RPF-III

PERFORMA FOR SUBMISSION OF FINAL REPORT OF RESEARCH PROJECTS

Part- I : General Information

800 Project Code : **Path. XII(813)**

8001 Institute Project Code No. : Path. XII (813)

8002 ICAR Project Code No.

801 Name of the Institute and Division

8011 Name and address of Institute : Indian Institute of Spices Research, Calicut –673 012, Kerala

8012 Name of Division / Section : Division of Crop Protection

8013 Location of the Project : IISR, Calicut, Kerala, India

802 Project Title : **Investigation of spike shedding of black pepper at high altitudes**

803 Priority Area : Crop Protection

8031 Research Approach :

Applied Res.	Basic Res.	Process or Tech. Dev.	Transfer of Tech.
✓	✓	✓	✓

804 Specific Area : Identification & development of diagnostics against pathogen

805 Duration of Project : 2 years

8051 Date of start : 2002

8052 Date of Completion : 2004

806 Total cost /Expenditure Incurred : Rs. 5, 65, 000/-
(Give reasons for variation, if any from original estimated cost)

807 Executive Summary

Spike shedding is a major problem in black pepper especially in higher elevations of Kerala and Karnataka. The problem is more severe in varieties such as Panniyur-1. The problem is acute in recent years as the rainfall pattern has changed considerably and the summer showers are delayed or not received al all. Delayed monsoon results in late emergence of spikes and production of female flowers instead of bisexual flowers resulting in lack of pollination. The problem gets aggravated when

anthracnose disease occurs causing severe spike shedding. A multidisciplinary study indicated that irrigation during summer months coupled with phytosanitation, shade regulation and fungicide application could effectively manage spike shedding.

808	**Key words**	: Spike shedding, irrigation, physiology, growth regulators, anthracnose and fungicides

Part-II : Investigator Profile

(Please identify clearly changes, if any in Project personnel)

810	**Principal Investigator**	:
8101	Name	: Dr. M. Anandaraj
8102	Designation	: Principal Scientist
8103	Division/ Section	: Crop Protection
8104	Location	: Indian Institute of Spices Research
8105	Institute Address	: Indian Institute of Spices Research Calicut-673 012, Kerala, India

811 Co- Investigator:

8111	Name	: Dr. M. N. Venugopal
8112	Designation	: Principal Scientist
8113	Division/ Section	: Crop Protection
8114	Location	: Indian Institute of Spices Research
8115	Institute Address	: Calicut-673 012, Kerala, India

812 Co- Investigator:

8121	Name	: Dr. K. S. Krishnamurthy
8122	Designation	: Scientist (Sr. Scale)
8123	Division/ Section	: Crop Protection
8124	Location	: Indian Institute of Spices Research
8125	Institute Address	: Indian Institute of Spices Research Calicut-673 012, Kerala, India

813 Co- Investigator:

8131 Name	: Dr. V. Srinivasan
8132 Designation	: Scientist (Sr. Scale)
8133 Division/ Section	: Crop Protection
8134 Location	: Indian Institute of Spices Research
8135 Institute Address	: Indian Institute of Spices Research Calicut-673 012, Kerala, India

814 Co- Investigator:

8141 Name	: Dr. S. J. Ankegowda
8142 Designation	: Senior Scientist
8143 Division/ Section	: Plant Physiology
8144 Location	: Indian Institute of Spices Research
8145 Institute Address	: Indian Institute of Spices Research Calicut-673 012, Kerala, India

815 Co- Investigator:

8151 Name	: Dr. K. Kandiannan
8152 Designation	: Scientist (Sr. Scale)
8153 Division/ Section	: Crop Protection
8154 Location	: Indian Institute of Spices Research
8155 Institute Address	: Indian Institute of Spices Research Calicut-673 012, Kerala, India

816 Co- Investigator:

8161 Name	: Dr. R. Ramakrishnan Nair
8162 Designation	: Scientist (Sr. Scale)
8163 Division/ Section	: Crop Protection
8164 Location	: Indian Institute of Spices Research

8165 Institute Address : Indian Institute of Spices Research
Calicut-673 012, Kerala, India

Par-III: Technical Details

820 Introduction and objectives

8201 Project Objectives : To identify the causes of spike shedding and to develop appropriate control measures

8202 Background information and importance of the projects

Spike shedding in black pepper at higher altitudes during monsoon period is emerging as a new problem in Idukki, Kerala and Coorg, Karnataka. The main reasons being lack of fruit set esp. the var. P-I and subsequent shedding of spikes. The fungus *Colletotrichum gloeosporioides* is found constantly associated with this malady.

821 Project Technical Profile

8211 Technical programme

(Indicate briefly plan of procedure, techniques, instruments and special materials, organisms, special environments etc.)

Irrigation at fortnightly intervals from April onwards and foliar application of Zn, Mo and K with growth hormones GA and NAA followed with fungicide schedules.

8212 Total man months involvement of component project workers

a) Scientific	5
b) Technical	5
c) Supporting	10

822 Final Report on the Project

Detailed report containing all relevant data with a summary of results (not exceeding 2-5 pages)

8221 Achievements in terms of targets fixed for each activity

Etiology and management of spike shedding in black pepper

Observations recorded on severity of spike shedding in various crop combinations, input management and light profiles indicated that the incidence varied from 9-87% in different field situations. Highest spike shedding was noticed in the rain fed blocks and heavily shaded conditions (Table.1).

Table. 1 Anthracnose incidence in different cropping system

Location	Situation /Crops	Disease index on laterals	Spike infection (%)	Fallen spikes (%)	Spike shedding (%)
Ashoka Est	Regulated shade	10	13	2	9
Ashoka Est	Partial shade	23	37	21	53
Ashoka Est	Shade	47	78	30	83
Laxmi Est	Cardamom + Pepper	52	62	28	74
Laxmi Est	Robusta + Pepper	19	23	12	16
Laxmi Est	Arabica +Pepper, irrigated	39	34	24	42
Chettalli	Regulated shade , rain fed	41	23	14	33
Udathmotte	Robusta + Pepper, irrigated	26	39	19	41
Boikeri	Robusta+ Pepper, irrigated	21	18	13	24
Boikeri	Arabica + Pepper, irrigated	27	34	16	32
Makkandur	Arabica+ Pepper, irrigated	72	83	33	87

Epidemiology

Monitoring of disease in Panniyur-I under different field conditions revealed that incidence commenced in the fourth week of June and reached its peak during August. The infection synchronized with the production of new flush and delayed emergence of spikes. Anthracnose infection declined after recession of monsoon and maturity stage of leaves and spikes. The spike infection varied from 13-83.4% and highest infection was recorded in the plants under high shaded conditions. Fallen spikes revealed 33% anthracnose infection and the rest had only female flowers instead of bisexual flowers.

Effect of fungicides and *Pseudomonas fluorescens* on anthracnose management

In the second year of disease management trail, the application of fungicides and bio control agent was carried out in two rounds during early monsoon and mid monsoon periods. The fungicides were tried as foliar spray in twelve separate treatment combinations. Bordeaux mixture(1%) was superior over other fungicides and bio control agent (*Pseudomonas fluorescens*) with mean green yield of 3.6kg/plant and 29% disease index compared to only 0.78kg green yield/plant and 61% disease index in untreated control. Application of *Pseudomonas fluorescens* as spray and drench during pre monsoon and mid monsoon period is also effective in management of anthracnose. The treated plants had 2.34kg green yield /plant with 35% disease index. The application of bio control was on par with many standard fungicides like Carbendazim, Hexaconazole, Mancozeb, Zineb and 0.5% Bordeaux mixture.

Field reaction of pepper cultivars and released selections to anthracnose

Anthracnose infection was recorded in 11 released selections and 14 popular cultivars. Among the released selections Panniyur-5, Panchami and Subhakara showed field tolerance to anthracnose infection and Panniyur-1 and 3 are highly susceptible. Among 14 cultivars Chomala, Thevanmundi, Karimunda, Chetalli selection, Aimpirian and Arakalamunda showed field tolerance to anthracnose.

Bisexual flower status in relation to light profiles

Light availability at different heights of shade trees, pepper vine and different levels of shade was measured by using lux meter. Lux reading was recorded in open place, under filtered shade of shade tree with pepper and natural conditions. Ten readings were recorded for each observation for four days in February 2004 from 9.30am to 10.30am. Average lux reading in open (71212.9 lux), filtered light in silver oak (17784.2 lux) and mutual shade (4656.9 lux) in silver oak with pepper. Amount of light intercepted by silver oak was 75% and filtered 25% and unused light under mutual shade of shade tree with pepper was only 6.5%.

Amount of light available in palwan (*Erythrina* sp.) with pepper system recorded 68502.5 lux in open condition; filtered 6547.5 lux and mutual shade was 3280.5 lux. The light intercepted by palwan was 90% and unused light under mutual shade of shade tree with pepper was only 5%.

97.8% of the flowers in Panniyur-1 showed bisexual status under irrigated and exposed conditions compared to only 3.9% bisexual flowers in rain fed and heavily shaded conditions. Predominance of female flowers and lack of pollination in the rain fed, shaded and delayed emergence and anthracnose infection are the major reasons for spike shedding in high altitudes (Table.2)

Table. 2 Bisexual flower status in Panniyur-1 under different exposure levels

Treatment	Light availability	% of Bisexual Flowers
Panniyur-5	10,000 – 12,000 lux	100
Panniyur-1 70% shade	6,547 lux	7.18
Panniyur-1 heavy shade	3,280 lux	3.9
Panniyur-1 Arabica Exposed	9,000 – 10,000 lux	83.57

Effect of phytohormones, potash, zinc and boron on spike shedding

Phytohormones like NAA (50ppm), GA (20ppm) and Kinetin (BAP 20ppm), potash, zinc and boron were tried to study their effect on spike shedding. Two rounds of hormones and nutrients were applied as foliar spray during spike initiation and fruit development stages.The spike shedding varying from 7 to 12% in the treatments compared to 19% in the untreated irrigated block. There were marked differences in the number of spikes/1mtr. height of canopy, total mean green yield and number of spikes to make 1kg (Table 3).

Table.3 Effect of hormones and nutrients on spike shedding and green yield

Treatment	Green wt.	Spikes/1m Canopy	Spikes/1kg	Spike shedding %
NAA	15.81	550	146	9
Kinetin	14.81	494	156	12
GA	15.04	597	161	10
NAA+GA+ Kinetin	13.60	551	152	12
NAA+GA+ Kinetin +K+Bo +Zn	15.3	522	146	11
MOP+Zn+Bo+ NAA	19.0	705	140	8
MOP	20.8	742	150	7
Zn+Bo	15.0	551	147	12
Control	11.9	464	183	19

Impact of irrigation on spike shedding

Many irrigation trials were taken up in hot spots of spike shedding. The trials were conducted purely as farmers participatory programme under coffee based pepper cropping system with Panniyur-1 selections. Four to five basin irrigation @ 50l/plant at an interval of 7 to 10 days was given to black pepper plants. The basin irrigation was followed by shade regulation of support trees to provide minimum light exposure of 6,500 to 12,000 lux under cloudy monsoon conditions. The basin irrigation was started in March 4th to 2nd week of April and continued up to mid May. Irrigation had tremendous impact in enhancing early spiking, maturity of laterals, high percentage of bisexual flowers and better setting compared to rainfed blocks of Panniyur-1 in respective locations.

8222 Questions- Answered

The causes for spike shedding was found to be predominance of female flowers and lack of pollination under unregulated shade, delayed emergence in rain fed conditions, synchronization of flushing at vulnerable stage of crop to anthracnose infection are the main reasons for spike shedding in high altitudes.

8223 Process/ Product/ Technology/ Developed

Management

Irrigation of black pepper vines 4-5 times at an interval of 5-7 days @ 40-50 plant commencing from 22 March, followed by shade regulation of support trees to provide minimum 7,500-10,000 lux light under cloudy condition is optimum for managing spike shedding in high altitudes.

8224 Practical Utility (not more than 150 words)

For holistic management of spike shedding and anthracnose in black pepper at high altitudes, irrigation coupled with recommended phytosanitary, prophylactic and nutrition management practices are necessary.

8225 Constraints, if any: Nil

823 Publications and Material Development
(One copy each to be supplied with this proforma.)

8231 Research papers

To be written

8232 Popular articles

8233 Reports

8234 Seminars, conferences and workshops (relevant to the project) in which the scientists have participated. (List abstracts forwarded)

Nil

824 Infrastructural facilities developed
(Details of field, laboratory, note books and final material and their location)

Nil

825 Comments / Suggestions of Project Leader regarding possible future line of work that may be taken up arising out of this Project.

Due to changes in rainfall pattern, cultivating a single variety such as Panniyur -1 has to be discouraged and planting of varietal mixtures and varieties that produce bisexual flowers must be advocated

Part-IV : Project Expenditure
(Summary)
Year-2004 - 2005

830 Total Recurring Expenditure

8301 Salaries: (Designation with pay scale)

	Estimated	Actual
i) Scientific	1,20,000.00	3,40,000.00
ii) Technical	50,000.00	1,00,000.00
iii) Supporting	50,000.00	1,00,000.00
Sub-Total	2, 20,000.00	5,40,000.00

Consumables

i) Chemicals	10,000.00	10,000.00
ii) Glasswares	5,000.00	5,000.00
iii) Others		
Sub-Total	15,000.00	15,000.00
8303 Travel	10,000.00	10,000.00
8304 Miscellaneous (other costs)		
8305 Sub-Total (Recurring)	25,000.00	25,000.00

831 Total Non – Recurring Expenditure (Equipments and works)

i)	Nil	Nil
ii)		
iii)		

823 Total (830 and 831) 2,45,000.00 5,65,000.00

Part-V : Declaration

This is to certify that the final report of the Project has been submitted in full consultation with the Project workers as per the approved objectives and technical programme and the relevant records, note-books, materials are available for the same.

Signature of the Project Investigator: Dr. M. Anandaraj

Co-Investigators:

1. Dr. M. N. Venugopal
2. Dr. K. S. Krishnamurthy
3. Dr. V. Srinivasan
4. Dr. S. J. Ankegowda
5. Dr. K. Kandiannan
6. Dr. R. Ramakrishnan Nair

All the work has been done as per the programmes identified

Signature & Comments of the Head
Of the Division/ Section

Signature & Comments of the
Joint Director (Research)

Signature & Comments of the
Director