biocontrol agents (*Trichoderma* spp and *Pseudomonas fluorescens*) as root dipping and drenching and fungicides (Carbendazim, Copper Oxy Chloride) reduced the disease incidence and increased the crop yield. Experiment on the management of damping off in nurseries showed that use of biocontrol agents (*Trichoderma* spp and *Pseudomonas fluorescens*) as seed treatment and soil application reduced the incidence of pre and post emergence damping off.

2.2 HORTICULTURE

The Institute continued to maintain and evaluate 166 promising local cashew accessions. During the year, six new cashew accessions identified from different parts of Goa were added to the germplasm block. During the year the accession GCC-94/8 (Dhave-3) was found to be promising, with a mean nut yield of 3.18 kg/tree. Among the introduced accessions H-1600 was found to be promising with a nut yield of 7.5 kg/tree.

Among the turmeric varieties evaluated Prabha, Pratibha and RCT-1 recorded fresh rhizome yield ranging from 25 to 30 t/ha. The production technology for turmeric as an intercrop in coconut was standardized.

Of the five oil palm hybrids of Dura X Pissifera combinations evaluated, the hybrid 35D X 291 P recorded the highest fresh fruit bunch yield of 142.35 kg/palm.

In mango, evaluation of different varieties were carried out under three broad categories namely *viz.* local varieties, hybrids and introductions from other States. In this three groups of mango varieties, the highest yield efficincy of 6.61, 3.05 and 2.85 kg per m^2 was recorded in Culas, Neelgoa and Alampur Bensan, respectively.

An effort was made to study the variability in Goa's premier mango variety (Mankurad). Fruits of this variety collected from different parts of Goa were found to have T.S.S ranging from 14 to19 per cent and average fruit weight of 234 to 406 g.

Besides this, studies pertaining to standardization of agrotechniques in two promising North-East Hilly region mango varieties (MDCH-1 and STH-1), 40 local mango varieties and two promising Mankurad types (RCMS-1 and CMKD) were taken up under high density planting during the year.

Methyl eugenol trap captures showed that fruit fly *Bactrocera* spp. was most active during the month of June. Fly captures were significantly and positively correlated (r = 0.78) to rainfall.

In a high density cropping model involving coconut (main crop), banana, mango and black pepper, an average yield of 77.86 nuts per palm per year was recorded in coconut (Benaulim). The variety Amrapalli was found to perform well in this high density cropping model, registering an yield ofr 4.75 kg/fruit.

Besides the eleven under utilized fruits identified last year, few more local fruits such as Churna (*Zizyphus rugosa*), Karonda (*Carrisa carandas*) and Mattom were identified. Further evaluation was made in case of important minor fruits such as Jamun (*Syzygium cumini*), Jagomas (*Flacourtia jangomas*) and mottam.

In Lady finger, local Okra type recorded the highest yield of 470.56 g/plant. In brinjal the popular Agassaim type (local) registered the highest individual fruit weight of 243.33g / plant.

Information on under utilized vegetable crops like Mangrove fern (*Acrostichum aureum*), Bamboo (*Dendrocalamus spp*), Aerial Yam (*Dioscorea bulbifera*), Taro (*Colacasia esculenta*), Chinese Potato (*Solenostemon rotundifolius*), Kakrol (*Momordica dioica*) etc., were collected for study and observation

During the year, a total of 323 medicinal plants species available in Goa, were identified. Among the identified species, a few like *Andrographis paniculata, Gloriosa superba, Rauvolfia serpentina, Hemidesmus indicus, Solanum nigrum, Withania sominifera, Adhatoda vesica, Ocimum basilicum, Coleus amboinicus, Aloe vera, Chlorophytum borivilianum, Asparagus racemosus, Curcuma amada, Gymnema sylvestre,* etc., are found abundantly in nature and could be commercially exploited.

Five Indian varieties of gladiolus namely Aarti, Sindoor, Tilak, Dhiraj and Darshan from IIHR, Bangalore and four Dutch varieties *viz.*, Nova Lux, White Prosperity, Spic and Span and Rose Supreme were introduced for evaluation studies. Among the Dutch varieties, White Prosperity registered the maximum spike length of 98 cm while Nova Lux recorded the best individual corn wieght of 60.83 g. The vase life of the spike in tap water for all the four varieties from Holland ranged from 10 to 11 days, while the number of flower buds/ spike ranged from 12 to 13.

Studies on storage of jackfruit bulbs indicated that the ripe bulbs could be stored under refrigerator for 23 days when packed in polythene bags. Those stored in sugar solution (40 °B) with Potassium meta bisulphate(250 ppm SO_2)or Sodium benzoate (250 ppm) kept well four months in polythene bags at room temperature. Matured, but unripe jackfruit bulbs could be stored for 12 months with their original colour and firm texture in brine solution at room temperature.

Carambola (Sweet type) squash (48° Brix, 0.5% acidity and 250ppm SO_2) could be stored under ambient as well as refrigerated conditions for more than 12 months.

Proximate analysis of nutmeg rind, parts of jackfruit and breadfruit revealed that these fruit wastes are rich sources of fat and fibre and can be incorporated in livestock feeds.

2.3 ANIMAL SCIENCE

With a view to improve the growth performance of young rabbits, different diets were formulated and tested. Experimental high energy diet with 3200 kcal formulated and compared with a control diet having 2900 kcal in a growth study, indicated that there is no significant difference in the daily weight gain. Under local climatic conditions, a dietary energy level of 2900 kcal DE was found to be sufficient for maintaining optimum growth in crossbred rabbit.

During the year survey work was initiated to ascertain the existing housing and management pracitices for goats in rural areas of Goa. Most of the animals were non descriptive and were brought from the neighbouring states of Karnataka and Maharshtra.

The Institute organised 18 infertility camps in collaboration with Department of Animal Husbandary & Veterinary Services, Government of Goa. The common problems encountered in these camps were anoestrous, silent estrous and repeat breeding.

Further, studies pertaining to synchronized estrous management was taken up in pigs and dairy cows. In rabbits, intensive breeding was done in winter so as to take advantage of low atmospheric temperature for better kit survival. The first artificially insemeinated rabbit was born in the Institute during the year.

A total of 31milk samples were collected from crossbred cows (field cases). Out of these 9 samples were from clinical cases of mastitis. Out of the remaining 22 milk samples from cows tested by California mastitis test 63.6 per cent were positive for subclinical 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.*

A total of 26.8 and 34.1 per cent samples from cattle revealed positivity for brucellosis and IBR, respectively by A-B ELISA. Out of 120 samples tested by RBPT, 17.5 per cent samples were positive for brucellosis.

Out of 73 bovine serum samples tested, eight (10.96%) and three (4.12%) were positive for brucellosis and IBR by A-B ELISA, respectively. None of the 15 goat serum samples were positive for brucellosis by RBPT. Of the 168 pig serum samples tested 11 (6.55%) were positive for brucellosis when tested by RBPT.

A total of 290 milk samples representing different societies were collected at the receiving platform of Goa State Co-operative Milk Producers' Union's (Goa Dairy) processing plant and subjected to milk based ELISA. Out of 290 milk samples tested 33 (11.37%) were found to be positive.

Poultry meat (20) and raw pork (9) samples collected from the market were processed for TPC for mesophiles and YMC. In poultry meat, the counts were $\log_{10}$ 7.2 cfu/g for mesophiles, less than $\log_{10}$ 3 cfu/g for psychrophiles, $\log_{10}$ 5.98 cfu/g for yeast and moulds. In pork, the mesophilic counts were $\log_{10}$ 7.62 cfu/g.

2.4 FISHERY SCIENCE

In a trial for enhancing production under rabbit- fish integration without aeration and supplementary feeding, three carp species were stocked at 6000 / ha density and dung of 15 rabbits added to the pond, which recorded a individual fish growth of 500 to 800 g / 8 months.

In a trial conducted with six Soviet Chinchilla rabbits of 1.250 kg each, it was found that on an average, rabbit gave 78 g of dung and 60 ml of urine /day. The dung and urine contained 2.32 and six per cent N, respectively. It was estimated that an individual rabbit would add 4.32 g N to the pond daily.

In a trial to find out the effect of Spirulina incorporated feeds on the growth of mrigal fry, feed formulate with 1.0 per cent Spirulina gave maximum values of percentage weight gain (168.13), SRG (0.4274), FCR (2.52) and PER (0.9953), compared to feeds with lower levels of inclusion.

2.5 ARIS

A project was initiated to develop agricultural information system for Goa aimed at collecting, storing and creating user interface for retrival of agricultural data pertaining to Goa. During the year local area network was established and made functional in the Inatitute. Further, the Institute web page was created and published. The site of the Institute is available at http://icargoa.nic.in.

2.6 TRANSFER OF TECHNOLOGY

During the period of report, Krishi Vigyan Kendra conducted 91 need based vocational training programmes both on the campus as well as off campus in various disciplines *viz.* Crop Science (14), Horticulture (31), Animal Sciences (10), Home Science (18), Plant Protection (12) and Agricultural Extension (6) and trained 1552 personnel drawn from the practicing farmers, rural youth and Extension staff comprising of 721 men and 831 women.

During the year under the report, six popular articles, and 12 research article and one technical report besides, four training notes were published. Six radio talks and two television programmes were broadcasted/telecasted by All India Radio / Doordarshan, Panji, Goa. Also 1279 progressive farmers visited to this Institute during the year for getting assistance from the Centre.

On farm testing trials were conducted on 15 farmer's fields to find the solutions to the problems related to agriculture.

During the year 18.8 hectares (rice: 13.8 ha and horticulture: 5 ha) was covered under the Front Line Demonstrationos on 40 farmer's fields, comprising of 36 males and four female farmers.

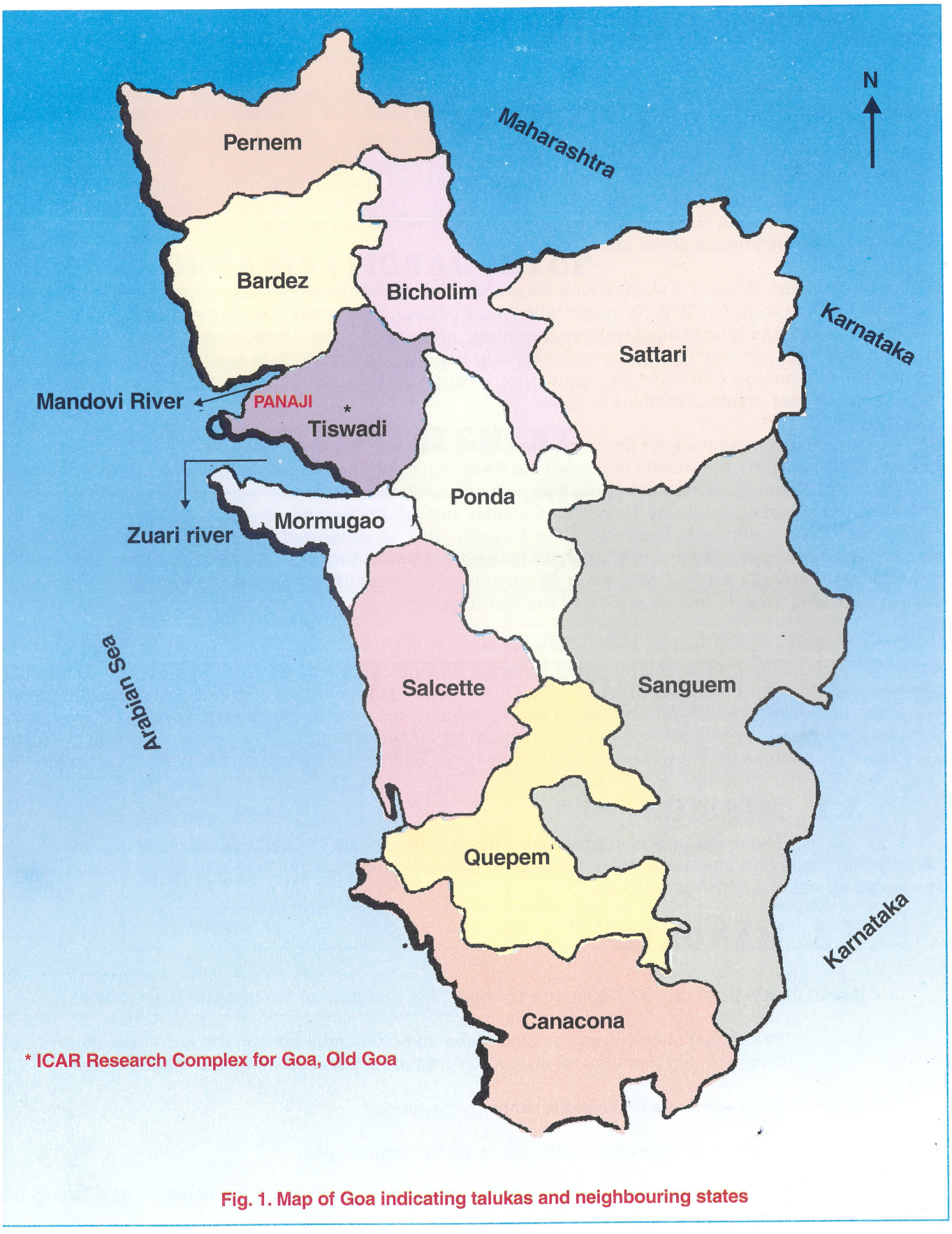


Fig. 1. Map of Goa indicating talukas and neighbouring states

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, horticultural crops, livestock enterprises and fish farming. Due to increasing labour costs, cultivation of field crops especially rice is becoming unprofitable. The farmers of the State are therefore increasingly taking up to Horticultural crops with emphasis on mixed farming where in farming system research including watershed management is gaining importance. Goa does not have Agricultural University or any other agency to look after 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, 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, a Krishi Vigyan Kendra was established at the research Complex in 1983.

Keeping in mind the ever growing needs of Agricultural Research, Education and Extension of the State of Goa, 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 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 18 technical, 18 administrative and 32 supporting staff, making the total staff strength of the Complex to 89. Besides one Scientific, 9 technical, 2 administrative and 2 supporting staff function under the KVK of the Institute.

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

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 and scientific exploitation of various aquatic resources for improving fish production"

3.2 MANDATE

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

1. To conduct strategic and applied research on potential agricultural and horticultural crops, livestock and fisheries for improving productivity and post harvest management
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 and 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 discipline based divisions and a Krishi Vigyan kendra (KVK). Different Committiees *viz;* Institute Management Committee, Research Advisory Committee, Scientific Research Council and Scientific Advisory Committee help the Management for the smooth functioning of the Institute.

3.3 ORGANISATIONAL SETUP

The Director heads the technical and the administrative units of the Institute. The Research and the Extension activities are carried out through a network of discipline based divisions/sections and a Krishi Vigyan Kendra (Organisational Chart detailed in Fig. 2). Different Committees as mentioned in the Institute mandate help the management for smooth functioning of the Institute.

3.4 FINANCIAL STATEMENT

The details of expenditure incurred during 2001 - 2002 under different heads for plan and non-plan of the Institute and KVK are presented in table 1.

Table 1. Abstract of expenditure of the Instiute for the year 2001 - 2002. (Rupees in lakhs)

Sr. No.	Head	Institute		KVK
		Non Plan	Plan	Non Plan
1.	Establishment charges	74.57	16.83	20.71
2.	Traveling expenses	1.99	2.97	0.35
3.	Other charges including equipments	34.95	37.64	1.84
4.	Works	6.60	26.78	--
5.	One time catch up grant			
	a) Replacement of equipments	--	19.61	--
	b) Renovation of old building	--	25.95	--
	TOTAL	**118.11**	**129.78**	**22.90**

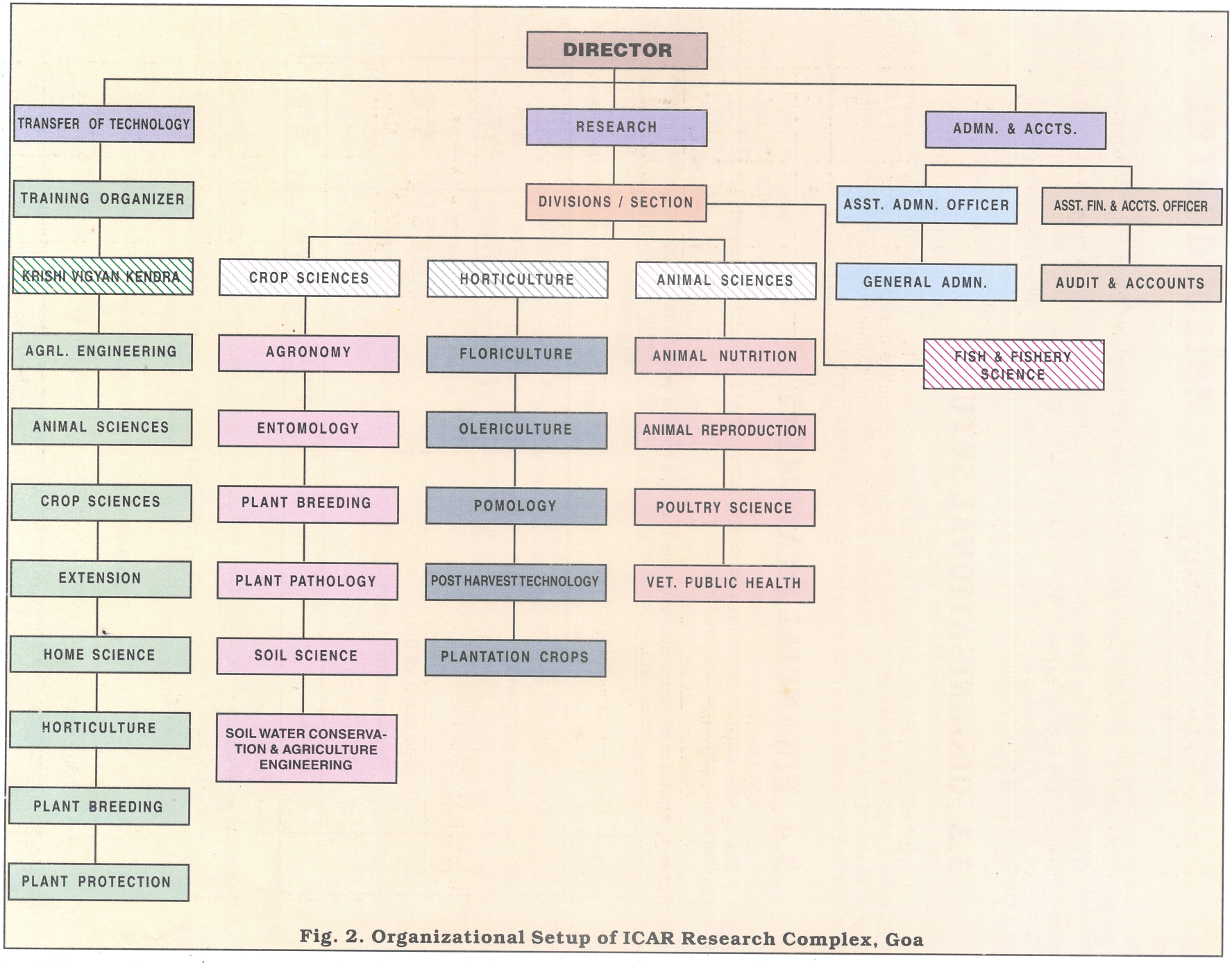


Fig. 2. Organizational Setup of ICAR Research Complex, Goa

3.5 STAFF POSITION

Brief statement of staff position of the Institute and Krishi Vigyan Kendra are furnished in tables 2 and 3, respectively.

Table 2. List of staff strefngth of ICAR Research Complex, Goa.

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	3	1	1	--
Scientist	14	14	--	2	2
	21	19	2	4	2
3. **Technical**	18	18	--	3	1
4. **Administrative and Accounts**	18*	11	7	1	--
5. **Supporting Staff**	32	29	3	3	3
TOTAL	**89**	**77**	**12**	**11**	**6**

RMP - Research Management Position
* Inclusive of two post under the AICRP (Pigs)

Table 3. List of staff strength of Krishi Vigyan Kendra, ICAR Research Complex, Goa.

Category	Sanctioned posts	Posts filled	Posts vacant	No. of SC.	No. of OBC
1. **Scientific**					
(Training Organizer)	1	--	1	--	--
2. **Technical**					
Training Associate	6	6	--	2	--
Training Assistant	1	1	--	--	--
Farm Manager	--	--	--	--	--
Computer Programmer	--	--	--	--	--
Driver	2	2	--	1	--
3. **Administrative**	2	1	1	--	--
4. **Supporting Staff**	2	4	--	1	--
TOTAL	**14**	**14**	**2**	**4**	**--**

4. RESEARCH ACHIEVEMENTS

4.1 Crop Science

4.1.1 Evaluation of medium duration and hybrid rice varieties in Goa.

(HR Prabhudesai, JR Faleiro, R Ramesh and S Talaulikar)

Rice is the most important staple food crop of Goa. In recent years, rice cultivation is not very profitable in the State mainly due to the increasing labour costs and plateau attained by yield levels in the popularly cultivated varieties of Jaya and Jyothi. The Institute has made efforts to break the yield barriers by introducing, testing and popularising hybrid rice varieties. Besides, high valued scented/basmati varieties have also been offered as an alternative to the farmers.

During *kharif,* 2001, eight promising rice hybrids were evaluated to study their comparative performance over the local check varieties *viz*, Jaya and Jyoti in a Randomised Block Design with three replications. Standard agronomic practices recommended for hybrid rice were carried out. Two seedlings per hill in case of local checks, whereas one seedling per hill in case of rice hybrids was maintained. A fertilizer dose comprising of 100:50:50 Kg NPK/ha in case of check varieties and 120:50:60 Kg NPK/ha in case of rice hybrids was applied.

A second trial was conducted to study the response of different organic manures/ fertilizers on the aroma content of four scented varieties, in a Factoral Randomised Design (FRBD) with four levels of manurial treatments *viz;* NPK@ 100:50:50 kg/ha, Farm Yard Manure (FYM) @20 t/ha, Vermicompost @5 t/ha and a recommended dose containing 10t/ha FYM along with 100:50:50 kg/ha NPK (Control). The recommended package of practices for Basmati/ scented varieties was followed.

Demonstration plots of ten promising varieties in the short duration group, previously tested were maintained to produce 0.8 tonnes of seed material. The pest and disease reactions were recorded. Also, the weather data during flowering to grain formation stage in case of scented varieties was closely monitored.

Observations on the yield and yield contributing characters of all the varieties under experimentation was collected. The results of these trials are presented in table 4.

From table 4, it is seen that among the eight hybrids evaluated, the hybrid "Sahyadri" out yielded (7.15 t/ha) all the other varieties and was found to be statistically superior to the local checks Jaya (5.27 t/ha) and Jyoti (4.68 t/ha). The hybrid Sahyadri was closely followed by hybrid KRH-2, PAC-6601 and DRRH-1, which yielded 6.87t/ha, 6.39 t/ha and 6.38 t/ha, respectively. KRH-2 was found to be statistically at par with Sahyadri.


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Table 4. Performance of rice hybrids during *Kharif*, 2001.

Variety	Earhed Length (cm)	Pannicle m^2	Filled grains/ Pannicle	1000 grain weight (g)	Days for 50% flowering	Yield (t/ha)	Grain type
PHB-71	22.6	419.6	124.6	26.0	95	5.36	LB
CORH-2	22.7	483.2	120.8	24.2	98	5.18	LB
NDS-2	25.0	470.0	133.4	24.4	94	5.08	MS
KRH-2	27.2	558.4	163.4	26.5	92	6.87	LS
DRRH-1	24.2	518.3	148.9	25.7	98	6.38	LS
PAC-6601	26.5	563.5	159.6	26.0	96	6.39	SS
Sahyadri	27.6	586.9	174.3	26.3	95	7.15	MS
CNRH-3	23.0	461.3	118.5	25.0	98	5.14	MS
Jaya	23.2	367.4	132.1	28.5	96	5.27	LB
Jyoti	22.2	346.7	128.4	26.4	85	4.68	MB
Triguna	23.8	337.8	149.2	23..4	86	4.84	MS

Study the field reaction of different rice varieties to major insect pests (*Kharif*, 2001)

During *kharif*, 2001 the incidence of gall midge, *Orseolia oryzae* and leaffolder, *Cnaphalocrocis medinalis* was recorded on two different groups of rice varieties namely, short duration and scented varieties at 30,45,60 and 75 Days After Transplanting (DAT). The result pertaining to this study are presented in table 5 and figures 3 and 4.

Table 5. Field reaction of rice varieties to leaffolder, *Cnaphalocrocis medinalis* and gall midge, *Orseolia oryzae* during *Kharif*, 2001.

Short duration varieties	Cummulative damage/m^2		Scented Varieties	Cummulative damage/m^2	
	L F	G M		L F	G M
Triguna	3.14	5.92	Pusa Basmati	2.33	2.83
IET – 16828	2.75	3.50	IET – 15390	1.17	4.00
IET – 1771	1.91	3.00	Indrayani	1.16	2.42
IET – 16830	1.83	3.08	IET – 15392	0.83	1.83
IET – 9240	2.33	4.00	Karnal local	2.33	2.67
Krishna Hamsa	2.17	3.25	IET – 14131	1.00	0.75
IET – 11768	1.33	3.58	IET – 13548	1.42	1.58
IET – 16832	1.42	2.83			
Jyoti	2.08	3.17			
IET – 16827	1.33	2.25			
IET – 16825	1.08	2.58			
IET – 8886	2.58	3.00			
IET – 16829	1.00	2.58			
IR- 64	1.33	2.50			

L F : Leaf folder G M : Gall midge

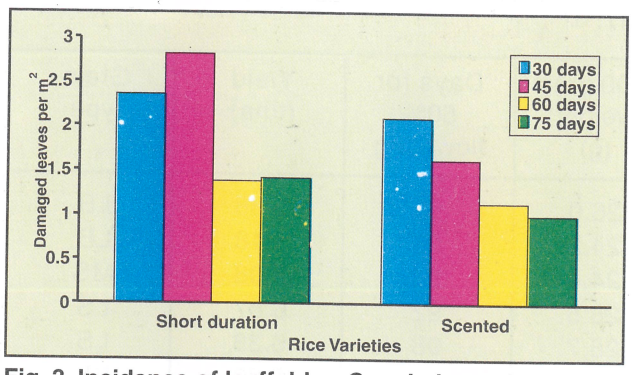


Fig. 3. Incidence of leaffolder, *Cnaphalocrocis medinalis* on rice varieties in Goa (*Kharif*, 2001)

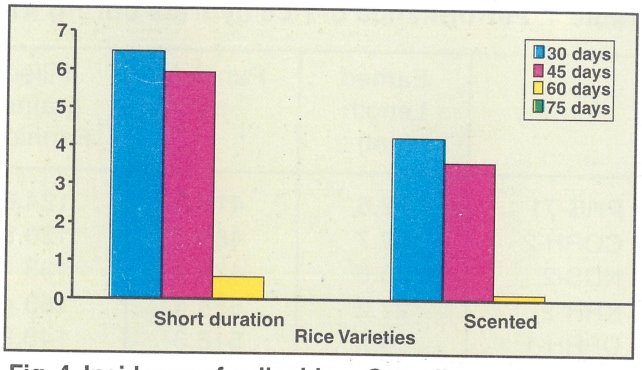


Fig. 4. Incidence of gall midge, *Orseolia oryzae* on rice varieties in Goa (*Kharif*, 2001)

The disease incidence was measured by standard methods in fourteen promising rice varieties transplanted in a randomized block design during *kharif*, 2001. IR 64 and Jyoti served as national and local check respectively. The intensity of major diseases was recorded in two phases *viz.* tillering and panicle initiation. The results showed that the incidence of blast, brown spot and sheath rot was negligible. Five *Trichoderma* species one *Gliocladium virens* and two *Pseudomonas fluorescens* isolated from different sources were used in the *in vitro* assays to identify and evaluate the efficient antogonist. The pathogens *viz. Pyricularia oryzae, Helminthosporium oryzae* and *Sarocladium oryzae* were isolated and purified by using single hyphal tip method. The radial growth of the pathogen was recorded and per cent inhibition of pathogen was calculated.

All the antagonists inhibited the growth of the three pathogens. However, inhibition of *P. oryzae* was maximum by Tv 5, Tv 3 and Tv 1. Inhibition of *H. oryzae* was maximum by Tv 4, Tv 3, Tv 5 and Tv 1 and the inhibition of *S. oryzae* was maximum by Tv4, Tv 2 and Pf 1 (Table 6). The *P. fluorescens* were effective in inhibiting *S. oryzae*. Gv was not effective in all the cases. In case of *Trichoderma* species parasitization of pathogen mycelium was observed in all the cases. However, the degree of parasitization varied from species to species.

Table 6. Effect of antagonists against rice pathogens.

Antagonists	*Pyricularia oryzae*		*Helminthosporium oryzae*		*Sarocladium oryzae*	
	Growth	Per cent inhibition	Growth	Per cent inhibition	Growth	Per cent inhibition
Tv1	14.7	83.7	14.0	84.4	8.7	90.3
Tv2	17.3	80.8	14.3	84.1	7.7	91.4
Tv3	14.0	84.4	12.7	85.9	11.3	87.4
Gv	28.7	68.1	23.3	74.1	12.7	85.9
Tv4	16.3	81.9	12.3	86.3	7.3	91.9
Tv5	13.7	84.8	12.6	85.9	8.7	90.3
Pf1	27.3	69.7	20.7	77.0	8.3	90.8
Pf2	29.7	67.0	21.3	76.3	9.3	89.7
Control	90.0	-	90.0	-	90.0	-
CD (P=0.05)	1.5485		1.1903		0.9338	

4.1.2 Studies on the quality aspects of scented / basmati rice.

(HR Prabhudesai, S Krishnan, JR Faleiro, R Ramesh and S Talaulikar)

During the year a project to study the quality aspects of scented / basmati rice variteis was initiated in collaboration with the Goa University. The Institute, has already identified promising scented / basmati rice varieties for Goa and standardized the package of practices for these varieties. Pusa Basmati has peformed well in Goa. Findings pertaining to 2 - acetyl - 1 pyroline (2 AP), cooking and chemical characterstics of scented and non scented varieties are presented in tables 7, 8 and 9. The 2 AP content which is responsible for the aroma was 0.030 ppm in Pusa Basmati and was closely followed by Ghansal with a value of 0.028 ppm. It is intresting to note (Table 7) that the aroma developed in Pusa Basmati only during the *kharif* season.

The response of four manurial treatments to four scented/ basmati varieties indicated that vermi- compost application @5 t/ha resulted in higher grain yield in Pusa Basmati (3.03 t/ha) and Indrayani (3.3 t/ha) with higher accumulation of 2-acetyl-1-pyroline content in the grain. Whereas, the varieties IET-15392 and Kasturi (2.63t/ha and 2.46t/ha, respectively) responded better to the recommended dose of 10 t FYM /ha along with 100:50:50 KgNPK/ha. The yields realised in this experiment were however found to be comparatively low due to reduction in the annual rainfall which was short by nearly 40 per cent during *kharif,* 2001.

Table 7. Concentration of 2-acetyl-1-pyroline (2AP) in some scented and non scented rice varieties during *Kharif,* 2001.

Variety	2 AP content (ppm)
Marketed Basmati (Kohinoor brand)	0.061
Pusa Basmati (*Kharif* produce)	0.030
Pusa Basmati (*Rabi* produce)	0.000
Ghansal	0.028
Krishna Hamsa	0.000
Triguna	0.000

Table 8. Cooking characteristics of different scented and non-scented rice varieties.

Variety	Before cooking		After cooking		Kernal elongation ratio	Cooking coefficient
	Length (cm)	Breadth (cm)	Length (cm)	Breadth (cm)		
Jaya	0.623	0.25	1.486	0.467	2.385	3.977
Jyoti	0.673	0.25	1.429	0.450	2.123	3.780
Triguna	0.744	0.25	1.423	0.530	1.913	2.425
Krishna Hamsa	0.724	0.24	1.433	0.495	1.864	2.437
IET-13548	0.701	0.24	1.378	0.511	1.846	2.498
IET-13549	0.725	0.25	1.258	0.508	1.966	2.066
IET-15390	0.838	0.20	1.922	0.433	1.735	4.652
IET-15391	0.846	0.20	1.740	0.421	2.294	4.060
IET-15392	0.924	0.20	1.713	0.420	2.057	3.586
IET-15396	0.833	0.20	2.374	0.352	1.854	—
Pusa Basmati	0.837	0.20	1.913	0.419	2.849	4.913
Karnal local	0.846	0.20	1.550	0.458	2.286	5.973
Ambemohar	0.479	0.25	1.119	0.412	1.832	3.951
Ghansal	0.490	0.25	0.921	0.500	2.336	1.724
Girga	0.484	0.24	0.805	0.460	1.663	1.466

Table 9. Chemical characteristics of different scented and non-scented varieties.

Varieties	Alkali spreading value	Gelatinization temperature (° C)	Apparent amylose content per cent
Jaya	7.0	55-69	17.25
Jyoti	7.0	55-69	20.00
Triguna	2.0	74.5 –80	19.25
Krishna Hamsa	2.3	64-80	18.49
IET-13548	5.0	55-69	18.50
IET-13549	7.0	55-69	19.00
IET-15390	5.0	70-74	18.00
IET-15391	4.0	70-74	20.50
IET-15392	7.0	55-69	20.00
IET-15396	4.5	70-74	15.75
Pusa Basmati	7.0	55-69	19.50
Karnal local	2.0	74.5-80	17.00
Ambemohar	2.0	74.5-80	12.50
Ghansal	1.0	74.5-80	17.00
Girga	1.0	74.5-80	14.75

4.1.3. Screening and management of salt tolerant rice varieties.

(HM Wasnik)

To identify salt tolerant varieties in rice, field experiments were conducted with three varieties *viz.* CSR-10, CSR-27 and Korgut during *kharif*, 2001 on farmer's field, at two locations (Carambolim and Chodan) where the soil electrical conductivity was 0.363 and 1.062 dSm^{-1}, respectively. The salinity level of water in the field tested at periodic interval showed that the electrical conductivity in the field progressively increased reaching a high in October. The Sodium, Chlorides and Sodium Adsorption Ratio (SAR) of the water was high, where soil salinity level was more. (Table 11) There was reduction in the root length, with less number of tertiary roots and increase in root to shoot ratio of the rice plants grown in the high salinity. Root damage of five per cent and 30 per cent reduction in the yield was noticed in the variety Korgut when grown at a high level of salinity with electrical conductivity of 3.40 dSm^{-1} (Table 10).

Table 10. Effect of salinity on root development and yield of salt tolerant rice cultivars.

Parameters	Carambolim			Chodan		
	CSR-27	CSR-10	Korgut	CSR-27	CSR-10	Korgut
Root length (cm)	32	35	31	22	21	20
No. of tertiary roots	219	92	210	105	75	95
Damage roots (%)	0	0	0	0	0	5
Root wt. ($g/plant^{-1}$)	3.0	1.0	1.0	1.0	0.50	1.0
Shoot wt.($g/plant^{-1}$)	34.0	11.0	14.0	6.0	4.50	10.0
Root : Shoot	0.09	0.09	0.07	0.17	0.11	0.10
Yield (t/h^{-1})	4.0	3.95	2.0	2.20	2.10	1.50

Table 11. Quality of ground water at different months and sampling sites.

Parameters	Carambolim			Chodan		
	August	September	October	August	September	October
PH	4.46	7.00	7.00	7.00	7.30	7.40
EC (dS/m^{-1})	0.24	0.29	0.42	0.85	3.00	3.40
Na (me/L^{-1})	0.97	1.39	2.78	11.57	24.13	24.56
Mg (me/L^{-1})	0.12	0.15	0.34	0.20	1.06	1.11
Ca (me/L^{-1})	0.10	0.13	0.20	0.25	0.33	0.38
K (me/L^{-1})	0.03	0.03	0.05	0.35	0.55	0.59
HCO_3 (me/L^{-1})	0.15	0.25	0.35	0.38	0.70	0.76
Cl (me/L^{-1})	1.20	2.40	4.20	7.06	26.28	26.86
SO_4 (me/L^{-1})	1.06	1.16	1.57	1.20	1.81	2.03
SAR	4.21	5.34	7.72	35.06	41.60	40.26

4.1.4 Evaluation and management of high yielding varieties of Sugarcane.

(HM Wasnik)

In Sugarcane, a field experiment was conducted on ratoon sugarcane (Co-7527 and Co-90009) during 2001-2002 with a fertilizer dose of 250:125:125 and 300:150:150 kg NPK/ha. Further, a dose of 250:125:125:10 and 300:150:150:10 kg NPKand Zn/ha was also tested in a Randomized Block Design with three replications. It was observed that the application of 300 kg N,150 kg P, 150 kg K and10 kg Zn recorded the highest cane height, individual cane weight, cane girth and also gave the maximum third ratoon sugarcane yield of (75.3 t/ha) with19.1 per cent Brix and 8.5 per cent sugar recovery in the variety Co-7527 and (73.6 t/ha) with 16.6 per cent Brix and 8.3 per cent sugar recovery by sugarcane variety Co-90009 (Table12).

Table 12. 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)	Wt./cane (kg)	Girth (cm)	Brix (%)	Yield (t/ha)	Recovery (%)
Co-7527						
250 N, 125 P, 125 K	2.50	1.50	1.90	18.20	46.33	8.20
250 N, 125 P, 125 K, 10 Zn	2.55	1.55	1.95	18.40	62.66	8.30
300 N, 150 P, 150 K	2.60	1.60	1.98	18.50	71.33	8.40
300 N, 150 P, 150 K, 10 Zn	2.65	1.65	2.10	19.00	75.33	8.50
Co-90009						
250 N, 125 P, 125 K,	2.48	1.50	1.85	16.00	46.66	8.10
250 N, 125 P, 125 K, 10 Zn	2.50	1.54	1.90	17.00	53.00	8.15
300 N, 150 P, 150 K,	2.55	1.58	1.95	18.00	61.00	8.20
300 N, 150 P, 150 K, 10 Zn	2.60	1.62	2.00	18.80	73.60	8.25

4.1.5 Rehabilitation of mine reject soils for crop production.

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

A multi-disciplinary strategy was planned to develop a cropping model involving multi-species for the dump yards of mine reject soils including its land development through soil and water conservation. Cashew and forage grasses were grown in the inter-spaces with land development involving contour and periferal bunding, partial leveling, contour staggered trenching and bench terraces.



Silvi-horticultural plantations in mine reject soil

The performance of hybrid napiers PBN-16 was satisfactory on mine reject soils with better growth, tillering and yield (10.66 t/ha/harvest). Border planted *Acacia auriculiformis* and *Casuarina* was satisfactory with a mean height 4.48 m in *Casuarina* and 4.37 m in *Acacia* (Table 13).

With a view to know the effect of different amendments in mine reject soils, three organic manurial treatments alongwith a control were imposed *viz.* pressmud, farmyard manure, poultry manure and no manure (control) with cashew as test crop. The initial indications showed that poultry manure application has favoured plant growth in terms of survival per cent, branching and growth (Table 13).

To provide an ecological site stability in terms of a diverse vegetative cover and in order to establish the mine areas with suitable horticltural species for mine dump yard soils, four hundred pits were dug at a spacing of 5x5 m in one hectare. FYM (10 kg) was incorporated into each pit. About 200 cashew grafts (Vengurla-4) and 200 mango grafts (50 each of Amarapalli, Hilario, Ball and Mussarat) were planted with the onset of monsoon in 1996. It was observed that there was 80 per cent survival of cashew grafts at end of six years. While the survival of mango grafts reduced from 80 per cent during 1996-97 to five per cent during 2001-2002.

Table 13. Growth parameters of different crop species on mine reject soils.

I. Forage grass PBN-16

Mean plant height	:	2.47 m
Tillers / hill	:	16
Yield	:	10.66 t/ha/harvest

II. Agro-forestry species

	Mean height (m)	Mean girth (cm)
Casuarina	4.48	13.80
Acacia	4.37	16.50

III. Cashew

	Plant height (cm)	Canopy size (m)	No.of branches / plant		Girth (cm)
			Primary	Secondary	
FYM	1.28	0.56	2.00	4.00	8.10
Press mud	1.53	0.56	1.40	3.20	9.30
Poultry manure	1.31	1.54	2.70	7.90	12.60
No manure	1.03	0.09	1.60	1.20	6.00

4.1.6 Rice based farming systems.

(BL Manjunath)

To identify an efficient rice based cropping system with inclusion of allied enterprises, the experiment was continued during the year in a Split-plot design with three replications in rice (variety Jyothi) during *kharif,* 2001. The main plot treatments included comparison of recycled manurial resources from integrated enterprises *viz.* recycled FYM (M_1), recycled poultry manure (M_2), recycled paddy straw with mushroom spent substrate (M_3) which were compared with no manure application (M_0). All the plots were uniformly fertilized with 80: 50: 50 Kg NPK/ ha. The sub-plot treatments included comparison of four commonly followed rice based cropping systems of the region *viz.* rice-groundnut, rice-cowpea, rice-brinjal, rice-sunnhemp and were compared to rice-fallow system as control under residual moisture situations except brinjal which was raised under protective irrigation as per the local practice.

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

Effect of recycled manures and cropping systems on succeeding rice

The effect of recycled manurial resources applied for rice and preceeding rice based crops on the subsequent rice crop in terms of yield attributes, grain and straw yield is given in tables 14 and 15.

Rotation with groundnut increased the grain yield of subsequent rice by over 5 q/ha (5061kg /ha) compared to keeping the land fallow (4531 kg/ha) while brinjal rotation was next best in order (4977 kg /ha). This may be attributed not only due to the crop rotation effect of the legume groundnut but also due to turning in of about 2.4 tonnes of haulms having narrow C: N ratio after harvest. However, there was no appreciable influence of cropping systems on the straw yield of subsequent rice.

Rice grown under recycled paddy straw with mushroom spent substrate in 2:1 ratio consistently recorded higher productivity (4590 Kg/ha) over other treatments. The treatment recorded 8.5 per cent higher grain yield over no recycled manure. Higher leaf production enhancing the photosynthetic surface resulted in increased number of panicles per unit area along with panicle length having more filled grains per panicle which resulted in consistently better performance of the treatment.

The increase in grain yield was also coupled with increase in straw yield (5358 kg/ha). Among the sequential crops, groundnut was found to have influenced the productivity of rice to an extent of 6.3 per cent in straw yield over rice –fallow sequence. This may be attributed to the increased plant height, profuse tillering and higher dry matter production in the succeeding rice crop.

Table 14. Yield attributes in rice at harvest as influenced by recycled manurial resources and cropping systems.

Treatment	Productive tillers/hill	Panicles/m²	Panicle length (cm)	No. of filled grains/panicle	Per cent chaffyness	1000 grain weight (g)
Manurial resource						
M_0	11.9	383	20.4	65.8	11.0	31.0
M_1	11.4	369	20.6	70.8	11.7	30.9
M_2	11.0	382	20.1	69.9	12.4	30.8
M_3	11.2	396	19.7	66.9	10.4	30.4
Cropping system						
CS_0	11.3	385	20.2	68.8	12.0	30.8
CS_1	11.5	388	19.8	68.4	11.8	30.9
CS_2	11.0	382	19.9	65.8	11.5	30.9
CS_3	11.9	382	20.0	70.0	10.2	30.6
CS_4	11.2	376	20.0	68.8	11.5	30.7
CD (P=0.05)	NS	NS	NS	NS	NS	NS

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 + Recycled mushroom spent substrate+ Recommended NPK

CS_0 - Rice- Fallow
CS_1 - Rice – Groundnut
CS_2 - Rice - Cowpea
CS_3 - Rice - Brinjal
CS_4 - Rice – Sunnhemp

Table 15. Grain and straw yield of rice as affected by recycled manurial resources and cropping systems.

Cropping system/ manurial resource	Mean grain yield (kg/ha)					Mean straw yield (kg/ha)				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
Rice – Fallow	4459	4241	4300	5125	4531	4888	5018	4454	5233	4898
Rice –Groundnut	4364	5125	5459	5296	5061	4810	4884	4871	4615	4795
Rice – Cowpea	4901	4718	4966	4220	4701	4584	4554	4800	3957	4474
Rice – Brinjal	5127	4672	4652	5456	4977	5327	3904	4526	5141	4725
Rice –Sunnhemp	4196	5510	4136	4783	4656	4266	5073	4334	3991	4416
Mean	4609	4853	4703	4976		4775	4687	4597	4587	
CD (P = 0.05)	NS					NS				

Performance of rice based crops

Among the cropping systems tried, rice-brinjal system yielded more productivity particularly under recycled FYM (14.13 t/ha) and recycled paddy straw with mushroom spent substrate (13.56 t/ha). The mean increase was 158, 70, 45 and 123 per cent over rice-fallow, rice-groundnut, rice- cowpea and rice- sunnhemp systems, respectively. Higher yield obtained with local brinjal with bigger sized fruits (average weight more than 250 g/fruit) and more number of fruits per plant resulted in this increase (Table 16).

Table 16. Recycled manurial resources in influencing economic yield of rice based crops.

Manurial resource /rice based crop	M_0	M_1	M_2	M_3	Mean
Groundnut pods(q/ha)	08.62	10.77	12.21	09.37	10.24
Cowpea seeds (q/ha)	07.15	08.10	08.42	11.68	08.84
Brinjal fruits (t/ha)	12.78	12.53	10.94	14.99	12.81
Sunnhemp biomass (t/ha)	12.10	11.19	11.91	11.85	11.76

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 + Mushroom spent substrate + Recommended NPK



A high yielding local brijnal (Agassaim) for rice fallows under protective irrigation

Rice-cowpea system seems to be the better option for residual moisture situations. The system yielded 78 per cent higher productivity over rice –fallow system. Early duration coupled with compact branching of the cowpea variety V-118 could accommodate more plant population per unit area. Further, better root system establishment in the early stages of crop growth could extract more moisture from the subsurface layers of soil resulting in increased productivity.

Economic analysis of the system

The pooled economic analysis of the system revealed that rice-brinjal system integrated with mushroom and poultry was highly economical with the highest net returns (Rs77,305 /ha). The system also recorded a moderate benefit - cost ratio (0.93) with better per day net return (Rs 204/day). Rice-cowpea system integrated with mushroom and poultry was next best in terms of net returns (Rs 73,430 /ha). The system with a lesser cost of production (Rs 63,510 /ha) had a better benefit-cost ratio (1.16) with highest per day net return (Rs 238/day). However, rice cropping alone was least yielding both in terms of gross returns (Rs 34,610 /ha) and net returns (Rs 19,205/ha). Although, the system had lower



Rice (Jyothi) under recycled paddy straw with mushroom spent substrate

cost of production (Rs 15,405 /ha), resulted in higher benefit : cost ratio (Table 17). The net return per day of the system was very poor (Rs 150).

Pooled mean analysis of the farming system study indicated that inclusion of mushroom and poultry enterprises incurred an additional cost of Rs 41,700/ha mainly for the poultry feed and mushroom spawn. The cost of formulated feed prepared on the farm using the ingredients of rice production system, was cheaper by Rs 1.75/kg (21.5% less). Between poultry and mushroom, the cost of maintenance of the latter was much cheaper (only 38.8 per cent of poultry) owing to the cheaper raw material (paddy straw) for its cultivation.

Table 17. Pooled economic analysis of rice based integrated farming system.

Farming system	Gross return (Rs/ha)	Cost of production (Rs/ha)	Net return (Rs/ha)	B : C ratio	Per day net return (Rs/ha)
Rice cropping alone	34,610	15,405	19,205	1.25	150
Rice – Groundnut + Mushroom + Poultry	127,140	66,490	60,650	0.91	173
Rice – Cowpea + Mushroom + Poultry	136,940	63,510	73,430	1.16	238
Rice – Brinjal + Mushroom + Poultry	160,195	82,890	77,305	0.93	204
Rice – Sunnhemp + Mushroom + Poultry	111,850	59,100	52,750	0.89	183

Thus, the results of the present study on selection of profitable cropping system and their integration with suitable enterprises and recycling of wastes has clearly brought out the possibility of linking rice production with different related components for increased profitability and sustainablity.

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

(S Manivannan and AR Desai)

The experiment was continued during the year with different treatments of soil and water conservation measures *viz.* Continuous Contour Trenching + Veg. Barrier (T_1), Staggered Contour Trenching + Veg. Barrier (T_2), Crescent Shaped Trenches + Veg. Barrier (T_3), Vegetative Barrier alone (T_4) and Control (T_5).

The crop growth parameters of cashew grafts (Goa - 1) were observed during the year 2001-02. In general, all conservation measures showed better results in respect of survival, establishment and growth of grafts when compared to the results in control plot. Maximum survival of 89.4 per cent was recorded in conservation measures with continuous contour trenching and vegetative barrier (T_1) followed by staggered contour trenching and vegetative barrier (73 %, T_2) as against the least survival of 52.0 per cent in control.

Further, data on growth parameters *viz*, height and girth of graft recorded at three and 12 months after planting indicated that various conservation measures influenced growth of the grafts. Grafts under continuous contour trenching coupled with vegetative barrier (T_1) recorded a maximum plant height and girth of 94 cm and 6.8 cm, respectively at 12 months after planting stage, followed by staggered contour trenching coupled with vegetative barrier (T_2) with corresponding values of 93.3 cm and 6.1 cm, as compared to growth of graft (64.35 cm and 2.9cm) in control plots.



Soil and water conservation measures in cashew

These preliminary 1observations indicated that conservation measures such as continuous / staggered contour trenching coupled with vegetative barriers would positively influence the growth performance in the initial period of establishment.

Observations on vegetative barriers and intercrop components would be initiated subsequently as stylo, cowpea, etc. had just established in the first year. Five sets of multi-slot devisers were designed, fabricated and installed at the out let of all experimental plots to monitor the runoff and soil loss.

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

(JR Faleiro)

Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Oliv. is a major pest of coconut in Goa. Currently RPW is managed through an Integrated Pest Management (IPM) strategy revolving around the use of food baited pheromone traps. Different aspect of pheromone trapping for RPW were assessed through a series of field and laboratory studies during 2001-2002. The major findings of these studies are presented below.

Location specific and seasonal distribution of RPW in Goa

During the year under report, 40 food baited pheromone traps set during 1999 in various coconut plantations throughout Goa were serviced at fortnightly intervals when, the food bait (coconut petiole) and insecticidal solution (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. This study continued up to December, 2001. The average catch per trap during the period under report was 23.53 weevils.

Weevil captures through pheromone traps between April to December,2001 indicated that RPW was most active during Octomber, 2001 and least active during June, 2001, indicating that the weather conditions influenced the activity of the pest. A similar trend in the activity of the pest was noticed in the previous year (2000-2001). Also, the weevil captures were female dominated indicating the potential benefit of using pheromone trapping technology to manage this pest.



Treating RPW breeding site with insecticide in farmer's field

Trapping density

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. In the present study six pheromone trap densities ranging from 2 traps/ha to 1 trap/5 ha were evaluated with an aim to determine the optimum trapping density for the pest in mass trapping programme. Although, the highest density of 2 trap/ha gave the best weevil captures, there is a good possibility of reducing the trapping density to 1 trap for 2-3 ha (Figure 5).

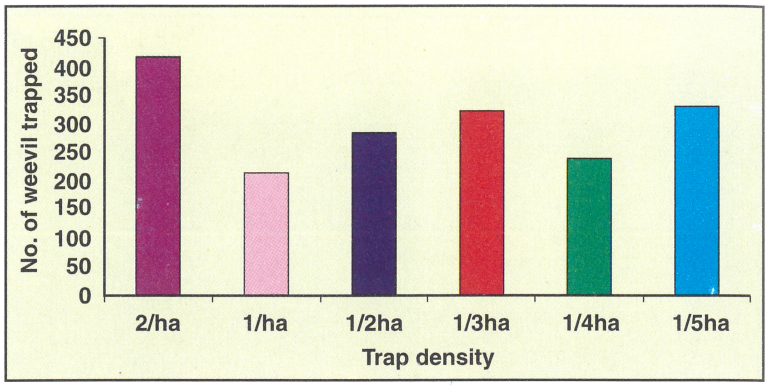


Fig. 5. Weevil captures under different pheromone trap densities (April, 2001 to March, 2002)

Trapping protocols

During the year under report, various trap components *viz.* longevity of the food bait, servicing of the trap at different intervals and suitability of different insecticides were tested. In all these field experiments the standard four window (1.5 x 5 cm) five litre capacity plastic bucket traps were used. Each trap was loaded with a new 800mg Ferrolure + sachet hung to the inner side of the bucket lid which also contained 250g of food bait (coconut petiole) immersed in one insecticide solution containing 10g of carbofuran 3G. During trap servicing the food bait and insecticidal solution was replaced and also a count of the trapped weevils was recorded. Within a given experiment treatments were separated by a distance of at least 25 m.

i. Servicing pheromone traps on weevil captures

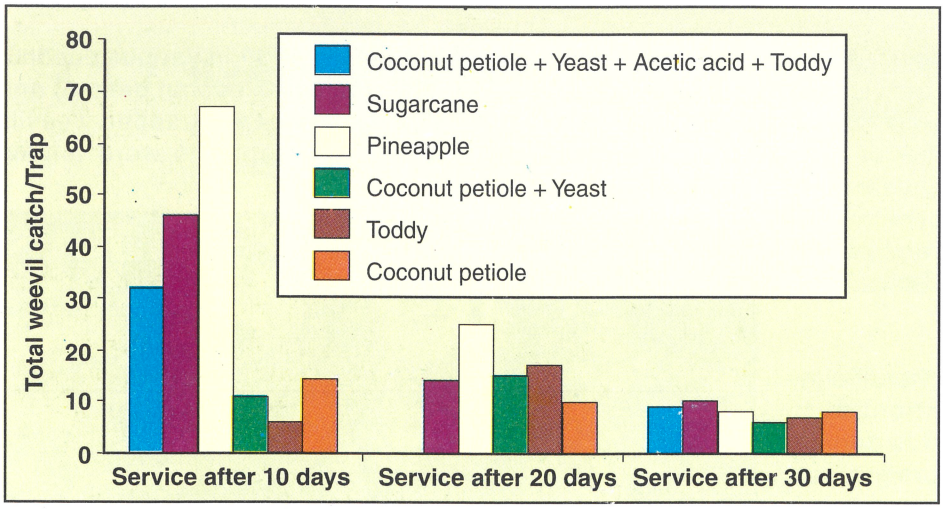


Fig. 6. Effect of trap servicing (replacement of food bait) on weevil captures in RPW pheromone traps (March, 2002)

Six different food baits were evaluated at different period of trap servicing to determine the best interval at which RPW pheromone traps should be serviced. 250g of all food bait tested were used, while 250ml of toddy, 5ml acetic acid and 5g yeast wherever mentioned. From result presented in figure 5 it is evident that all the food baits registered the best weevil captures when the traps were serviced at an interval of ten days. Trap serviced at intervals of 20 and 30 days registered low weevil captures irrespective of the food bait used. Thus, replacing of food baits with fresh plant attractants at ten days interval is essential to sustain RPW captures in pheromone traps. In the present study pineapple gave the best weevil captures (Figure 6 and Table 18.)

Table 18. Effect of food baits and Trap servicing on weevil captures in red palm weevil pheromone trap (1- 3-2002 to 31 –3-2002).

Treatments	Mean weevil captures/trap
A. Food baits	
Coconut petiole + Yeast + Acetic acid + Toddy	6.11 (2.33)
Sugarcane	7.77 (2.60)
Pineapple	12.22 (3.05)
Coconut petiole + Yeast	3.55 (1.90)
Toddy	3.22 (1.83)
Coconut petiole	3.55 (1.92)
CD (P = 0.05)	0.65
B. Trap servicing	
Trap serviced after 10 days	9.77 (2.88)
Trap serviced after 20 days	5.77 (2.27)
Trap serviced after 30 days	2.61 (1.66)
CD (P =0.05)	0.46
C. Interaction	NS

NS = Non significant

Figures in paranthesis are transformed values using $\sqrt{x+0.5}$, Where x = Number of weevils captured / trap

ii. Suitability of Insecticide for use in RPW pheromone traps.

During the year under report eight commonly available insecticides were tested under this study. Result presented in table 19 indicate that carbofuran 3G was most suitable for use in RPW pheromone traps.

Reproductive status of pheromone trap captured weevils

Insecticide free four window bucket traps (5 litre capacity) containing ferrugineol based pheromone lure (800 mg) and kairomone releasing coconut petiole bits (250gm) were set in the farm of the ICAR Research Complex for Goa during May, 2001 to collect and evaluate the longevity and reproductive status of the summer brood of RPW emerging from coconut plantations of Goa. Adult weevils attracted and captured in the above traps were collected every day over a period of one week and reared in the laboratory on coconut petiole.

Trap captured adult weevils were divided into two sets *viz.* (i) a single female caged individually and confined to a celibate life (Set-I) and (ii) a female caged together with a trap captured male partner (Set-II). Five replications were maintained in each set. The average life span of female weevils in set-I and set-II for the summer broods was 63.40 and 87.4 days, respectively. Further, in Set-I and set-II the average egg lay was 112.0 and 159.0, respectively. The egg hatch in Set-I was lower as compared to Set-II (Table 20). This shows that the female weevils attracted to the pheromone traps during the summer season were young, fertile and gravid. The male weevils in Set-II lived for more than two months. A similar trend was observed for monsoon and winter broods.

Table 19. Mean weevil captures in red palm weevil pheromone traps with different insecticides (12/10/01 to 17/11/01).

Insecticides used	Average weekly weevil captures *					Cumulative
	Week 1	Week 2	Week 3	Week 4	Week 5	
Carbofuran 0.05%	2.08 (4.33)	3.07 (9.33)	2.60 (6.66)	1.87 (3.00)	1.35 (1.66)	4.97 (25.00)
Chlorpyriphos 0.05%	1.44 (1.66)	1.35 (1.66)	1.09 (1.00)	1.09 (1.00)	1.05 (0.66)	2.53 (9.00)
Nimbicide 0.5%	1.42 (2.00)	1.93 (4.00)	0.71 (0.00)	1.05 (0.66)	1.35 (1.66)	2.52 (7.00)
Monocrotophos 0.1%	1.05 (0.66)	1.44 (1.66)	1.74 (2.66)	2.18 (4.33)	1.29 (1.33)	3.27 (10.6)
Phorate 0.03%	1.17 (1.00)	1.48 (2.00)	1.74 (2.66)	0.88 (0.33)	1.34 (1.33)	2.77 (7.33)
Carbaryl 0.1%	1.00 (0.66)	1.83 (3.66)	2.29 (5.66)	1.26 (1.33)	1.49 (2.33)	3.37 (13.66)
Endosulfan 0.1%	1.42 (2.00)	1.46 (1.66)	1.17 (1.00)	1.47 (2.00)	1.55 (2.66)	3.07 (9.33)
Deltamethrin 0.0028%	1.61 (2.66)	1.34 (1.33)	2.08 (4.00)	1.34 (1.33)	1.79 (3.33)	3.62 (12.6)
Control	1.44 (1.66)	0.88 (0.33)	1.17 (1.00)	1.95 (3.33)	1.09 (1.00)	2.77 (7.33)
CD (P= 0.05)	NS	0.68	NS	0.31	NS	1.17

* Data transformed using $\sqrt{x + 0.5}$, where x is the average weevil catch / trap.
Figures in paranthesis are original values.

Table 20. Biological Parameters of pheromone trap captured red palm weevil, *Rhynchophorus ferrugineus* (Oliv.), during summer, 2001.

Parameter	Female only	Female + Male
Mean life span (days)	63.40 (±3.67)	66.4 (±3.23)
Mean No.of eggs laid	112.00 (±26.45)	159.00 (±16.98)
Per cent egg hatch	53.94 (±11.87)	75.48 (±1.89)
Mean post ovipositional period (days)	19.66 (±7.83)	6.40 (±1.47)

Figures in parenthesis are standard errors

Longevity of RPW 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, the pheromone sachet was retained in the original silver foil cover since July, 2000, to which were made two longitudinal cuts for release of the chemical into the environment. In order to measure the amount of pheromone in a given lure at different intervals, the quantity intact in a sachet was assessed by visual observation using the standard grade index of 0-4 where zero indicates a spent sachet while four denotes a new lure.

Accordingly, pheromone lures in the monitoring programme were graded from April, 2001 to December, 2001 and the results obtained on various aspects of lure longevity under the agroclimatic conditions prevailing in Goa showed that ferrolure+ 800mg lasted in the field for nearly six months. The release of the chemical in to the environment and weevil activity did not have any correlation. Both were however governed by the prevailing weather conditions. Further, it was also seen that silver foil wrapping around the sachet did not slow down the release of chemical in to the environment.

Mass trapping of RPW infested coconut gardens

Two weevil infested gardens were mass trapped during the year. In Site-I (Farm of Mr. Vidyadhar Mallya – 10 ha) 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 – 5 ha) was brought under the MTP during November 2000 where a trapping density of 1 trap/ha was maintained. It is significant to point out that the incidence of RPW in Site-I has considerably declined during the year under report when a total of 627 weevils were trapped (Table 21). This plantation has been successfully managed against RPW attack. In site –II, MTP continued upto July,2001. In this garden between April to July,2001, a total of 214 weevils were captured. In both the plantations there was no report of new infestation. Besides the above gardens three weevil infested gardens were brought under MTP during January, February and March, 2002. A complete IPM package to manage RPW in these plantations is in progress adopting phytosanitary practices, curative measures and mass trapping the population with pheromone traps.

Table 21. Weevil captures in Mass Trapping Programme (April, 2001 to March, 2002).

Trap No.	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
1	54	32	09	05	NIL	35	27	20	11	09	07	22	231
2	06	04	04	13	NIL	16	11	18	07	03	08	11	101
3	06	13	02	07	NIL	20	17	10	08	04	05	26	118
4	04	03	06	NIL	NIL	06	04	09	02	05	04	04	47
5	24	26	05	NIL	NIL	02	01	22	10	11	11	18	130
Total	94	78	26	25	NIL	79	60	79	38	32	35	81	627

4.1.9 Management of economically important crop diseases of Goa region.

(R Ramesh and HRC Prabhu)

Brinjal wilt

A survey was undertaken in the brinjal growing areas of the state to assess the severity of wilt. The incidence of disease varied between 0 and 90 per cent. The oblong type (Agassim) was found to be more susceptible than round type (Taligao).

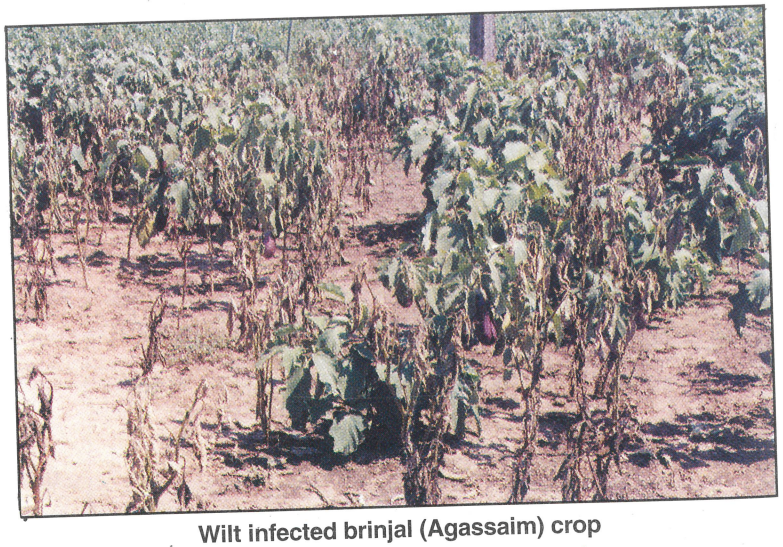


Healthy brinjal (Agassaim) crop

The pathogens were isolated and identified as species of *Fusarium*, and *Ralstonia solanacearum*, which are the causal agents of wilt in this crop. Earlier either *Fusarium spp* or *Ralstonia solanacearum* was only isolated. Later it was observed that the frequency of combined infection was more.

Antagonists like *Trichoderma* spp and *Pseudomonas fluorescens* were isolated from rhizosphere region of various crops from different parts of Goa (Orlim, Cuncolim, Velsao, Agassaim, Ponda, Verna, Pima, Calengute, Old Goa etc). About eight *Trichoderma* spp. and six *Pseudomonas fluorescens* were selected for further study.

Apart from these isolates, one *Trichoderma viride* and one *Pseudomonas fluorescens* culture were received from Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore to include in the ongoing study.



Wilt infected brinjal (Agassaim) crop

The antagonists were tested against the pathogen in laboratory conditions. Based on the efficiency of inhibition (Table 22), two *Trichoderma* isolates (Tv 1 and Tv 2) and two *Pseudomonas* isolates (Pf 1 and Pf 7) were selected for field study.

Carbendazim and Copper Oxy Chloride (COC) were evaluated *in vitro* for their efficiency against *Fusarium* spp, since these are the common fungicides used for seed treatment or soil drenching. Based on dose response curve, Minimum Inhibitory Concentration (MIC) was determined.

A field trial was conducted to test the efficiency of these biocontrol agents and fungicides against wilt disease. Two fungicides (carbendazim 0.2%, COC 0.3%) and three biocontrol agents (Tv 1, Tv 2, Pf 1 @ 10 g/ l of water) were evaluated in this study. Liquid cultures of biocontrol agents were used in the treatment of seedlings (root dipping for 15 minutes) during transplanting and talc based formulation for drenching after

30 days of planting. The wilt incidence was recorded regularly. Plant height, number of fruits and fruit weight were also recorded. The results (Table 23) showed that maximum infection was observed in carbendazim treated plot (17.875%) followed by control plot (10.65%). The lowest was recorded in Tv 1 (2.775%), COC (2.875) and Tv 2 (4.4%) treatments. However, the highest yield was recorded in carbendazim treatment (11.88 t/ha) followed by Pf 1 (10.43 t/ha). Though, Tv 1 recorded less disease incidence, the yield was only next to control (6.08 t/ha). Number of fruits was higher in carbendazim treatment (55.75) followed by COC (52.5) and Pf 1 (45.5) treatments. Fruit weight and plant height were highest in carbendazim treatment (0.172kg, 59.825 cm) followed by Pf 1 treatment (0.162kg, 57.975 cm).

Table 22. Efficiency of antagonists against *Fusarium* spp under *in vitro* conditions.

Antagonists	Per cent inhibition *
Tv3	76.1
Gv	23.3
Tv 4	76.1
Tv 1	76.7
Tv 5	76.7
Tv 6	77.9
Tv 2	76.7
Pf 1	23.1
Pf 2	12.9
Pf 3	42.7
Pf 4	12.0
Pf 7	28.4
Control	00.0

* Mean of three replications

Table 23. Effect of fungicides and biocontrol agents on wilt incidence and yield parameters.

Treatments	Per cent of infection	Yield (t/ha)	Mean no. of fruits	Mean fruit weight (kg)	Plant height (cm)
Carbendazim	17.875	11.88	3.33	0.172	59.825
COC	2.875	9.49	2.84	0.140	50.625
Pf 1	9.925	10.43	3.19	0.162	57.975
Tv 2	4.400	9.15	2.91	0.157	50.950
Tv 1	2.775	6.08	2.31	0.125	41.825
Control	10.650	4.42	27.50	0.117	38.150

Number of fruits was higher in carbendazim treatment (3.33) followed by Pf1 (3.19) and Tv2 (2.91) treatments.

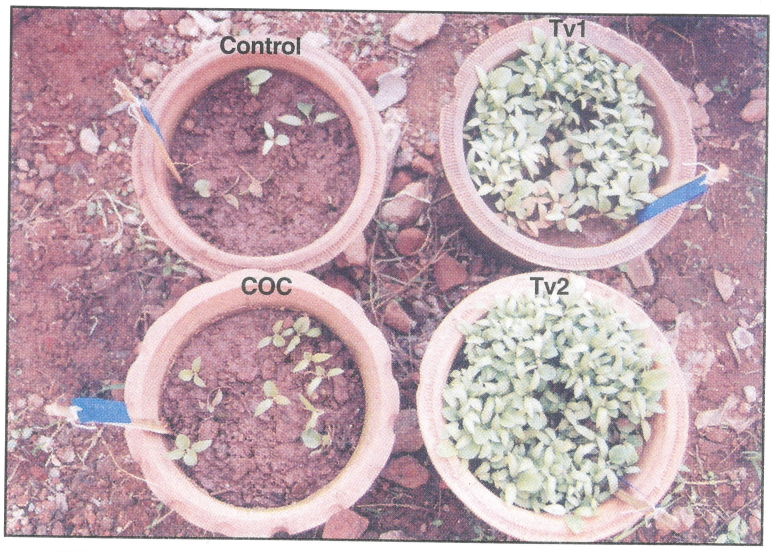
Damping off in brinjal nursery

The pathogen was isolated from infected seedlings and identified as *Pythium aphanidermatum*. The antagonists (*Trichoderma, Pseudomonas*) isolated from various sources were screened against the pathogen *in vitro*. Based on inhibition efficiency (Table 24), two *Trichoderma* spp (Tv 1 and Tv 2) and two *Pseudomonas fluorescens* (Pf 1 and Pf 7) were selected for field study.

Table 24. Efficiency of antagonists against *P. aphanidermatum* under *in vitro* conditions.

Antagonists	Per cent inhibition *
Tv3	67.8
Gv	35.9
Tv 4	60.8
Tv 1	57.0
Tv 5	38.9
Tv 6	60.3
Tv 2	77.8
Pf 1	55.6
Pf 2	16.7
Pf 3	44.4
Pf 4	16.7
Pf 7	45.2
Control	00.0

* Mean of three replications



Effect of biocontrol agents in managing brinjal damping off



Plant growth promoting ability of *P. fluorescens*

Talc based formulations of these biocontrol agents were prepared and used for treating soil and seed. Different combinations of treatments were tried in glass house condition. The experiment was conducted in a split plot design. Since damping off is primarily a soil borne disease, treatment of soil was taken as main plot treatment and use of biocontrol agents was maintained as sub plot treatment. Main plot treatments were 1) sterilized soil and pathogen inoculated 2) unsterilized soil and pathogen inoculated and 3) unsterilized soil and pathogen uninoculated. Soil was sterilized by autoclaving at 121 °C for one hour for two consecutive days. Inoculation of *Pythium* was done by mixing the fully grown culture with zoospores and mycelium to soil. Sub plot treatments include talc based preparation of two *Pseudomonas fluorescens* (Pf 1, Pf 7), two *Trichoderma* spp (Tv 1, Tv 2) and one fungicide (Copper Oxy Chloride). Control with out any treatment was also maintained for each main plot treatment. Brinjal seeds were treated with talc based formulations of *Trichoderma* spp and *Pseudomonas fluorescens* (4g/ kg) and COC (2g/ kg) before sowing. Soil mixture was

also treated with biocontrol agents (10g/ kg) and COC (2g/ kg). Pots were irrigated regularly. The percentage of pre and post emergence damping off, plant stand, shoot length, root length were recorded. Vigour index was calculated according to the formula given by Abdul Baki and Anderson.

Sterilization of soil and pathogen inoculation had a significant effect on the incidence of pre emergence damping off. Pre emergence damping off was less in unsterilized and pathogen uninoculated treatments irrespective of biocontrol agents used. The incidence of pre emergence damping off was comparatively high in unsterilized soil and pathogen inoculated treatment. The soil treatment had no significant effect on post emergence damping off (Table 25). However, the biocontrol agents influenced the incidence of post emergence damping off.

Table 25. Number of damping off seedlings.

Treatments	Pre emergence	Post emergence
I. Sterilized soil and pathogen inoculated		
Pf 1	54.7	171.3
Pf 7	32.3	214.7
Tv 1	35.0	160.3
Tv 2	21.3	188.0
COC	21.0	171.0
Control	74.7	236.3
II.Unsterilized soil and pathogen inoculated		
Pf 1	51.7	218.0
Pf 7	60.7	225.3
Tv 1	59.3	137.7
Tv 2	63.3	141.0
COC	51.7	155.0
Control	79.3	233.0
III.Unsterilized soil and pathogen uninoculated		
Pf 1	19.3	223.3
Pf 7	26.3	156.7
Tv 1	21.7	134.0
Tv 2	18.7	147.0
COC	20.3	185.0
Control	32.3	292.0
CD (P = 0.05) Main	4.03**	90.73 NS
Sub	9.26**	48.63 **
M at S	15.15**	117.54 NS
S at M	16.04**	84.24 NS

Mean of three replications. ** Significantly different, NS = Non Significant

Sterilized soil and pathogen inoculated

Per cent reduction of pre emergence damping off was maximum in COC (71.9%) and Tv 2 (71.5%) treatments. Per cent reduction of post emergence damping off was maximum in Tv 1 (32.2%), COC (27.6%) and Pf 1 (27.5%) treatments. Per cent plant stand was high in COC (42.39%), Tv 1 (41.4%) and Tv 2 (37.2%) treatments. Increase in shoot length was high in Pf 7 (14.9%) and root length was high in Pf 1 (75.4%) treatment. Vigour index was higher in all treatments when compared to control (Table 26).

Table 26. Effect of biocontrol agents on damping off incidence and growth parameters.

Treatments	Per cent reduction of pre emergence damping off	Per cent reduction of post emergence damping off	Per cent plant stand	Per cent increase in shoot length	Per cent increase in root length	Vigour index
Sterilized soil and pathogen inoculated						
Pf 1	26.8	27.5	32.19	11.1	75.4	863.6
Pf 7	56.8	09.1	25.89	14.9	38.6	885.0
Tv 1	53.1	32.2	41.40	07.8	09.7	785.0
Tv 2	71.5	20.4	37.20	09.5	31.9	873.3
COC	71.9	27.6	42.39	06.1	36.7	864.9
Control	0.0	0.0	6.69	0.0	0.0	628.6
Unsterilized soil and pathogen inoculated						
Pf 1	34.8	06.4	19.11	27.8	57.0	695.4
Pf 7	23.5	03.3	14.19	27.8	59.1	676.5
Tv 1	25.2	40.9	40.89	19.7	53.9	644.4
Tv 2	20.2	39.5	38.70	08.8	46.6	588.1
COC	34.8	33.5	38.01	20.4	31.1	627.8
Control	0.0	0.0	06.30	0.0	0.0	457.2
Unsterilized soil and pathogen uninoculated						
Pf 1	40.2	23.5	27.21	30.0	78.7	892.1
Pf 7	18.6	46.3	45.09	34.2	51.4	844.6
Tv 1	32.8	54.1	53.31	09.7	32.8	716.2
Tv 2	42.1	49.7	50.31	05.5	46.0	726.9
COC	37.2	36.7	38.40	02.7	60.1	735.2
Control	0.0	0.0	02.70	0.0	0.0	596.0

Mean of three replications

Unsterilized soil and pathogen inoculated

Reduction of pre emergence damping off was maximum in COC and Pf 1 (34.8%) treatments. Per cent reduction of post emergence damping off was maximum in Tv 1 (40.9%), and Tv 2 (39.5%) treatments. Plant stand was high in Tv 1 (40.89%) and Tv 2 (38.70%) treatments. Increase in shoot length was high in Pf 1, Pf 7 (27.8%) and root length was high in Pf 7 (59.1%), Pf 1 (57.0%) treatments. Vigour index was higher in Pf 1 and Pf 7 treatments than others (Table 26).

Unsterilized soil and pathogen uninoculated

Reduction of pre emergence damping off was maximum in Tv 2 (42.1%) and Pf 1 (40.2%) treatments. Per cent reduction of post emergence damping off was maximum in Tv 1 (54.1%), and Tv 2 (49.7%) treatments. Plant stand was high in Tv 1 (53.31%) and Tv 2 (50.31%) treatments. Increase in shoot length was high in Pf 7 (34.2%), Pf 1 (30.0%) and root length was high in Pf 1 (78.7%), COC (60.1%) and Pf 7 (51.4%) treatments. Vigour index was higher in Pf 1 and Pf 7 treatments than others (Table 26).

Only in the sterilized soil and pathogen inoculated, chemical treatment showed a higher degree of disease reduction and plant stand compared to biocontrol agents. However, *Trichoderma* treatment was also

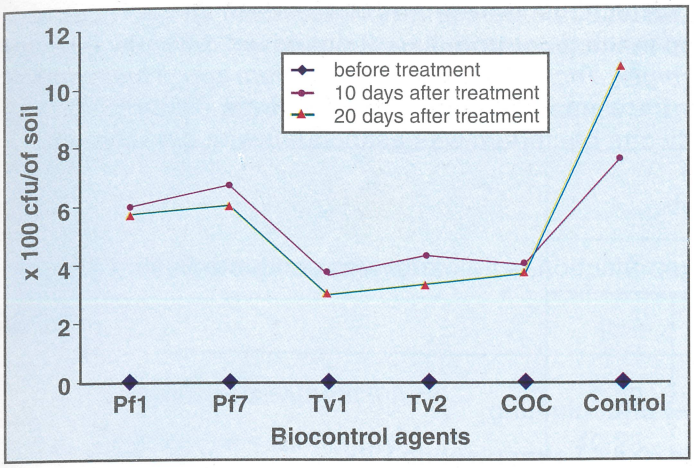


Fig. 7. Effect of biocontrol agents on the population of *Pythium* spp. in soil (sterilized-inoculated)

onpar with chemical treatment. In other main plot conditions, the degree of disease reduction and plant stand were higher in *Trichoderma* and *Pseudomonas* treatments.

Increase in shoot length, root length and vigour index was observed in *Pseudomonas* treatments irrespective of main plot treatments. However, the reduction of post emergence damping off was less in Pf treatments. Increased shoot and root growth by *Pseudomonas* could be due to the growth promoting ability of *Pseudomonas fluorescens*. Disease reduction by *Trichoderma* was due to the higher antagonistic potential of *Trichoderma* by different means *viz.* parasitism, production of lytic enzymes, etc.

Soil samples from each plot were collected before, 10 days after and 20 days after treatments for assessing the population of *Pythium*.

Change in Population of *Pythium* in soil in response to treatments

In sterilized-pathogen inoculated soil, population of *Pythium* increased after 10 days but reduced slowly at 20th day. The lowest population was recorded in *Trichoderma* (3, 3.3 x 10^2 cfu/ g of soil) and COC (3.7 x 10^2 cfu/ g of soil) treatments (Figure 7). In unsterilized-pathogen inoculated soil, the population increased after 10 days, but decreased below the initial level in case of *Trichoderma* treatments (4.3, 4.7 x 10^2 cfu/ g of soil) (Figure 8). This may be due to the hyperparasitization by *Trichoderma*. In *Pseudomonas* treatments the population remained under check. In unsterilized-pathogen uninoculated soil, the

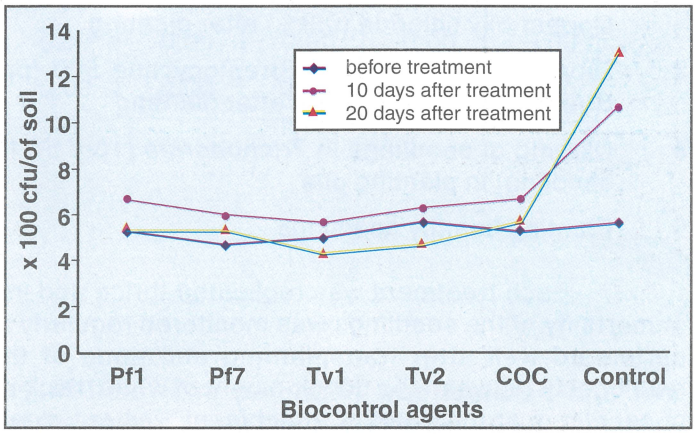


Fig. 8. Effect of biocontrol agents on the population of *Pythium* spp. in soil (unsterilized-inoculated)

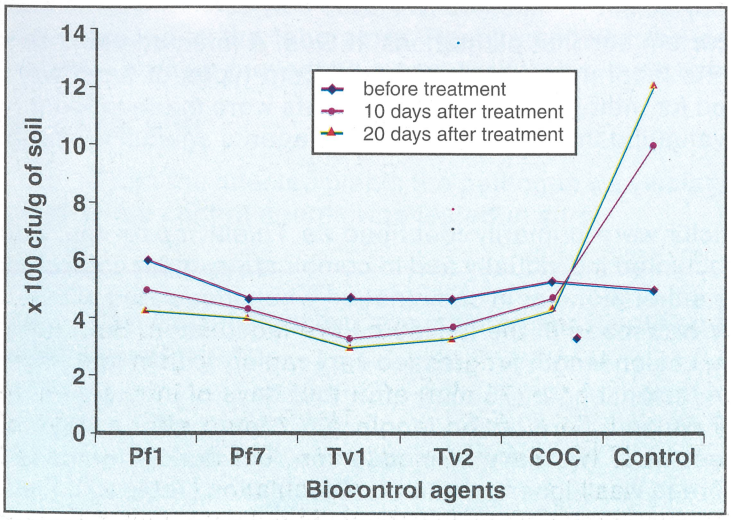


Fig. 9. Effect of biocontrol agents on the population of *Pythium* spp. in soil (unsterilized-uninoculated)

population decreased after the treatment in all the cases even after 10 days (Figure 9). This may be due to the synergistic effect of native microflora and absence of introduced pathogen to soil. In all the three cases, control treatment showed a rapid increase in the population of *Pythium*, which is responsible for increased disease incidence and reduced plant stand. Therefore, use of biocontrol agents will help in bringing down *Pythium* population in soil.

Seedling detachment and rotting of coconut seedlings

This problem was brought to the notice of ICAR Research Complex by Agricultural

Officer, State coconut nursery, Codar, Ponda. A thick white mould growth was observed in all the detached/ weak seedlings. The infected seedlings were analysed in the laboratory and about seven different types of fungi (*Aspergillus* spp, *Eupenicillium* spp, *Aspergillus niger*, *Trichoderma* spp, *Penicillium* spp, *Thielaviopsis* spp and an unidentified black coloured fungus) and one bacterium were isolated. None of the fungi was involved in the rotting at the point of detachment. Only one bacterium was associated with detachment.

Field trial- treatments

With a view to manage and prevent any further infection, a field trial was conducted using infected seedlings with different treatments.

1. Planting infected/ weak seedlings- Control
2. Drenching of seedlings with Carbendazim (0.2%) after planting
3. Drenching of seedlings with Copper oxy chloride (0.3%) after planting
4. Application of neem cake (1 kg/seedling) in the planting pits
5. Dipping of seedlings in Carbendazim (0.2%) for 10 minutes and drenching of seedlings with Carbendazim (0.2%) after planting
6. Dipping of seedlings in Copper oxy chloride (0.3%) for 10 minutes and drenching of seedlings with Copper oxy chloride (0.3%) after planting
7. Dipping of seedlings in Streptocycline 500 (ppm) for 10 minutes and drenching of seedlings with Streptocycline 500 (ppm) after planting
8. Dipping of seedlings in *Trichoderma* (10g/ lit) for 10 minutes and application of *Trichoderma* (100g/ seedling) in planting pits
9. Planting healthy seedlings

Each treatment was replicated thrice and in each replication five seedlings were planted. Wilting or mortality of the seedlings was monitored regularly up to six months. Results showed that weak seedlings performed well after transplanting and none of them (including control) showed any mortality. The relationship between the development of white, thick mould growth on the nuts of seedlings and detachment of seedlings at the point of attachment was not clearly understood. However, it was clear that the mould growth/ weak seedlings were not detrimental to initial establishment of the seedlings after planting.

Coconut leaf rot

This was the peculiar problem found in certain coconut plantations in Goa. A infected plantation was visited and the samples were diagnosed in the laboratory. Totally four different types of fungi were isolated from the samples. Two of them were proved for their pathogenicity. Attempts were made to identify the above fungi. Further work in this regard and evaluating the chemicals or other agents against the fungi are being done.

The two fungi proved for their pathogenicity were primarily identified as *Thielaviopsis* spp. and Pycnidia producing fungus. Both the fungi were inoculated individually and in combination under controlled conditions. Both fungi failed to produce symptoms either alone or in combination when inoculated with out injury. In another set of treatment, pin prick injury was made in the leaves before inoculation. Both fungi produced symptoms either alone or in combination. Lesion length progressed very rapidly with in four days. In first inoculation, *Thielaviopsis* spp caused more lesion length (75 mm) after four days of inoculation. In reinoculation, combined inoculation of both fungi caused more lesion length (66.75mm) after 4 days of inoculation. In reinoculation, lesion length was less after two days of inoculation, but rapidly increased within next two days. Hence, per cent increase in spread was higher in case of reinoculation (Table 27). Field inoculation studies also showed the same trend. Only injured leaves showed lesion development, however the length of lesion was less compared to leaces inoculated under controlled conditions. The reason

attributed may be the tissue hardness and unfavourable environmental conditions. Combined inoculation produced more lesion length than individual inoculation in field studies.

Table 27. Inoculation of coconut leaf rot fungi under controlled and field conditions.

Pathogen treatments	Lesion length (mm) days after inoculation				Per cent increase over 2 days	
	2 days		4 days			
	F	R	F	R	F	R
Thielaviopsis without injury	0.00	0.00	0.00	0.00	0.00	0.00
Thielaviopsis with injury	49.25	12.75	75.00	57.25	52.30	349.0
Pycnidial fungus without injury	0.00	0.00	0.00	0.00	0.00	0.00
Pycnidial fungus with injury	43.25	06.75	64.25	57.50	48.60	751.9
Both fungi without injury	0.00	0.00	0.00	0.00	0.00	0.00
Both fungi with injury	43.25	20.25	69.75	66.75	61.30	229.6
Control (no injury)	0.00	0.00	0.00	0.00	0.00	0.00
Control (only injury)	0.00	0.00	0.00	0.00	0.00	0.00

Mean of four replications

F = First inoculation, R = Reinoculation

Water melon rot

Rotting of watermelon fruits was observed in field. The pathogen was isolated and the pathogenicity was proved. However, the identification of the causal agent has to be done.

Banana wilt

This disease was severe at Bicholim taluka of North Goa. Infected field was visited and the samples were analysed in the laboratory. Results showed the severe infection of Panama wilt. The farmer was advised to take up preventive measures to save the existing young plantation.

Red gram wilt

From the infected plants the pathogen was isolated and identified as *Fusarium udam*. Antagonistic activity of bio control agents was tested *in vitro*.

Tuberose leaf spot

The causal organism was isolated and identified as *Sclerotium* spp. Bio control agents were tested against the pathogen.

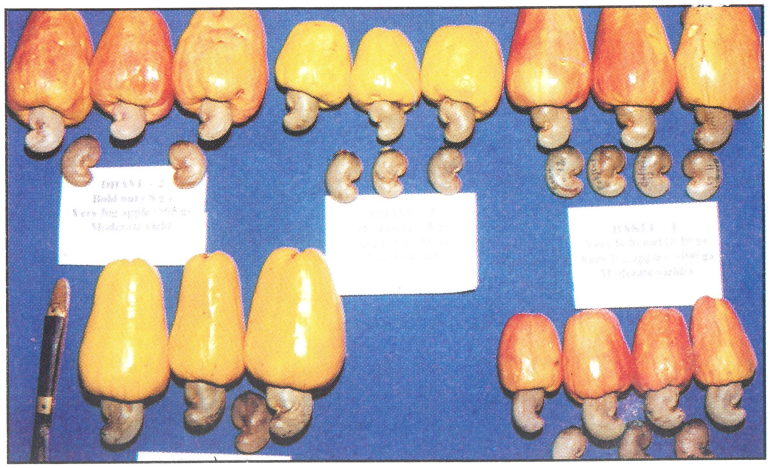
4.2 HORTICULTURE

4.2.1 Collection and evaluation of plantation crops and spices.

(AR Desai, PG Adsule, S Priya Devi, VY Gaonkar and J Ashok Kumar)

Cashew germplasm

Cashew germplasm collection of 166 accessions (76 in Germplasm bank -I and 90 accessions in Germplasm Bank -II) was maintained for further evaluation. Six more local promising accessions of cashew were identified from Ponda, Sattari, Tiswadi and Canacona zones (Table 28) and these were clonally multiplied for adding to clonal germplasm block maintained in the Institute's farm.



Promising cashew accessions from Goa

Evaluation

Among the local accessions that came to bearing during the last two seasons, the accession 'GCC-94/8 (Dhave –3)' continued to be promising in the evaluation trial by recording 3.18 kg/tree of nut yield with average nut weight of 8.85 g and kernel recovery of 30.54 per cent during the period under report, as compared to the nut yield of 2.34 and 2.85 kg/tree, mean nut weight of 8.15 and 8.04 g and kernel recovery of 31.55 and 28.75 per cent in Goa-1 and V-4 varieties respectively (Table 29). The grafts of GCC-94/8 were prepared for taking up multilocational trials in the ensuing season. The highest shelling per cent of 31.56 was recorded in Goa-1 followed by GCC-94/2 with 30.92 per cent shelling and 1.12kg of nut yield per tree.

Among the introduced accessions, H-1600 recorded the highest nut yield of 7.5 kg per tree with 6.6 g of average nut weight, 54.2 g of average apple weight and 28 per cent of kernel recovery, followed by H-1608 with nut yield of 3.90 kg per tree and nut weight of 7.02 g (Table 30). The performance of these accessions was observed to be consistent in the last three seasons. The accession - VTH-59/2, with medium nut size of 7 g recorded nut yield of 3.05kg/tree with highest shelling of 29.0 per cent. HB-1610 continued to record the bold nut size (8.8g) although the nut yield was less (1.8kg/tree).

Spices

High yielding varieties of turmeric namely, Prabha, Pratibha RCT-1 and Sudarshan were introduced and evaluated. These varieties recorded fresh rhizome yield of 25 to 30 tons per hectare. Production technology of turmeric as intercrop in coconut gardens was standardized and the information was furnished to The Directorate of Agriculture, Government of Goa.



Turmeric as an inter crop in coconut

Coconut survey

In a suvey conducted, forty Super palms in local Benaulim variety were identified in South Goa district for further studies.

Table 28. New accessions identified during 2001-02.

Zone	New accessions	Remarks
Sattari	Sattari –6 / 01	Bold nut type and high yielding
Ponda	Torla-1/01	Bold nut type and high yielding
	Esthmal-1/01	Bold nut type
Tiswadi	Tiswadi-7/01	Bold nut, good kernel filling
Canacona	Kuddi-1/01	Very bold nut, good kernel filling
	Kuddi-2/01	Medium nut size, very high yield

Table 29. Initial performance of local cashew accessions during 2000-01 and 01-02.

Accessions/Variety		Nut yield * (kg/tree)		Average nut weight (g)		Average apple weight (g)		Total soluble sugar (°B)		Shelling per cent
Number	Name	00-01	01-02	00-01	01-02	00-01	01-02	00-01	01-02	01-02
GCC-94/1	Ganje -1	NA	1.37	8.20	7.96	68.0	72.5	12.7	12.2	30.70
GCC-94/2	Ganje -2	0.255	1.12	9.20	8.56	86.1	84.5	11.9	12.0	30.92
GCC-94/3	Backle-1	NA	1.01	9.25	10.07	80.5	88.2	11.8	11.2	28.15
GCC-94/4	Karapur-1	0.120	0.94	8.03	8.10	85.4	79.8	11.4	11.6	28.88
GCC-94/5	Karapur-2	0.160	0.52	8.00	7.55	75.1	75.0	12.3	11.8	28.28
GCC-94/6	Dhave -1	-	0.75	-	6.71	-	71.5	-	11.6	30.70
GCC-94/7	Dhave -2	0.210	1.72	7.60	7.46	89.0	95.5	13.1	12.8	27.12
GCC-94/8	Dhave -3	0.550	3.18	9.35	8.85	78.8	84.6	12.6	12.0	30.54
GCC-94/9	Paikul -1	0.150	0.66	8.90	8.45	98.0	88.6	13.1	13.4	30.04
GCC-94/10	Balli-1	0.305	1.10	9.25	8.95	98.1	93.4	13.4	12.6	27.08
Goa-1	(Balli-2)	0.285	2.34	8.05	8.15	72.5	75.4	12.8	11.8	31.55
	V – 4	0.310	2.85	7.94	8.04	60.1	66.3	12.5	12.0	28.75

NA = Complete yield not available, Mean nut yield of unequal number of trees.

Date of planting – 1994 to 1997.

Spacing = 8m X 8m

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

Accessions	Nut yield (kg/tree)		Average nut weight (g)		Average apple weight (g)		Shelling per cent	
	00-01	01-02	00-01	01-02	00-01	01-02	00-01	01-02
HB - 1600	6.36	7.50	6.3	6.60	56.5	52.4	27.6	28.0
HB - 1608	3.66	3.90	6.7	7.02	43.6	50.0	28.0	28.2
HB - 1610	<1	1.80	9.3	8.80	60.0	58.2	--	27.6
HB - 1598	1.70	2.20	5.6	6.40	35.5	50.0	27.9	28.6
VTH - 59/2	1.94	3.05	6.9	7.00	52.1	55.4	28.7	29.0
VTH - 30	1.06	1.40	9.2	8.10	44.4	52.2	28.1	28.0
VTH - 125	1.30	0.95	5.4	6.00	65.6	60.2	--	27.1
M - 26/2	1.89	1.55	6.7	6.60	--	42.4	--	27.6

4.2.2 Evaluation of Oil palm (DxP) hybrid combinations under Goa conditions.

(AR Desai, K Ramachandrudu and S Priya Devi)

Of the five oil palm hybrids of Dura x Pissifera combinations evaluated under Goa conditions, the hybrid 35D x 291P recorded the highest fresh fruit bunch yield (142.35 kg/palm) with highest number of fresh fruit bunches (13.25 / palm) and average bunch weight of 10.74 kg, followed by the hybrid 18D x 32P (132.82 kg FFBs/palm) during 2001-02. (Table 31). Similarly, cumulative yield of FFBs from 1995-96 to 2001-02 showed significant trend among the hybrids, mostly due to difference in the average bunch weight. In terms of cumulative yield for the last six years, the hybrids 35 D x 291 P and 82 D x 266 P were on par with 436.77 and 409.81 kg FFB /palm, respectively followed by 18 D x 32 P which recorded a cumulative yield of 380.35 kg FFB per palm. However, cumulative number of FFBs did not follow the significant trend.

Table 31. Growth and Fresh Fruit Bunch (FFB) yield of oil palm hybrids.

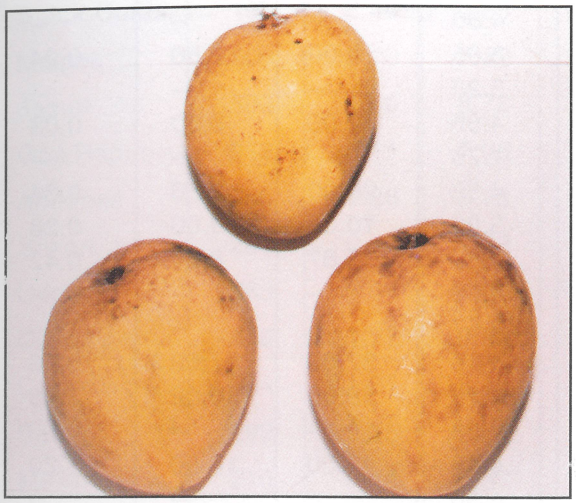
Hybrid Combinations	Height (m)	Girth (m)	FFB Yield		Average weight of bunch (kg)	Cumulative yield	
			Number of FFB's	Total yield (kg/palm)		Number of FFB's	Total FFB yield (kg/palm)
82 D x 266 P	7.31	3.05	12.63	112.41	8.89	65.32	409.81
124 D x 266 P	7.25	2.94	11.26	88.84	7.88	62.02	329.18
18 D x 32 P	7.56	2.56	10.95	132.82	12.13	54.95	380.35
35 D x 291 P	7.95	3.25	13.25	142.35	10.74	66.25	436.77
65 D x 111 P	7.65	2.84	12.65	96.23	7.61	59.41	312.63
CD (P=0.05)	NS	0.12	2.01	21.33	2.32	NS	38.46

4.2.3 Survey, collection, conservation and evaluation of fruit crop.

(SP Singh and VY Gaonkar)

Mango

Growth and yield performance of local varieties



Hilario - A promising local mango variety

Growth performance of 48 local mango varieties was studied during 2001-2002. The result pertaining to plant height. Stem girth spread of branches besides yield parameters *viz.* fruit / plant, fruit weight/ plant and yield efficiency are presented in table 32. Maximum yield of 40.00 kg/plant was recorded in variety Jesuit while, maximum yield efficiency of 6.5kg/$m^2$was obtained in variety Culas.

Fruit and stone characters of local varieties

During the year 15 local mango varieties were evaluated for different fruit parameters. The result pertaining to this study is presented in table 33. The highest TSS of 24.75 per cent was recorded in Monteiro followed by Hilario (24.20%). The highest fruit weight was registered in Jesuit (500 g/fruit)

Variability in Mankurad

The popular mango variety Mankurad collected from different parts of Goa also showed a lot of variability in fruit size, weight, appearance and quality. The fruit weight ranged from 234.00 g to 406.00 g in Shivolim area. The T.S.S of the fruit ranged from 14 to 19 per cent. Mankurad collected from Bamanwada of Siolim village was excellent in colour and appearance with Sindhuri red colour on shoulder with less fibre content. A single fruit was 320.00 g.(Table 34)



Amrapali-A promising hybrid for Goa



Genetic variability in Mankurad

Growth and yield performance of hybrids

Growth performance of 13 Hybrid varieties introduced at Institute were studied during the year (Table 35). Neelgoa recorded the highest yield and yield efficiency of 92.00 kg per plant and 3.05 kg per sq. m, respectively.

Table 32. Growth and yield performance of local mango varieties (2001-2002).

Variety	Plant height (m)	Girth of main stem (cm)	Spread of branches		No. of fruits / plant	Fruit weight/ plant (kg)	Yield efficiency (kg/m^2)
			NxS (m)	ExW (m)			
Mankurad(IC)	3.59	38.75	3.11	2.77	--	--	--
Mankurad (PWD)	4.03	43.00	2.40	2.55	3.00	0.80	0.18
Mankurad (Assolna)	3.50	30.00	2.20	2.15	--	--	--
Mankurad (Improved)	4.07	50.00	3.00	4.50	--	--	--
Mankurad (Yellow)	5.05	51.00	4.85	3.65	9.00	2.50	0.24
Mankurad(Diwar)	3.70	46.50	2.25	3.25	--	--	--
Mankurad (Keni)	4.93	60.50	4.55	4.55	2.00	0.50	0.03
Mankurad (Benaulim)	4.80	26.00	1.90	1.75	--	--	--
Mankurad (Sport)	4.40	52.33	3.60	4.52	20.00	3.50	0.34
Bismi	4.20	52.50	5.25	5.00	10.00	6.00	0.28
Hilario	5.13	60.00	4.90	5.30	31.67	8.00	0.42
Hilario (Ela)	4.20	46.00	4.57	3.53	--	--	--
Hilario (Marian)	6.00	59.00	4.20	4.57	--	--	--
Hilario (MPSA)	4.61	46.25	3.88	4.16	37.00	7.50	0.66
Jesuit	5.18	60.50	4.85	4.18	58.00	40.00	2.16
Miranda	3.53	46.00	3.25	3.53	--	--	--
Koita	3.83	46.32	4.17	4.40	42.00	16.50	1.20
Toranj	4.20	57.00	4.20	4.50	--	--	--
Papel Branca	3.35	42.50	2.55	2.83	--	--	--
Salcette Musarat (D)	4.79	51.50	3.59	3.86	13.00	2.75	0.27
Monterio	4.23	45.00	2.30	2.90	15.00	2.50	0.60
Fernandin	4.48	48.67	3.73	2.70	21.66	8.33	0.76
Colaco Branca	3.75	42.00	3.13	3.38	13.00	3.50	0.45
Furtado	4.00	45.00	4.05	4.05	4.00	1.00	0.08
Manga Rosa	5.80	76.00	3.90	5.50	4.00	1.50	0.13
Ball	4.50	44.00	4.20	5.00	42.00	18.00	1.30
Sakari	5.30	65.00	6.70	7.00	29.00	8.50	0.24
Oliveira	4.55	41.00	3.70	4.62	--	--	---
Culas	3.40	35.00	1.70	2.65	43.00	15.00	6.61
Malgoa	3.35	37.33	3.25	3.15	11.00	2.00	0.24
Bemcorado	3.55	76.50	4.35	3.65	14.00	14.50	0.97
Caria Alphonso	4.90	50.00	3.20	4.35	--	--	--
Salgadin	4.93	51.50	3.75	4.05	--	--	--
Goa Hapus	3.53	26.00	1.90	1.75	--	--	--
Caria Branca	3.85	39.50	3.40	3.80	15.00	5.00	0.55
Bindao	3.85	37.75	2.80	2.58	--	--	--
Aranjo	4.00	38.50	2.98	2.82	---	--	--
Reynald	3.06	33.50	2.28	2.19	--	--	--
Costa	3.26	33.25	2.80	2.69	2.00	0.50	0.08
Rebello	4.13	42.50	4.13	3.50	--	--	--
Annanas	3.90	5.15	3.75	4.24	40.00	14.00	1.26
Maxima	5.30	66.50	6.50	6.08	15.00	4.50	0.13
Malgesh	4.95	57.00	4.05	4.65	--	--	--
Sakar Ambo	3.48	22.00	3.00	2.00	--	--	--

Table 33. Characterization and preliminary evaluation of different local mango varieties.

Variety	Fruit Characters				Stone Characters				Skin wt. (g)	T.S.S. per cent
	Weight (g)	Length (cm)	Width (cm)	Girth (cm)	Weight (g)	Length (cm)	Width (cm)	Girth (cm)		
Hilario	240	8.98	7.38	6.30	30.0	6.72	3.04	2.09	56.8	24.20
Monteiro	138	7.15	6.75	5.33	19.4	5.10	4.06	1.28	32.8	24.75
Black Culas	190	8.48	6.85	5.96	27.3	6.69	3.44	1.80	26.0	18.30
Malgoa	206	8.70	7.12	6.03	30.8	6.87	3.68	2.07	52.2	18.10
Jesuit	500	11.66	8.72	7.64	70.5	9.48	4.71	2.43	84.5	12.04
Goa Hapus	212	8.11	7.06	5.70	40.0	6.46	2.26	3.86	40.0	-
Annanas	465	11.88	8.78	7.71	51.0	10.04	3.67	2.22	65.0	-
Sakari	280	9.46	7.78	6.94	57.0	6.85	3.79	2.33	82.8	21.00
Udgo	263	9.54	7.04	6.27	26.0	7.87	3.57	1.83	47.0	14.50
Coita	488	21.77	6.59	5.19	73.8	19.88	3.57	2.21	141.2	-
Colaco Branca	364	11.81	8.18	7.50	37.8	9.51	3.82	2.21	79.2	14.70
Ball	299	9.75	7.21	7.09	32.4	7.58	3.66	1.91	47.6	16.40
Maxima	210	9.44	7.87	6.75	42.4	7.39	4.13	2.30	56.0	17.95
Bismi	476	10.55	8.89	8.33	43.0	7.34	4.18	2.23	68.0	14.40

Table 34.Variability in Mankhurad.

Variety	Fruit Characters				Stone Characters				Skin wt. (g)
	Weight (g)	Length (cm)	Girth (cm)	Width (cm)	Weight (g)	Length (cm)	Width (cm)	Girth (cm)	
Mankurad (Siolim)	234	7.86	7.74	6.78	30.0	6.15	3.68	2.20	40.00
Mankurad (Special)	406	10.49	8.25	7.73	42.0	8.00	4.31	1.90	80.00
Mankurad (Assolna)	292	2.92	7.59	7.59	51.5	8.18	4.62	1.98	53.76
Mankurad (Bamanwada)	320	9.44	8.44	7.41	36.0	7.14	1.87	4.10	52.00

Fruit and stone characters of hybrids

Of the 13 hybrid mango varieties introduced by the Institute, eight hybrids were studied for various fruit and stone parameters (Table 36). The highest TSS of 24.8 per cent was recorded in Ratna. Arka Aruna registered the highest fruit weight of 540 g per fruit.

Growth and yield performance of introduced varieties

Maximum yield of 60.1kg/plant was recorded in Ratnagiri Alphonso, while the maximum yield efficiency of 2.85kg/m^2 was registered by Alampur Benesan yielding 14.0kg/plant. Neelam also performed well yielding 39 kg/plant with yield efficiency of 2.52 kg/m^2 (Table 37).

Table 35. Growth and yield performance of hybrid mango varieties (2001-2002).

Variety	Plant height (m)	Girth of main stem (cm)	Spread of branches		Fruit / plant	Fruit weight/ plant (kg)	Yield efficiency (kg/m^2)
			NxS (m)	ExW (m)			
KxB	3.00	43.30	3.78	3.57	92.0	19.00	1.69
Ratna	4.43	53.50	4.00	5.10	37.0	3.25	0.25
HB-56	5.35	1.25	7.50	8.20	78.0	27.00	0.61
HB-45	4.70	77.50	4.70	5.73	37.0	15.50	0.89
HB-151	4.30	73.00	4.80	5.00	244.0	29.50	1.63
HB-87	5.20	78.00	7.10	6.20	29.5	14.50	0.37
Arka Puneet	4.55	53.30	4.73	5.58	13.5	4.00	0.22
Arka Aruna	4.98	59.25	4.63	4.36	15.0	7.50	0.45
Arka Anmol	5.58	60.75	4.20	4.43	15.0	5.00	0.36
Amrapali	4.48	69.50	4.80	3.93	101.0	22.30	1.24
Neelgoa	4.80	98.00	6.20	8.00	172.0	92.00	3.05
HB-117	2.60	32.00	2.25	2.41	5.5	1.75	0.44
Mallika	3.75	40.00	3.50	3.50	62.0	8.50	0.88

Table 36. Characterization and preliminary evaluation of different introduced hybrid mango varieties.

Variety	Fruit Characters				Stone Characters				Skin wt. (g)	T.S.S. per cent
	Weight (g)	Length (cm)	Width (cm)	Girth (cm)	Weight (g)	Length (cm)	Width (cm)	Girth (cm)		
HB-56	356.4	9.49	9.53	7.30	28.5	7.72	4.38	1.55	89.5	14.10
HB-45	539.8	12.87	9.81	8.18	50.6	9.34	4.93	2.14	69.4	17.68
Ratna	370.4	10.67	8.37	7.21	47.6	8.67	4.55	2.05	65.9	24.80
Arka Aruna	540.0	11.67	10.31	8.24	32.0	8.93	4.50	1.86	78.0	-
Amrapali	288.4	11.95	7.00	6.17	40.8	10.61	3.68	1.97	48.4	18.80
KxB	216.4	11.28	6.49	5.44	22.8	9.12	3.43	1.42	75.6	20.20
Arka Puneet	236.0	9.68	6.97	5.83	46.4	8.02	4.09	2.09	54.2	17.82
Mallika	177.2	11.21	5.80	4.86	26.8	10.09	3.30	1.54	28.0	18.08

Table 37. Growth and yield performance of introduced mango varieties (2001-2002).

Variety	Plant height (m)	Girth of main stem (cm)	Spread of branches		Fruit / plant	Fruit weight/ plant (kg)	Yield efficiency (kg/m^2)
			NxS (m)	ExW (m)			
Himayuddin	3.70	45.00	4.00	3.50	6.50	4.00	0.42
Kesar	4.10	60.00	4.40	4.65	98.50	21.00	1.24
Vallaicolamban	3.75	40.00	3.60	4.00	76.70	14.70	1.17
Neelam	4.13	52.00	4.10	4.45	200.00	39.00	2.52
Elavaygan	4.30	63.50	4.70	4.83	6.00	4.50	0.25
Ratnagiri Alphonso	6.40	95.75	7.15	7.46	260.70	60.10	1.38
Alampur Benesan	2.45	31.00	3.00	2.50	39.00	14.00	2.85
Kalapaddy	3.95	49.50	4.33	5.05	41.00	8.45	0.42

Fruit and stone caharcters of introduced varieties

The T.S.S. in different introduced varieties ranged from 14.4 to 24.05 per cent and was maximum in Kalapady (24.05 %) followed by Kesar (23.44 %). Neelgoa registered the maximum fruit weight of 634 g/ fruit

Promising mango varieties from North - East Hilly Region

Growth parameters of two promising varieties from N.E.H. Region i.e MDCH-1 and STH-1 were studied. The average plant height of MDCH-1 was 2.36 m. Girth of the main stem was 25.16 cm, with a plant spread of 1.88 x 1.80m towards NxS and ExW, respectively. The variety STH-1 recorded an average height of 1.86m. Spread of the plants towards NxS and ExW was 1.27 x 1.38m, respectively.

Table 38. Characterization and preliminary evaluation of different introduced varieties of Mango.

Variety	Fruit Characters				Stone Characters				Skin wt. (g)	T.S.S. per cent
	Weight (g)	Length (cm)	Width (cm)	Girth (cm)	Weight (g)	Length (cm)	Width (cm)	Girth (cm)		
Kesar	201	9.35	6.76	5.91	35.2	7.98	3.56	2.19	42.6	23.44
Elavayangan	372	10.06	8.27	8.02	48.0	7.83	4.18	2.37	80.0	--
Himayuddin	615	14.98	6.77	6.99	50.0	11.65	4.89	2.33	205	--
Ratnagiri Alphonso	275	9.41	7.51	6.78	34.8	7.22	3.55	2.06	45.2	17.88
Vellaicolamban	292	12.75	7.15	5.65	43.2	10.53	3.54	1.95	92.4	15.00
Alampur Benesan	294	13.51	6.36	7.61	34.0	10.97	2.47	3.41	67.3	--
Kalapady	228	9.06	7.07	6.17	37.2	7.09	3.74	2.12	62.4	24.05
Neelgoa	634	11.84	10.33	8.83	46.0	9.83	5.64	2.08	134.0	14.40

During the year the two promising local mango selections *viz* Cardozo mankurad and Bencarado were monitored for their growth performance. Besides this the growth performance of two promising varieties introduced from the north East hilly region of the Country was studied and a new mango block consisting of 40 varities was established. Some minor fruits *viz*. kokum, jackfruit, rose apple, Portuguese jackfruit, bread fruit, ambada were also collected and established in the Institute.

4.2.4 Survey, collection, conservation and evaluation of fruits available / grown in agro-forest areas of Goa.

(S Priya Devi, AR Desai, M Thangam, SM Talaulikar and PG Adsule)

Survey work was continued in fields and markets of Goa. In addition to 15 local fruits reported last year, an additional fruit called 'mattom' was identified. Besides, field survey was done to study the variation found in jagomas (Governor's plum). The details about the above-mentioned fruits are as follows

Mattom



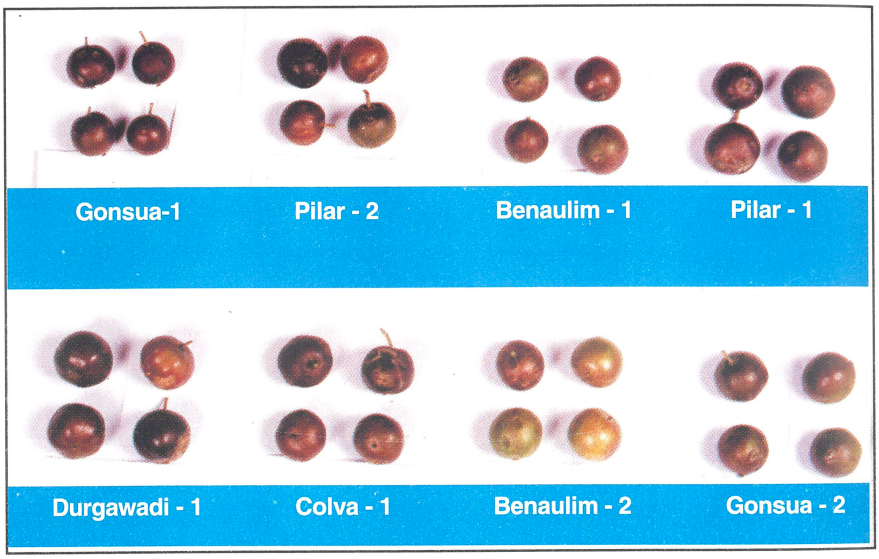
Mattom - A rare minor fruit of Goa

This fruit is very rare in Goa and is borne on large perennial trees, found on river banks or proximal to water sources. The fruit looks like Sapota, oval –round in shape, light brown in colour and skin coarse to feel. Skin can be peeled off and the seed inside is big and single. Pulp is creamish yellow-light yellow in colour. Seed is covered with fibre (like mango).

The average fruit weight, length and diameter are 32.19cm, 4.35cm and 3.72cm respectively. Like wise, average moisture, total titrable acids, total sugars, reducing and non-reducing sugars are 70.68, 0.49,16.64,12.29 and 4.35 per cent respectively, while the Total Soluble Sugar (TSS) was 20° Brix.

Jagoma (*Flacourtia jangomas*)

Field survey was conducted in four taluks and 17 accessions of Jagomas were identified. Morphological observations were made on only eight accessions. (Table 39) Average values of individual fruit weight, TSS, acidity, total sugars and moisture were found to be 5.1g, 15° Brix, 0.56,12.12, 73.05 per cent respectively. Among the accessions studied, DG 1 recorded the highest fruit weight of 7.14g.



Variation in local jagoma accessions



Variation in ambada accessions

Ambada / Hog plum (*Spondias pinnata*)

Field and market surveys for ambada revealed two distinct types, based on seed size and sourness. One type is oval with a big seed inside, with sour pulp, whereas the other type is round – oblong, with a comparatively sweeter pulp and a ganglion type of seed. The variation between these two types in terms of physico-chemical traits are furnished in table 40.

Besides this, the institute germplasm was enriched by procuring four released amla varieties (NA10, NA6, Kanchan and Chakaiya), one kokum variety (Konkan Amruta), jack (firm type) grafts and

three Jamun varieties (G1, G2 and G3). Two roseapple layers started fruiting during the year. Observations on these layers and also vegetative characters like plant height, stem girth, number of branches etc. of other materials planted were also recorded.

Table 39. Variation in morphological characters of jagoma accessions.

Location	Name	Fruit wt (g)	Fruit length (cm)	Fruit diameter (cm)	Number of seeds	Individual seed wt (g)
Siolim	S 1	6.09	1.94	2.11	10.33	0.05
Pilar	P 1	5.54	2.01	2.16	11.20	0.05
Pilar	P 2	5.46	2.09	2.13	8.00	0.04
Gonsua	G 1	3.82	1.84	1.83	11.30	0.04
Gonsua	G 2	5.67	2.09	2.12	10.80	0.04
Colva	C 1	5.42	1.89	2.18	10.00	0.05
Benaulim	B 1	4.10	1.86	1.87	10.10	0.04
Durgawadi	DG 1	7.34	2.16	2.48	11.22	0.07

Table 40. Variation in ambada types.

Character	Elongated	Round
Fruit wt (g)	37.19	90.32
Fruit length (cm)	7.70	8.78
Fruit circumference (cm)	10.41	15.52
Seed weight (g)	16.59	9.56
Seed (%)	44.60	10.58
Moisture (%)	79.66	73.42
Acidity (%)	2.39	0.96
Ascorbic acid (mg/100g)	122.07	70.42

4.2.5 Survey on the requirement of exotic and indigenous fruits, vegetables and flowers and their processed products in Goa from tourism point of view.

(S Priya Devi, M Thangam and AR Desai)

An exclusive proforma was formulated for this project. Market surveys were conducted in Ponda, Mapusa, Madgaon and Banastri markets to collect details about quantity of fruits and vegetables coming into Goa. Additional surveys are to be made. Besides, all star deluxe and five star hotels in Goa, five hotels each in categories of three, two, one star hotels, unclassified, GTDC hostels etc were surveyed in Calangute and Panjim areas. Information on annual requirement of fruits, vegetables and flowers of these hotels were collected.

4.2.6. Collection, conservation and evaluation of vegetable crops.

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

Evaluation trial in Okra

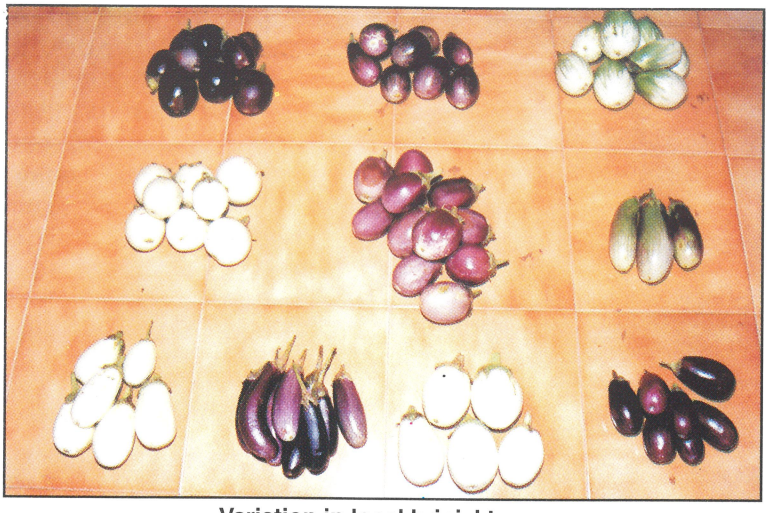
The selfed seeds of okra extracted in Janauary, 2000 were sown during kharif 2001. The treatment included local types along with released varieties as check. The morphological and yield traits were recorded (Table 41 and 42). Three local types *viz* No. 6, 3 and 11 recorded higher yields of 470.56, 344.78 and 334.78 g of fresh fruits per plant when compared to released varieties like Arka Anamika (221.89g / plant) and Parbhani kranti (193.56g / plant).

Unlike the last year crop (*rabi* 2000), there was no incidence of Yellow Vein Mosaic (YVM) during this year, which might be due to difference in the environmental factors that influence the vector population. Some of the local types yielded long fruits of desirable edible quality.

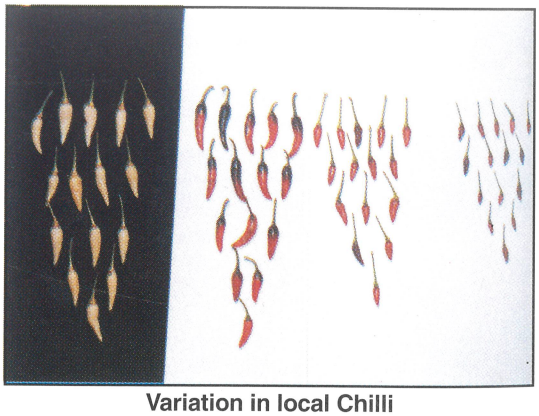


A promising local Okra type

Evaluation trial in Brinjal



Variation in local brinjal types



Variation in local Chilli

The lines evaluated included popular local types *viz.*, *Agassim* and *Taleigao* along with other types. All the lines were subjected to two different types of bio control agents *viz.*, *Trichoderma spp* and *Pseudomonas spp* before transplanting. The difference in fruit characters of all the local types evaluated is furnished in table 43.

Collection of under utilized vegetable crops of Goa region

Information on under utilized vegetable crops like Mangrove fern (*Acrostichum aureum*), Bamboo (*Dendrocalamus spp*), Aerial Yam (*Dioscorea bulbifera*), Taro (*Colacasia esculenta*), Chinese Potato (*Solenostemon rotundifolius*), Kakrol (*Momordica dioica*) etc., was collected. The basic physico-chemical analysis is being carried out.

Table 41. Morphological characters of okra accessions/varieties.

Variety / type	Plant height (cm)	Number of nodes	Germination per cent
Arka Anamika	110.00	11.00	90
Parbhani kranti	139.33	11.67	80
DVR-1	96.33	10.33	100
DVR-2	134.00	13.00	100
Sel-10	125.00	12.67	90
Bo-1	108.22	11.67	70
VRO-6	108.67	10.33	100
Local type-1	145.23	12.00	100
Local type-2	145.00	13.33	100
Local type-3	135.33	11.00	100
Local type-4	119.33	11.00	100
Local type-5	112.33	11.33	100
Local type-6	107.67	10.00	90
Local type-7	152.67	13.33	90
Local type-8	116.33	10.33	60
Local type-9	108.00	11.00	100
Local type-10	122.33	11.33	100
Local type-11	104.83	9.00	100
Local type-12	93.33	10.00	40
Local type-13	108.00	9.00	20
CD (P=0.05)	NS	NS	17.35

NS = Non Significant

Table 42. Yield characters of okra accessions/varieties.

Variety / type	Days to first flowering	Individual fruit wt. (g)	Yield per plant (g)
Arka Anamika	32.67	22.35	221.89
Parbhani kranti	32.67	22.14	193.56
DVR-1	31.33	20.42	184.44
DVR-2	31.67	21.35	217.44
Sel-10	33.67	23.27	210.78
Bo-1	32.67	21.75	198.89
VRO-6	32.67	19.54	173.89
Local -1	38.33	26.14	285.22
Local -2	34.00	20.12	208.33
Local -3	35.67	33.70	344.78
Local -4	32.67	22.06	213.45
Local -5	32.67	22.56	247.00
Local -6	36.00	35.59	470.56
Local -7	36.00	22.48	259.89
Local -8	35.33	32.51	315.78
Local -9	34.33	22.58	185.66
Local -10	35.33	21.53	218.78
Local -11	38.33	32.29	334.78
Local -12	35.67	22.22	126.33
Local -13	38.67	23.30	201.67
CD (P=0.05)	1.48	5.57	113.32

Table 43. Fruit characters of local brinjal types.

Local type	Individual fruit wt. (g)	Fruit length (cm)	Fruit circumference (cm)
Agassim	243.33	22.50	18.17
Taleigao	208.00	13.00	24.50
Taleigao dark purple	223.33	15.00	24.67
White long	240.67	15.50	23.33
White round	118.00	9.63	19.75
Green-white striped	133.50	11.63	18.88
Agassim long green	159.33	17.83	16.27

4.2.7 Survey, collection and evaluation of flower crops.

(K Ramachandrudu, M Thangam and PG Adsule)

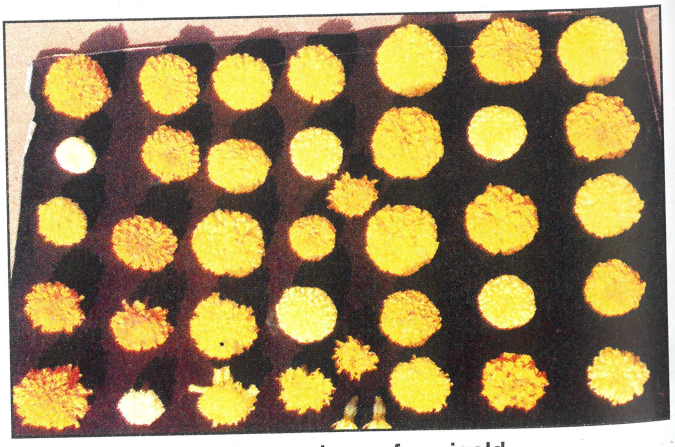
Varietal evaluation of gladiolus in Goa



Gladiolus varieties evaluated in Goa

Four varieties from Holland namely Nova Lux, White Prosperity, Spic and Span and Rose Supreme were evaluated between November, 2001 and March, 2002 in replicated trial by using simple Randomized Block Design under open field conditions. Data on various aspects like germination percentage, plant height, number of days to spike emergence, spike length, number of flower buds per spike, vase life etc were recorded.

All varieties performed well and differed significantly in certain characters (Table 44). The variety Spic and Span was too early and took just 51 days for spike emergence, while Nova Lux took 66 days to reach the same stage. The maximum spike length (98 cm) and the minimum spike length (58 cm) were observed in White Prosperity and Spic and Span, respectively. The Variety Nova Lux had shown maximum flower diameter (11.62 cm) where as the minimum size was recorded in Rose Supreme. The first floret of spike lasted for 3.17 days in Nova Lux, while in White Prosperity it lasted for two days. The maximum corm size (5.90 cm) and weight (60.83 gms) were observed in Nova Lux and the minimum corm size (4.31 cm) and weight (22.60 gms) were noticed in Rose Supreme.



Local germplasm of marigold

Table 44. Performance of gladiolus varieties over growth and flowering characters.

Character	Nova Lux	White Prosperity	Spic and Span	Rose Supreme	CD (P=0.05)
Germination percentage	100.00	100.00	100.00	100.00	—
Days to emergence of spike	66.00	55.00	51.00	52.00	1.09
Days to showing of colour	72.00	61.00	56.00	58.00	1.89
Days to opening of first flower bud	75.00	64.00	60.00	62.00	2.42
No of leaves per shoot	9.00	8.00	8.00	8.00	0.24
Leaf length (cm)	48.17	49.08	46.00	48.67	1.08
Leaf width (cm)	3.30	3.10	2.37	3.37	0.19
Plant height (cm)	80.09	75.80	58.67	71.68	6.22
No of shoots / plant	1.00	1.00	1.00	1.00	—
Spike length (cm)	96.32	98.00	58.00	86.78	3.24
Rachis length (cm)	40.83	45.17	29.30	48.50	4.37
No of flower buds/spike	13.00	12.00	12.00	13.00	0.72
First floret diameter (cm)	11.62	11.33	9.17	9.13	0.97
No of spikes/plant	1.00	1.00	1.00	1.00	—
Life of first floret (days)	3.00	2.00	3.00	3.00	0.23
Vase life of spike in tap water (days)	11.00	11.00	10.00.	10.00	0.55
No of corms per plant	1.00	1.00	1.60	1.10	1.69
Individual corm weight (g)	60.83	36.77	34.27	22.60	19.70
Individual corm size (cm)	5.90	5.17	4.93	4.31	1.44

4.2.8 Inventory on the basic information of economic forest tree species and medicinal plants in the Goa region.

(M Thangam, K Ramachandrudu and AR Desai)

Survey and identification of medicinal plants of Goa

Based on the recommendations of the RAC, this work was taken up initially for one year. As a result of the survey work carried out, a total of 323 medicinal plants species of 238 genera were identified, which belong to 72 families. Among the 323 species, a few, which are found in abundance have the scope, to be domesticated and commercialized are short-listed.

Among the identified species, a few like *Andrographis paniculata, Gloriosa superba, Rauvolfia serpentina, Hemidesmus indicus, Solanum nigrum, Withania sominifera, Adhatoda vesica, Ocimum basilicum, Coleus amboinicus, Aloe vera, Chlorophytum borivilianum, Asparagus racemosus, Curcuma amada, Gymnema sylvestre,* etc., are found abundantly in nature and can be commercially exploited in the field of medicine.

4.2.9 Standardization of agrotechniques for horticultural crops.

(SP Singh)

Establishing high density mango orchard

In this project, 40 local mango varieties were planted at a spacing of 4x4m in the new block for establishing a high-density mango orchard. Evaluation, with regard to growth parameters was studied.

Introduction of dwarf varieties from North-Eastern Region in high-density orchard

Two promising varieties from NEH region, MDCH-1 and STH-1 were planted with a spacing of 2.5 x 2.5m in the high density block. Growth parameter of both these varieties was studied in detail. Plant height of MDCH-1 ranged from 1.4 to 2.9m with a average height of 2.36m. The girth of the main stem was 25.16 cm with plant spread of 1.88 x 1.80m towards NxS and ExW, respectively. The variety STH-1 registered an average height of 1.86m. Spread of the plants towards NxS and ExW was 1.27 x 1.38 m, respectively.

Introduction of RCMS-1 and CMKD for developing agrotechniques

Two promising local varieties i.e Bemcorado selection (RCMS-1) and Cardozo Mankurad (CMKD) were planted in the new block at 5x5 m spacing for preparing nucleus-planting material and to standardize agrotechniques. Maximum plant height in Bemcorado was 1.86 m with stem girth of 16.83 cm. Plant spreading found towards NxS and ExW was 1.22x1.16 m, respectively. In Cardozo Mankurad, height recorded was 1.32 m followed by stem girth of 13.5 cm. Plant spread towards NxS and ExW was 0.81 x 0.75 m, respectively.

Suitable agrotechniques for multistoried cropping system in Goa

In High Density Cropping Model (HDCM) in coconut, three varieties *viz*; Calangute, Benaulim and DxT were tested along with mango (Amrapali) in the middle of four coconut and banana (Saldatti). Black pepper (Panniyur-1) was trailed on coconut. The yield and other data of different crop components were recorded.

In the HDCM block, out of the three coconut varieties, Benaulim gave the highest yield. A total nut yield of 2253 nuts was obtained from Benaulim with an average yield of 77.86 nuts/palm/year. DxT gave an average yield of 52.62 nuts/palm/year. It was on par with Calangute which gave an average of 53.10 nuts/palm/year. The mango variety Amrapali, planted in between four coconut palms performed well. The average yield was 44.75 kg/plant while, the overall average number of fruits/plant was 221.43 fruits. The yield almost doubled during the year as compared to 26kg fruit/plant recorded during 1999-2000.

4.2.10 Post harvest management technologies for fruits available / grown in agro-forest areas of Goa

(PG Adsule, AR Desai, K Ramachandrudu, S Priya Devi, M Thangam and BK Swain)

Survey, collection and evaluation of some more traditional processed products

Four different types of papads *viz*. black gram-red chilli papad, black gram-tarwatti chilli papad, garlic papad, dhangar (Bengal gram +green gram +black gram) and bottle gourd cakes and stuffed mango pickle were collected from the local processors in the region. Initially, moisture and acidity contents were estimated in these products (Table 45). The average moisture and acidity in papads was found to be 9 per cent and 1.01 per cent, respectively. The products subjected to improved storage conditions with

appropriate packaging material (0.6mm thickness of HDPE bags) are under observation along with conventionally packed ones (0.3mm thickness).

Table 45. Intial moisture and acidity in products before packing.

Product	Moisture (%)	Acidity (%)
Blackgram-redchilli papad	10.179	1.465
Black gram-tharawatti chilli papad	8.982	0.848
Garlic papad	9.954	0.816
Dhangar	8.543	0.881
Bottle gourd cake	4.644	0.987
Stuffed mango pickle	67.143	1.871

Storage trial of fruits available in season

Bulbs of ripe jackfruit were stored in refrigerator after packaging in polythene bags. TSS and acidity were recorded periodically during 30 days of storage. The bulbs kept well for 23 days without any preservatives. (Table 46)

Table 46. Periodic observation on jack bulbs stored.

Day of storage	TSS^0 Brix	Acidity
Initial	15.4	0.35
23rd day	21.0	0.40

At room temperature, ripe bulbs of jackfruit were stored in sugar solution (40° Brix) at two concentrations of SO_2 *viz.*, 100 and 250 ppm. Bulbs in 100ppm SO_2 got spoiled after first week of storage, whereas bulbs in 250ppm SO_2 kept well for four months.

Similarly, ripe bulbs of jackfruit were stored in 40 ° Brix sugar syrup with two levels of sodium benzoate *viz.*, 250 ppm and 750 ppm. Bulbs stored in 250 ppm sodium benzoate got spoiled within two weeks of storage, whereas the latter kept well for four months. Studies on the preservation of matured, but unripe jackfruit bulbs at room temperature revealed that the bulbs could be stored for 12 months with their original colour and firm texture. Storage studies on the well dried jackfruit seeds found that the seeds stored in glass bottle had more shelf life as compared with traditional method of storage (seeds coated with mud paste).

Besides this study, the jack seeds were also stored at different concentrations of brine solution along with preservatives 0.05 per cent KMS or 0.025 per cent SO_2. Periodical observations were recordd on the preservation level. The seeds kept well in all the treatments. (Table 47).

Table 47. Level of preservative after 12 months of storage.

Brine concentration (%)		SO_2 concentration (%)
2.5	Solution	0.024
	Seeds	0.019
5.0	Solution	0.022
	Seeds	0.019
7.5	Solution	0.025
	Seeds	0.022

Bimblli (*Averrhoa bilimbi*)

An attempt on the storage of this indigenous fruit in appropriate level of salt (5%), acetic acid and SO_2 (0.025 %) found that the fruits could be stored for about six months without losing their firm texture. However, they changed their original green colour at the end of a month after initial storage. The periodic observations taken during the study are furnished in table 48.

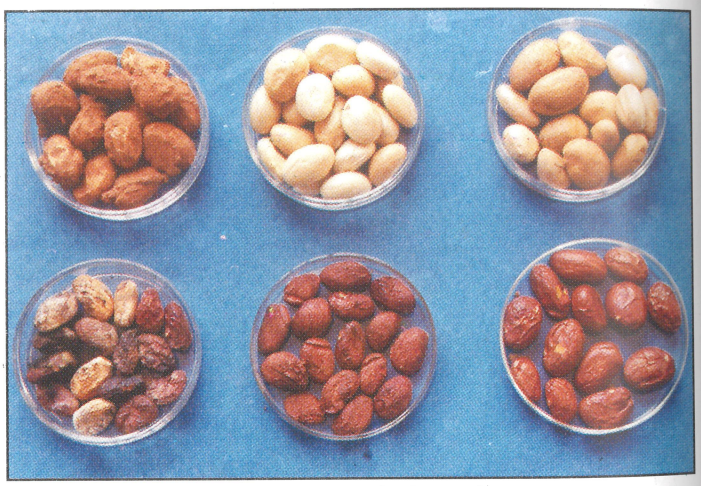
Table 48. Periodic observations made on bimblli stored in brine.

Days after storage	Acidity (%)	SO_2 concentration (%)	Remarks
225- Solution	0.928	0.0192	Colour of fruit turned brownish, texture was soft but was good to taste. No foul odour was noticed
-Fruit	1.031	0.0178	

Storage of indegenous fruits

Jackfruit pulp

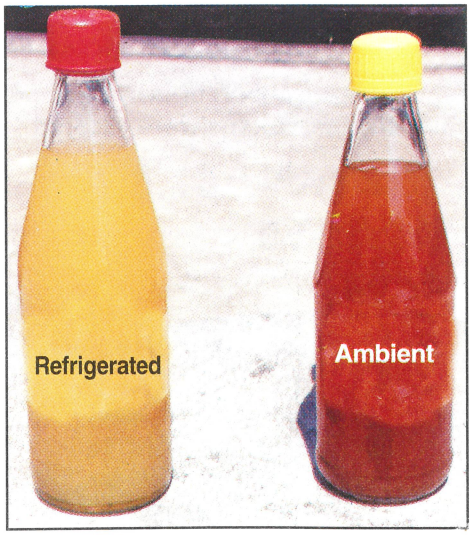
Homogenized pulp of ripe jack bulb along with preservatives like citric acid and SO_2 was stored. It kept well only for 3 months, under ambient conditions.



Preserved dry jack seeds

Bread fruit pulp

Homogenized pulp of well-matured bread fruit was stored in bottles with or without blanching by adding five per cent salt and varying levels of preservatives. All the treatments kept well for 12 months, except the one without salt. Similarly, pulp stored in sugar in jam consistency kept well for nine months.



Carambola Juice

Carambola juice

Juice extracted from ripe Carambola fruits (Sweet type) converted into squash (48^0 Brix, 0.5% acidity and 250ppm SO2) was stored under ambient as well as refrigerated conditions. Both treatments kept well and were edible after a period of 12 months. The refrigerated squash retained the natural colour and flavour whereas the product stored under ambient conditions turned brown and lost the natural flavour (Table 49).

Table 49. Biochemical parameters on squash.

	TSS (Brix)	Acidity (%)	SO_2 (%)	Remarks
Refrigerated	47.5	0.35	0.0192	Kept as good as fresh
Ambient	47.5	0.35	0.0218	Turned brown

Nutmeg rind

Rind of well ripe nutmeg was washed, cut into small cubes and stored in different concentrations of salt, along with preservative. The study is under progress. Similarly, rind pieces with red chilli and green chilli, stored separately are under observation.

Proximate analysis of nutmeg rind, parts of jackfruit and breadfruit was taken up. The results are presented in table 50.

Table 50. Proximate analysis of nutmeg rind, jackfruit and bread fruit.

Fruit	Fat (%)	Total ash (%)	Acid soluble ash (%)	Crude fibre (%)
Nutmeg rind	0.603	4.74	0.014	14.247
Bulb cover of jack (inedible)	2.438	4.17	0.055	3.947
Skin of jack fruit	1.188	5.27	0.570	12.152
Skin and cover of Bulb	1.827	7.82	0.960	17.288
Breadfruit	1.052	3.27	-	1.014
Breadfruit Skin	2.969	5.34	-	1.039

The studies revealed that these fruit wastes are rich sources of fat and fibre and can be incorporated in to cattle feed and other animal feed formulations.

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)

With a view to improve the growth performance of young rabbits two experimental diets were formulated and evaluated through feeding trials. In trial I a low cost feed was formulated incorporating dried brewery grain waste (BDG) at 25 per cent level as replacement for wheat bran. The experimental feeds were analysed for chemical composition. The crude protein content of control and experimental feed was 16.4 per cent and 18.72 per cent and the Crude fibre content was 3.5 per cent and 7.23 per cent respectively.

Table 51. Effect of feeding dried brewery grain waste (BDG) on the performance in cross bred rabbit.

Composition	Control diet	Experimental diet
Maize (%)	40.00	40.00
Ground nut cake (%)	20.00	20.00
Wheat bran (%)	40.00	15.00
BDG (%)	-	25.00
Feed cost/kg (Rs.Ps)	6.40	5.45
Crude protein (%)	16.40	18.65
Digestable energy (Kcal/kg)	3040.00	2990.0
Average daily weight gain (g)	15.82	17.32
Initial body weight (g)	594.00	596.00
Final body weight (g)	2177.00	2328.67
Weight gain (g)	1582.67	1732.00
Feed cost/kg wt gain (Rs)	30.84	23.810

The average daily weight gain of control and experimental group was 15.82 g and 17.32 g, respectively indicating that the incorporation of BDG at 25 per cent level has no adverse effect on the growth performance in rabbit.

In trial II an experimental high energy diet with 3210 Kcal Digestable Energy (DE) was formulated and compared with a control diet having 2910 Kcal (Table 52).

Table 52. Effect of dietary energy level on the growth performance of rabbit.

Composition	Control diet	Experimental diet
Maize (%)	30.00	50.00
Ground nut cake (%)	30.00	30.00
Wheat bran (%)	40.00	20.00
Feed cost/kg (Rs.Ps)	6.80	7.00
Crude protein (%)	19.80	19.60
Digestable energy (Kcal/kg)	2910.00	3210.00
Average daily weight gain (g)	16.34	16.87
Initial body weight (g)	405.33	411.00
Final body weight (g)	1896.00	1957.00
Weight gain (g)	1490.67	1546.00
Feed cost/kg wt gain (Rs)	32.88	32.34

Feeding trial conducted on 12 crossbred young rabbits for a period of 4 months indicated that there is no significant difference in the daily weight gain. The average daily weight gain of control and experimental group was 13.76 g and 14.10 g, respectively indicating that the growth performance under dietary energy level of 3210 Kcal DE is at par with the control diet (2910 Kcal) under the local climatic condition.

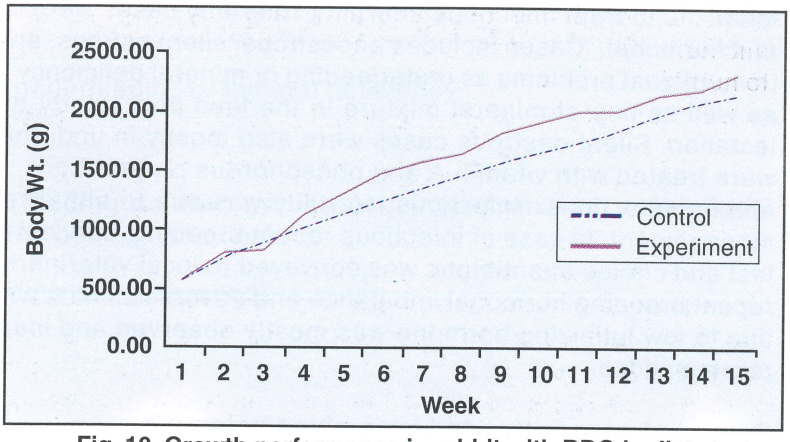


Fig. 10. Growth performance in rabbit with BDG in diet

4.3.2 Evaluation and identification of suitable management practices for goat rearing under coastal climatic condition.

(RNS Sundaram, EB Chakurkar, SB Barbuddhe and BK Swain)

During the year a survey work was initiated and data regarding the existing housing and management practices for goat in rural areas of Goa were collected. As per the preliminary survey the main purpose of rearing animals in the State is for meat. Most of the animals were non-descriptive brought from the neighboring State of Karnataka and Maharashtra. The average weight of adult male was 45 kg and that of female was 25 kg. Animals were found to be kept under backyard with thatched, ill-ventilated houses and not maintained for commercial or large-scale farming. Crosses of Alpine and Sanen with Malabari goats were found performing well under the climatic condition of Kerela as observed during a visit to Veterinary College, Mannuthy. Visit to other neighboring states to identify suitable dual-purpose breed will be taken in the coming year (2002 – 2003).

4.3.3 Investigations on etiology of infertility in farm animals and identifying suitable remedial measures.

(EB Chakurkar, RNS Sundaram and SB Barbuddhe)

Eighteen infertility camps were organized by Department of Animal Husbandry and Veterinary Services and ICAR Research Complex for Goa. During these camps total of 173 infertility cases were thoroughly examined and information was collected which includes previous history of the case, opinion of the local veterinarian , actual physical and gynaecoclinical examination. Biological material as cervical mucous, vaginal /cervical discharge, and /or blood serum was collected. The collected samples were examined in the laboratory for infections as brucellosis, Infectious Bovine Rhinotrachitiis etc. Culture and sensitivity test was conducted for cervical mucous to know the choice of



Feeding trial on pigs (Yorkshire White)

medicine to treat infectious infertility. Infertility cases were categorized broadly in to nutritional , infectious and hormonal. Cases includes anoestrous, silent estrous, and repeat breeding. Anoestrous was mostly due to nutritional problems as underfeeding or mineral deficiency and farmers were advised for balanced feeding as well as use of mineral mixture in the feed particularly during last trimester of pregnancy and peak of lactation. Silent oestrous cases were also mostly in underfeeding or feeding without greens. These cases were treated with vitamin A and phosphorous preparations. Repeat breeding cases were due to infectious and noninfectious. Infectious infertility was due to either retention of placenta or unhygienic shelter and management. In case of infectious repeat breeding cervical mucus was subjected to cultural and sensitivity test and choice of antibiotic was conveyed to local veterinarian for further follow-up action. In noninfectious repeat breeding hormonal imbalance and adverse climate were the suspected etiologies. Delayed ovulation due to low lutinizing hormone was mostly observed and insemination with HCG or chlomiphen citrate was recommended.

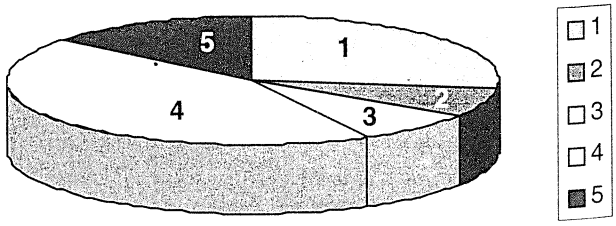
Details of cases attended is as given below-

Anoestrous	Silent estrus	Repeat breeding	Abortions	PD	Total
2	1	6	0	1	10
0	1	3	0	2	6
10	1	4	0	0	15
2	1	1	0	1	5
5	1	5	1	2	14
3	1	8	0	0	12
3	0	4	0	1	8
2	0	4	1	3	10
8	5	0	1	3	17
0	0	0	7	0	7
0	0	6	0	0	6
0	0	8	0	1	9
5	3	6	0	4	18
0	1	2	0	1	4
3	0	4	3	5	15
4	1	7	0	1	13
2	0	5	0	2	9
3	0	9	1	0	13

In the 18 camps conducted, a total of 173 cases were attended, of which 47 were anoestrus, 12 silent estrus, 14 abortion , 76 repeat breeding and 24 cases were presented for confirmation of pregnancy. Out of cases presented for pregnancy confirmation a rare case of mummified fetus and one case of pregnancy estrous was observed.

Proportion of different cases

1. Anoestrous - 27.10 per cent
2. Silient estrus - 6.93 per cent
3. Abortion - 8.09 per cent
4. Repeat Breeding - 43.93 per cent
5. Confirmation of pregnancy - 13.80 per cent



Recomondations

1. Anoestrous — nutritional problems as underfeeding or mineral deficiency.

Recomondation

Farmers were advised for balanced feeding as well as use of mineral mixture in the feed particularly during last trimester of pregnancy and peak of lactation.

2. Silent oestrous — underfeeding or feeding without greens.

Recomondation

Vitamin A and phosphorous preparations.

3. Repeat breeding — infectious and noninfectious.

a) Infectious infertility was due to either retention of placenta or unhygienic shelter and management.

Recomondation

In case of infectious repeat breeding cervical mucus was subjected to cultural and sensitivity test and choice of antibiotic was conveyed to local veterinarian for further follow-up action.

b) In noninfectious repeat breeding hormonal imbalance and adverse climate were the suspected etiologies.

4. Delayed ovulation —— low lutinizing hormone.

Recomondation

Insemination with HCG or chlomiphen citrate was recommended.

Reproduction management of livestock

Pigs

A trial for synchronized estrus management and breeding in Pigs was conducted by injecting 10 mg dianoprost (2 ml lutalyse) a natural prostaglandin preparation, for inducing oestrus. Out of eight oestrus only one (sow) exhibited positive signs of oestrus within 48 hours. This sow was mated naturally. In remaining gilts and sow, the dose of prostaglandin was separated after 9 days from first injection. All exhibited oestrus in 24-48 hours and all were mated naturally. Out of eight, four (3 gilts and one sow) remain pregnant and delivered after completion of gestation period.

Dairy cows

Oestrus was ssynchronized in six cows using 25 mg dianaprost (Lutalyse) I/m, of which five cows exhibited oestrus in 48 hours. They were inseminated artificially by procuring frozen semen from Goa Dairy, Ponda.

Semen studies and Artificial Insemination in rabbits

Semen studies have been undertaken in rabbit buck to know the characteristics as volume, consistency, total sperm count, motility at different intervals and with different dilutors in refrigeration temperature Artificial insemination was performed in rabbits and could get babies on 1st Nov 2001. Conception rate is about 50 percent. First baby born through AI in rabbits in Goa is from ICAR Research Complex for Goa.

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

(SB Barbuddhe, RNS Sundaram and BK Swain)

The project was initiated with an aim to survey livestock diseases including zoonoses in Goa region in a systematic manner and establishment of disease investigation laboratory. A brief account of the work done during the year is as follows.

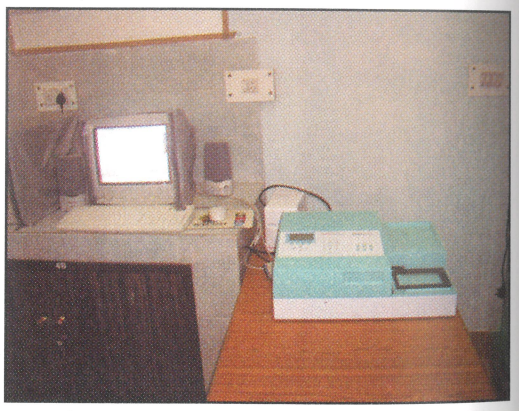
Mastitis

A total of 31milk samples were collected from crossbred cows (from field cases). Out of these, nine samples were from clinical cases of mastitis. Out of remaining 22 milk samples from cows tested by California mastitis test 63.6 per cent were positive for subclinical mastitis. The milk samples were processed for bacteriological examination. After enrichment of the milk samples in 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. Isolates were found to be sensitive to gentamicin, norfloxacin, chloramphenicol, and ampicillin-cloxacillin.

Disease investigations

A total of 120 serum samples from cattle were collected. Samples from cattle were tested by A-B ELISA (41), Standard tube agglutination test (25) and Rose Bengal plate test (120) for *Brucella* antibodies and by A-B ELISA (41) for infectious bovine rhinotracheitis. Of these 26.8 per cent and 34.1 per cent samples from cattle were positive for brucellosis and Infectious Bovine Rhinotraicheites(IBR), respectively by A-B ELISA.Out of 120 samples tested by RBPT 17.5 per cent samples were positive for brucellosis. A total of 20 animals each were tested for Bovine Tuberculosis and Johne's disease.



ELISA reader for serological investigations

Vaginal discharge

Vaginal swabs (4) were collected from cattle. The bacteria isolated were *Bacillus, Staphylococcus aureus,* and *Escherichia coli.* The organisms were sensitive to kanamycin and gentamicin.

Feacal samples

A total 13 fecal samples from captive wild animals were refered by Bondla National Park, Bondla, Goa. The samples were positive for *Strongyle sp., Trichuris, Toxocara sp.*

Blood smears

A total of 15 blood smears were examined for protozoan parasites. None found positive for protozoa.

Post Mortem samples

Nine Post Mortem samples were collected and examined bacteriologically.

The project was concluded during the year.

4.3.5 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 namely, Total Plate Count (TPC) for mesophiles and psychrophiles, Yeast and Mould Count (YMC), and *Salmonella* sp. were estimated.

Poultry meat (20) and raw pork (9) samples were processed for TPC for mesophiles and YMC. The meat samples were collected from the markets. In poultry meat the counts were $\log_{10}$ 7.2 cfu/g for mesophiles, less than $\log_{10}$ 3 cfu/g for psychrophiles, $\log_{10}$ 5.98 cfu/g for yeast and moulds. In pork the mesophilic counts were $\log_{10}$ 7.62 cfu/g.

As an ancillory work 29 meat samples were tested for the presence of *Listeria monocytogenes* organism.

The project was concluded during the year.

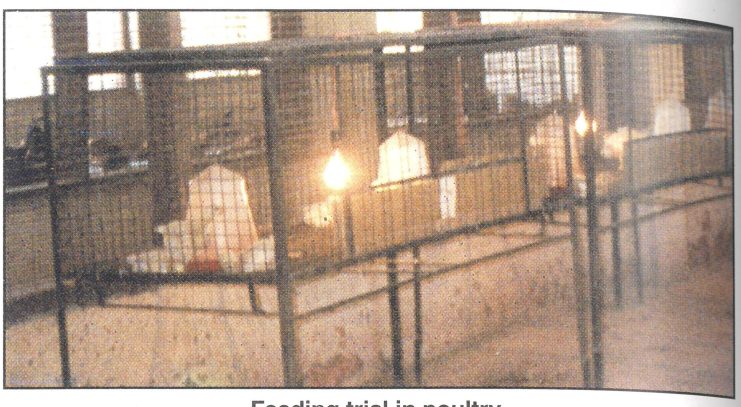
4.3.6 Performance of the commercial broilers fed Cashew Apple Waste (CAW).

(Swain BK, Sundaram RNS and Barbuddhe SB).

Cashew Apple Waste (CAW) was evaluated as a feed ingredient for formulating broiler feed by replacing 0, 5, 10, 15 and 20 per cent of the maize in the control diet (Table 53). The feeding trial was conducted in broilers from 1st day to 42 day of age. The proximate composition of CAW and feed (Table 54) was done as per AOAC (1990). Data were recorded on weekly body weight gain, feed consumption, feed efficiency, carcass traits and organ weights. The data were analysed statistically.

Results indicated that there was no significant difference between the body weight gain of different treatments. Broilers fed with diet containing 5 per cent CAW replacing maize exhibited less body weight gain compared to those fed on control diet although it was not statistically significant (Figure 11). This may be due to their quick differentiation ability in palatability of food containing CAW in small quantity. Birds given diet containing 20 per cent CAW gained similar weight compared to the control group. However, feed efficiency and feed consumption differed significantly among the various treatments. Broilers fed with diet containig 10 and 15 per cent of maize replaced with CAW consumed significantly less feed compared to their counterparts fed on control diet and diets with 5 and 20 per cent maize replaced by CAW (Figure 12). Feed efficiencies were comparable for all the treatments except those chicks fed diet with 5 per cent maize replaced by CAW where in very poor efficiency was recorded (Figure 13). The carcass traits and relative weights of organs did not differ significantly among themselves for different treatment groups (Table 55 and 56). However, numerically higher dressing per cent and giblet weights were observed for groups fed on diets with 10 and 15 per cent maize replaced by CAW. The cost of feed containing CAW replacing 20 per cent maize was Rs0.60/- less than the feed without CAW i.e.control feed (Table 57). Net profit per bird was higher for the group fed CAW replacing 20 per cent maize compared to all other groups including the control group.

CAW could replace 20 per cent maize in the broiler ration without any adverse effect on the body weight gain, feed consumption, feed efficiency, carcass traits, organ weights and with better economics of production.



Feeding trial in poultry

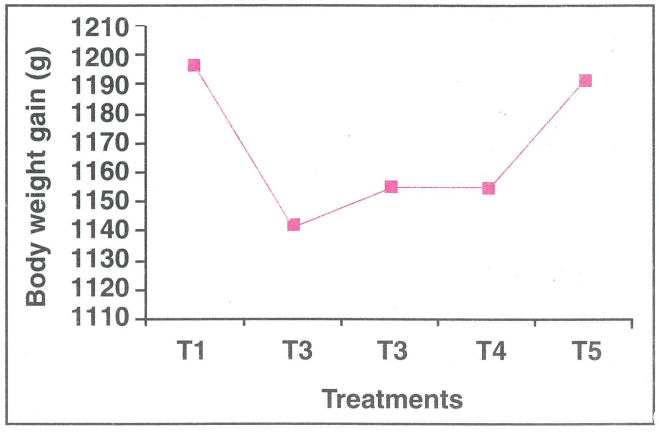


Fig. 11. Effect of feeding CAW on the body weight gain of broilers

*Treatments

T1 = Control
T2 = 5 per cent maize replaced by CAW
T3 = 10 per cent maize replaced by CAW
T4 = 15 per cent maize replaced by CAW
T5 = 20 per cent maize replaced by CAW

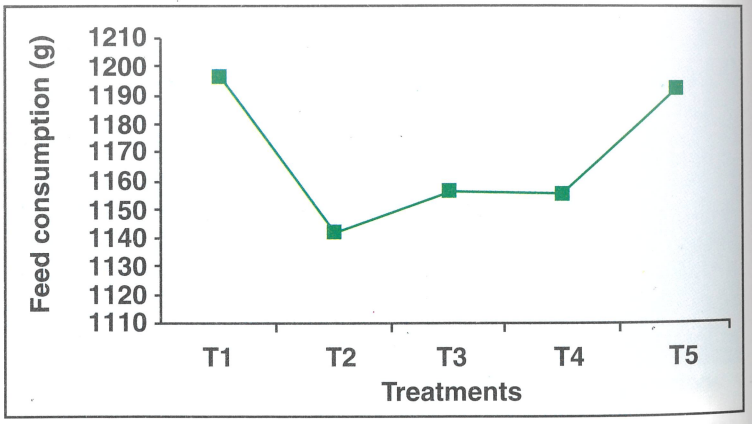


Fig. 12. Effect of feeding CAW on the feed consumption of broilers

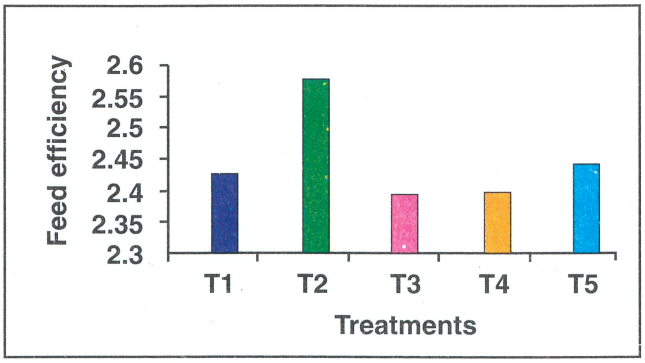


Fig. 13. Effect of feeding CAW on the feed efficiency of broilers

Table 53. Proximate Composition (DM basis) of Cashew Apple Waste (CAW).

Proximate constituents	Per cent composition
Dry matter	18.40 ± 0.09
Crude protein	11.48 ± 0.77
Ether extract	3.67 ± 0.12
Crude fibre	8.49 ± 0.15
Total ash	3.51 ± 0.06
Acid Insoluble Ash	1.26 ± 0.05
Nitrogen Free Extract (NFE)	72.85 ± 0.85

Table 54. Composition of control/basal diet.

Ingredients	Per cent composition
Maize	55.00
Ground Nut Cake	28.00
Fish meal	10.00
Wheat bran	4.28
Di Calcium Phosphate	1.30
Limestone	0.88
Common salt	0.50
L-Lysine HCl	0.24
DL-Methionine	0.14
AB_2D_3K	0.01
B-complex mixture	0.02
Mineral mixture	0.11
Total	100.00

Table 55. Carcass traits in broilers fed with various levels of CAW as replacement for maize.

Treatments	Dressing (%)	Relative weight of cut up parts (per cent of dressed weight)					
		Breast	Back	Thigh	Drumstick	Wing	Neck
T_1	59.19	23.27	17.45	18.29	14.02	9.54	5.87
T_2	60.19	22.72	19.36	17.63	14.21	9.41	6.45
T_3	62.21	22.70	18.70	18.32	13.54	9.24	5.99
T_4	63.55	22.50	19.13	17.87	14.35	9.46	5.93
T_5	60.78	23.06	19.84	18.04	13.28	9.15	5.66
SEM	1.325	0.769	0.683	0.360	0.409	0.316	0.200

T1 = Control
T2 = 5 per cent maize replaced by CAW
T3 = 10 per cent maize replaced by CAW
T4 = 15 per cent maize replaced by CAW
T5 = 20 per cent maize replaced by CAW

Table 56. Relative weight of organs as influenced by feeding of cashew apple wastes as a replacement for maize in the diet of broilers.

Treatments	Relative weight of organs (per cent of dressed weight)					
	Liver	Gizzard	Heart	Giblets	Spleen	Bursa
T_1	3.646	3.726	0.932	8.304	0.285	0.420
T_2	3.593	3.921	0.812	8.328	0.310	0.403
T_3	4.443	4.211	1.055	9.710	0.275	0.340
T_4	3.967	4.168	0.973	9.109	0.273	0.343
T_5	3.969	4.107	0.810	8.885	0.265	0.265
SEM	0.201	0.229	0.056	0.373	0.010	0.059

T1 = Control
T2 = 5 per cent maize replaced by CAW
T3 = 10 per cent maize replaced by CAW
T4 = 15 per cent maize replaced by CAW
T5 = 20 per cent maize replaced by CAW

Table 57. Economics of production.

Treatments	Net Profit/bird (Rs)	Cost/Kg diet (Rs)
T_1(Control)	4.50	9.27
T_2	2.05	9.12
T_3	4.66	8.97
T_4	5.05	8.82
T_5	5.91	8.67

T_1 = Control
T_2 = 5 per cent maize replaced by CAW
T_3 = 10 per cent maize replaced by CAW
T_4 = 15 per cent maize replaced by CAW
T_5 = 20 per cent maize replaced by CAW

4.4 FISHERY SCIENCE

Under the Fisheries mega project, 'Introduction and evaluation of technology package for culture and propagation of appropriate fish and shellfish species under Goa conditions', there are two ongoing projects namely 'Production enhancement studies under rabbit-fish integrated farming system' and 'Formulation of economic fish feeds utilizing locally available feed ingredients'.

4.4.1 Production enhancement studies under rabbit-fish integrated farming System.

(S Subramanian, KN Mohanta, RNS Sundaram and EB Chakurkar)

One 0.1 ha pond with built in cage was desilted, cleared of aquatic weeds and prepared for the rabbit-fish integration trial without aeration and supplementary feeding. Excreta and urine of 15 rabbits were collected daily and put in the pond. Cages, feeders and waterers were prepared for taking up the growth performance studies in pond cage. Electrical connections for fixing aerators are being made for taking up the trial with pond aeration. Pond was stocked with three species of carps (catla, rohu and mrigal) at the stocking density of 6000/ha. Another pond is prepared for taking up concurrent trial.

In a trial conducted for a month with six Soviet Chinchilla rabbits of 1.250 kg each, it was found that each rabbit could void on an average 78 g of dung and 60 ml of urine /day. Analysis indicated that the dung contained 2.32 per cent N and urine contained 6 per cent N. Estimated nitrogen addition to the pond was 4.32 g N / rabbit daily and 129.6 g N / rabbit / month. At this rate, 15 rabbits void 35.5kg of dung and 27 litre of urine and would add 1.944 kg of N per month for 0.1 ha pond. Actually, weight of dung and urine collected and put in the pond for 15 rabbits ranged from 48.920 kg in January to 55.632 kg in April. That means 15 rabbits would add about 8000 kg of excreta including urine, adding about 25 kg 'N' to 0.1 ha pond/ year.

Growth performance of fish at 6000 / ha stocking density was observed without aeration and supplementary feeding. It was observed that individual fish growth was 500 to 800 g / 8 months, with length ranging from 34 to 45 cm. For monitoring the water quality and change due to the addition of rabbit excreta, pond water samples were collected periodically and analysed. Ranges of water quality parameters recorded during the trial are indicated in table 58. Increase in pH from the initial 6.0 to 8.5 after the addition of rabbit excreta is an encouraging improvement. The trials of the project are continuing.

Table 58. Range of water quality parameters during rabbit-fish integration trial without aeration and supplementary feeding.

Parameter	September, 2001	March, 2002
Dissolved oxygen (ppm)	5.47	8.42
Ammonium (ppm)	0.00	0.05
Nitrite (ppm)	0.05	0.05
Nitrate (ppm)	100.00	125.00
Alkalinity (ppm)	1.00	1.40
Tranparency (Sachi disc)cm	42.00	53.00
pH	6.00	8.50

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

(S Subramanian and KN Mohanta)

Under the project, diet improvement through supplementation of formulated feeds with *Spirulina,* was tested, as it was reported to provide essential nutrients such as carotenoids, vitamins and minerals. Use of *Spirulina* as a feed supplement was reported to help in better growth rate, increased survival, etc. in animals and fish. A feeding trial was conducted for testing the influence of *Spirulina* incorporation in feed, as growth promoter, on *Cirrhinus mrigala* fry. Carp starter feed tested earlier was taken as control to which Spirulina was added at 0.1, 0.3, 0.5 and 1.0 per cent levels (Table 59). The feed formulates were tested for growth performance, with three replicates in each treatment. Experimental details are furnished in table 60. Basal diet contained fish meal and groundnut oil cake as the main ingredient at 30 per cent level each and had 40.27 per cent crude protein. The fish were fed daily at 5 per cent body weight. The ingredient composition and proximate contents of basal diet are furnished in tables 61 and 62, respectively. Trial indicated that feed formulate with 1.0 per cent *Spirulina* incorporation gave best growth performances. However, values of FCR and PER only were significant (P=0.05) indicating that *Spirulina* incorporation at 1.0 per cent level was better than the rest and values of PWG, SGR and condition factor of fish were not significantly different. Further studies with higher levels of *Spirulina* incorporation in feed will be taken up. Results of the trial indicating the growth performance of mrigal fry on feeding different levels of *Spirulina* incorporated feeds, are furnished in table 63.

Table 59. Dosages of *Spirulina* supplement used in carp basal feed.

Treatment	Dosage of *Spirulina* incorporation	Percentage of *Spirulina* incorporation
T_1	0.0 g /kg of basal feed (control)	0.0
T_2	1.0 g /kg of basal feed	0.1
T_3	3.0 g /kg of basal feed	0.3
T_4	5.0 g /kg of basal feed	0.5
T_5	10.0 g /kg of basal feed	1.0

Table 60. Experiment details of the *Spirulina* incorporated feed trial on *Cirrhinus mrigala* fry.

Weight of the fry	1.75±0.20 g
Duration of study	60 days
No. of treatments	5
No.of replicates	3/treatment
Daily feeding rate	5 % of the body weight
Volume of water maintained	100 litre / container

Table 61. Ingredient composition of basal diet.

Ingredient	Percentage
Fish meal	30
Ground Nut Cake	30
Shrimp paste meal	10
Wheat bran	10
Maize powder	11
Wheat flour (binder)	5
Mineral & Vitamin Mixture	2
Vegetable oil	2

Table 62. Chemical composition of basal diet.

Constituent	Percent composition (dry matter basis)
Protein	40.27
Ether extract	08.58
Crude fibre	03.20
Total ash	15.90
Moisture	10.20
Energy (Kcal/g)	03.12

Table 63. Growth performance of mrigal fry on feeding *spirulina* incorporated feeds.

Growth parameters	Experimental diet				
	T_1	T_2	T_3	T_4	T_5
Percent weight gain (PWG)	125.49 (±5.42)	159.28 (±4.86)	142.81 (±7.49)	158.03 (±15.29)	168.13 (±17.42)
Food conversion ratio (FCR)	3.24 ^{a} (±0.1265)	2.62 ^{b} (±0.0819)	2.99 ^{a} (±0.1772)	2.62 ^{b} (±0.1987)	2.52 ^{b} (±0.1720)
Specific growth rate (SGR)	0.5883 (±0.0173)	0.6889 (±0.0139)	0.6416 (±0.0270)	0.6850 (±0.0424)	0.7124 (±0.0474)
Protein efficiency ratio (PER)	0.7731 ^{a} (±0.0276)	0.9543 ^{bc} (±0.0309)	0.8386 ^{ab} (±0.0514)	0.9576 ^{bc} (±0.0740)	0.9953 ^{c} (±0.0705)
Condition factor (K)	0.7758 (±0.0324)	0.7994 (±0.0481)	0.7536 (±0.0049)	0.8224 (±0.0321)	0.7376 (±0.0349)

Mean values with the common superscripts are not significantly different in FCR and PER (P=0.05) within the same row. Figures in parenthesis indicate standard error.

4.5 AGRICULTURAL RESEARCH INFORMATION SYSTEM (ARIS)

4.5.1. Development of Agricultural Information System for Goa.

(J Ashok Kumar, BL Manjunath, JR Faleiro, M Thangam, EB Chakurkar and S Manivannan)

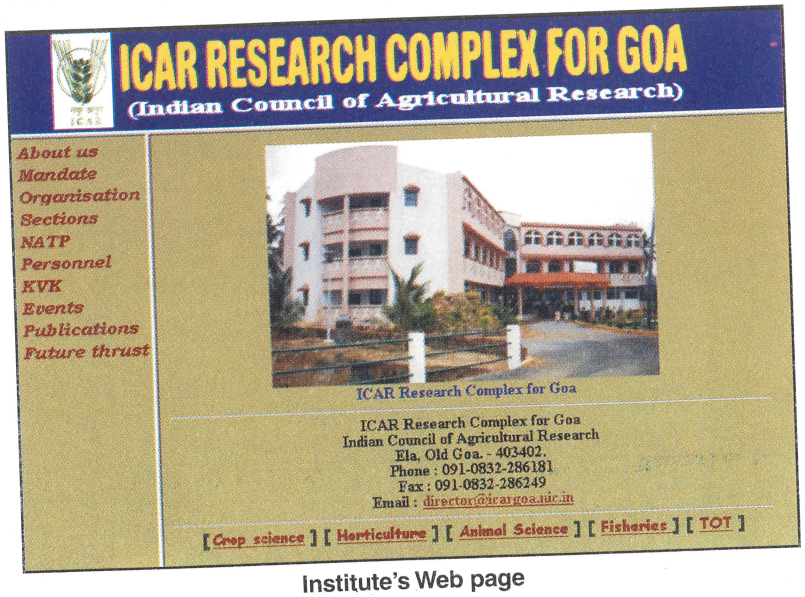
The project is aimed at collecting, storing and creating an user interface for retrieval of the Agricultural data pertaining to Goa. The likely databases aimed to be created under this project are soil database, crop production database, pest and diseases database, meteorological database, livestock database and fisheries database of the State. Various Government organizations, Developmental agencies related to Goan agriculture were contacted to obtain the above data. The data collected during the year pertain to crop acreage, production, pests and diseases of important crops grown in Goa, soils information, meteorological information, statistics on livestock and fisheries.

Institute's Server Linex Powered

During the year Local Area Network (LAN) was established and made functional using open source net working operating system Linux. Several servers *viz* mail server, proxy server, web server, ftp server were configured for the facilities like e-mail, internet, webpage hosting and file and printer sharing. Around 20 computers are connected to LAN including the Institute's library.

Web Page for ICAR Research Complex for Goa

Web page of the Institute was created and published in the Institute's own server. The URL of the site is http://icargoa.nic.in. The webpage gives detailed information about the Institute's origin, mandate, Divisions, ongoing Research Projects, personnel, Institute's publications and future thrust areas. The activities of Krishi Vigyana Kendra (KVK), attached to the Institute are also given in the page along with a list of the training programmes that are being conducted by KVK.



Institute's Web page

Databases acquired

AGRIS on CDROM has been acquired by the Institute's library and is available for all the scientist for literature search.

4.6 TRANSFER OF TECHNOLOGY

The Krishi Vigyan Kendra (KVK) is a project of 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. The Krishi Vigyan Kendra (KVK) of the Institute carried out the following activities during 2001-2002.

- 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, pulses and other enterprises related to agriculture.
- In service training of field level extension officials.

4.6.1 Training and other activities.

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

During the period of report, the KVK conducted 91 need based vocational training programmes both on as well as off campus in various disciplines *viz.* Agronomy, Horticulture, Animal Sciences, Home Science, Plant Protection and Agricultural Extension and trained 1552 personnels in two categories *viz.*practicing farmers/ farm women and rural youth. The whole group comprised of 721 male and 831 female participants. The details of the vocational training courses conducted in different disciplines are provided in table 64.

Table 64. Vocational Training programmes conducted in agriculture and allied enterprises.

Title of the course	No. of courses conducted			No. of participants		
	On Campus	Off Campus	Total	Male	Female	Total
I **AGRONOMY**						
A. Practicing farmers and farm women						
1. Basmati and Hybrid rice technology	2	2	4	48	17	65
2. Soil health and fertilizer use efficiency	1	1	2	22	11	33
3. Cropping systems for rice lands	-	2	2	12	03	15
4. Recycling agrowaste for manure production.	2	1	3	39	19	58
SUB TOTAL – A	5	6	11	121	50	171
B. Rural Youth						
1. Vermiculture as an enterprise	3	-	3	26	13	39
SUB TOTAL –B	3	-	3	26	13	39
TOTAL (A + B)	8	6	14	147	63	210

Title of the course	No. of courses conducted			No. of participants		
	On Campus	Off Campus	Total	Male	Female	Total
II. HORTICULTURE						
A. Practicing farmers and farm women						
1. Coconut based farming system	3	-	3	32	9	41
2. Nutrition garden	1	2	3	52	3	55
3. Improved cultivation practices for vegetables	1	4	5	8	116	124
4. Improved cultivation practices for fruit crops	1	3	4	8	69	77
5. Floriculture	1	1	2	26	06	32
SUB TOTAL –A	7	10	17	126	203	329
B. Rural Youth						
1. Mushroom cultivation	6	4	10	155	36	191
2. Grafting techniques in important horticultural crops	3	1	4	28	49	77
SUB TOTAL –B	9	5	14	183	85	268
TOTAL (A + B)	16	15	31	309	288	597
III. PLANT PROTECTION						
A. Practicing farmers and farm women						
1. Safe use of pesticides	1	-	1	13	-	13
2. Pest of rice	-	1	1	21	01	22
3. Pest management in plantation crops	-	3	3	31	24	55
4. Pest management in fruit crops	1	-	1	-	9	9
5. Pest management in vegetable crops	-	1	1	7	-	7
SUB TOTAL – A	2	5	7	72	34	106
B. Rural Youth						
1. Spawn production	5	-	5	17	17	34
SUB TOTAL –B	5	-	5	17	17	34
TOTAL (A + B)	7	5	12	89	51	140
IV. ANIMAL SCIENCES						
A. Practicing farmers and farm women						
1. Piggery as an enterprise	1	-	1	23	4	27
2. Dairy animal management	1	-	1	12	2	14
3. Enrichment of karad hay	-	2	2	13	-	13
4. Integrated fish farming system	1	-	1	3	-	3
SUB TOTAL –A	3	2	5	51	6	57

Title of the course	No. of courses conducted			No. of participants		
	On Campus	Off Campus	Total	Male	Female	Total
B. Rural Youth						
1. Broiler farming	2	-	2	35	24	59
2. Layer farming	1	-	1	7	2	9
3. Rabbit farming	1	-	1	14	-	14
4. Aquarium management	1	-	1	6	1	7
SUB TOTAL –B	5	-	5	62	27	89
TOTAL (A +B)	8	2	10	113	33	146
V. **HOME SCIENCE**						
A. Practicing farmers and farm women						
1. Low cost nutritious recipes	2	4	6	-	171	171
2. Mushroom recipes	-	4	4	-	81	81
3. Child care	-	1	1	-	30	30
SUB TOTAL –A	2	9	11	-	282	282
B. Rural Youth						
1. Home scale food preservation	2	1	3	-	38	38
2. Income generating activities for housewives	4	-	4	-	38	38
SUB TOTAL – B	6	1	7	-	76	76
TOTAL (A +B)	8	10	18	-	358	358
VI. **AGRICULTURAL EXTENSION**						
A. Practicing farmers and farm women						
1. Panchayat Raj system	-	1	1	6	6	12
SUB TOTAL –A	-	1	1	6	6	12
B. Rural Youth						
1. Panchayat Raj system	-	2	2	37	2	39
2. Leadership development	-	2	2	12	19	31
3. Organizational climate	-	1	1	8	11	19
SUB TOTAL –B	-	5	5	57	32	89
TOTAL (A + B)	-	6	6	63	38	101
GRAND TOTAL (I+II+III+IV+V+VI)	47	44	91	721	831	1552

In service training of filed level extension officials

During the year under report, the KVK conducted six in-service training programmes for field level extension officials in various disciplines *viz.*, Horticulture, Plant Protection, Animal Sciences, Home Science and Agril. Extension and trained 77 participants comprising of 50 men and 27 women. The details of the in-service training programmes conducted for field level extension officials are furnished in table 65. The details pertaining to Farm Advisory Services and extension activities are presented in tables 66 and 67.

Table 65. In service training programmes conducted for field level extension officials.

Title of the course	No. of courses conducted			No. of participants		
	On Campus	Off Campus	Total	Male	Female	Total
Horticulture						
Floriculture	1	-	1	15	3	18
Plant Protection						
Bio agents in IPM	1	-	1	24	1	25
Animal Sciences						
Dairy Animal Management	1	-	1	6	-	6
Home Science						
Food preservation	1	-	1	-	23	23
Agriculture Extension						
Use of Audio-visual aids	1	-	1	1	-	1
Training and Technology transfer	1	-	1	4	-	4
TOTAL	6	-	6	50	27	77

Table 66. Farm Advisory Services and Extension programmes.

Particulars	No. of programmes	No. of farmers covered	Male	Female	SC/ST
Visit to farmers field	46	413	258	155	80
No. of farmers visited	26	1279	665	614	130
Field days	5	310	208	102	29
Kisan Mela	1	140	112	28	2
Women Mela	1	54	-	54	-
World Environment day	1	13	13	-	2
World food day	1	18	-	18	-
Women in Agriculture day	1	27	-	27	-
Farmers day	1	8	7	1	-
National Science day	1	15	10	5	-
Farmers meetings	36	381	228	153	79
Exhibitions	2	205	177	28	14

Table 67. Other extension activities.

Activities	Numbers
Radio talks	6
TV coverages	2
News paper coverages	22
Popular articles published	6
Research articles published	12
Technical reports published	1
Training notes published	4
Special guest lectures	37
KVK staff deputed for attending training/workshop/conference	6

Bench Mark Survey

To identify the training needs of the practicing farmers, farm women and rural youth, one hundred farm families out of the 862 farm families from Bastora (Bardez) and Mopa (Pednem) were surveyed personally with the help of structured schedule. Nineteen, 18 and 12 per cent of the geographical area were found to be as, area not available for cultivation, cultivable waste and forest, respectively. Fifty and one per cent of the geographical area were unirrigated and irrigated, respectively. A total of 487 and 294 persons in both the villages were found to be cultivators and agricultural labourers, respectively.

Majority of the respondents stated that they would like to attend training courses of KVK on basmati and hybrid rice production, improved practices for groundnut cultivation, coconut based farming system, propogation techniques in important horticultural crops, dairy animal management, income generating activities for housewives, home scale food preservation, pest management in plantation crops and rice, Panchayat Raj System and leadership development.

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 of seedlings/grafts is given in table 68.

Table 68. Planting materials prepared and supplied during 2001-2002.

Planting materials	Quantity
Cashew grafts	3392
Mango grafts	1664
Coconut seedlings	892
Arecanut seedlings	4066
Bush pepper	519
Other (papaya, guava, ornamental plants)	913
Total	11,446

4.6.2 On Farm Testing.

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

On farm testings were conducted on fields of 15 farmers to find solutions to the problems related to Agricultural development. Out of 15 beneficiaries selected under on farm testing, twelve (80%) were men and three (20 %) are women.

During the year, two demonstrations on recycling of agro waste using technology of microbial composting were demonstrated to compare with the traditional composting in Pilar and Molcornem villages in North and South Goa Districts, respectively.

At Pilar, Fr.Inacio Almeida used paddy straw while at Molcornem, Shri Mohan Tendulkar, a progressive farmer operating a self help group used weeds and other farm waste from his horticultural farm for composting with micro organisms. At both locations heap method was used covering an area of 5 x 2 x 1.5 m.

Requisite technology was demonstrated which does not require pitting or turning of the material. It was seen that the original heap of 1.5 mts height dropped to 80 cms within a period of 30 days. The original biomass heaped over 10 sq.m and weighing over 1.5 tonnes was reduced to 800 Kg of black soft compost within 45 days.

The technology was well accepted by the beneficiary farmers as it is the fastest method of recycling compared to traditional composting as well as vermicomposting which requires pit making and/or tank preparation and extensive use of cow dung.

4.6.3 Front line demonstrations.

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

Front line demonstrations (FLD) was organised on 18.8 ha covering 40 farmers comprising of 36 (90 %) males and 4 (10 %) females. Two (5 %) farmers were from SC and ST category (Table 69).

Table 69. Details of front line demonstrations.

Particulars	Cereals		Horticulture crops	Total
	Rice	Hybrid rice		
Area in hectares	4.8	9	5	18.8
No. of farmers	15	10	15	40
Male	12	9	15	36
Female	3	1	-	4
SC/ST	2	-	-	2

Front line demonstration on cereals (Rice)

During the year, an area of 4.8 ha was covered under the FLD on rice in 15 villages of North and South Goa District covering 15 beneficiaries during the kharif season with an objective to test and demonstrate promising rice varieties for their superiority over the predominant short duration "Jyoti". Four short duration varieties namely Triguna, Krishna Hamsa, IET-9240 and IET-11768, three Basmati cultures namely Pusa Basmati, Kasturi and IET-15391 and one salt tolerant variety CSR-10 were demonstrated on

the farmer's fields to test their superiority visa-vis performance at multilocational sites. Each demonstration had three treatments as mentioned below

1. Farmer's traditional variety (Jyoti) with his own cultivation practice (T1).
2. Promising variety with farmers cultivation practice (T2)
3. Promising variety with improved package of practice (T3)

The demonstration plots were regularly monitored and data/feedback was collected which is presented in the table 70.

Table 70. Performance of rice varieties under the front line demonstration during *kharif*.

Village/ Location	Name of the farmer	Variety	Area (ha)	Yield(t/ha)			Per cent increase of T3 over T1
				T1	T2	T3	
Guirim	Mahanand Asnodker	Krishna Hamsa	0.4	2.38	3.30	4.15	74.36
Cuncolim	Lucracia Vaz	Pusa Basmati	0.4	2.60	3.10	3.60	38.46
Goa Velha	Antonio Rosario	CSR-10	0.6	1.60	2.80	3.15	99.87
Nadora	Shantaram Gauns	Triguna	0.4	2.80	3.40	4.00	42.86
Karapur	Raghunath Munji	IET-9240	0.2	2.60	3.45	4.10	61.53
Pernem	Sudhakar Pednekar	IET-11768	0.4	2.35	3.20	3.80	61.70
Pernem	Shankar Pednekar	K.Hamsa	0.4	2.50	3.40	3.75	50.00
Sangolda	Shripad Palienkar	Triguna	0.5	3.20	4.10	4.45	39.06
Chorao	Barbian Barreto	K.Hamsa	0.2	2.30	3.25	3.80	65.21
Borim	Apolonio Luis	P. Basmati	0.2	2.60	3.00	3.25	25.00
Verla	S.Shirodkar	Kasturi	0.2	2.45	2.85	3.10	27.03
Sancoale	S.M.Sanzgiri	P. Basmati	0.4	2.30	3.10	3.40	47.82
Colvale	Maria Isabel D'Souza	IET-15391	0.2	2.60	3.05	3.50	34.81
Torshem	Gopal S.Naik	P. Basmati	0.2	2.80	3.00	3.25	16.07
Dhauji	John Dias	Triguna	0.1	2.65	3.25	4.10	54.71
Total			4.8				
Mean			—	2.51	3.25	3.69	47.35

From the results obtained at various multilocations, it was observed that the promising rice varieties demonstrated performed better than the farmer's traditional practice in all the locations indicating the superiority of the variety. The overall mean productivity increase over the farmer's traditional practice was 47.35 per cent.

Most of the promising rice varieties performed better than the check varieties. In the short duration group, the variety Triguna gave a mean yield of 4.08 t/ha (47.69 % increase), IET-9240 yielded 4.10 t/ha (61.53 % increase) and Krishna Hamsa yielded 3.90 t/ha (65.21 % increase). In the Basmati group, Pusa Basmati yielded 3.37 t/ha (31.84 % increase) and in the salt tolerant group the variety CSR-10 yielded 3.15 t/ha (99.81 % increase). The demonstrations therefore indicated that the promising rice varieties would bring about an increase in the productivity of the crop.

The cost benefit analysis of these demonstrations were also worked out based on the information supplied by the farmers pertaining to the cultivation costs and is presented in table 71.

Table 71. Cost benefit analysis of FLD in rice during *kharif*, 2001.

Rice group	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	C:B ratio	
					T.P	DP
Coarse	3.90	16,750	22,510	5,760	1:1.28	1:1.34
Basmati	3.37	17,695	37,200	19,505	—	1:2.10

TP : Traditional Practice DP : Demonstrated Practice

Note: The selling price of coarse rice and Basmati rice in paddy form is taken at Rs.5000/- and Rs.10,000 per tonne, respectively.

Front line demonstrations on Hybrid rice

During the year, FLD on hybrid rice was taken in 9 ha to demonstrate this frontier technology for breaking yield barriers of traditional varieties and its popularisation with close collaboration at taluka level with the assistance of Zonal Agricultural Offices at Soccorro and Calangute villages in Bardez, Ela in Tiswadi, Quitla Fatorpa in Quepem and Lolyem and Khalwada villages in Canacona taluka, respectively in one hectare blocks. The selection of villages in consultation with respective ZAO, and demonstrations were laid at strategic locations so as to create an awareness about the new technology.

Table 72. Performance of rice hybrids under the FLD on hybrid rice during *kharif*, 2001.

Taluka	Location	Hybrid	Area (ha)	Name of beneficiary	Yield (kg/ha)		Per cent increase over check varieties	Yield advantage (kg/ha)
					Hybrid	Check variety		
Bardez	Socorro	Sahyadri	1.00	Nanda Halarnker	6253	3210	94.79	3043
Bardez	Calangute	KRH-2	1.00	Jane Mathews	5653	2875	96.62	2778
Bardez	Calangute	Sahyadri	1.00	Dashrath Govenkar	5260	2652	98.34	2608
Quepem	Quitla	Sahyadri	1.00	Shailesh Kholkar	6810	3080	121.10	3730
Quepem	Fatorpa	KRH-2	1.00	Dayanand Phaldesai	6535	2758	136.94	3777
Canacona	Loliyem	Sahyadri	1.00	Jairam Tengse	6105	3020	102.15	3085
Canacona	Khalwada	KRH-2	1.00	Prabhat Amolkar	6508	3150	106.60	3358
Canacona	Khalwada	Sahyadri	0.50	Prabhat Amolkar	6213	3050	103.70	3163
Tiswadi	Old Goa	Sahyadri	0.40	Zonal Agril.Officer	—	—	—	—
Tiswadi	Old Goa	KRH-2	0.05	ICAR	7256	3620	100.44	3636
Tiswadi	Old Goa	Sahyadri	0.05	ICAR	6842	3620	89.00	3222
Tiswadi	Old Goa	KRH-2	0.50	John Gonsalves	5740	2835	102.46	2905
Tiswadi	Old Goa	Sahyadri	0.50	Jhon Gonsalves	5486	2810	95.23	2676
			9.00		6225	3056	112.58	3165



Farm Science Centre (KVK)

Two hybrids namely "Sahyadri" and "KRH-2", earlier evaluated at the Institute trials were demonstrated in comparison to the local traditional varieties i.e. Jaya or Jyoti. The technology was demonstrated in the rice fields of 12 beneficaries including one female. The demonstrations were regularly monitored and three field days were organised at Ela, Soccorro, Khalwada and Quitla villages to highlight the yield advantage of the demonstrated hybrids. Adequate press coverage was given to the success of the hybrid rice technology in the selected area.

The results obtained at various locations and the cost benefit analysis are presented in table 72 and 73, respectively. The results of FLD on rice hybrids indicated that the mean yield of hybrids (6.22 t/ha) against the local checks namely Jaya and Jyoti (3.05 t /ha) has resulted in 112.58 per cent increase in the grain yield over the traditional variety/practice. This corresponds to an yield advantage of 3165 kg/ha over the traditional varieties indicating clear superiority of hybrids. Further, "Sahyadri and "KRH-2", gave a clear yield advantage of 3220 kg/ha and 3089 kg/ha, respectively. The cost: benefit analysis of the demonstration results is provided in table 73.

Table 73. Cost benefit analysis of hybrid rice FLD during kharif, 2001.

Variety	Overall mean yield (t/ha)	Yield advantage of hybrids	Cultivation cost (Rs./ha)		Net profit (Rs./ha)	C:B ratio
			Check	Hybrid		
Jaya/Jyoti	3056	—	16,570	—	5769	1:1.34
Sahyadri	6332	3276	—	19,695	16,465	1:1.83
KRH-2	6067	3011	—	19,695	15,140	1:1.76

The results of the hybrid rice demonstrations indicated that the farmers could double the present yield levels obtained from traditional varieties (Jaya and Jyoti) by using rice hybrids. Hybrid rice performed well in spite of nearly 40 per cent less annual rainfall received by the State during kharif, 2001. The limiting factors stated in wider adoption of hybrid rice technology as expressed by the farmers during interactions was high cost of seed and the need to buy fresh seed every season. The milling quality of the slender grain was found to be inferior to the coarse varieties. Besides, there is a need to improve the milling infrastructure in the State.



"Woman International Day" celebration

4.7 EXTERNALLY FUNDED PROJECTS

A) NATIONAL AGRICULTURAL TECHNOLOGY PROJECT

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

(SP Singh, BL Manjunath and SB Barbuddhe)

Effect of manurial treatment on growth and yield of forage grass (NB-21 and PBN-16) as intercrop in coconut

In Hybrid Napier NB-21, four harvests were made in the second year between March and November, 2001. Untill March, 2002 eight harvests were made in the experimental block. Maximum plant height of 145.18 cm was obtained in treatment T_1 (100 per cent organics) but no significant difference was observed among the treatments. Similarly, no significant difference was observed in parameters like number of tillers, nodes/tiller, number of leaves/tiller, leaf length, leaf width and internodal length. Maximum yield of 106.4 kg was recorded in treatment T_2 in the sixth harvest of the fodder grass during the month of August, 2001. The total yield (72.52 t/ha) was also highest in treatment T_2 (50 per cent organics + 50 per cent inorganics). However, there was no significant difference between treatments (Table 74).

Table 74. Mean growth and yield parameters of Hybrid Napier NB-21 (April 2001 to March 2002).

Treatment	Plant height (cm)	No. of tillers/ clump	No. of nodes/ tiller	No. of leaves/ tiller	Leaf length (cm)	Leaf width (cm)	Inter-nodal length	Yield kg/ plot	Yield (t/ha)
T_1	145.18	19.30	10.32	14.29	95.06	2.77	13.92	348.2	75.28
T_2	137.70	17.76	10.09	14.12	94.69	2.54	13.61	349.3	75.52
T_3	144.20	19.89	10.32	13.93	96.23	2.58	13.44	346.2	74.85
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

T_1 - 100 per cent organics, T_2 - 50 per cent organics + 50 per cent inorganics,
T_3 - 100 per cent inorganics

Table 75. Mean growth and yield parameters of Hybrid Napier PBN-16 (April, 2001 to February, 2002).

Treatment	Plant height (cm)	No. of tillers/ clump	No. of nodes/ tiller	No. of leaves/ tiller	Leaf length (cm)	Leaf width (cm)	Inter-nodal length	Yield kg/ plot	Yield (t/ha)
T_1	106.60	26.54	14.29	10.55	70.13	2.45	9.81	333.88	72.18
T_2	119.67	27.93	15.09	11.27	76.79	2.67	9.71	344.07	74.40
T_3	123.06	26.24	14.86	11.08	77.82	2.64	10.09	339.16	73.34
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

T_1 - 100 per cent organics, T_2 - 50 per cent organics + 50 per cent inorganics,
T_3 - 100 per cent inorganics



Hybrid Napier intercropped in coconut

Four harvests of forage grass PBN-16 were taken between April, 2001 and February, 2002. However, till March, 2002 six harvests were made. Maximum plant height of 123.0cm was recorded in treatment T_3 (100 per cent organics). Number of tillers, number of leaves/tiller and nodes/ tiller was was highest in treatment T_2 (27.93, 15.09, 11.27, respectively). No significant difference was observed in the number of leaf length, leaf width and internodal length (Table 75). Yield of forage grass PBN-16 grass was maximum in treatment T_2 (74.4t/ha) followed by treatment T_3 (73.34t/ha). Of the four harvests, a maximum of 24.93t/ha was obtained in the third harvest during the month of April, 2001 in treatment T_2 (50 per cent organic 50 per cent inorganics).

It is significant to point out that forage grass, Co-3 from TNAU performed well as an intercrop in coconut garden. This grass will be used in the coming season as treatment blocks for further evaluation.



Pineapple (Giant Kew) intercropped with coconut

Yield of coconut in the system

A total of 3908 nuts were harvested from 69 palms in the fodder block. The overall average was 56.73 nuts/palm/year. An increasing trend in yield over the years was observed. This shows an improvement of the system over the period due to better management of the entire system. The average number of coconut bunches per row was 12.55.

Treatment wise yield of coconut in NB-21 and PBN-16 forage plots

In the treatment block with NB-21, maximum nut yield of 304 nuts was recorded in the treatment T_3 (100 per cent organics) while, the maximum average nut yield/ palm/ year of 63 nuts was recorded in treatment T_2 (50 per cent inorganics + 50 per cent organics). The total production in the treatment block was 790 nuts with an average yield of 60.7 nuts/ palm/ year.



NATP Peer Review Team in the Experimental plot

In PBN-16 forage block, a maximum yield of 261.00 nuts and an average nut yield of 87 nuts/ palm/year was recorded in treatment T_3 followed by T_1 (81.33 nuts/palm/year) between May, 2001 and March, 2002. The average number of bunches per palm was 2.53 while, the average nut yield was 78.22 nuts/palm/year.

It is interesting to note that, the local variety of papaya (23 plants) grown on the bunds of the fodder block yielded 273 fruits between April and August, 2001, with an aeverage fruit weight of 1.4 kg.

Analysis of soil and status of nutrient in the coconut & fodder block

Soil fertility status after four harvests of forage grasses showed that there was no significant difference among the treatments with regards to salt content of the soil in grass as well as coconut plots. The pH of the soil varied significantly among the treatments in the grass plots. Plots receiving only organic manures depicted an increase in soil pH, while the pH in plots receiving inorganic fertilizers decreased. There was slight increase in the organic carbon content in the manure-applied plots. However, the result obtained was nonsignificant. Nitrogen content at a depth of 30-60 cm in the coconut basins was found to be high in the plots receiving only inorganic fertilizers. Phosphorus and potassium contents were high in treatments receiving 50 per cent organic and 50 per cent inorganic manures. The results obtained were however, nonsignificant. (Table 76 and 77)

Table 76. Mean yield of coconut under different treatments in NB-21 and PBN-16 grass plots.

Mean coconut yield per palm in NB-21 grass plot	Mean cocnut yield per palm in PBN-16 grass plot
T_1 58.5	81.33
T_2 63.0	66.33
T_3 60.8	87.00
Average 60.7	78.22

Table 77. Soil fertility status in the grass plots at different depths.

I. 0-15 cm depth (grass plot)

Treatment	EC(mmhos/cm)	pH	Org. carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1	0.073	5.87	1.22	174.59	85.03	238.90
T_2	0.088	5.83	1.22	126.66	127.40	365.90
T_3	0.105	5.52	1.06	117.52	103.00	216.50
CD (P=0.05)	NS	0.207	NS	NS	NS	98.39

II. 0-30 cm depth (coconut basin)

Treatment	EC(mmhos/cm)	pH	Org. carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1	0.079	6.03	1.59	126.21	204.40	612.30
T_2	0.085	5.90	1.22	122.23	163.50	559.00
T_3	0.175	5.73	1.32	120.48	174.90	470.40
CD (P=0.05)	NS	NS	NS	NS	NS	NS

III. 30-60 cm depth (coconut basin)

Treatment	EC(mmhos/cm)	pH	Org. carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1	0.075	5.80	1.17	117.16	201.10	537.90
T_2	0.069	5.90	1.63	134.54	119.40	582.40
T_3	0.054	5.70	0.95	151.08	122.60	403.20
CD (P=0.05)	NS	NS	NS	NS	NS	NS

T_1 - 100 per cent organics, T_2 - 50 per cent organics + 50 per cent inorganics, T_3 - 100 per cent inorganics

Table 78. Soil fertility status in the control plots at different depths.

Treatment	EC(mmhos/cm)	pH	Org. carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
0-15	0.045	5.70	1.14	116.89	156.90	324.80
0-30	0.050	5.85	1.22	141.41	232.20	369.60
30-60	0.043	5.80	0.90	126.07	282.20	481.60

Integration of dairy unit in the system

During April, 2001, all the cows were in the milking stage and 787 L of milk was recorded with an average of 5.25 L/cow/day. Later, the milk yield decreased, which again increased to a maximum of 7.87 L/day/cow in the month of November, 2001. The overall average milk production was 6.27 L/day/cow in the integrated dairy system. The total milk production obtained from the system was 7202.25 litres between April, 2001 and March, 2002. Green fodder (25 kg) of NB-21/PBN-16 and five kg concentrate high protein feed was fed to each cow every day. Six female calves born during the experimental period have been maintained.

Table 79. Mean daily yield of milk and cowdung (April, 2001 to March, 2002).

Month	Mean production of milk and cowdung/cow/day	
	Milk (L)	Cowdung (kg)
2001		
April	5.25	13.87
May	4.29	13.66
June	4.56	13.36
July	4.93	13.77
August	5.23	14.63
September	6.50	15.07
October	8.33	14.90
November	7.87	15.10
December	7.34	14.26
2002		
January	6.92	15.27
February	6.88	15.92
March	7.10	14.21
Mean	6.27	14.50

Besides recording the milk yield, observations were also recorded on the cowdung produced by five cows. A total of 26395 kg of dung was recorded from the test animals during the period with a mean production of 14.50 kg of cowdung/cow/day. The dung was used to prepare high quality compost along with the biomass including coconut leaves, banana stem and leaves etc.

Coconut wastes from the system

Coconut leaf waste obtained from the system was 1488.62 kg from the experimental block, which worked out to 2646 kg/ha. Similarly 1025.56kg/ha, of leaf petioles was also recorded.

Preparation of biogas and use of cowdung slurry

A biogas (Deenbanhu model) was constructed and made operational. The cow dung obtained from the dairy unit is being used to generate biogas. The present model has a capacity of $4m^3$. The slurry obtained is collected in pits made for the purpose and will be utilized/recycled for FYM/compost preparation.

Economic analysis of the system

The gross annual income obtained from the system was Rs 2,44,449 while the net income was Rs. 1,29,423. Details pertaining to the economic analysis of the system are presented in table 80. The Cost - Benefit ratio of the system worked out to 1:2.12.

Table 80. Economic analysis of integrated farming system.

INPUT						
Crop		Labour	Fertilizer		Cost of Irrigation (Rs)	Total (Rs)
	No/ha	Cost/ha (Rs)	Quantity NPK (kg/ha)	Cost/ha (Rs)		
Coconut } Grasses }	77	11,920	89:89:214 147:98:65	4752 4463	1800 (60 hrs)	22,935
Papaya	7	2449				500
Black pepper	6	1000	FYM 5kg/plant	-	-	1000
Miscellaneous	5	100				500
Dairy (5cows+6calves)	274	23,760(labour) + 63,375(feed)	-	-		87,135
Biogas						3200 *
Total						1,15,270

OUTPUT				
	Quantity/ha	Rate of product (Rs)	Total (Rs)	
Coconut	7815 nuts	4.00	31,264	
Grass	75 t	600.00	45,000	
Papaya	7292 kg	4.00	29,168	
Black Pepper	-	-	-	
Dairy (5 cows+6 calves)				
Milk	7202.25 L	12.00	86,427	
Compost	7.3 t	175.00	1,278	
Leaf wastes	4112 kg	1.00	4112	
Calves	5	8000.00	40,000	
Biogas	$4m^3$		7,200	**
Total			2,44,449	

Net income: Rs.1,29,423. C:B ratio:1:2.12

* Depreciation cost of biogas unit @Rs 3200/year for a period of ten has been calculated from the total cost of unit of Rs 32,000. ** Gas generated from biogas unit

Coconut based cropping systems

Coconut (main crop)

During 2001, yield of coconut under intercropping, was 53.43 nuts/palm/year while in monocrop it was only 41.8 nut/palm/year. Thus the positive impact of intercropping, increased the productivity of the system.

Banana (inter crop)

Tissue culture banana (Variety Grand Nain Williams) planted in last week of October, 2000 was ready for harvest from October, 2001. In the month of October, 2001 only three bunches were harvested while a maximum of 22 bunches were harvested in the month of December, 2001. A total of 75 bunches were harvested from the system weighing 1433 kg (Table 81) . The average bunch weight was 21 kg/bunch. The second crop from the suckers also started flowering and thus two or more crops can be taken from the system. The total production of banana from the system was estimated to be 14470 kg/ha of coconut garden.

Table 81. Month wise yield and other characteristics of banana (October, 2001 to March, 2002).

Months	No. of bunches	Average no. of hands/bunch	Average no. of fingers/bunch	Total weight (kg)	Average wt. /bunch
October	3	9.00	113.00	96.10	32.00
November	12	7.92	113.25	338.88	28.24
December	22	7.72	104.50	401.08	18.23
January	11	8.64	117.60	176.46	16.04
February	12	6.58	93.00	171.68	14.30
March	15	7.20	92.10	249.00	16.60
Total	75			1433.00	
Average		7.84	105.57		20.90

Pineapple (inter crop)

Pineapple planted in the month of June, 2000 started fruiting from April, 2001. The crop yielded 73.2 kg from four harvests made during the month. A total of 388 fruits were obtained in the month of June, 2001 weighing 479 kg. A total yield of 1044.25 kg was obtained from 1063 suckers through the system. The average fruit weight was 1.73 kg. Average length of the fruit was 19.88 cm while the average girth was 16.63 cm. A crown length of 37.76 cm was recorded. The T.S.S of the fruit ranged from 11 to 19 per cent.

Black pepper (inter crop)

Black pepper (Cv.Karimunda) was planted during the year and has established well in the system.

Glyricidia (peripheral crop)

For use as biomass in composting and as a green manure, *glyricidia* was planted on the bunds. These plants also acted as wind breaks and improved the soil status.

Biomass production

As regards biomass, 297.5 kg of banana stems were obtained from the system and are being used for the preparation of compost. Coconut leaf wastes (60 palms) collected from the system (2000 m^2) weighed 969.85 kg. Other material that contributed to the biomass in the system i.e weeds, spathes and crown of pineapple worked out to be 662.00 kg (Table 83). Most of the material were used for the preparation of compost to recycle in the system.

Table 82. Coconut yield from monocrop and intercroped systems.

Year	Nut yield in monocrop (15 palms)			Nut yield in intercrop (40 palms)		
	Av.yielding palms	Total nut	Av.nut/palm	Av.yielding palms	Total nut	Av.nut/palm
1999	4.33	91	21.00	12.33	513	41.60
2000	7.00	242	34.57	16.25	892	54.89
2001	4.66	195	41.84	21.00	1122	53.43
Average	5.33	176	32.47	16.52	842.33	49.97

Table 83. Crop wastes generated in the experimental block.

Crop wastes	Kg/Experimental plot	Kg/hectare
Coconut leaflets	969.85	4849.00
Coconut leaf petioles	210.55	1052.75
Other wastes (banana stem, grasses, pineapple waste etc.)	662.20	3311.00
Total	1842.60	9212.75

Economic analysis

The gross income obtained from the system was Rs.1,25,285 /ha while the net return obtained was Rs.73, 545 /ha. The Cost: benefit ratio of the intercropping system was found to be 1:1.4 while it was only 1:0.22 in monocropping system. (Table 84)

Table 84. Economic analysis of coconut based cropping system.

INPUT

Crop	Labour		Cost of planting material (Rs)	Fertilizer		Irrigation		Total cost/ha (Rs)
	No/ha	Cost/ha (Rs)		Quantity (kg/ha)	Cost/ha (Rs)	Hrs	Rs	
Coconut	15	7400		89:89:214 (NPK)	4752	60	1800	13,952
Pineapple	20	2000	2657	1.2:1.7:0.5 (NPK)	5676	40	1000	11,333
Banana	25	12333	1300	200:100:300g (NPK/plant) Plant protection chemicals	7957 1965	40	1000	24,555
Black pepper	10	1000	400	--	--			1400
Glyricidia	5	500	-	-	-	-	-	500
Total								51,740

OUTPUT

	Yield Expt.plot (kg)	Yield/ha (kg)	Rate of Produce (Rs)	Gross return from Expt. Plot (Rs)	Income/ha (Rs)
Coconut	1317.00	4271.50 (nuts)	4.00	5268	26,340
Pineapple	1044.25	5221.25	4.00	4177	20,885
Banana	2894.08	14,470.4	5.00	14,470	72,352
Black pepper	-	-	-	-	-
Glyricidia	100	500.00	2.00	200	1000
Wastes		4710.50	1.00	942	4710
Banana leaf and stem	481.10				
Coconut leaves,	334.00				
Coconut petiole	127.60				
Total					1,25,285

Net Return = Rs. 73,545 C:B ratio = 1:1.4

4.7.2 Animal health information system through disease monitoring and surveillance.

(SB Barbuddhe, EB Chakurkar and BK Swain)

Under NATP (Mission Mode) a project was initiated with an outlay of Rs.14.1 Lakhs for animal disease surveillance as a part of generation of national database on livestock diseases, movement of livestock, passive disease reports, vaccine procurement and delivery systems.

The project was implemented as per the technical programme. The administrative and financial powers delegated to Principal Investigator were executed for successful and timely accomplishments of the annual targets. Equipment approved under the project *viz.* ELISA reader with accessories, deep freezer and multi-channel pipettes have been procured. In the year data on following aspects was collected.

1. Population of livestock in the State of Goa: district wise and taluka wise,
2. Livestock movement routes,
3. Livestock disease profile: district wise and taluka wise,
4. Slaughter house data,
5. Vaccination

A village Majorda in Salcette taluka of South Goa district was surveyed for livestock population and serum samples were collected randomly for assessing serological prevalence of selected livestock diseases. A summary data is presented below (Tables 85 and 86). The collected serum samples had been tested for brucellosis, infectious bovine rhinotracheitis and rinderpest by ELISA in case of cattle, by RBPT for brucellosis in case of pigs and goats, and for ranikhet disease in poultry by haemagglutination inhibition test. Out of 73 bovine serum samples 8 (10.96%) and 3 (4.12%) were positive for brucellosis and IBR by A-B ELISA, respectively. Distribution of absorbance values is presented in Figs. 14 and 15. None of the 15 goat serum samples were positive for brucellosis by RBPT. Of the 168 pig serum samples tested 11 (6.55%) were positive for brucellosis when tested by RBPT. Distribution of HI tires against Ranikhet disease is given in Fig.16. Results of milk based ELISA for bovine brucellosis are presented in Fig. 17.

Table 85. Summary of Majorda village Survey -Samples Collected.

Species	Total	Samples collected				Cumulative total
		I Collection 27-3-2001	II Collection 7-06-2001	III Collection 21-09-01	IV Collection 11-12-2001	
Cattle	221	16	15	14	16	61
Buffalo	28	3	1	5	3	12
Goats	64	5	5	1	4	15
Pigs	432	30	50	53	29	168
Poultry	812	51	35	38	33	157

Table 86. Results of analysis of serum samples.

Species	Samples tested	Brucellosis		IBR	RP
		A-B ELISA	RBPT	A-B ELISA	ELISA
Bovines	73	8 (10.96%)	3 (4.12%)	3 (4.12%)	0
Goat	15	0	0	—	—
Pig	168	ND	11(6.55%)	—	—

Another village, Sancordem (as given in the list of selected villages by the Lead Centre) in Sanguem taluka of South Goa district was surveyed between January and March, 2002. The village is nearly a forest village. The main crops grown are cashew, arecanut and coconuts. The village has a sizeable livestock population including crossbred cattle.

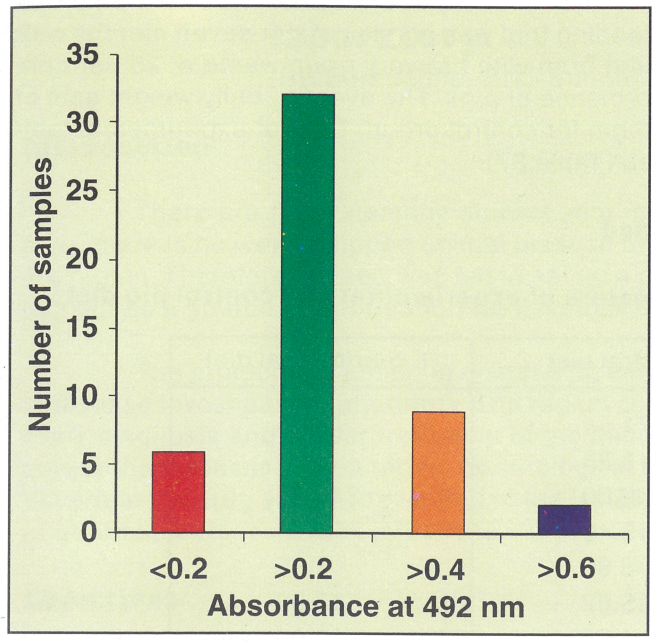


Fig. 14. Results of Brucellosis A-B ELSA

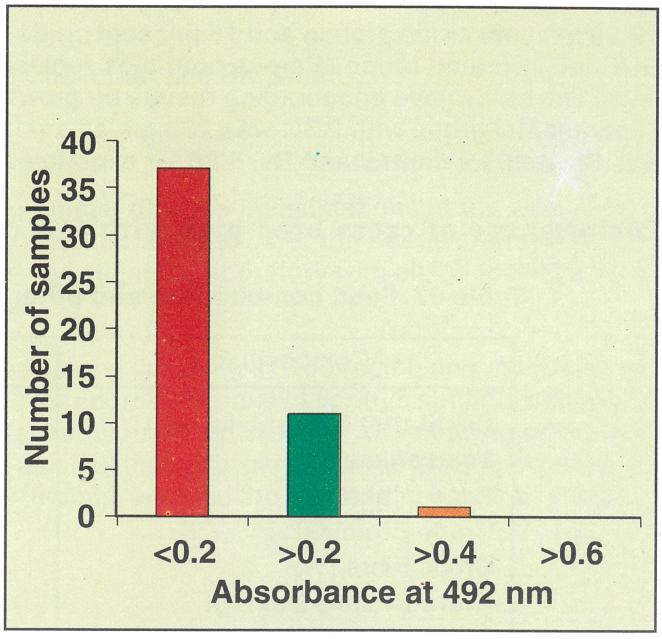


Fig. 15. Results of IBR A-B ELISA

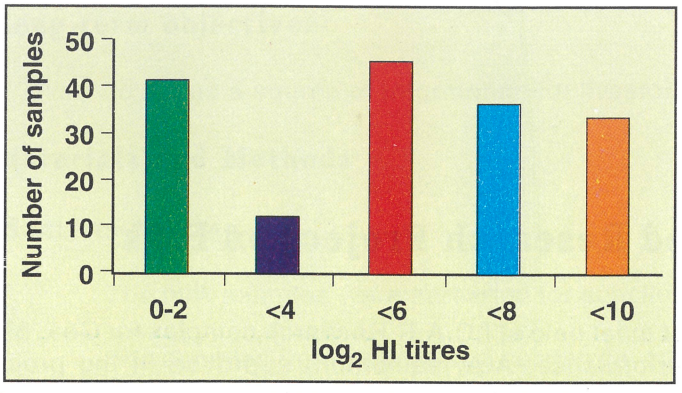


Fig. 16. Distribution of HI titres against Ranikhet disease (log2)

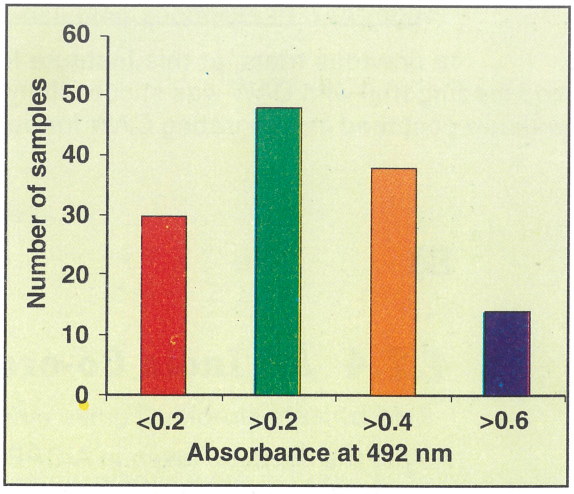


Fig. 17 Results of milk based ELISA for bovine Brucellosis

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

Studies on evolving low cost pig feed was continued utlising the dried brewery grain waste (BDG). About 1200 metric tons of BDG is available from the local brewery in the State. The spent BDG has 18.25 per cent crude protein and 16 per cent crude fat. A feeding trial was conducted for seven months with BDG incorporated ration in cross bred pigs replacing wheat bran with brewery grain waste at 25 per cent level. The study gave encouraging results on growth performance of pigs. The average daily weight gain of experimental group with BDG was 230 gm as against 196 gm for control group. Cost of experimental feed was Rs. 6.85 for control and Rs. 5.85 for experimental feed (Table 87).

Performance of cross bred pigs with low cost feed

Table 87. Feed composition and other parameters of experimental and control pig diet.

Composition	Control diet	Experimental diet
Dry Matter Digestibility (%)	71.54	72.85
Feed efficiency	5.28	6.11
Feed intake(kg)	246.00	246.00
Crude Protein (%)	16.40	18.70
Crude Fibre (%)	3.96	7.25
Average Daily Gain (g)	15.82	17.32
Initial Weight (g)	11.75	10.66
Final Weight (g)	51.00	57.20
Weight Gain (g)	39.25	46.54
Feed cost/kg wt. Gain (Rs)	30.84	23.81

In previous trials, at this Institute low cost feed was formulated with Cashew Apple Waste (CAW) and feeding trial with CAW was successfully completed. Six field piggery units were identified and provided with low cost feed incorporating CAW for demondstration at the farmers field.

B)

4.7.4 All India Co-ordinated Research Project on Pigs.

As per the decision taken in AICRP Scientist meet held at I.C.A.R.Research complex for Goa, nine local pigs have been purchased to study their performance. Also equipment approved in the project (computer, platform balance) were purchased. While a solar feed drier was designed for drying agrowastes. As a part of the project the existing pig unit was modified and eight new farrowing pens were constructed.

It has been decided in AICRP Scientist meet held at I.C.A.R. Research complex for Goa to procure twenty local pigs and study their performance. Nine pigs have been already purchased and remaining are being purchased.

To tackle the major breeding problems (anoestrous, silent oestrous, repeat breeding, delayed ovaluation) encountered in pigs in the State, suitable recommendations were made to the farmers.

4.8 COMPLETED PROJECTS

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

(SB Barbuddhe, RNS Sundaram, EB Chakurkar and BK Swain)

Introduction

There are no systematic studies with regard to animal disease investigations in the Goa region. Also, there is no well equipped animal disease investigation laboratory to cater the needs of the farmers in the region. Therefore, a need was felt to set up a disease investigation laboratory with all the facilities which can act as a source of information for livestock diseases.

The project was aimed at disease investigations among livestock in Goa region and establishment of disease investigation laboratory. The region continues to report outbreaks of various notifiable diseases. Early diagnosis and proper treatment of the animal is desirable. In this project an attempt was be made to survey the diseases in Goa region by serological testing and isolation of organisms wherever necessary and ascertain the drug sensitivity testing of the isolates. The findings enabled the Institute to act as a repository of information for livestock infections.

Objectives

Immediate objectives

1. To establish a disease investigation laboratory.
2. To survey the existing diseases among livestock including zoonoses in Goa region.
3. To conduct disease investigations in livestock.
4. To suggest measures for their control.

Long term objectives

To act as a source of information for livestock diseases.

Materials and Methods

Mastitis testing

The milk samples were screened for subclinical mastitis using California mastitis test.

The samples from clinical and subclinical cases of mastitic glands were cultured in nutrient broth and nutrient agar, and incubated at 37°C for 24 to 48 hr. For isolation of *Listeria* sp., *Listeria* enrichment broth was used. The identification of isolates was done on basis of cultural, morphological and biochemical characteristics (Carter, 1995). Isolates were subjected to antibiotic sensitivity test by standardized disc diffusion technique.

Brucellosis testing

The Rose Bengal plate test antigen used in test and *Brucella abortus* plain antigen used in STAT were procured from the Division of Biological Products, Indian Veterinary Research Institute, Izatnagar. The STAT and RBPT were carried out as described by Alton et al. (1975).

The serum samples from animals were tested for Brucella antibodies by avidin-biotin Brucellosis ELISA kits procured from Project Directorate on Animal Disease Monitoring and Surveillance, Bangalore, India.

Samples

The details of samples collected are given in table 88.

Table 88. Details of samples collected from different species of animals.

Species	Sample details	No.of samples
Cattle	Milk samples	145
	Serum	468
	Blood smears	45
	Blood	12
	Pus	07
	Faeces	23
	Nasal discharge	09
	Cervical mucus	27
Goat	Milk samples	32
	Serum	24
	Blood smears	19
	Faecal samples	16
Rabbit	Serum	74
	Vaginal swabs	24
	Nasal swabs	09
	Faecal samples	09
	PM samples	01
Poultry	Serum	18
	PM samples	11
Pig	Faecal samples	07
	PM samples	07
	Skin lesions	02
Dog	Blood smear	02
	Fecal sample	01
Wild life	Feacal samples	13
	Total	1005

Results

Equipments procurred

1. BOD incubator
2. Deep freezer
3. LPG gas connection
4. Tissue homogenizer
5. pH meter
6. Refrigerators
7. Laminar flow
8. Pressure cooker
9. Mechanical shaker
10. Air conditioner
11. Autoclave
12. High speed centrifuge
13. Electronic balance
14. Microscope

Infrastructure created

Inoculation chamber within the laboratory for minimizing the laboratory contamination.

Establishment of disease investigation laboratory

To cater the needs of the region for animal health related problems, establishment of a full fledged disease investigation laboratory was suggested. Basic facilities like refrigerators, glassware, chemicals and other items were procured. To strengthen the infrastructural facilities a project under NATP on disease surveillance have been approved.

Investigation of diseases

A total of 1005 samples were collected from different species of animals and processed for disease investigations. Also three outbreaks one each of pasteurellosis in rabbits, Foot and mouth disease in cattle and ehrlichiosis in cattle and buffaloes were investigated. The details of collected samples are given in table 88.

Mastitis

A total of 219 milk samples were collected from crossbred cows (145) and goats (32) (from field cases). Out of these 74 samples were from clinical cases of mastitis. Remaining milk samples from cows (73) and goats (30) were tested by California mastitis test for presence of subclinical mastitis and 53.4 per cent and 37.5 per cent were positive in cows and goats, respectively. The total viable counts of 25 samples of milk were carried out which ranged from 68.7×10^4 cfu/ml to 11.1×10^7 cfu/ml with an average of 52.95×10^6 cfu/g. *Staphylococcus aureus* and *Pseudomonas aeruginosa* were found to be the major causative organisms. Other pathogens isolated were *Streptococcus* sp., *Listeria* sp., *Escherichia coli, Bacillus* sp. and *Proteus* sp. Of the 48 samples from cows suffering from clinical mastitis 43.75%s had multiple etiological agents.

After confirmation the isolates were subjected to antibiotic sensitivity. Some of the isolates revealed multiple antibiotics resistant. Isolates were found to be sensitive to gentamicin, norfloxacin, chloramphenicol and pefloxacin. The antibiotic sensitivity patterns are given in table 89.

Table 89. Antibiotic sensitivity pattern of the different isolates.

Isolate	No. of isolates	Sensitivity (%)							
		G	C	O	Nx	Pef	P	S	Ax
P. aeruginosa	52	96.15	98.07	32.69	96.15	100.0	3.84	17.30	90.38
S. aureus	20	95.00	100.00	40.00	95.00	100.0	45.00	10.00	95.00
Streptococcus sp.	10	90.00	100.00	40.00	90.00	100.0	40.00	20.00	80.00
Escherichia coli	09	77.77	100.00	22.22	100.00	100.0	11.11	33.33	66.67
Bacillus sp.	07	100.00	100.00	57.14	100.00	100.0	42.85	14.28	57.14
Listeria sp.	05	100.00	100.00	40.00	100.00	100.0	20.00	R	60.0
Proteus sp.	08	87.50	100.00	62.50	100.00	100.0	12.50	12.50	75.00

G: Gentamicin, C: Chloramphenicol, O: Oxytetracycline, Nx: Norfloxacin,
Pef: pefloxacin, P: Penicillin, S: Streptomycin, Ax: Ampicillin-cloxacillin

Sero survey

A total of 584 serum samples were collected from cattle (468), goats (24), rabbits (74) and poultry (18). Samples from cattle and goats were tested by Standard tube agglutination test and Rose Bengal plate test for *Brucella* antibodies. Out of these samples 9.83 and 4.16 per cent from cattle and goats, respectively were positive for brucellosis. None of rabit sera were positive for brucellosis. Samples from

cattle(41) were tested by A-B ELISA for *Brucella* antibodies and Infectious bovine rhinotracheitis. Of these 26.8 and 34.1 per cent samples from cattle revealed positivity for brucellosis and IBR, respectively by A-B ELISA (Table 90).

Poultry sera were subjected to salmonellosis testing and none could yield antibodies against it.

Table 90. Results of analysis of serum samples.

Species	Samples tested	Brucellosis		IBR	Salmonellosis
		A-B ELISA	RBPT/STAT	A-B ELISA	Plate test
Bovines	468	11 (26.8%)*	46 (9.83%)	14 (34.1%)*	—
Goat	24	ND	1(4.16%)	—	—
Poultry	18	ND	ND	—	0
Rabbit	74	ND	00	—	

*Only 41 samples were tested.

Infectious causes for reproductive disorders

Trichomoniasis and vibriosis were confirmed from two cases in cattle. The isolates were sensitive to gentamicin and doxycycline, and resistant to tetracycline, oxytetracycline and sulphadiazine.

From other cervical mucus samples different organisms namely, *Staphylococcus aureus, Streptococcus* sp., *Escherichia coli, Listeria* sp. were isolated. The isolates were sensitive to norfloxacin, ciprofloxacin, pefloxacin, gentamicin, and chloramphenicol. The isolates were resistant to ampicillin, cloxacillin, oxytetracycline and sulphadiazine.

The vaginal swabs from rabbits were processed for bacteriological examination. The bacteria isolated were *Bacillus, Pseudomonas, Staphylococcus aureus, Streptococcus* sp., *Escherichia coli,* and other commensal organisms. The isolates were sensitive to doxycycline, tetracycline and gentamicin.

Haematological/biochemical examination

A total of 66 blood smears comprising 45 from cattle and 19 from goats, 2 from dogs, and 12 blood samples from cows were examined. The blood smears were stained by Leishman's stain. In one of the case *Theileria* organisms were detected. The blood smears from 3 cows were positive for microfilariae. Out of 2 blood smears from dogs, one was positive for babesiosis.

The blood samples from cows were negative bacteriologically. The cows were hypocalcemic when tested for serum calcium.

Outbreak investigations

An outbreak of pasteurellosis was investigated. Young rabbits (2-3 months old) were affected manifesting the symptoms of dyspnoea and acute mortality. Post mortem of dead animals revealed retention of urine, pleurecy, swollen kidney and congestion of liver. Preliminary bacteriological investigations showed gram- negative rods. Biochemical characterisation revealed it to be *Pasteurella spp.*

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 observed were fever, profuse salivation, anorexia, erruption on tongue and palate, and hoof lesions. The animals were off-feed for two days. 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 separate the affected animals immediately considering the contagious nature of the disease. The farm persons were advised to put sanitizer on the floor of animals for atleast a week. It was advised to apply antiseptics on tongue and to administer supportive antibiotic treatment with the help of local veterinary doctor.

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 4 buffaloes and 3 cows including 1 death. The animals were earlier treated with the injection Paracetamol and injection enrofloxacin. Blood smears were collected for lab examination. On Leishmans staining Rickettsia, *Ehrlichia* were seen. It was advised to treat the animals with high doses of oxytetracyclines.

Others

Nasal discharge

Nasal swabs (9 Nos.) were collected from cattle. The bacteria isolated were *Bacillus, Staphylococcus aureus,* and *Escherichia coli.*

Nasal swabs (9 Nos.) were collected from healthy rabbits to know the commensal microflora. The common bacteria isolated were *Bacillus, Pseudomonas, Staphylococcus aureus, Streptococcus* sp., and *Escherichia coli.* In one case *Pasteurella* sp. was isolated.

Post mortem samples

The P.M. samples (10 Nos.) from pigs (2) and rabbits (2) and poultry (6) were processed bacteriologically. From pig cases *Salmonella* sp. were isolated. From two cases of poultry *Salmonella* sp. were isolated.

Feacal samples

Faecal samples (46 nos.) were collected from cattle (14), goats (16), pig (7) and rabbits (9). All the samples from cattle, rabbits and goats were negative for parasitic infestations. One sample from cattle was positive for *Escherichia coli.* The organisms were sensitive to gentamicin and norfloxacin only and resistant to ampicillin, oxytetracycline, chloramphenicol, and sulphadimidine. One faecal sample from pig was positive for *Ascarid* ova and *Balantidium coli* and another for trophozoites of *Balantidium coli.*

Principal findings / achievements of the projects

An Animal Disease Investigation Laboratory having infrastructure for bacteriological and serological investigations have been established.

Staphylococcus aureus and *Pseudomonas aeruginosa* were found to be the major causative organisms of mastitis. Suitable treatment was suggested for the animals suffering from mastitis after conducting drug sensitivity testing.

Brucellosis, Trichomoniasis and vibriosis were identified as infectious causes of reproductive disorders in dairy animals.

Brucella antibodies were detected in 9.83 per cent and 4.16 per cent of cattle and goats, respectively.

Three outbreaks of livestock diseases *viz.* FMD, ehrlichiosis and pasteurellosis were investigated and control measures were suggested for their control and prevention.

Recommendations

1. The health care aspects specialy the diagnostic facilities for livestock diseases need to be strengthened.
2. Goa being a important destination for exports of animal products surveillance and monitoring of important notifiable diseases should be strengthened.
3. Important livestock diseases are prevalent in the region, therefore, vaccinations, health care need to be enhanced against those diseases.
4. Brucellosis is widely prevalent in the region. Calf hood vaccination and culling of infected animals from herds may be practiced.
5. Some of the diseases of livestock prevalent in the region are zoonotic in nature. Awareness of Livestock owners is required about the consequences of these infections.
6. Due to hot and humid conditions, high yielding animals are more prone to mastitis. Proper hygienic measures and detection of mastitis in subclinical stages should be carried out. Treatment of infected animals should be advocated in clinical/subclinical cases after drug sensitivity testing to avoid drug resistance.
7. Productivity of animals is affected by problems of infertility which needs attention.

Needs for future research

1. Mastitis is an important problem in this region. Suitable preventive measures employing sanitizing agents, extracts of plants need to suggested.
2. Brucellosis is widely prevalent in the region. Calf hood vaccination and culling of infected animals from herds may be practiced. Also suitable treatment regimes for high yielding animals need to be undertaken.
3. Problems of infertility need to be addressed separately.

4.8.2 Microbiological studies of meat and meat products.

(SB Barbuddhe and BK Swain)

Introduction

In Goa about 80 per cent population is non-vegetarian. Changing food habits pose a health risk to human beings. The atmospheric conditions are favourable for rapid multiplication of microbes. In this context it is imperative to estimate the microbial count of meat and meat products. Ever increasing

outbreaks of food-borne diseases world over poses a great threat to public health. Also rigid standards applied for meat quality necessitates to examine the quality of meat.

Food protection is one of the most important priorities of the health and agriculture sectors in practically all countries. Millions of human cases of diarrhoea are due to food-borne diseases loosing billions of tons of food each year from contamination and improper handling. Food safety needs to be ensured throughout the process from production, processing and distribution to consumers. This include the organization of an integrated and comprehensive national food protection programme, the development and strengthening of analytical services, the application of Hazard Analysis Critical Control Point (HACCP) method in inspection services, the surveillance and control of food-borne diseases, and consumer protection.

The safety crisis world over involved different foods of animal origin including *Salmonella* in chicken, *Escherichia coli* and banned growth promoters in beef, antibiotics in pork, and finally the BSE crisis. The major threat to food safety is the emergence of new pathogens. Only four food-borne pathogens were recognized in 1942, compared with over a dozen which emerged in the past two decades, for example, *Listeria monocytogenes, E. coli* 0157:H7 and *Campylobacter* sp. Further new pathogenic strains continue to emerge, such as *Salmonella typhimurium* DT 104 and *S. enteritidis.* The causative factor is believed to be the continuing industrialization of food processing, creating ecological niches for previously suppressed pathogens.

There is a need to improve the quality of meat and meat products so as to promote the internal consumption as well as to boost export.

Objectives

Immediate objectives

1. To estimate total plate count (TPC) and yeast and mould count (YMC) of meat and meat products.

2. To study the occurrence of *Salmonella* sp. in meat and meat products.

Long term objectives

1. To assess the quality of meat and meat products.

Materials and Methods

Samples

A total of 198 samples comprising of beef (54), raw pork (49), chicken (37), and pork products (58) were processed for TPC and YMC. TPC were estimated for mesophiles as well as psychrophiles. The samples were collected fresh in sterile sachets and transported to the laboratory.

Processing of samples

The samples were analyzed for total plate count for mesophiles, psychrophiles, and yeast and mould counts (ICMSF, 1978). The pork product samples were processed for total plate count for mesophiles, and *Staphylococcus* counts. To estimate mesophiles, psychrophiles and yeast and mould counts, 10 g sample was homogenized with 90 ml normal saline solution (NSS). For mesophiles and psychrophiles counts the homogenate was diluted serially in 10 fold dilutions in NSS and inoculated onto plate count agar and incubated at 37^{0}C for 24-48 h and at 7^{0}C for 10-14 d, respectively. For yeast and mould counts the serially diluted homogenate was inoculated onto Sabaraud dextrose agar and incubated at 20-25^{0}C for 2-4 days. For *Staphylococcus* count homogenate was inoculated onto Baird Parker agar.

Bacterial colonies obtained from the samples were selected randomly for confirmation. The isolates were subjected to morphological and biochemical identification (Carter, 1995).

Results

A total of 198 samples comprising of beef (54), raw pork (49), chicken (37), and pork products (58) were processed for TPC and YMC. TPC were estimated for mesophiles as well as psychrophiles. In beef the highest mesophilic count was estimated to be 7.70log$_{10}$ colony forming units (cfu)/gm, whereas, the lowest count was 3 log$_{10}$cfu/g with an average of 6.89log$_{10}$cfu/g. Psychrophiles were estimated at 5.03 log$_{10}$cfu/g. YMC was found to be as high as 7.15 log$_{10}$cfu/g and the lowest count was about 3 log$_{10}$cfu/g with an average of 6.38 log$_{10}$cfu/g (Table 91).

Table 91. Counts of Mesophiles, Psychrophyles and yeast and moulds in different meats.

Type of meat	No. of Samples	Counts log$_{10}$ cfu/gm		
		MPC	PPC	YMC
Beef	54	6.89	5.03	6.41
Chicken	37	7.24	<3.00	6.86
Pork	49	6.84	5.48	6.38

Table 92. Counts of Mesophiles and *Staphylococcus* in different meat products.

Product	No. of Samples	Counts log$_{10}$ cfu/gm	
		MPC	*Staph count*
Sausages (unpacked)	37	7.56	3.57
Canned	10	<2.00	<2.00
Croquets	11	7.46	3.61

Salmonella sp. was isolated from 17 samples.

The average mesophilic, psychrophilic, and yeast and mould counts of raw pork were 6.84, 5.48 and 6.38 log$_{10}$ colony forming units (cfu)/gm, respectively. In canned sausages mesophilic and *Staphylococcus* counts were less than 2 log$_{10}$ cfu/gm, whereas, in unpacked sausages and croquets the mesophilic and *Staphylococcus* counts were 7.56 and 7.46, and 3.57 and 3.61 log$_{10}$ cfu/gm, respectively (Table 92).

Based on the morphological and biochemical characteristics the pathogens belonged to the genera/species *Salmonella, E. coli., Staphylococcus, Bacillus, Pseudomonas, Serratia, Kleibsiella, Alkaligens, Citrobacter, Proteus* and others. Occurrence of high microbial counts in raw pork is of great public health significance. Facilities have been created for testing quality of the food samples, which can be offered as consultancy services.

Principal achievements/findings of the project

1. High counts of mesophiles, psychrophiles, and yeast and mould counts were recorded in meat and meat product samples particularly sold at fairs.
2. Various species of spoilage and pathogenic bacteria were isolated.
3. Facilities have been created for testing quality of the food samples, which can be offered as consultancy services.

Recommendations

1. Proper cleanliness and hygiene at places of slaughter of livestock and poultry need attention.
2. There is need to create slaughtering facility with all amenities for small ruminants.
3. Pork is an important animal product in Goa. Quality of raw pork and pork products need to be monitored to avoid meat borne outbreaks.
4. Facilities for quality testing of meat and meat products need to be created.
5. Poultry are slaughtered in unorganized sector only. This creates a lot of foul smell and also degrade the environmental conditions. This also adds to the quality of meat. Centralized facilities for slaughtering of poultry with proper hygiene can be a solution to the problem.

Needs for future research

1. Prevalence of specific pathogens like *Salmonella, Escherichia coli, Campylobacter* and *Listeria monocytogenes* in meat and meat products need to be studied.
2. Shelf life of meat and meat products at ambient temperature need to be studied.
3. Preservative effect of certain plants available in the region on meat can be studied.

5. TECHNOLOGY ASSESSED AND TRANSFERED

The Krish Vigyan Kendra attached to the Institute functions as an extension unit for the assessment of relevant technologies both within the campus and in the farmer's fields and their transfer through the 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 farmer's fields 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 red palm weevil *Rhynchophorus ferrugineus* Oilv. in coconut.
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, coconut and arecanut.
10. Technology for increased profitability from coconut garden through farming system approach.
11. Technology for year round cultivation and spawn production of *Pleurotus florida* and *Pleurotus sojorcaju* mushrooms.
12. Technology package for meat rabbit production.
13. Technology for enhancement of broiler and layer production.

6. EDUCATION AND TRAINING

As Goa does not have an Agricultural University, the Institute is also shouldering 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 various colleges under the Goa University.

Trainings conducted / Lectures delivered

During the year under report Scientists and KVK faculty delivered regular lectures and conducted training to specific groups on relevant topics as indicated below :

1. "Managing of Red Palm weevil" for farmers at Kissan Mela held at Pillar organsied by KVK, ICAR Research Complex, Old Goa, on April 10th, 2001. (JR Faleiro)

2. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Sal village organised by Zonal Agriculture Office, Bicholim, on April 23rd, 2001. (HR Prabhudesai)

3. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Mencurem village organised by Zonal Agriculture Office, Bicholim, on April 24th, 2001. (HR Prabhudesai)

4. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Mandrem village organised by Zonal Agriculture Office, Pernem, on May 2nd, 2001. (HR Prabhudesai)

5. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Dhargal village organised by Zonal Agriculture Office, Pernem, on May 3rd, 2001. (HR Prabhudesai)

6. "Role of biotechnolgy in animal nutrition" for students of Carmel College, Nuvem on May 14th and 15th, 2001. (BK Swain)

7. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Madkai village organised by Zonal Agriculture Office, Ponda, on May 14th, 2001. (HR Prabhudesai)

8. "Groundnut and production technology" for farmers in State level Groundnut seed village training programme held at Ponda, organised by Zonal Agriculture Office, Ponda, on May 15th, 2001. (HR Prabhudesai)

9. "IPM in coconut, cashew, mango and spices" for farmers at Kissan Mela held at Mulgao, organsied by Zonal Agriculture Office, Bicholim, on May 10th, 2001. (JR Faleiro)

10. "Cultivation of spices" for farmers at Kissan Mela held at Mulgao, organsied by Zonal Agriculture Office, Bicholim, on May 10th, 2001. (VY Gaonkar)

11. "Coconut based cropping system" for farmers at Kissan Mela organised by Zonal Agriculture Office, Ponda on May 15th, 2001. (VY Gaonkar)

12. " Biotechnology and farming systems" for students of Goa University, Bambolim on May 16th, 2001. (BL Manjunth)

13. " Meat inspection techniques" for M/S Al-Nafees Frozen Foods, Usagaon, from May 18th to 21st, 2001. (SB Barbuddhe)

14. " IPM in paddy cultivation" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 26th, 2001. (JR Faleiro)

15. " Soil fertility management in rice" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 26th, 2001. (BL Manjunath)

16. " Promising rice varieties from research and their production technology" and "Ragi cultivation - prospects and problems for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 26th, 2001. (HR Prabhudesai)

17. " Pest management in paddy" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 27th, 2001. (JR Faleiro)

18. " Integrated weed management in rice" and "Biological nitrogen fixation" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 27th, 2001. (BL Manjunath)

19. "Disease management aspects in rice" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela farm, on July 27th, 2001. (R Ramesh)

20. " Hybrid rice cultivation technology suitable for Goa State" for Agricultural Officers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on July 27th, 2001. (HR Prabhudesai)

21. "Cultivation of oyster mushroom" for the trainees of course on mushroom cultivation organised by Horticulture Development Corporation, Panjim on August 7th and September 11th, 2001. (VY Gaonkar)

22. "IPM in paddy" for farmers of Socorro Village organised by Zonal Agriculture Office, Mapusa, on August 9th, 2001. (JR Faleiro)

23. "Package and practices for rice hybrids under Goa conditions" for FLD farmers organised by Zonal Agriculture Office, Mapusa, on August 9th, 2001. (HR Prabhudesai)

24. "Information on dairy industry" and "Breeding and management of dairy animals" for the Zoology teachers of Goa University, on August 27th and 30th, 2001. (EB Chakurkar)

25. "Rabbit rearing and important diseases of rabbits" for trainees at the training organised by Tulip Laboratories, on September 3rd, 2001. (EB Chakurkar)

26. " Poultry production and management" for lecturers of colleges of Goa University organised by Academic Staff College of Goa University, on September 3rd, 2001. (BK Swain)

27. "Feed formulation, feed quality and feeding management of broilers" for farmers on September 10th and 11th, 2001. (BK Swain)

28. "IPM in coconut" for farmers organised by KVK, ICAR Research Complex for Goa, Old Goa, on September 14th, 2001. (JR Faleiro)

29. "Breeding of pigs" for farmers in the training organised by KVK, ICAR Research Cimplex for Goa, Old Goa, on September 14th, 2001. (EB Chakurkar)

30. "Poultry feeds and feed formulation and poultry disease management" for lecturers of various colleges of Karnataka, Maharshtra and Goa, on September 15th, 2001. (BK Swain)

31. "IPM in Plantation crops" for farmers at Krishi Mela held at Keri, organised by Zonal Agriculture Office, Ponda, on November 22nd, 2001. (JR Faleiro)

32. "Plant diseases and their management " for forest officials organized by Forest Training School, Valpoi, on November 30th, 2001. (R Ramesh)

33. "Preparation of organic compost and vermicomposting in coconut gardens" for farmers in State Level Coconut farmers training programme organised by Cococonut Development Board, Cochin and Directorate of Agriculture, Goa held at Mapusa, Bicholim, Ponda, Margao, Tiswadi, Cancona and Pernem, on December 13th , 14th, 15th, 16th, 20th, 2001, Janauary 1st and 4th, 2002, respectively. (HR Prabhudesai)

34. "Quality control of milk, egg and meat in relation to dairy and poultry farming" for students of Department of Zoology, Goa University, Bambolim, on December 21st, 2001. (SB Barbuddhe)

35. "Eco-friendly technologies" for delegates in Seminar on Hart Sankalp organised by WWF held at National Institute of Oceanography, Donapaula, on Janauary 8th, 2002. (HR Prabhudesai)

36. "High yielding forage grasses for integrated dairy production" for Veterinary Assistants organised by Krishi Vigyan Kendra, Old Goa, on Janauary 11th, 2002. (BL Manjunath)

37. "Diseases of ornamental plants and their management " for forest officials organized by Forest Training School, Valpoi, on January 18th ,2002. (R Ramesh)

38. "Integrated pest management" for Agriculture Officers, Pesticide Dealers and Farmers organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 2nd, 2002. (JR Faleiro)

39. " Technology for groundnut and pulses" for Village Level Workers organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 6th, 2002. (HR Prabhudesai)

40. "Insect pests of groundnut and pulses" for Village level workers (Talathi) organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 8th, 2002. (JR Faleiro)

41. " Vermi-composting bio-technology" for Village Level Workers organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 8th, 2002. (HR Prabhudesai)

42. "Insect pests of arecanut, sapota, papaya, etc," for Village level workers (Talathi) organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 11th, 2002. (JR Faleiro)

43. "Pest management in spices" for farmers of North Goa in training of spices development organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 14th, 2002. (JR Faleiro)

44. "Pest management in spices" for farmers of South Goa in training of spices development organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 15th, 2002. (JR Faleiro)

45. "Cultivation of spices" for Gram Sevaks held at FTC, Old Goa, on February 18th, 2002. (VY Gaonkar)

46. "Vegetative propogation of fruit crops" for the trainees on course of plant propogation organised by Horticulture Development Coorporation held at Panjim, on February 19th, 2002. (VY Gaonkar)

47. "Diseases of Paddy and their management", "Disease of vegetables and their management" and "Disease management aspects in fruits and plantation crops" for Village level workers organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on February 20th , 2002 (R Ramesh)

48. " Microbial composting technology" for Village Level Workers organised by Directorate of Agriculture at FTC, Ela, Old Goa, on February 20th, 2002. (HR Prabhudesai)

49. "High yielding forage grasses for integrated dairy production" for farmers organised by Krishi Vigyan Kendra, Old Goa, on February 21st, 2002. (BL Manjunath)

50. "Integrated Aquaculture" and "Culture of *Macrobrachium rosenbergii*" for trainees in the short training course on 'Freshwater fish farming', organized by the Dept. of Fisheries, Govt. of Goa, on February 26th and 27th, 2002 respectively. (S Subramanian)

51. "Sugarcane production" and "Integrated farming system in rice" for Agricultural Assistants organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on February 26th, 2002 (BL Manjunath)

52. "Improved cultivation practices for coconut" for the trainees of the course on production technology for horticulture crops held at Navelim and Davorlim, on February 26th and 27th, 2002, respectively. (VY Gaonkar)

53. "Technologies for rice and rice based cropping systems" for farmers under command area organized by CADA, at Ela Farm, on February 26th, 27th and March 6th, 2002 (HR Prabhudesai)

54. " Cultivation tips for minor fruits like jack, amla, custard apple, kokum, carambola, jamun and carrisa" for Gram Sevaks organised by Directorate of Agriculture at FTC, Old Goa, on February 28th 2002. (S Priya Devi)

55. "Fish culture potentials in Goa" in the refresher course for the village level workers organized by the Directorate of Agriculture, on March 7th, 2002. (S Subramanian)

56. "Integrated coconut based farming systems in Goa", "Wonder mango variety of 21st Centuary" and "Production of different mango varieties in Goa" for Gram Sevaks organized by Farmers Training Centre and State Agricultural Department at FTC, Ela Farm, on March 7th, 2002. (SP Singh)

57. "Coconut based farming system" for participants in Womens Mela organised by Krishi Vigyan Kendra, Old Goa, on March 8th, 2002. (SP Singh)

58. "Crop improvement in Cashew and latest in cashew research in Goa" for the trainees in the Refresher's Training Course for village level workers in Agriculture held at FTC, Ela, Old Goa, on March 8th, 2002. (AR Desai)

59. " Prevention of diseases and maintenance of hygiene at farm" for farmers organised by Krishi Viygan Kendra, Old Goa, on March 9th , 2002.(SB Barbuddhe)

60. "Fabrication and Management of Aquarium and ornamental fishes" for trainees in the training programme organised by KVK, ICAR Research Complex for Goa, Old Goa, on March 15th and 16th, 2002. (S Subramanian)

61. "Integrated Fish Farming Systems" for the trainees at training programme organise by KVK, ICAR Research Complex for Goa, Old Goa, on March 18th and 19th, 2002. (S Subramanian)

62. "Disease of poultry and their control" for farmers organised by Krishi Viygan Kendra, Old Goa, on March 22nd , 2002.(SB Barbuddhe)

63. "Disease of rabbit and their control" for farmers organised by Krishi Viygan Kendra, Old Goa, on March 23rd , 2002.(SB Barbuddhe).

Training Programmes

Discipline	Title of the 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 Rose cultivation Propogation techniques in important horticultural crops Vegetable production
Home Science	Low cost nutritional recipes Recipes from mushrooms Child care and preparation of weaning mixture Diet cousnselling Home scale food preservation Bakery and crafts Methods of food preservation
Plant Protection	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 combinations Composite fish culture Brackishwater fish farming Aquarium management
Agril. Extension	Leadership development Organizational climate Panchayat Raj System in Goa Use of audio visual aids Training and Transfer of Technology

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

7. AWARDS AND RECOGNITION

- Dr. B. L. Manjunath, Scientist Sr. Scale (Agronomy) was awarded Ph.D. degree in Agronomy by the University of Agricultural Sciences, Dharwad for his thesis entitled "Integrated Farming Systems for Coastal Region of Goa".

- Dr. E. B. Chakurkar, Scientist Sr. Scale. (Animal Reproduction), was awarded Ph.D. degree in Veterinary Sciences by Bala Saheb Konkan Krishi Vidhyapeth, Dapoli for his thesis entitled "Studies on different aspects of embryo transfer in cattle under farm conditions".

8. LINKAGE AND COLLABORATION

Viable linkage and close collaboration are maintained by the Institute with State Departments of Agriculture, Animal Husbandry and Veterinary Services, Fisheries, Rural Development Agencies, Horticulture Development Corporation, Goa Chamber of Commerce of the State, Universities and NGOs related to Agricultural Research and Development for free flow of improved technology, access to latest developments in the field of Agruicultural Research taking place else where and constant upgradiation of Research at the Institute. Besides, in areas of mutual intrest in the Agricultural Research and Development of the state, the Institute and Development Departments were actively involved in arranging joint meetings, training and extension activities. The expertise and experience of specialists from other relavant of ICAR Institutes, neighbouring Agricultural Universities and the local Development Departments, including feedback from the farmers were obtained while finalising the Research programme of the Institute. This experts and officials were also invited for all the major meetings and committees arranged for this purpose.

Being an multi-commodity Institute having focus on applied an adaptive Research the Institute draws latest technologies, improved varieties and planting materials from its different sister ICAR Institutes such as DRR, Hyderabad, CRRI, Cuttak, NRC on Groundnut, Junhagad, PDBC, Bangalore, CSWCRTI, Regional station, Ooty, CIAE, Bhopal, IGFRI, Jhansi, NRC on Weed Scineces, Jabalpur, IARI, New Delhi, IIHR, Bangalore, PDVR, Varanasi, NRC on Cashew, Puttur, IISR, Calicut, CPCRI, Kasargod, NRC on Oilpalm, Elluru, CISH, Lucknow, IVRI, Izzatnagar, Project Co-ordinator, AICRP on Pig, PDP, Hyderabad, CIBA, Chennai, CIFA, Bhubaneshwar, CISFE, Mumbai, IASRI, Delhi, Zonal Co-ordinator, Zone VIII (TOT), Bangalore, NBSS & LUP, Nagpur etc.

The Institute has also combined Research and technology transfer programme with Baba Atomic Research Centre, Mumbai. It has also training programmes and elite material distribution to farmers funded by Coconut Development Board, Kochi. The National Institute of Oceangraphy, Dona Paula, Goa being a local CSIR Institute dealing with Marine Resources, the Institute draws support and co-operation particularly in the fields of fisheries, coastal eco-system management and administrative functioning. Institute has established meteorological observatory with the co-operation and guidance of IMD, Pune.

The Institute has identified areas of Inter Institutional Collaborative Research with the University of Agricultrual Sciences, Dharwad, Karnataka in which infrastructural and manpower facilities available under both the organizations would be utilized for, common Research programmes. To accrue the benefits in the field of Research and education, the Institute also colloborates with Konkan Krishi Vidhyapeeth, Dapoli. Since both, UAS, Dharwad and KKV, Dapoli are situated in the distinct agro climatic situations and near to Goa, the programme of these two Universities have got high relevance to the mandate of the Institute.

The Institute has been nominated as a participant member in various State Level Committees constituted by the Government of Goa. The Institute has a active and reciprocal involvement in the activities of agencies like NABARD, CADA, Sanjeevani Sugar Factory, Central Integrated Pest Mnagement Centre, Banks, Co-operatives, Mahila Mandal, Private Nurseries, Panchayats, SISI, Colleges etc,. In the Agricultural Programmes of All India radio and Doordarshan, Panaji Centre, the scientific and transfer of technology staff of the Institute participate. The Institute has also a close liasion with Goa University and students of various colleges, and help them in formulating their academic programmes and in carrying out the projects and assignments.

9. OTHER PROJECTS / PROGRAMMES

1. Institute has seven NATP projects one each in Soil Science, 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. Land use planning for management of agricultural resources.

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

   C. Development and evaluation of soil and water conservation measures and land use systems for sustainable crop production in Western Ghats of Coastal region.

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

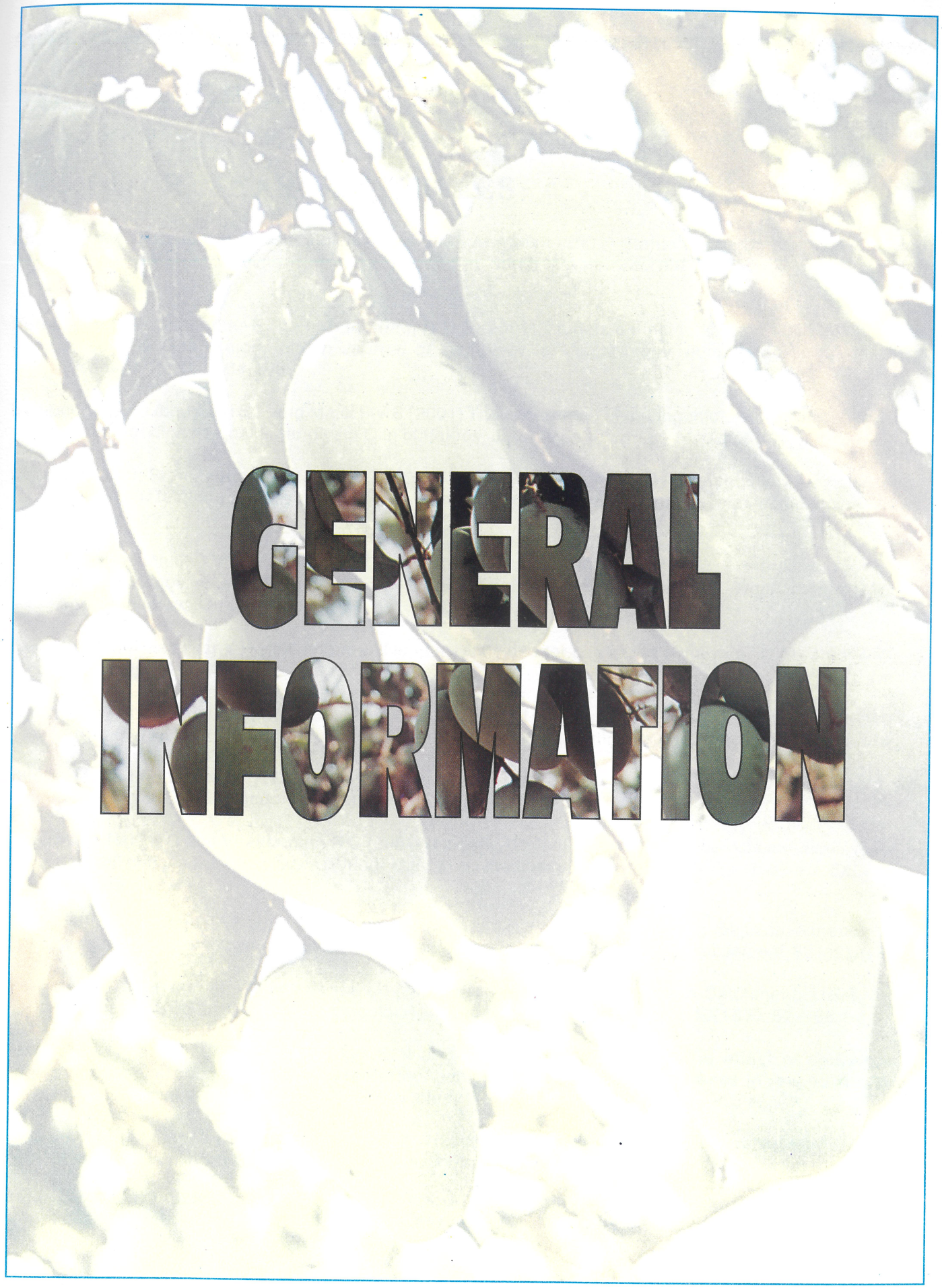
   E. Institute Village Linkage Programme (IVLP) for Technology Assessment and Refinement (TAR) in coastal agro eco-system of North Goa district of Goa.

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

   G. Animal Health Information System through Monitoring and Surveillance.

2. One All India Co-ordinated Project on Pigs is in progress in the Animal Science Division. The details of the project are furnished under externally funded Projects in this report.

3. As per the guidelines, a project on Front Line Demonstration in oilseeds is being carried out at the Institue. the details of the Project are furnished under Transfer Of Technology in this report.


GENERAL
INFORMATION

10. LIST OF PUBLICATIONS

(A) RESEARCH ARTICLES

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Swain B K, Johri T S, Swain P and Shrivastav A K (2001) Effect of supplementation of different combinations of some selected nutrients on the performance and immune response of broilers. *Indian J. Poultry Science* , 35(3):247-251.

Swain B K, Sundaram R N S, Nirmale A V and Barbuddhe S B (2001) Effect of different types of litter materials on slaughter characteristics and biochemical parameters in broilers. *Indian Journal of Veterinary Research* 10(2): 41-43.

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B) PAPER PRSENTED AT THE SEMINARS / WORKSHOPS/SYMPOSIA

Adsule PG, Desai AR, Priya Devi S, Thangam M and Ramchdarddu K (2001) Status and prospects of Horticultural and Plantation crops in Goa and their utilization. National Symposium on Post Harvest Technologies for agricultural produce and prospects for the food processing industry in Konkan region, Goa. 23-24 November, 2001, Souvenir pp 10-11.

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Malik S V S and Barbuddhe S B (2002) Hurdles and prospects in diagnosis and control of listeriosis. Proceedings, National Symposium on "Concepts in Sustainable Livestock Production and Health in New Millenium", Nagpur, February 4-5, 2002.

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Prabhudesai H R, Manjunath B L and Faleiro J R, (2001) Production potential and processing infrastructure of cereals, pulses and oilseeds in Goa, In: Proceedings, Symposium on Post Harvest Technologies for agricultural produce and prospects for the food industry in Konkan region, 23-24 November, 2001, Goa, pp 28-30.

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(C) POPULAR ARTICLES

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(D) REVIEW ARTICLES

Swain B K and Sundaram R N S (2001) Role of biotechnology in poultry nutrition. *Poultry punch*, 17 (9):31-45.

(E) BOOK CHAPTERS

Dhandar D G and Prabhudesai H R (2001) Indigenous nutrient management technology in Goa. Published in the Book entitled *"Indigenous Nutrient Management Practices... Wisdom alive in India"* published by the Indian Institute of Soil Science, Bhopal: Chapter 23,pp 347-358

(F) REPORTS/BULLETINS/ TECHNICAL FOLDERS / MISC. PUBLICATIONS

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(G) RADIO TALKS

- "Pest management in sugarcane" on 17.04.2001. J R Faleiro
- "Land preparation for kharif rice" on 06.06.2001. H R Prabhudesai
- "Grafting techniques in mango" on 25.06.2001. V Y Gaonkar
- "Planting and aftercare of mango" on 27.07.2001. V Y Gaonkar
- " Nursery raising and fertilizer management for kharif rice" on 30.07.2001 H R Prabhudesai
- "Manuring in mango" on 14.08.2001. V Y Gaonkar
- "Pest management in mango" on 16.12.2001. V Y Gaonkar
- "Protection of mango inflorescence" on 09.01.2002. H R Prabhudesai
- "Harvesting, yield and economics of mango cultivation" on 08.02.2002 V Y Gaonkar

(H) DOORDARSHAN PROGRAMMES

- "Use of pheromone traps to manage red palm weevil in coconut plantations" on 19.04.2001. J R Faleiro
- "Cultivation and propogation of bread fruit" on 02.05.2001. V Y Gaonkar
- "Intercropping in cocnut gardens" on 01.08.2001. V Y Gaonkar
- " Insect pest of cashew and their management" on 06.09.2001. J R Faleiro

11. LIST OF APPROVED ONGOING PROJECTS

A. Crop Sciences

1. Evaluation of medium and hybrid rice varieties.
2. Studies on the quality aspects of scented / Basmati Rice
3. Screening and management of Salt tolerant rice varieties.
4. Evaluation and management of high yielding varieties of Sugarcane
5. Rehabilitation of mine reject soil for crop production.
6. Rice based farming systems.
7. Hydrological investigations on soil and water conversation measures under cashew crop.
8. Management of red palm weevil, *Rhynchophorus ferrugineus* Oliv. using food baited pheromone traps.
9. Management of economically important crop diseases of Goa region.

B. Horticulture

10. Survey, collection and evaluation of plantation crops and spices.
11. Evaluation of oil palm hybrid combinations (DXP) under Goan conditions.
12. Survey, collection, conservation and evaluation of fruit crops.
13. Survey, collection, conservation and evaluation of fruits available/grown in agroforest areas of Goa.
14. Collection, conservation and evaluation of vegetable crops.
15. Survey on the requirement of exotic and indigenous fruits, vegetables, flowers and their processed products in Goa from tourism point of view.
16. Collection, conservation and evaluation of flower crops.
17. Inventory on the basic information of economic forest tree species and medicinal plants in Goa region.
18. Standardization of agotechniques for horticultural crops.
19. Post harvest management technologies for fruits available/grown in agroforest areas of Goa region.

C. Animal Sciences

20. Evaluation of varying energy and protein level in rabbit diet for better performance.
21. Evaluation and identification of suitable management practices for Goat rearing under coastal climatic condition.
22. Investigation on etiology of infertility in farm animals and identifying suitable remedial measures.
23. Studies on existing diseases including zoonoses in Goa region and establishment of disease investigation laboratory.
24. Microbiological studies on meat and meat products.
25. Performance of crossbred broilers (commercial) under different feeding and rearing systems in Goa condition.

D. Fishery Science

26. Production enhancement studies under rabbit-fish integrated system
27. Formulation of low cost feed for fish and prawn using locally available feed ingredients.

E. Agricultural Research Information System

28. Development of agricultural information system for Goa.

F. Transfer of Technology

29. Training and other extension activities.
30. Front line demonstration on cereals, pulses, oilseeds, horticultural crops and other enterprises related to agriculture.
31. On farm testing in crop production, horticulture, livestock production and fisheries.

12. CONSULTANCY, PATENTS COMMERCIALISATION OF TECHNOLOGY

The ICAR Research Complex for Goa acts as a nodal agency in identifying, modifying and refining available agricultural technologies suitable for the coastal situations of this region. The Research activities aimed at solving the problems and bottle necks faced in various agricultural production systems. The Transfer of Technology is being carried out to disseminate information on agricultural production directly to the beneficiaries to a limited extent through training, demonstrations and other extension programmes and indirectly through the development agencies and NGOs by passing on the suitable technologies besides, nucleus planting material and improved varieties of plant and animal species.

The small and marginal farmers of the state are the bulk beneficiaries of the technology generated by the Institute. Technical advice, consultancies and trainig are imparted mostly free through programmes of Krishi Vigyan Kendra and extension programmes of the Scientists. Seeds of fine grained and scented varieties, hybrids in rice, imrpvoed varieties in groundnut and flower etc. were distributed to the farmers through the State Agricultural Department. Simillarly promising cashew, mango, coconut, mushrooms and ornamental plants were multiplied and sold at the Institute. Based on the individual request of farmers, home steads were visited by the Scientists and spot solutions for the wide ranging problems in field crops, horticulture, animal science and fisheries, for improvement of production were provided.

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

A) RESEARCH ADVISORY COMMITTEE

The Research priorities of the Institutre were critically examined and achievements reviewed in light of local agricultural requirements and thrust areas identified, by the Research Advisory Committee constituted for the Institute, in its Second meeting held on 22 - 23rd May, 2001 at the conference hall of the Research Complex for Goa. The current Research Advisory Committee constituted by the Council for 3 years w.e.f. 10-3-2001, consisted of the following members.

1)	Dr. Y. S. Nerkar Ex-Vice-Chancellor, MPKV, Rahuri	- Chairman
2)	Dr. S. T. Gaikwad Ex-Director, NBSS & LUP, Nagpur	- Member
3)	Dr. M. B. Magdum Ex-Professor & Head, Horticulture Division, BSKKV, Dapoli	- Member
4)	Dr. Uttam Ingale Ex-Director of Extn., MAU, Parbhani	- Member
5)	Dr. S. D. Tripati Ex- Director, CIFE, Mumbai	- Member
6)	Shri. Mohan Amshekar President, BJP Kisaan Morcha Ponda - Goa	- Member (Farmer Representative)
7)	Smt. Aruna J. Deshpande Andheri, Mumbai	- Member (Woman Representative)
8)	Dr. P. G. Adsule / Dr. V. S. Korikanthimath Acting Director / Director, ICAR Research Complex for Goa, Ela, Old Goa	- Member
9)	Asst. Director General (Agro Forestry), ICAR, Krishi Bhavan, New Delhi	- Member (ICAR Representative)

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

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 of council of the Institure. The 12th Annual Scientific Research Council meeting of the Institure was held on 27-28th June, 2001 in the conference hall of the Research Complex. The meeting comprised of six sessions which included the inagural session, four technical sessions and the plenary session.

The technical sessions of the meeting were guided by Dr. P. G. Adsule, Acting Director of the Institute, Shri. W. M. Khade, Director, Directorate of Agriculture. The others who attended the meeting were the represenatives of the development departments of State Government and all project leaders and associates of the Institute.

The Scientific Research Coucil review the progress made under various research projects for the year 2000-01 before finalising the technical programmes of the ongoing research projects for the year 2001-02. The Memebrs of the Council are as under.

1) Dr. P. G. Adsule / Dr. V. S. Korikanthimath - Chairman
Acting Director / Director
ICAR Research Complex for Goa,
Ela, Old Goa

2. All Project Leaders - Member

3. Dr. B. L. Manjunath - Member - Secretary
Scientist. Sr. Scale
ICAR Research Complex for Goa
Ela, Old - Goa

C) INSTITUTE MANAGEMENT COMMITTEE

The Institute Management Committee constituted for financial and adminsistrative guidance of the Institute, met on 22-4-2001 and reviewed the progress of infrastructural development before approving the important financial and adminsistrative proposals of the Institute for the year. The composition of the committee is as follows :

1) Dr. P. G. Adsule / Dr. V. S. Korikanthimath - Chairman
Acting Director / Direcor,
ICAR Research Complex for Goa,
Ela, Old Goa

2) Dr. P. D. Sharma - Member
Asst. Director General (Soils),
ICAR, Krishi Bhavan,
New Delhi

3) Dr. Fernando Furtado - Member
Deputy Director (SLBP),
Directorate of AH & VS,
Panjim - Goa

4) Shri. Mohan Amshekar
President,
BJP Kisaan Morcha,
Ponda - Goa
- Member

5) Smt. Aruna Deshpande
Andheri, Mumbai
- Member

6) Dr. R. N. S. Sundaram
Principal Scientist,
ICAR Research Complex for Goa,
Ela, Old Goa
- Member

7) Dr. S. Subramanian
Principal Scientist,
ICAR Research Complex for Goa,
Ela, Old Goa
- Member

8) Shri. S. Mannivanan
Scientist (SW & CE)
ICAR Research Complex for Goa,
Ela, Old Goa
- Member

9) Miss. S. Priyadevi
Scientist (Horticulture)
ICAR Research Complex for Goa,
Ela, Old Goa
- Member

10) Shri. V. Y. Gaonkar
I/C Training Organisor,
KVK, ICAR Research Complex for Goa,
Ela, Old Goa
- Member

11) Assistant Administrative Officer,
ICAR Research Complex for Goa,
Ela, Old Goa
- Member, Secretary

12) 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 organizations and farmers, met on 29-6-2001 in the conference hall of the Research Complex and reviewed the progress of Transfer Of Technology programmes of Krishi Vigyan Kendra as per the modified norms of the council and approved the technical programmes for 1999-2000. Following are the members of the committee..

1) Director,
ICAR Research Complex for Goa,
Ela Old Goa
Chairman

2)	Director of Agriculture, Govt. of Goa	Member
3)	Director 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. Saeby 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)	Dr. V. Y. Gaonkar I/C Training Organiser, KVK, ICAR Research Complex for Goa, Ela, Old Goa	Member Secretary

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

☆ Planning Workshop of Mission Mode NATP project on Land Use Planning for Management of Agricultural Resources in Coastal Agro-ecosystems held at the Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore, on 2-3 May, 2001. **HM Wasnik**

☆ National seminar on Kokum organized by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli in association with National Horticulture Board, Govt. of India and Western Ghat Kokum Foundation, Goa held at RFRS, Vengurla, on 12-13 May, 2001. **AR Desai, S Priya Devi and M Thangam**

☆ Launching Workshop (phase-2) of Mission Mode NATP project on Land Use Planning for Management of Agricultural Resources held at National Bureau of Soil Survey and Land Use Planning, (ICAR). Nagpur, on 14-15 May, 2001. **HM Wasnik**

☆ Workshop on " Popularising Vermiculture technology for households" organised by Lion's Club of Margao held at Municipal Council Hall, Margao on 26 May, 2001. **HR Prabhudessai**

☆ Natioanl Conference on Agricultural Information Technology organised at university of Agricultural Sciences, Bangalore during 2 -3 June, 2001. **J Ashok Kumar**

☆ Regional plant quarantine advisory committee meeting organize by Directorate of Plant Protection, Quarantine and Storage held at CIRCOT, Mumbai, on 18 June, 2001. **PG Adsule and JR Faleiro**

☆ Annual Review Workshop of National Agricultural Technology Project on " Animal health information system through disease monitoring and surveillance" at Project Directorate on Animal Disease Monitoring and Surveillance, Bangalore, during 28-30 June, 2001. **SB Barbuddhe and BK Swain**

☆ Seminar on Purak organised by Godrej Agrovet Limited held at Grace Church hall, Margao on 26 July, 2001. **VY Gaonkar**

☆ National seminar on Changing scenario in the production systems of horticultural crops held at Horticultural College and Research Institute, TNAU, Coimbatore during 28-30 August, 2001. **S Priya Devi and M Thangam**

☆ Workshop on Project management and participatory rural appraisal techniques held at Extension Education Institute, Gujrat Agriculure University, Anand during 27 August to 3 September, 2001. **VS Sakharkar**

☆ Annual Review Workshop of the project "Development and evaluation of soil and water conservation measures and land use systems for sustainable crop production in western ghats of coastal region" held at Central Plantation Crops Research Institute, Kasargod during 6 -7 September, 2001. **S Mannivanan, J Ashok Kumar and S Priya Devi**

☆ Meeting on production forecast of cashew for the year 2002 held at NRCC, Puttur on 7 September, 2001. **AR Desai**

☆ Re-orientation programme on contractual labour act held at National Institute of Public Administration, Bangalore, during 15 - 17 September, 2001. **S Mannivanan**

- ☆ Review meeting of Krishi Vigyan Kendra's held at Hulkot, Gadag on 23-24 September, 2001. **VY Gaonkar**
- ☆ First SAARC Poultry Conference held at Pune, during 24-26 September, 2001. **SB Barbuddhe and BK Swain**
- ☆ Seminar on agriculture and tourism organised by Goa Tourism Development Corporation held at Institute of Hotel Management, Porvorim on 28 September, 2001. **VY Gaonkar**
- ☆ National Symposium of Compound Livestock Feed Manufacturer's Association (CLFMA) held at Marriott Resort, Goa on 29 September, 2001. **RNS Sundaram and BK Swain**
- ☆ National seminar on Emerging trends in Pests and Diseases and their management organized by Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore on 11-13 October 2001. **R Ramesh**
- ☆ Second National Symposium on IPM in Horticultural crops: New molecules, Biopesticides and Environment" organized by Association for advancement of pest management in horticultural ecosystem, Bangalore, during 17-19 October, 2001. **JR Faleiro**
- ☆ XV Biennial Workshop of AICRP on Cashew held at National Research Centre for Cashew, Puttur, from 18-20 October, 2001. **PG Adsule and AR Desai**
- ☆ National seminar on "Scope and strategies for increasing meat production from small ruminants and rabbits in new millenium", Bharthiar University, Coimbatore, during 9-11 November, 2001. **EB Chakurkar**
- ☆ Symposium on post-harvest technologies for agricultural produce and prospects for the food processing industry in Konkan region, organized by Association of food scientists and technologists (India) and ICAR Research Complex for Goa, on 23-24 November, 2001 at International Centre, Dauna Paula, Goa. **Director and Scientists**
- ☆ Workshop for Teachers under India Canada environment facility organised by Goa University and WWF (Goa Unit) held at Goa University during 4-7 December, 2001. **HR Prabhudesai**
- ☆ AFST(I) Professor. Dinanath. V. Rege Felicitation Seminar on Nutraceuticals and functional Foods at Mumbai University's Department of Chemical Technology, Matunga, Mumbai during 18–20 December, 2001. **PG Adsule**
- ☆ Seminar on "Functional Foods and Neutraceuticals", held at UDCT, Mumbai, during 19-20 December, 2001. **PG Adsule and SB Barbuddhe**
- ☆ 89th Session of Indian Science Congress organised by Indian Science Congress Association and University of Lucknow held at Lucknow during 3-7 January, 2002. **SP Singh**
- ☆ Seminar on " Harit Sankalp" organised by WWF, Goa Unit held at National Institute of Oceanography (NIO), Dona Paula on 8 Janauary, 2002. **HR Prabhudesai**
- ☆ Meeting with review team of NATP on the project ""Integrated Nutrient Management of Palm Based Cropping / Farming System for Sustained Productivity Under Coastal Ecosystem" held at CPCRI, Kasaragod, on 12 Janauary, 2002. **SP Singh**
- ☆ National seminar on Export of agricultural products-Prospects and Challenges, organized by EXIM bank and Bank of Maharashtra, held at Pune on 21- 22 January, 2002. **S Priya Devi and M Thangam**

- ☆ XXXVI Annual Convention of Indian Society of Agricultural Engineers, held at Agricultural & Food Engineering Department, IIT, Kharagpur during 28-30 Janauray, 2002. **S Mannivanan**

- ☆ National Seminar on Indigenous nutrient management practices and brain stroming session on organic farming organised by Indian Institute of soil Sciences, Bhopal during 30-31 Janauary, 2002. **BL Manjunath**

- ☆ National symposium on "Concepts in Sustainable Livestock Production and Health in New Millenium", held at Nagpur, during 4-5 February, 2002. **RNS Sundaram and BK Swain**

- ☆ National Workshop on Post harvest management of horticultural produce, organized by National Productivity council, held at Chandigarh during 7–8 February, 2002. **PG Adsule**

- ☆ VI group meeting of the Post harvest technology workers of All India co-coordinated research project on Post Harvest Technology of Horticultural crops held at Dr. Balasaheb Sawant KKV, Dapoli during 4-12 March, 2002. **PG Adsule**

- ☆ Local Advisory Committee meeting of All India radio, Panjim held on 20 March, 2002. **VY Gaonkar**

15. WORKSHOPS, SEMINARS, MEETINGS, FARMERS AND FIELD DAY, ETC, ORGANISED BY THE INSTITUTE

- ICAR Reseach Complex for Goa along with Association of Food Scientists and Technologists (India), Mysore sucessfully organised a Symposium on Post Harvest Technologies for Agricultural produce and Prospects for the Food Processing Industry in Konkan Region" at the International Centre, Dona Paula, on 23-24th, November, 2001. Symposium was inagurated by Dr Anwar Alam DDG (Agril. Enginnering), ICAR, New Delhi in presence of Shri A.Venkatraman, Secretary (Agriculture), Government of Goa and Dr. A.S.Bawa, Director, Defence Food Research Laboratory, Mysore. Valedictory function was attended by Honourable Union Minister of State for Shipping Shri. Sripad Naik along with Dr. S.B.Sondhe, Vice Chancellor, Goa University. The symosium was attended by over 100 delegates from State Agricultural Universities, ICAR / CSIR Institutes and other organizations.



Dr. Anwar Alam, DDG (Ag. Engg.) releasing the Souvenir at the Symposium on Post Harvest Technology



Dr. S.B. Sonde, VC, Goa University addressing the Symposium, in presence of Shri. Shripad Naik, Hon. Union Minister of State for Shipping

- ICAR Research Complex for Goa along with Directorate of Agriculture organised a meeting on Floriculture Develoment in Goa at Old Goa on 29 September, 2001. The meeting was headed by Honourable Minister of State for Agriculture, Shri Sripad Naik. Shri. Ulhas Assnodkar, Deputy Speaker, Government of Goa, Dr. M.L.Choudhary, Head, Division of Floriculture and Landscaping, IARI, New Delhi, also participated in the meeting.



Shri. Sripad Naik, Hon. Union Minister of State for Agriculture distributing gladiolus bulbs to farmers

- ICAR Research Complex for Goa in collaboration with Ministry of Information and Broadcasting and Petrolium Conservation Research Association, organised a workshop on "Save Oil" at Old Goa on 10th October, 2001. Shri Pandurag Raut, Minister of Transport, Government of Goa inagurated the workshop in presence of Shri. R.K.Gupta, Chief Regional Co-ordinator, PCRA, Mumbai and Shri. B.N.Sundareshwara, Jt. Director, Department of Field Publicity, Maharashtra.

- ICAR Research Complex for Goa sucessfully orgainised Krishi Mela at Pillar Seminary on 10 April, 2001. Shri Sripad Naik, Hon. Union Minister of State for Agriculture was the chief Guest.

- ICAR Research Complex for Goa sucessfully orgainised the pre-Rabi Interface meeting with development departments of the states on 30th October, 2001.

- ICAR Research Complex for Goa celebrated the World Environment Day at the Institute on 6th June, 2001. Shri. Shantaram Garud, Project Co-ordinator, Watershed Society was the Chief Guest.

- ICAR Research Complex for Goa celebrated the Hindi Day on 27th September, 2001 at the Institute. Shri. Umesh Kumar Singh, Hindi Officer, NIO, Donapaula was the Chief Guest.

- ICAR Research Complex for Goa celebrated the World Food Day at the Institute on 26th October, 2001. Dr. Nandkumar Kamath, Project Scientist, Goa University was the Chief Guest.

- Krishi Vigyan Kendra, ICAR Research Complex for Goa celebrated the Womens in Agriculture Day on 6th December, 2001 at the Institute. Mrs. Pratimha Dhond, Chairman, Womens Co-operative Bank, Panjim, was the Chief Guest.

- ICAR Research Complex for Goa celebrated the National Science Day on 28th February, 2002 at the Institute. Shri. Arun Madgaonkar, President, Bhartiya Kisan Sangh was the Chief Guest.

- Krishi Vigyan Kendra, ICAR Research Complex for Goa celebrated the Womens International Day by organizing a Women Mela on 8th March, 2002 at the Institute.

16. DISTINGUISHED VISITORS

Visiting Dignitary	Date of visit
SHRI. SRIPAD NAIK Minister of State for Agriculture and Co-operation, Government of India	29-09-2001 & 25-10-2001
SHRI. PANDURANG RAUT Minister for Transport, Government of Goa	10-10-2001
DR. A.K.SANGMA Minster for Soil Conservation, Government of Meghalaya	13-09-2001
SHRI ULHAS ASSONDKAR Deputy Speaker, Government of Goa	29-09-2001
SHRI LAWRENCE FERNANDES Ex Mayor of Banglore City & Member, ICAR Governing Body	25-05-2001
DR. ANWAR ALAM DDG (Agril. Engg), ICAR, New Delhi	23-11-2001
DR G.V.GOUD Ex Vice Chancellor, UAS Dharwad	22-04-2001
SHRI P.B.SHARMA ADG (Soils), ICAR, New Delhi	22-04-2001
DR A.G.SAWANT Member, ASRB, ICAR, New Delhi	30-10-2001
DR P.S.PATHAK Director, IGFRI, Jhansi	12-08-2001
DR D.G.DHANDAR Director, NRC Oil Pam, Elluru	9-07-2001 & 4-10-2001
DR NAGENDRA SHARMA Jt. Director (Academic) & Dean, IVRI, Izzatnagar	13-09-2001

DR A.K.SIKHA Head, CSWC&RTI Regional Centre, Ooty	29-01-2002
DR M.L.CHOUDHARY Head, Division of Floriculture and Land Scaping, IARI, New Delhi	29-09-2001
DR B.B.SINGH Head, Division of Fruits, IARI, New Delhi	26-12-2001
DR Y.S.NERKAR Director, Vasnant Dada Sugar Institute & Ex. Vice Chancellor, MPKV, Rahuri	20-04-2001 & 22-05-2001
DR S. T. GAIKWAD Ex Director, NBSS & LUP, Nagpur	22-05-2001
DR S.D.TRIPATHI Ex Director, CIFE, Mumbai	22-05-2001
DR UTTAM INGLE Ex Director of Extension, MAU, Parbhani	22-05-2001
DR M.K.NAIR Ex Director, CPCRI, Kasargod	07-01-2002
DR V. RAJGOPALAN Ex- VC, TNAU, Coimbatore	07-01-2002
DR M.R.SETHURAJ Ex-Director, Rubber Research Institute, Kottayam	07-01-2002
DR MOHAN KUMAR Ex. Dean, KAU, Mannoty	07-01-2002
DR MOHAN NAIDU Ex-Director, SBI, Coimbatore	07-01-2002
SHRI W.M.KHADE Director of Agriculture, Government of Goa	27-06-2001
DR H.K.MALVIYA Director of AH&VS, Government of Goa	27-06-2001

SHRI VERENKAR Director of Fisheries, Government of Goa	27-06-2001
DR K.S.MOMEEN Addl. Director of soil Conservation, Government of Meghalaya	13-09-2001
SHRI B.N.SUNDARESHWARA Jt. Director, Department of Field Publicity, Mahrashtra	10-10-2001
SHRI R.K.GUPTA Chief Regional Co-ordinator, PCRA, Mumbai	10-10-2001
DR PADWAL DESAI President, AFST(I) Mysore	04-10-2001
SMT ARUNA DESHPANDHE Social Worker, Mumbai	22-05-2001
SHRI MOHAN AMSHEKAR President, BJP Kisaan Morcha	22-04-2001
SHRI SHANTANU GARUD Project Co-ordinator, Watershed Society of Goa	06-06-2001
DR NANDAKUMAR KAMAT Project Scientist, Goa University, Bambolim	16-10-2001
MRS PRATIMA DHOND Chairman, Womens Co-operative Bank, Panjim	06-12-2001
SHRI ARUN MADGAONKAR President, Bhartiya Kisan Sangh, Goa	28-12-2001

17. PERSONNEL

Name	Designation	Specialisation
Managerial		
VS Korikanthimath Ph. D.	Director (From 25 / 01 / 02)	Agronomy
PG Adsule Ph. D.	Director (Acting) (Upto 24 / 01 / 02) Principal Scientist & Head, Horticulture	Horticulture
Scientific		
S Subramanian Ph. D.	Principal Scientist & Head, Fishery Science	Fishery Science
RNS Sundram Ph. D.	Principal Scientist & Head, Animal Science,	Animal Nutrition
HM Wasnik Ph. D.	Senior Scientist & Head, Crop Science	Soil Science
SP Singh Ph. D.	Senior Scientist Horticulture	Horticulture
JR Faleiro Ph. D.	Senior Scientist	Agril. Entomology
AR Desai M.Sc. (Ag.)	Scientist (Selection grade)	Horticulture
BL Manjunath Ph. D.	Scientist Sr. Scale	Agronomy
EB Chakurkar Ph. D.	Scientist Sr. Scale	Animal Reproduction
SB Barbudhe Ph. D.	Scientist Sr. Scale	Vet. Public Health
BK Swain Ph. D.	Scientist Sr. Scale	Poultry Science
K Mohanta M.F. Sc.	Scientist	Fish & Fishery Science
K. Ramchandradu Ph. D.	Scientist	Horticulture

S. Manivanan M.E. (Agri.)	Scientist	Agriculture Engg.
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-8)	Agronomy

KVK

VY Gaonkar M.Sc. (Ag.)	I/C. Training Organizer & Training Associate (T-7)	Horticulture
Avinash V. Nirmale M.V. Sc.	Training Associate (T-7)	Animal Science
HR Prabhudesai B.Sc. (Ag.), PG Dip. (PP)	Training Associate (T-7)	Agronomy
Sunetra M. Talaulikar B.Sc. (Home Sci), PG. Dip. (D & Ap. N)	Training Associate (T-6)	Home Science
HR Chidananda Prabhu M.Sc. (Ag.)	Training Associate (T-6)	Plant Protection
VS Sakharkar Ph. D.	Training Associate (T-6)	Agril. Extension
KK Metar	Technical Officer (T-5)	

Administrative

Ram Avataar Parashar	Asst. Finance & Accounts Officer (Upto 26 / 04 / 2001)	
Anand Mamlekar	Asst. Finance & Accounts Officer (From 11 / 06 / 2001)	

18. ANY OTHER INFORMATION

A) Training attended

Dr EB Chakurkar, Scientist Sr.Scale (Animal Reproduction). Short term course on nutrition and dietetics under clinico-therapeutic conditions of pet and farm animals organized by Center of Advanced Studies for AnimalNutrition I.V.R.I. Izzatnagar during March 20 to April 18, 2001.

Shri. J Ashok Kumar, Scientist (Computer Application). "Development of Internet and Intranet using Linux operating system" conducted at Central Institute for Research on Goats, Makhdoom, during September 10-15, 2001.

Mrs S Priya Devi, Sceintist (Horticulture). IPR and WTO issues, held at CIFE, Mumbai during September 18-20, 2001.

Shri. J Ashok Kumar, Scientist (Computer Application). "GIS Applications in Agricultural Research" conducted by National Academy of Agricultural Research Management (NAARM), Hyderabad, September 30 to November 9, 2001.

Er S Mannivanan, Scientist (SWCE). State Level trainers associated with watershed programme held at National Institute of Agricultural Extension Management, Hyderabad, October 8 to 13, 2001.

Shri Raghuram Kukkude, Technical Assistant (Library). "Libraray automation and resource sharing" conducted by Indian National Scientific Documentation Centre, Chennai Janauary 7-11, 2002.

Dr. HM Wasnik, Sr. Scientist (Soil Science). "Soil survey and land evaluation for land use planning" organised by NBSS & LUP, Regional Centre, Hebbal, Bangalore, January 17 to February 6, 2002.

Dr P.G.Adsule, Principal Scientist (Horticulture) and Shri AR Desai, Scientist Sr.Scale (Horticulture). Vigilance awareness organised by Vigilance Division of ICAR, New Delhi held at CIFE, Mumbai February 1-4, 2002.

Dr EB Chakurkar, Scientist Sr. Scale (Animal Reproduction). Application of Molecular Genetic Techniques for Livestock Improvement organized by Center of Advanced Studies for Animal Genetics and Breeding in the Division of Dairy Cattle Breeding National Dairy Research Institute Karnal, February 6 to 26, 2002.

B) Appointments

New Director Appointed

Dr. V.S.Korikanthimath was appointed as Director of the Institute with effect from 25/01/2002.

Others

Shri Anand Mamlekar was appointed as AF & AO on deputation from Government of Goa with effect from 11/06/2001.

Shri Yeshwant Govekar was appointed as SRF (IPM) with effect from 21/07/2001.

Kum Vidhya Satarkar was appointed as SRF (IPM) with effect from 17/09/2001.

Shri Manoj Wahane was appointed as SRF (LUP) with effect from 22/09/2001.

Dr. Elizabeth Diniz was appointed as SRF (PIG) with effect from 22/03/2002.

Dr. R.B.Bansode was appointed as Research Associate (AHIS) with effect from 26/03/2002.

Shri Jagdish Desai was appointed as SRF (NWDPRA) with effect from 19/04/2002.

Kum Maria Savita Cota was appointed as JRF (NWDPRA) with effect from 17/09/2001.

C) Transfers

Shri. Ram Avtar Parashar, Asst. Finance & Accts. Officer of the Institute was relieved and transferred from the Institute to Central Institute of Post Harvest Engginering & Technology, Dehradhun on 26/04/2001.

D) Promotions

Scientific

Name	Specialization	Promoted		w.e.f.
		From	To	
Dr. S.Subramanian	Fishery Science	Sr. Scientist	Principal Scientist	27/07/1998
Dr. R.N.S.Sundaram	Animal Nutrition	Sr. Scientist	Principal Scientist	27/07/1998
Dr. J.R.Faleiro	Entomology	Scientist Sr.Scale	Senior Scientist	29/05/1998
Shri A.R.Desai	Horticulture	Scientist Sr. Scale	Scientist, Selection Grade	07/08/2000
Dr. B.L.Manjunath	Agronomy	Scientist	Scientist, Sr. Scale	27/07/1998
Dr. E.B.Chakurkar	Animal Reproduction	Scientist	Scientist, Sr. Scale	27/07/1998
Dr. S.B.Barbuddhe	Vet. Public Health	Scientist	Scientist, Sr. Scale	05/07/2000
Dr. B.K.Swain	Poultry Science	Scientist	Scientist, Sr. Scale	10/03/2001

Technical

Name	Promoted		w.e.f.
	From	To	
Shri M.S.Balbatti	Farm Superintendent (T-7)	Farm Superintendent (T-8)	01/01/1998
Dr. A.V.Nirmale	Training Associate (T-6)	Training Associate (T-7)	16/07/1997
Shri. H.R.Prabhudesai	Training Associate (T-6)	Training Associate (T-7)	31/05/1998
Shri V.D.Kulkarni	Farm Assistant (T-4)	Technical Officer (T-5)	01/01/2000
Shri U.B.Porwar	J.T.A (T-3)	J.T.A. (T-4)	01/01/2000
Shri Suresh Naik	Driver (T-3)	Driver (T-4)	01/01/2000
Shri Edward Crasta	Stockman (T-2)	Stockman (T-3)	01/07/1997
Shri Laxman Naik	Driver (T-1)	Driver (T-2)	29/06/2001
Shri Irappa Chalwadi	Driver cum Mechanic (T-1)	Driver cum Mechanic (T-2)	29/06/2001
Shri Suresh Gomes	Supproting Staff	Tractor Driver (T-1)	24/01/2002

E) Study Leave

Shri. K N Mohanta, Scientist (Fish & Fishery Science) was deputed on study leave for carrying out Ph.D. Degree Course at Central Institute of Fisheries Education, Mumbai w.e.f. September, 2001.

F) Weather data for the year 2001-2002

Month	Rain fall (mm)	Mean Temperture (°C)		Total sunshine hours	Relative Humidity per cent	
		Max.	Min.		8.30 hrs.	17.30 hrs.
2001						
April	006.3	32.9	25.9	271.1	79	69
May	167.6	33.2	26.0	262.2	80	72
June	527.0	30.5	25.5	142.8	87	81
July	832.4	28.8	25.3	087.3	93	98
August	414.4	28.9	24.3	131.9	94	88
September	096.3	30.8	24.3	188.3	92	81
October	070.1	31.4	24.0	199.4	91	79
November	005.6	34.0	23.1	271.4	81	65
December	000.0	33.3	21.3	267.6	72	58
2002						
January	000.0	31.3	20.1	289.0	61	52
February	000.0	32.8	22.2	256.1	68	58
March	000.0	32.7	24.2	278.1	76	62

Source : Indian Metreological Department, Panaji-Goa.

19 प्रगति सारांश

भारतीय कृषि अनुसंघान परिषद, अनुसंघान परिसर गोवा ही केवल एक ऐसा संस्थान है जो गोवा राज्य में अनुसंघान के क्षेत्र में राज्य की आवश्यकताओं मे फसल विज्ञान, उद्यान विज्ञान, पशुपालन विज्ञान और मत्स्य् पालन विज्ञान के शोध के रुपमें अपना योगदान दे रहा है। अनुसंघान के अतिरिक्त यह संस्थान प्रौद्योगिकी हस्तान्तरण का कार्य भी कृषि विज्ञान केन्द्र द्वारा राज्य में किसानो के लिए करता है। संस्थान की विभिन्न अनुसंघान प्रायोजनाओं एवं प्रौद्योगिकी हस्तांतरण का कार्य संस्थान एंव कृषि विज्ञान केन्द्र द्वारा वर्ष 2001 एवं 2002 में इस प्रकार से है -

19.1 फसल विज्ञान

संकर धान की आठ प्रजातियों का मूल्यांकन खरीफ 2001 के आने पर सह्याद्री प्रजातिद्वारा 7.15 टन/ हे उपज प्राप्त की गयी जबकि के आर. एच. द्वारा 6.87 टन/ हे. उपज प्राप्त की गयी। दोनो ही प्रजाति स्थानीय उपयुक्त (चेक) प्रजाति जया एवं ज्योति जिनकी उपज 5.72 टन/ हे. तथा 4.68 टन/ हे. क्रमशः है, से अधिक उपज वाली पायी गयी ।

एक अन्य परीक्षण में सुगन्धित वासमती धान का परीक्षण खाद की आवश्यकता के लिए किया गया इसमें केचुए द्वारा बनायी गयी खादद्वारा 5 टन/ हे उत्पादन पाया गया जब कि पूसा वासमती और इन्द्रायनी प्रजाति में क्रमशः 3.03टन/हे तथा 3.3टन/हे उपज पायी गयी। इन विभिन्न परीक्षणो में 2.एसीटाइल-1 प्रोलीन की मात्रा दोनो मे अधिक पायी गयी जो अच्छी सुगंध के लिए जिम्मेदार होता है।

खरीफ 2001 में चौदह कम अवधिवाली तथा सात सुगंधित धान की प्रजातियों का अध्ययन करने पर उनके प्रतिकार का प्रभाव पत्तीमुड़ने वाले कीणे, चफालो कोसिस मेडिनेलिस एवं गालमिर्च, तथा ओरसेओलिया ओराइजी पर किया गया। कम अवधि वाले समूह में सुगंधित प्रजातियों में आई. ई. टी 16829 और आई. ई. टी. 16827 का नामांकन कम इकट्ठे प्रभाव 1.00 क्षतिग्रत पत्ती और 2.25 सिल्वरतना प्रति मी.^{3} लीफ फोल्डर और गाल मिर्च मे क्रमशः पाया गया। सुगन्धित प्रजातियों में आई. ई. टी. 15392 तथा आई. ई. टी. 13548 द्वारा कम इकठ्ठी संग्रहित क्षति 0.83 एवं 0.75 सिल्वरतना प्रति मी.^{3} लीफ फोल्डर और मालमिर्च के लिए क्रमशः पाया गया।

प्रजाति त्रिगुना, आई आर 64 और आई ई. टी. 16830 द्वारा मध्यम स्तर की प्रतिरोधक क्षमता क्रमशः ब्लास्ट, लीफस्पाट सीथ राट खेतो में दर्शायी गयी।

विट्रो मूल्यांकन में एन्टीगोनिस्टिक प्रभाव का अध्ययन प्राकृतिक जैविक रोकथाम द्वारा रोगाणु ट्राइकोडर्मा एवं स्यूडोमोनसप्रजाति को पाइरेकुलेरिपा ओराइजी, हेलमेन्थेस्पोरिमम ओराइजी और सैरोक्लेडियम ओराइजी की वृध्दि को रोकने में प्रभावी पाया गया।

एक अन्य परीक्षण में नमकरोधी धान की प्रजातियों के चयन में धान के पौधे की वृध्दि अधिक क्षारीय भूमि में जड़ की वृध्दि तथा सहायक जड़ को भी कम करती है तथा जड़ के भारको बढ़ाकर जड़ और तने के अनुपात को बढ़ाती है।

गन्ने की अधिक उपजवाली प्रजातियों के मूल्यांकन एवं प्रबंधन के परीक्षण में 300: 150:150:10 किलो नत्रजन, पोटाश, फास्कोरस, जिंक द्वारा अधिक गन्ने की रैटून फसल 75.3 टन/हे. उपज के साथ 19.1 प्रतिशत ब्रिक्स तथा 8.5 प्रतिशत चीनी प्राप्तता प्रजाति सी. ओ. 7527 में पायी गयी।

फसल पध्दति की विभिन्न नमूनों के परीक्षणों में अनेक प्रजातियों को मिलाकर खान से निकाली हुई भूमि में चारे की फसल पी. बी. एन. 16 द्वारा अच्छी वृध्दि एवं 10.66 टन/हे. एक कटाई में प्राप्त की गयी। पुनः यह भी देखा गया कि मुर्गी की खाद का प्रयोग करने से काजू के पौधों की जैविक क्षमता में वृध्दि खान से निकली मृदा में पायी गयी।

एक अन्य परीक्षण में धान पर आधरित कृषि पध्दति में मूगफली तथा धान के फसल चक्र में धानकी पैदावार 5 टन/हे.

से अधिक पायी गयी । एक अन्य फसल चक्र में धान के पुआल एक कुम्भी फसल अवशेष का प्रयोग भूमिमे 2:1 के अनुपातमें प्रयोग करने पर अधिक उत्पादन 4.5टन/हे पाया गया ।

अन्य फसल पद्धतियों में द्यान वैगन फसल चक्र द्वारा अधिक उत्पादन प्राप्त किया गया इसमें गोवर की खाद का पुनः प्रयोग किया गया। धान तथा लोविया फसल चक्र अवशेष नमी अवस्था में सबसे उपयुक्त फसल पध्दती सिध्द हुई । धान-लोबिया फसल चक्र द्वारा 78 प्रतिशत अधिक उत्पादन धान से खाली जमीन में लिया गया। सभी पध्दतियों का एक साथ आर्थिक मूल्याकंन करने पर धान-वैगन का खुम्भ व मुर्गी की खाद के साथ सबसे उपयुक्त पाया गया और इससे रू. 77305 टन/हे. प्राप्त किया गया।

खरीफ 2001 रक्षा एवं बचाव के लिए अरहर की फली में फलवेधक कीणे का प्रभाव कम करने के लिए 0.07 प्रतिशत इन्डोसल्फान 35 ई. सी. का प्रयोग फूल लगने के समय करके किया जा सकता है ।

नारियल के लाल तना वेधक कीणे का अध्ययन फेरामोन ट्रेप द्वारा विश्लेषण करने पर इसका प्रभाव पूरे प्रदेश में अधिक प्रभावी पाया गया। फेरामोनट्रेप द्वारा सबसे अधिक लाल तना वेधक कीणा नवम्बर 2001 में सबसे अधिक (32.50 कीणा/ट्रेप) पाया गया । जबकि यही कीणा सबसे कम प्रभावी (16.13 कीट/ट्रेप) जून 2001 में पाया गया।

दो से तीन हेक्टर नारियल के उद्यान के लिए एक फेरामाने ट्रेप एक साथ कीणा पकड़ने के लिए उपयुक्त पाया गया। सबसे अधिक 62 कीणा प्रति टेप तव पाया गया जब फेरामोन के साथ भोज्य पदार्थ का प्रयोग किया गया। कार्वोफ्यूरान 3जी (0.05%) का प्रयोग लाल नारियल के कीणे को पकड़ने के लिए सबसे उपयुक्त पाया गया।

एक अन्य जीवनक्षमता अध्ययन में फेरू जिनाल पर आधारित फेरामोन पदार्थ (फेरालूर + 800 मि. ग्राम) की संम्पूर्ण जीवन अवधि गोवा में 6 माह तक पायी गयी जब इसका प्रयोग छाया में रखकर किया गया।

बैंगन की सूख की बीमारी के अध्ययन में इसमें फंफूद और वैक्टीरिया का प्रभाव संयुक्त रुप से पाया गया। प्रयोगशाला अध्ययन में यह पाया गया की जैविक रोकथाम वस्तुए (ट्राइकोडर्मा एवं स्पूडोमोनस फ्लोरीसेन्स) को जड़ मे डुबाकर तथा फंफूदीनाशक (कार्बेडेजिम तथा कापर आक्सीक्लाराईड) का प्रयोग ड्रेचिंग के रुप में करके रोग को कम करके अधिक उत्पादन लिया जा सकता है । गलन रोग को नर्सरी (पौधशाला) की अवस्थामें रोकने के लिए जैविक रोकधाम वास्तुओं का प्रयोग वीजशोधन तथा मृदा मे प्रयोग करके कम किया जा सकता है।

19.2 उद्यान विज्ञान

संस्थान में काजू के 166 एक्सेसन्स की व्यवस्थारखते हुए उसका मूल्यांकन जारी रखा गया। इस वर्ष गोवा के विभिन्न क्षेत्रों से पहचान करके 6 नये एक्सेस्न्स को जननद्वव्य मे जोड़ा गया। इस वर्ष एक्सेसन्य सी. जी. सी. 98/8 (घावे-3) काफी प्रभावी जिसकी उपज 3.18 किलो/ पौधा प्राप्त किया गया। जबकी अन्य एक्सेसन्स एच 1600 अच्छे गुणों से युक्त 7.5 किलो/ पौधा उपज प्राप्त की गयी ।

हल्दी की विभिन्न प्रजातियों के मूल्यांकन में प्रभा, प्रतिभा और आर सी टी-1 द्वारा ताजा राइजोम की उपज 25-30 टन/हे के बीच पायी गयी। नारियल के बीच में अन्त फसल के रुप मे हल्दी के उत्पादन तकनीक को प्रमाणित किया गया।

आयल पाम की पांच संकर प्रजातियों इ्यूरा पैसीफेरा के विभिन्न संयुजन में संकर 35 डी X 291 पी द्वारा सबसे अधिक ताजे फलों के गुच्छे का उत्पादन 142.35 किलो प्रति पौधा पाया गया।

आम में विभिन्न प्रजातियों के अध्ययन में इसको विभिन्न तीन विभागों स्थानीय प्रजाति, संकर प्रजाति तथा अन्य प्रदेशों से चयनित प्रजाति के रुप में विभाजित किया गया। इन विभिन्न आम के समूहों में अधिक उत्पादन क्षमता 6.61, 3.05 और 2.85 किलो प्रति वर्गमीटर क्षेत्र में आमकी प्रजाति कुलास, नीलगोवा, और आलमपुरवेनेसान में क्रमशः प्राप्त किया गया।

एक अन्य प्रयास में गोवा की प्रसिध्द आमकी प्रजाति मानखुराद के अंतरगत विभिन्नताओंके अध्ययन का प्रयास किया गया। गोवा के विभिन्न भागो से संकलित फलो में सम्पूर्ण ठोस शर्करा की मात्रा 14-19 प्रतिशत तथा औसत फल का भार 234 से 406 ग्राम प्रति फल तक पाया गया।

इसके अतिरिक्त पौध उत्पादन तकनीक की प्रमाणिकता के लिए पूर्वोत्तर पर्वतीय क्षेत्र की दो प्रसिध्द आमकी प्रजाति (एम. डी. सी. एच-1 और एस. टी. सच-1) तथा 40 स्थानीय आम की प्रजाति एवं दो प्रसिध्द स्थानी प्रजाति (सी. एम. के डी एव आर. सी. एम. एस-1) को सधन पौध. पध्दति के अंतरगत लिया गया।

मीथाइल यजीनाल द्वारा आम की फलमक्खी को पकड़ने के लिए फलमक्खी वैक्ट्रोसेरा प्रजाती जून में अधिक प्रभावी पायी गयी। मक्खी के पकड़ने को घनात्मक रुप से वर्षा द्वारा कोरिलेट (आर = 0.78) किया गया।

एक अन्य सघन फसल पध्दति मे माडल में नारियल को मुख्य फसल के रुप में लेकर केला, आम काली मिर्च लेकर नारियल की प्रजाति वेनोलिम 1577.86 नट/पाम/वर्ष तक प्राप्त किया गया। आम्रपाली आम की प्रजाति का उत्पादन अंत फसल के रुप में नारियल के अतरगर्त अधिक अच्छा पाया गया और इसकी उपज 47.5 किलो प्रति पौधा प्राप्त की गयी।

ग्यारह कम उपयोग वाली फलो के पहचान के अतिरक्ति पिछले वर्ष कुद्द अन्य स्थानीय फल जैसे चुरना (जिसाइफस रोगोसा) करौंदा (कारसा कारिएन्डास) एवं माटोम की पहचान की गयी। पुनः अन्य सूक्ष्म फलवृक्षो एवं फलों का मूल्यांकन जैसे जामुन (साइजियम क्यूमिनी) जगोमा (फ्लैकोरिटा जनगोमाज) माटोम का पुनः मूल्याकन किया गया)

भिन्डी के दैहिकी एवं उत्पादन क्षमतावालो गुणो का अध्ययन करनेपर 470.56 ग्राम/पौधाउत्पादन पाया गया। बैगन की अगासिम प्रजाति द्वारा अधिक फलभार 243.33 ग्राम/पौधा प्राप्त किया गया।

कम उपयोग मे आनेवाली सब्जियों जैसे मैनग्रोव व फर्न (एक्रोस्चम औरसेम) वॉस (ड्रेन्ड्रोकैलमस प्रजाति), हवाई याम (डायस्कोरियावल्वी फोर) टारो (कोले केसिया इसकुलेरा) चाइनीज पोटैटो (सोलेनोस्टेमन रोटन्डी कोलिएस ककरोल (मोमोर्डिका डायोइका) का संकलन अध्ययन एवं विस्तृत विवरण के लिए किया गया।

इस वर्ष के दौरान गोवा में प्राप्त 323 औषधीय पौधो की पहचान की गयी। पहचानकी गयी प्रजातियों में जैसे एन्ड्रो ग्रेफिस पैनीकुलाटा, ग्लोरियोसा सुपर्वा, रावोल्फिया सर्पेन्टाईना, हेमीडेसमस इन्डिकस, सोलेनम नाइग्रम विथैनिया सोमिनीफेरा, अघाटोडावैसिका, ओसीमम वैसीग्लिकम, को लिएस एम्कोनिकस, एलोववेरा, क्लोरोफाइटम वोरवीलिएनम, एस्परगस रेसीमोसस, करकुमा एमाडा, जाइमेनोमा सिलवेस्टेरे इत्यादि बहुतायत से प्रकृति में पाये जाते है और इनका व्यावसायिक उपयोग किया जा सकता है।

गत्नैडियोलस की 5 भारतीय प्रजाति जैसे आरती, सिन्दूर, तिलक, धीरज और दर्शन जिनको भारतीय वागवानी अनुसंघान संस्थान बंगलौर से तथा चार डच प्रजाति जैसे नोवालक्स, हवाइटप्रास्परिटी, स्पाइस एण्डरुपान तथा रोज सुप्रीम को सम्मिलित करके इनका मूल्याकंन एवं अध्ययन किया गया। डच प्रजातियों में व्हाईट प्रास्परिटीद्वारा सबसे अधिक स्पाइक लम्बाई 98 से.मी. का जबकि नोवालक्स से सबसे अधिक स्वंय कार्नभार 60.83 ग्राम प्राप्तकिया गया फूलो की ताजी जीवन क्षमता स्पाइक के साथ साधारण नल के पानी में सभीचारो हालैण्ड की प्रजाति 10-11 दिन तक रही । जबकि फूलो के कली की संख्या प्रतिस्पाइक 12-13 तक पायी गयी।

कटहल के कोये के भण्डारण के अध्ययन में यह पाया गया कि पके कोये को वातानुकूलित अवस्था में पाली थीन बैंगन में 23 दिन तक भण्डारित किया जा सकता है। इसका भण्डारण कमरे के तापमान पर चानी के घोल (40^0 ब्रिक्स तथा पोटेशियम मेटाबाइसल्फाइट (250 पी. पी. एम. एस. ओ.-2) या सोडियम वेन्जोएट (250 पी. पी.एम.) के पालीथीन वैग में चार माह तक रखा सकता है। पूर्ण विकसित किन्तु विना पका हुआ कटहल का कोया अपने वास्तविक रंग में एंव आकार में कमरे के तापमान पर नमक के घोल में 12 माह तक रखा सकता है ।

करम्वोला (मीठा) स्क्वैश (48^0 ब्रिम्स, 0.5% अम्लता और. 250 पी. पी. एम. एस. ओ 2) को कमरे का तापमान और वातुनाकुलित अवस्था में बारह माह से अधिक समय तक सुरक्षित रखा जा सकता है।

जायफल के छिल्के के प्राक्जीमेट विश्लेषण में कुछ भाग कटहल एवं ब्रेडफ्रूट को मिलाकर इनफला के अवशेष भाग की वसा एवं रेशा के अच्छे स्रोत के रुपमें पशुओं के भोज्यपदार्थ के रुप में उपयोग किया जा सकता है।

19.3 पशुपालन विज्ञान

युवा खरगोशों के वृध्दि को बढाने के उद्देश्य से विभिन्न प्रकार के भोज्य पदार्थ बनाकर उनका परीक्षण किया गया। प्रयोगात्मक अधिक उर्जा वाला भोज्य पदार्थ जिसमें 2100 के. सी ए. एल. के साथ वृध्दि अध्ययन में यह पाया गया कि उसमें प्रतिदिन के वृध्दि में वजन बढाने में कोई सकारात्मक अंतर नही पाया गया। स्थानीय वातावरण के अनुसार 2900 के सी. ए. एल भोज्य ऊर्जा स्तर संकर खरगोसों के अधिकतम वृध्दि को बनाये रखने में पर्याप्त पाया गया।

इस वर्ष के दौरान सर्वेक्षण का कार्य शुरु करते हुए गोवा के ग्रामीण क्षेत्रों में मौजूदा वकरी के रखरसाव एव उनके प्रबन्धन का अध्ययन किया गया । अधिक तर जानवरों के बारे में विवरण नही प्राप्त हो सका क्योंकि उन्हे पास के राज्यों जैसे कनार्टक और महाराष्ट्र से लाया जाता है ।

संस्थान मे पशुपालन विभाग गोवासरकार के सहयोग से 18 इनफरटिलिटी कैम्पका आयोजन किया/इनकैम्पों में एनोस्टोरस, साइलेन्ट एस्टोरस और पुनः प्रजनन की समस्या का समाधान किया गया।

इसके अतिरिक्त सैन्कोनाइजइस्टोरसप्रबध द्वारा सुअर एवं गायों में इसका अध्ययन किया गया। खरगोस में सघन प्रजनन का कार्य जाड़े की ऋतु में किया गया जिससे कम तापमान मे वातावरण में अधिक बच्चों को जीवनक्षम बनाया जा सके। संस्थान में पहलीबार वर्ष के दौरान बनावटी गर्भाधारण प्रक्रिया द्वारा खरगोस को पैदा किया गया।

कुल 31 दूध के सैम्पल संकर गायो गायों द्वारा (मैदान अध्ययन) इकठ्ठे किय गये। इसमें से 9 सैम्पल मेस्टाइटिस रोग से प्रभावित गायो से लिए गये। बचे हुए 22 दूध के सैम्पल गायोंद्वारा कैलीफोर्निया मेस्टाइटिस परीक्षण के अन्तरगत लिए गये इसमें इसका घनात्मक प्रतिशत 63.6 प्रतिशत मेस्टाइटिस में रहा। स्टेफाइलोकोकस आरेपूस और स्ट्रेप्टोकोकस प्रजाति प्रमुख स्मारक के रुप मे पाये गये। अन्य रोगजनाणुओ में स्पूडोमोनास प्रजाति, लिस्टेरिया प्रजाति, और इचेरिचिया कौलाई प्रमुख पाये गये।

कुल 26.8 और 34.1 प्रतिशत सैम्पल जो जानवरो से लिए गये उसमें घनात्मक ब्रोसेलोसिस और आई. वी. आर, ए-वी इलिसा द्वारा क्रमशः पाये गये। 15 वकरे के सील सैम्पल में कोई भी घनात्मक उसीलोसिस, आर. वी. पीटी द्वारा नही पाया गया। 168 सुअर के सीरम सैम्पल का परीक्षण करने पर 11 (6.55%) को घनात्मक वूसीलासिए युक्त पाया गया, जबे इसका परीक्षण आर. वी. पी. टी. द्वारा किया गया। कुल 290 दूध के सैम्पल जो विभिन्न सहकारी संस्थाओं के थे उनको गोवा राज्य के सहकारी दुग्ध उत्पादन समितियों (गोवा डेअरी) प्रसंस्करण संयन्त्र एवं दूध पर आधारित इलिसा का परीक्षण करने पर 33 (11.37%) घनात्मक पाये गये।

कुक्कुट मांस (20) तथा कच्चे सुअर के मांस (9) सैम्पल का संकलन बाजार से करके इसका प्रसंस्करण टी पो सी को मीजोफाइल और वाई. एम. सी के लिए किया गया। कुक्कुट मांस में इसकी संख्या लाग 10, 7, 2 सी एफ. यू / ग्राम मीजोफाइल्स के लिए तथा कम से कम लाग 10 सी एफ 3. प्रतिग्राम खमीर साइक्रोफाइल्स के लिए लाग 10, 5.98 सी. एफ. यू. प्रतिग्राम खमीर और मोल्ड के लिए पाया गया। सुअर के मांस में मीजो फिलिम की संख्या लाग 10 7.62 सी. एफ. यू/ ग्राम पायी गयी।

19.4 मत्स्य पालन विज्ञान

20 परीक्षण में उत्पादन बढ़ाने के लिए खरगोस-मछली समन्वित पालन के विना एयरेसन और अन्य भोज्य पदार्थ दिए बिना तीन प्रकार के कार्प प्रजातियों को 6000/ हे. के घनत्व और 15 खरगोस के डग (गोवर) का प्रयोग तालाव में करके 500 से 800 ग्राम तक प्रतिमछली 8 माह के अन्दर प्राप्त की गयी।

एक अन्य परीक्षण मेक्षहसोवियत चिंचिला खरगोस की प्रजाति प्रत्येक 1.250 ग्राम द्वारा प्रति दिन 78 ग्राम डंग (गोवर) 60 मिलीमीटर मूत्र प्रतिदिन प्राप्त किया गया । डंग में 2.32 प्रतिशत नाइट्रोजन जबकि मूत्र में 6 प्रतिशत नत्रजन पाया गया। यह पाया गया प्रितिदिन प्रति खरगोसद्वारा 4.32 ग्राम नत्रजन तालाव में प्राप्त किया जा सकता है ।

एक अन्य परीक्षण मे स्पीरुलिना से युक्त भोज्य पदार्थ में मृगालफ्राई की वृध्दि, भोज्यपदार्थ 1.0 प्रतिशत स्पीरुलेना द्वारा अधिकतम मूल्य प्रतिशत भार वृध्दि (168.13) एस. आर. जी. (0.4274), एफ. सी. आर (2.52) और पी. ई. आर (0.9953) पाया गया जबकि इसकी तुलना भोज्य पदार्थ के न्यूनतमस्तर के सम्मिलन से की गयी ।

19.5 कृषि अनुसंधान सूचना पध्दति

कृषि अनुसंघान एवं सूचना पध्दतिपर आधारित एक प्रायोजना की शुरुआत गोवा, में इसके संकलन, भण्डराज और लोगों के आवश्यकताओं की पूर्ति के लिए कृषि से सम्बधित विवरण गोवा विशेष के सम्बध मे शुरु की गयी । वर्ष के अंन्तरंगत स्थानीय नेटवर्क को स्थापित किया गया तथा इसे संस्थान के लिए कार्यरुप में परिचालित किया गया। इसके पश्चात संस्थान के वेब पेज को बनाया गया तथा इसका प्रकाशन किया गया। संस्थान का बेवसाइट एच टी. टी. पी।।आई.सी. ए.आर टी. ओ. ए. एन. आईसी.इन. बनाया गया।

19.6 तकनीक का हस्तान्तरण

इस वर्ष के दौरान कृषि विज्ञान केन्द्र द्वारा 91 आवश्यकता के आधार पर व्यावसायिक प्रशिक्षण कार्यक्रम शुरु किया गया जिसमे फसल विज्ञान (14) उद्यान विज्ञान (31) पशुपालन विज्ञान (10) गृहविज्ञान (18) पौद्य संरक्षण (12) एवं कृषि प्रसार (6) प्रशिक्षणद्वारा 1552 लोगों की प्रशिक्षित किया गया इसमें किसान, ग्रामीण युवा, प्रसार कार्य कर्ता सम्मिलित थे जिसमें 721 पुरुष 831 महिलाए शामील थी।

वर्ष के दौरान 6 लोकप्रिय लेख, 12 अनुसंघान प्रपत्र, तथा एक तकनीकी प्रतिवेदन तथा 4 प्रशिक्षण विवरण प्रकाशित किए गये। द्दह रेडियो प्रसारण और दो दूरदर्शन कार्यक्रम आकाशवाणी तथा दूरदर्शन पणजी गोवा द्वारा प्रसारित किया गया। इसके अतिरिक्त 1279 उन्नतशील किसान वर्ष के दौरान संस्थान में आये और केंन्द्र से सहायता प्राप्त की ।

प्रक्षेम परीक्षण में किसानो की भूमिपर 15 किसानों के यहाँ परीक्षण चलाया गया जिससे किसानो की कृषि से सम्बन्धित समस्याओंका समाधान किया जा सके ।

वर्ष के दौरान 18.8 हेक्टर भूमि (धान 13.8 हे और उद्यान फसले 6 हेक्टेर) को लेकर फ्रंटलाइन प्रदर्शन का कार्य किया गया जिसमें 40 किसानो की भूमिशामिल थी इसमें 36 पुरुष किसान तथा 4 महिला किसान सम्मिलित थे ।