

PEPPER RESEARCH STATION PANNIYUR



**REPORT FOR QUINQUENNIAL REVIEW
(01-4-92 TO 31-12-96)**

PEPPER RESEARCH STATION, PANNIYUR

QUINQUENNIAL REVIEW

Report of All India Co-ordinated Research Project on Spices
(for the period April 1992 to December 1996)

The All India Co-ordinated Research Project on Spices started functioning in the year 1971 with the mandate to carry out location specific research to augment spices productivity in the country. Pepper Research Station, Panniyur was selected as the lead centre of the Project, considering the commendable work carried out in the past and to strengthen the research activity in future. With the release of **Panniyur 1** the first hybrid black pepper in 1967, the station attained world-wide recognition. Later, in 1989, three varieties of black pepper, viz. Panniyur 2, Panniyur 3 and Panniyur 4 were released. Panniyur 5, the latest in the series, was released in 1996. Apart from crop improvement work, several recommendations on propagation, cultural and plant protection aspects of black pepper are evolved from this station.

1. Status of Black pepper cultivation in the state-area, production and productivity of black pepper in Kerala

Black pepper is grown in an area of 2.97 lakhs ha. In Kerala (Farm Guide, 1997) and the total production during 1994-95 was 0.59 lakh tonnes. The average yield at this level works out to 294 kg/ha. Eventhough, there was an increase in productivity in 1994-95 compared to that of 1992-93 and 1993-94(270 kg/ha), it is not high. The reasons for low productivity are many, starting from the cultivar/variety grown, management and cultural attention paid to the crop and the most important being the **Phytophthora** foot rot disease. Eventhough, several recommendations are made on these aspects, the extent of adoption is very low. Black pepper is mostly cultivated as a homestead crop, hence it does not get as much attention as a monocrop. Price fluctuation of the produce is also another factor for non-adoption of proper technology.

2. A BRIEF NOTE ABOUT THE UNIVERSITY CENTRE PEPPER RESEARCH STATION, PANNIYUR HISTORICAL BACKGROUND

Pepper Research Station, Panniyur had its humble beginning as a small scheme which started in 1949 under the erstwhile Madras Department of Agriculture, which was partly financed by the ICAR. The Scheme for scientific aid to pepper industry in South India commenced on 23-12-1949 at Mattanur in Kannur district. After two years, the scheme was shifted to Agricultural Research Station, Taliparamba. The present location at Panniyur was selected in 1952-53, from which time, the station obtained the status of Pepper Research Station. On 1-11-1956, the station was brought under the Dept. of Agriculture, Kerala. Later, in 1972, with the establishment of Kerala Agricultural University, it became one of its constituent research stations.

Major objectives :

The station is unique among all the agricultural research stations in India, in that, it is the only station solely devoted to the research on black pepper. Research programmes on crop improvement, crop management and crop protection aspects of black pepper are undertaken right from its inception.

The major objectives of the co-ordinated project are;

1. Evolving high yielding varieties resistant/tolerant to diseases
2. Standardisation of agro techniques for the crops under different agro-climatic conditions
3. Evolving control measures for major pests and diseases and
4. To work as an interface and feed back between State Agricultural universities, Indian Institute of Spices Research and the ICAR

Organisational structure:

Pepper Research Station, Panniyur is under the administrative and technical control of Kerala Agricultural University, headquartered at Vellanikkara, Trichur. Research programmes are financed by the ICAR under the All India Coordinated Research Project on Spices, started during 1973. Besides research, the station distributes nucleus planting materials of black pepper under the Central Sector Scheme for large scale production of rooted cuttings, funded by the Directorate of Cocoa, Arecanut and Spices Development, Calicut. The station has KAU and NARP (phase I & II) programmes also.

Physical facilities :

1. Total area of the farm : 26.52 ha.

Area covered by roads/ buildings/pond/well/ drying yard : 2.42 ha.

2. Details of buildings available

Sl.No.	Name of building
1	office building
2	Store house
3	Clerks quarters(I)
4	Peons quarters(duplex building)
5	Res. Asst. Quarters(duplex building)
6	Green house
7	Type quarters (4 Nos in two duplex buildings)
8	Type II quarters (4 Nos in two duplex buildings)
9	Type I quarters
10	Type II quarters
11	Laboratory building
12	Nursery shed
13	Propagation shed
14	Type V quarters
15	Labourers waiting shed

(Buildings under item 2 to 5 are in a dilapidated condition and can be used only after effecting major repairs)

3. Farm Structure :

Seed store, net house. One temporary threshing and drying yard of 150 M². Seed store is in a dilapidated condition. Propagation shed was constructed with funds allotted by AICRP on pepper.

4. Irrigation facilities:

1. One borewell with two pumpsets -1.5 HP electric and 1.5 HP kerosene engine.
2. Two wells and one pond - Well-1- 5 HP diesel pump Pond ~15 HP electric and 8 HP diesel Well- 2-1.5 HP electric and 5 HP diesel pumpset

3. Staff Strength (April 1992 to December, 1996)

Sanctioned post	No. Discipline	1992	1993	1994	1995	1996
1. Assoc. Professor	1 Plant path	S.Sasikumar	P.K.Unnikrishnan (upto 30-10-92)	Nair	--K.P.Mammootty	
2. Asst. Professor	1 --do---	P.K.Unnikrishnan Nair (upto 30-10-92)	K.P.Mammootty	-- K.N.Satheeshan (upto 21-8-95)	T.Premanathar (joined on 1-4-96)	
3. Asst. Professor	1 Agrl. Botany	-----	vacant	-----	Gregory Zachariah (from 7-11-95)	
4. Asst. Professor	1 Agronomy	-----	K.N.Satheeshan	-----	A.Rajagopalan (from 8-4-94 onwards)	
5. Lab Asst.	1	-----	vacant	-----		
6. Farm Asst.	2		1. T.Mohammed Haneefa (present throughout the period)			
			2. K.Lakshmanan	(-----do-----)		
7. Peon	1		M.P.Narayanan	(-----do-----)		

4. RESEARCH PROGRAMMES OF THE CENTRE FOR THE PERIOD UNDER REVIEW :

The following 12 experiments were in operation during the period:

1. Germplasm collection and screening of pepper genotypes 2. Intervarietal hybridisation in black pepper
2. Intervarietal hybridisation in black pepper
3. Multilocational trial of promising cultures of pepper(MLT 1984 Series II)
4. Multilocational trial of black pepper cultivars(MLT 1984-Series ii)
5. Multilocational trial of pepper genotypes(MLT 1987-Series III) (Comparative yield trial of pepper genotypes)
6. Multilocational trial in black pepper(MLT 1991-Series IV)
7. Evaluation of promising cultures and released varieties of black pepper under different agroclimatic conditions
8. Irrigation-cum-fertiliser requirement in black pepper cultivars
9. **Phytophthora** foot rot and nematode disease management in black pepper
10. Field trial for the control of **Phytophthora** foot rot disease of pepper
11. Field trial for the control of slow decline disease of black pepper
12. Control of nursery diseases in pepper

Out of these 12 experiments, four (3,4,8 and 11) were concluded in 1995.

At present, there are 8 experiments under AICRP on pepper.

5. a. RESEARCH ACHIEVEMENTS(HEADWISE)

Crop Improvement :

The station maintains a germplasm collection of 65 cultivated types of black pepper till 1993, there were 117 wild types which were shifted to RARS, Ambalavayal because of extreme climatic conditions(especially drought) at Panniyur. Systematic study on morphological and yield characters of the different accessions in the germplasm had resulted in the identification of some promising cultures of black pepper. Kuthiravaly Type II was released as Panniyur 4 in the 12th AICRP workshop held at Vellanikkara during July 1993. Karimunda III, Karimunda I, Sullia and Taliparamba IV in the germplasm are some of the promising accessions with yield potential upto 50 Q/ha.

Evaluation of open pollinated and hybrid progenies of black pepper led to the release of three varieties viz. Panniyur 2(OP of Balankotta), Panniyur 3(Uthirankotta X Cheriakaniakadan) and Panniyur 5(OP of Perumkodi). Some of the promising cultures are Cul.1558, Cul.5232, Cul.5308 and Cul.5403.

From the multilocational trial of promising cultures (concluded during 1995), Cul.331(Uthirankotta X Cheriakaniakadan) and Cul.239(OP of Perumkodi) were found to be promising. These were already released as Panniyur 3 and Panniyur 5 varieties of black pepper respectively. Cul.54 (OP of Karivally) showed the least incidence of *Phytophthora* foot root disease.

Crop Production :

Irrigation-cum-fertiliser trial conducted during 1985 to 1995 showed that irrigation during summer months(December to March) at the rate of 100 l/vine given at an interval of 8-10 days increased the yield upto 50 % in cv. Panniyur 1.

Crop Protection:

Treatment involving all cultural practices + 1 kg neem cake + 3g a.i. phorate/vine + 1 % Bordeaux mixture + two drenching with 0.2 % copper oxychloride was effective in minimising *Phytophthora* foot rot and nematode disease.

Studies on the management of *Phytophthora* foot rot disease revealed that combined application of Bordeaux mixture (1 %) spray, drench and pasting + 2 kg neem cake + 1 kg lime per vine was the best treatment.

For the management of nursery disease, fortnightly spraying and drenching with 1 % Bordeaux mixture followed by 0.1 % Difolitan was found to be effective. In another study, solarisation of potting mixture and application of 0.2 % Akomin was found to be effective in minimising nursery disease. In another study, spraying with 0.2 % Akomin followed by spraying and drenching with 1 % Bordeaux mixture was effective in checking the disease under different shaded conditions.

List of germplasm holding-yearwise :

YEAR	Germplasm already present	New Collection	Area of Collection
1992-93	76 cultivated and 117 wild types	--	--
1993-94	76 cultivated types	--	--
1994-95	76 cultivated types	--	--
1995-96	65 cultivated types	23	22 from NBPGR Regional Centre, Vellanikkara and 1 from Mannarghat.

Collection-area surveyed/source of material

In August 1996, a survey was undertaken in Mannarghat of Palghat dist. and one local cultivar **Mundi** was collected.

Information on germplasm exchange between centres

22 collections from NBPGR regional centre, Vellanikkara.

Exotic germplasm received : Nil

Others If any : Nil

b. VARIETIES RELEASED AND PROMISING LINES IN THE PIPELINE FOR RELEASE

Varieties released : Panniyur 5 (on 2nd March, 1996).

Promising lines:

Sl. No.	Acc./Cul. No.	Parentage	Yield (Q/ha.)
1.	PRS 20	Karimunda I	45.4
2.	PRS 22	Karimunda III	52.9
3.	PRS 49	Sullia	44.8
4.	Cul.1558	Kalluvally OP	55.1
5.	Cul.5232	Karuvilanchy OP	50.1
6.	Cul.5308	Cul.331 OP	42.6
7.	Cul.5403	Karimunda OP	38.4
8.	Cul.5834	Irumanian OP	38.8

c. RESEARCH RECOMMENDATIONS MADE DURING THE PERIOD - TECHNOLOGIES TRANSFERRED AND REMAINING TO BE TRANSFERRED :

Black pepper variety Panniyur 5 was released for cultivation in the state. Rooted cuttings of released varieties, viz. Panniyur 1,2,3,4 and 5 are distributed for cultivation every year during the planting season.

Irrigating pepper vines from December to the end of March at the rate of 100 l/vine and withholding irrigation thereafter till monsoon break is recommended for cv.Panniyur 1.

For the management of *Phytophthora* foot rot disease, application of 1 kg lime + 2 kg neem cake per vine is recommended as a pre monsoon dose. Neem cake should be applied only four weeks after lime application.

In order to minimise the nursery disease, the pepper cuttings are to be planted in potting mixture drenched with 1 % Bordeaux mixture. When they start sprouting, spray Captafol or Bordeaux mixture (both at 1 % concentration) at weekly intervals.

Technologies remaining to be transferred :

1. For the management of **Phytophthora** foot rot and nematode disease, all cultural practices + 1 kg neem cake + 0.3 % a.i. of phorate (30 g/vine) + pre-monsoon spraying of 1 % BM + second round spraying of 0.2 % Akomin is effective .
2. Spraying and drenching with 0.2 % Akomin followed by drenching with 1 % BM is effective for the management of nursery disease under different shaded conditions.

6. INFRASTRUCTURE AND PHYSICAL FACILITIES PROVIDED DURING 1992-97 WITH COST

a. List of important equipment

Sl. No.	Name of Equipment	Year of Purchase	Cost in Rupees
1.	Laminar flow	21-3-1994	32,940/-
2.	Shaking machine	28-3-1994	7,769/-
3.	Double distillation water still	5-4-1994	10,475/-
4.	Trinocular Research Microscope	5-9-1994	2,60,000/-
5.	Air conditioner	20-5-1996	23,244/-

b) Works completed during the period (cost and year of completion)

Sl. No.	Item of Work	Year of Completion	Cost (Rs in Lakhs)
1.	Propagation Shed	1994	1.00

7. **PLANTING MATERIAL PRODUCTION- YEARWISE PRODUCTION AND DISTRIBUTION OF PLANTING MATERIAL**

Sl. No.	Variety	1992-93	1993-94	1994-95	1995-96	1996-97
1.	Panniyur 1	29572	15709	89516	78369	73535
2.	Panniyur 2	30626	14000	20647	25589	21694
3.	Panniyur 3	9464	6900	5499	5992	3232
4.	Panniyur 4	3236	800	3656	1200	921
5.	Panniyur 5	14150	13362	3335	10644	22368
6.	Karimunda	21420	11328	58277	64974	53492
7.	Others	--	--	--	--	22163
	Total	108468	62099	180930	186768	197405

ii. **Production & Distribution of Bush pepper**

Year	Production	Distribution
1992-93	462	460
1993-94	580	550
1994-95	494	490
1995-96	303	300
1996-97	258	258

8. LIST OF PUBLICATIONS

1. Mammooty, K.P., Sasikumar, S. and Pillai, V.S. 1992. Management of nursery disease of black pepper. Indian Cocoa Arecanut and Spices J. 25(3):11-13.
2. Ranjith, A.M., Sasikumar, S. and Mammooty, K.P. 1992. New record of white fly (*Bemisia tabaci*) on black pepper (*Piper Nigrum*) Indian J. Agri. Sci. 62(2):166-168.
3. Unnikrishnan Nair, P.K. 1992. Live standards for black pepper. 'Deepika Daily', 2nd July, 1992.
4. Ibrahim, K.K., Pillai, V.S. and Sasikumar, S. 1993. Seed germination studies in Panniyur 1 black pepper J. Tropical-Agriculture, 31.
5. Unnikrishnan Nair, P.K. and Sukumara Pillai. 1993. Diseases and pests of black pepper. The Hindu Daily, 30th June, 1993.
6. Unnikrishnan Nair, P.K., Mammooty, K.P., Sasikumar, S. and Pillai, V.S. 1993. Management of *Phytophthora* foot rot disease of black pepper with organic amendments. Paper presented at the Golden Jubilee Symposium-"Horticultural Research-Changing Scenerio" held at Bangalore on May 24-28, 1993.
7. Unnikrishnan Nair, P.K., Mammooty, K.P., Sasikumar, S. and Pillai, V.S. 1993. *Phytophthora* foot rot of black pepper- a management study with organic soil amendments. Indian Cocoa Arecanut and Spices J. 17 (1&2) :1-2.
8. Raiagopalan, A. 1996. Panniyur 5-A high yielding variety of black pepper. Spice India 9(6):14.
9. Raiagopalan, A. 1996. Performance of black pepper cv. Karimunda grown on different tree standards. Spice India 9(8):13-14
10. Rajagopalan, A., Ibrahim, K.K., Sukumara Pillai, V., Satheeshan, K.N. Neema, V.P. and Mammooty, K.P. 1996. A comparative evaluation of black pepper cultivars and promising cultures for yield and tolerance to pests and diseases. Paper presented in the PLACROSYM-XII held at RRII, Kottayam on 27-29 November, 1996.

9. A. Recommendations of the 1st QRT-Action taken-Action pending

Sl. No.	Recommendation	Action Taken/Action Pending
1.	Survey for collection of wild and cultivated types of black pepper may be continued in Kerala and Karnataka.	Wild types have been collected from Western Ghats of Kerala and Karnataka
2.	Attempts may be made to collect varieties from S.E. Asian countries particularly Sarawak and Indonesia. The species of live standards used in those countries may also be found out	No Action Taken
3.	Karimunda, Kalluvally, Kottanadan, Cheriakaniakadan and Uthirankotta may be crossed with Panniyur 1 and Uthirankotta using the latter two as female parents	Already done
4.	Kerala Agri. University will be requested to make available at least 2 ha. of land for planting hybrid seedlings at Panniyur	Acquired 11.05 ha. in 1981 of which 2 ha. has been utilised for planting hybrid seedlings
5.	Ecological factors like soil temperature, night temperature etc. may be recorded and possibility of correlating these factors with the incidence of Phytophthora foot rot disease may be explored	Action taken and results are published
6.	Studies on histopathology may be taken up	Not taken up for want of facilities and staff
7.	Hybrid and open pollinated seedlings of cultivated and wild varieties may be evaluated for disease tolerance/resistance	This is being done
8.	The present field trials on the control of foot rot may be modified using BM and Bordeaux paste to find out correct time of spraying and number of sprays for effective control of the disease	This has been done. Application of Bordeaux paste(10 %) in the collar region and spraying the vines and drenching the soil with 1 % BM in May -June and August prevents the disease.

9	The present field experiments of slow wilt may be discontinued.	Discontinued
10.	The correct time and stage infection by the fungus causing the pollu disease may be ascer tained. Isolate the fungus at periodic intervals from the time of spiking to time of harvest. Based on this, the best time for application of plant protection chemicals may be determined. The laboratory studies may be supported with field observations on the disease incidence.	The problem has been studied at Panniyur. Three sprayes of 1% B.M. in May, 1st week of July and last week of September could effectively control the disease.
11.	Since the pepper hybrid Panniyur 1 is widely distributed to the farmers, it is necessary to evolve suitable cultural and nutritional recommendations immediately.	NPK and irrigation requirement has been worked out for Panniyur 1.
12	Studies on two serious diseases of pepper, viz.slow decline and foot rot should be intensified	Work has been intensified
13.	In order to provide exhaustive collection of germplasm,both indigenous and exotic, a detailed survey in the Western Ghat urgently required for including the wide variability that are likely to exist in this area	During 1982-83, 56 wild types were added to the collection. For effective collection,a Jeep with trailor is essential.
14.	Multilocational trials may be laid out in different agroclimatic conditions	Experiment has been laid out in different agroclimaticconditions
15.	A project on the evaluation of newer fungicides against foot rot disease should be initiated. Ridomil, Foltat, Boyer 5072 should be included in the trial.	Trial laid out and results published
16.	Studies on the etiology and control of nursery disease of pepper should be done	Studies taken up and results published
17.	Epidemological studies on <i>Phytpphthora</i> should be included	Taken up partially.

b. Recommendations of the IInd QRT(1982-92)-Action taken-Action pending

Sl. No.	Recommendation	Action Taken/Action Pending
1.	Few more areas may be surveyed for indigenous collection of black pepper genotypes (page 96 of the QRT 1993)	Partially taken up
2.	The importance of further work on variety evolution, standardisation of agro-techniques under different cropping systems, working out economics, soil dynamics, standardisation of leaf analysis techniques for fertiliser recommendation and control of pests and diseases biological agents to reduce the residue problems are stressed for pepper (Page 97 of the QRT 1993)	Partially taken up
3.	The committee felt that some of the existing vacant residential buildings can be utilised as laboratory. Provision may be made for setting up a laboratory including furniture and minimum equipment necessary for the work already allotted (Page 59 and 99 of QRT 1993)	Action in progress
4.	On farm trials may be initiated under the auspices of co-ordinating centres utilising the development under spices either directly or through the development depts/Spices Board. Sufficient techniques have been developed for increasing productivity of spices crops, but they are not translated into the field. Large scale farm trials covering recommended package of practices to convince the extension agencies and cultivators are recommended.	Funds not provided, hence not laid out. Efforts will be made to contact the development departments to lay out the trial.

5.	Scientists in the co-ordinated project may be given training in crop technology and other specific areas of specialisation. (Page 103)	Not having sufficient funds.
6	Each co-ordinating centre may be provided funds to procure atleast Indian Journals, Library facilities at IISR may be strengthened and copies of the relevant papers made available to the centres.	Action taken system of centralised library is insisted in the University. However essential books for reference are being purchased.
7.	Copies of published papers from the co-ordinating centres may be send to the project co-ordinator for documentation from the IISR library.	Action taken

10. Major gaps in research - New focus of research and thrust areas constraints identified-interaction and linkages - collaboration with other institutions and agencies :

The work on crop improvement could not be carried out effectively for want of sufficient staff. The post of plant breeder was lying vacant for the last four years and hence the continuity of research on crop improvement is lost. Survey for the collection of germplasm of black pepper and related species could not be done for want of sufficient scientific staff.

New focus of research and thrust areas

1. Collection, characterisation and cataloguing of black pepper germplasm
2. Preparation of descriptor for black pepper germplasm
3. Isozyme studies for the correct identification of genotypes
4. Finding out a variety best suited for homestead cultivation and also for growing as a bush pepper in pots
5. Research on organic farming-use of vermicompost, biofertilisers etc. for growing pepper and to study their effect on quality attributes
6. Standardisation of agrotechniques like irrigation and fertiliser application for newly released varieties of black pepper, viz. Panniyur 2, Panniyur 3, Panniyur 4 and Panniyur 5.
7. Studies on micronutrient requirement of black pepper

8. Research on post harvest technology-studies on varieties suitable for different processed products
9. Evolving varieties tolerant to drought and **Phytophthora** foot rot
10. Research on biological control of **Phytophthora** foot rot and nursery diseases
11. Evolving varieties tolerant to drought-they are to be screened and subjected to biochemical characterisation
12. Effect of solarisation in the incidence of **Phytophthora** foot rot disease of pepper
13. Potentiating the bioefficiency of the biocontrol agents through biotechnical approaches.
14. Identification of efficient biocontrol agents which are comparable with agrochemicals and suppressive to *P. capsici* and nematodes
15. Identification/induction of resistance to obtain productive genotype to the horizontal resistance to **Phytophthora** foot rot and nematode disease.
16. Management of **Phytophthora** foot rot disease with VAM fungi.
17. Use of botanicals In the management of diseases.
18. Integrated disease management of **Phytophthora** foot rot and slow decline diseases.
19. Breeding for durable disease resistance.
20. Evaluating rhizosphere of **Phytophthora** foot rot disease affected and healthy plants.
21. Development of **Phytophthora** resistance in pepper using biotechnological aspects.
22. Studies on the management of **Phytophthora** foot rot disease with newer fungicide groups like Anilinopyrimidines, Strobilurins and Quinoxifen.

Constraints identified :

1. Shortage of scientific staff :

The major constraint identified is the shortage of scientific staff in the project. The post of plant breeder and that of plant pathologist is lying vacant at present. Immediate action may be taken to fill up the vacant posts. Outstation Allowance may be reinstated considering the remote nature of the station.

2. Laboratory facilities :

The present laboratory is insufficient to carry out studies on physiological, biochemical, qualitative and pathological aspects and other new thrust areas of research. A new laboratory providing sophisticated equipments may be sanctioned.

3. Library facilities :

At present there is no library facilities in the station. Sufficient funds may be allocated to subscribe Journals on spices and related crops and to purchase books on these crops.

4. Transport facilities :

One minibus may be provided exclusively for schooltrip as the strength of students has increased.

INTERACTION AND LINKAGES

Pepper Research Station, Panniyur maintains direct linkage with Indian Institute of Spices Research, Calicut, National Bureau of Plant Genetic Resources Regional Centre, Vellanikkara, Directorate of Cocoa, Arecanut and Spices Development, Calicut, Dept. of Agriculture, Kerala and Spices Board, Cochin.

COLLABORATION WITH OTHER INSTITUTES AND AGENCIES

Pepper Research Station wants to collaborate with other institutions like:-

1. NBPGR and TBGRI - for germplasm collection of exotic types
2. Centre for water technology centre,
New Delhi and CWRDM, Calicut - Water management studies
3. IISR, Calicut, TNAU, Coimbatore
Madras University, Chennai and
Biotechnology Division, IARI - Biocontrol Research
4. CFTRI, Mysore - Quality and post harvest technology

11. Budget details : Given as annexure(p.19)

12. Training

A. Training programmes organised :

Scientists of the station took classes on agricultural and allied subjects for the departmental officers at RATTC (Regional Agricultural Technology Training Centre), Taliparamba. Students from various educational institutions visit the station frequently and scientists explain the research activities to them. Training was imparted on pepper production technology to the officials of the dept. of agriculture, sponsored by the Spices Board, Cochin. The scientists offered courses to the students of the College of Agriculture, Nileshtar, Pilicode.

B. Training programme attended by scientist during 1992-97 :

Dr. A. Raiagopalan, Assoc. Professor attended summer institute (short course) on technology for dryland horticulture in arid and semiarid area held at MPKV, Rahuri during July, 1995.

C. Training needed for the staff in the next five years

1. Training on equipment required for studies on drought physiology, nutrient uptake and carbon assimilation
2. Training on post harvest technology
3. Training on biological control of pests and diseases
4. Training on advanced computer operations
5. Training on protoplast fusion technology for the improvement of *Trichoderma sp.*
6. Training on biotechnological approaches in the induction of resistance to **Phytophthora**

Panniyur,

25-11-97

(Associate Professor)

Annexure

II. Budget details-VIII plan yearwise allocation-Expenditure details pay and allowances,TA,RC,NRC (equipments-works-vehicle separately). Provide total figures ICAR plus State share

Head of A/C	1993-93		1993-94		1994-95		1995-96		1996-97		Total (VIII plan)	
	Allocation	Expenditure	Allocation	Expenditure	Allocation	Expenditure	Allocation	Expenditure	Allocation	Expenditure	Allocation	Expenditure
Salaries & Allowances												
110 Scientists	2.00	1.85	3.10	1.51	3.20	2.42	3.50	2.54	3.80	3.95	15.60	12.27
120 Technical & Suppl. Staff	0.92	0.87	1.25	1.13	1.40	1.42	1.70	1.61	2.00	2.25	7.27	7.27
130 Admn. Supp. & GS	0.12	0.006	0.21	--	0.50	--	0.50	0.09	0.50	0.41	1.83	1.10
152 Health & Medical Travelling Allowance	0.06	--	0.10	0.013	0.12	--	0.04	--	0.07	0.023	0.93	0.04
300 T.A.	0.08	0.06	0.26	0.22	0.12	0.12	0.26	0.26	0.17	0.17	0.84	0.835
Recurring Charges												
Research Materials	0.32	0.81	0.32	0.27	0.32	0.55	0.55	0.83	0.60	0.45	2.11	2.90
Cost of Labour	0.48	--	0.48	0.48	0.48	0.18	0.25	0.30	0.20	0.43	1.89	1.38
Non Recurring Charges												
Civil works	--	--	1.00	1.00	--	--	--	--	--	--	1.00	1.00
Equipment & Mach.	--	--	4.20	2.87	1.38	0.25	1.07	0.42	0.49	--	7.14	3.55
Total	3.98	3.60	10.92	7.50	7.52	4.94	7.87	6.05	7.78	7.67	38.07	29.75
ICAR Share	2.995	2.698	8.19	5.62	5.64	3.71	5.91	4.54	5.83	5.75	28.56	22.31
KAU Share	0.985	0.899	2.73	1.87	1.88	1.24	1.97	1.51	1.95	1.92	9.51	7.44