

R.P.F III

FINAL REPORT

1. Institute Code No. Stat. IV(813)

2. I.C.A.R. code No.

3. Name and address of the Research Institute NATIONAL RESEARCH CENTRE FOR SPICES
Marikunnu P.O., Calicut - 673 012, Kerala.

4. Project Title : Evolving a disease index for *Phytophthora*/ Nematode induced damage in black pepper

5. Name and Designation of the Project Leader : Jose Abraham
Scientist (SG)

6. Name(s) and designation of Project Associates including project Leader and work done :

Sl. no.	Name and Designation	Time spent	Work done
1.	Jose Abraham (Leader)	18	Selected 3 black pepper gardens in the hot-spot areas of Wynad, Calicut and Idukky. Labeled the vines and scoring was done for the various symptom expressions. The vines were monitored for three years and scoring was done at four month intervals. Compilation and analysis of data and preparation of the report was completed.

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|----|-------------------------|---|--|
| 2. | M.Anandaraj (Associate) | 6 | Identification, scoring, soil and root sampling and analysis for assessing the presence and inoculum load of <i>Phytophthora capsici</i> |
| 3. | .K.V.Ramana (Associate) | 6 | Soil and root sampling and analysis for assessing the inoculum load of nematodes and also scoring the vines for the various symptoms. |
| 4. | Y.R. Sarma (Associate) | 3 | Selection of vines, scoring for the various symptoms, assessing the root damage caused by the fungus and interpretation of results |

7. Location of Research Project with complete address (Division/Section/Sub-Centre)

Statistics Section

National Research Centre for Spices

Marikunnu P.O., Calicut - 673 012

Kerala.

8. Date of start **April 1990**

9. Date of termination **March 1993**

10. (a) Objectives (Not more than 150 words):

*To evolve an indexing technique for quantifying the severity of disease on *Phytophthora/Nematode* affected black pepper.*

(b) Practical utility including background information (Not more than 150 words):

The necessity of quantifying the severity of disease on black pepper based on foliar symptoms, is felt in the context of field control trials involving different treatments. It is also essential in field surveys for estimating crop losses due to the disease. Such indexing methods were already evolved in various other crops like the indexing the root (wilt) disease of coconut (George et al, 1973), yellow leaf disease of arecanut (George et al, 1980), thatipaca disease of coconut (Rama Pandu and Rajamannar, 1983), Thanjavur wilt of coconut (Vijayan and Natarajan, 1975) and indexing of stem bleeding disease of coconut (Jacob Mathew et al, 1989).

11. Technical Programme :

1. *Selection of a large sample of black pepper vines in the hot-spot areas of Calicut, Wynad and Idukky and labeling them serially.*
 2. *Monitoring the vines for recording the disease scores by allocating scores from '0' to '4' depending on the percentage of foliage affected.*
 3. *Soil and root sampling for assessing the inoculum load of Phytophthora and Nematodes.*
 4. *Statistical analysis of data and preparation of report.*
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12. Final Report on the project :

MATERIAL AND METHODS

The study was carried out in three locations, viz. Calicut, Wynad and Idukki. A large sample of 1500 vines in the disease affected gardens in these districts were selected and monitored for three years during 1991 to 1993. During the first year of the study, the frequencies of incidence of the visual symptoms of Foliar Yellowing (FY), Defoliation (DF), Foliar Infection (FI), and Collar Infection (CI) were recorded for the three locations of Peruvannamuzhi farm at Calicut district, Kuppady plantations in Wynad district and in a farmers' plot at Nedumkandam in Idukki district. The incidence of disease in these gardens were severe and vines of all stages of the disease were present for observation. In order to study the relationship between the symptom expressions and the root damage in the vines, the data generated by a pot culture study conducted by the Pathology Section of National Research Centre for Spices were utilized. The growth parameters like, Height (Ht.), No. of nodes (N), Root Volume (RV), Root Weight (RW) and Shoot Weight (SW) were recorded. The vines which were inoculated with the pathogen, were also scored from '0' to '3'

visually, depending on the expression of foliar yellowing and root rotting as Foliar Index (FI) and Root Index (RI).

RESULTS AND DISCUSSION

For identifying the predominant symptoms in foot rot/nematode infected black pepper vines, a sample of 1,000 vines were scored for various symptom expressions viz., Yellowing, Defoliation, Foliar infection and Collar infection. Scores from '0' to '4' were allocated for 'healthy', '1 to 25%', '26 to 50%', '51 to 75%' and 'above 75%' of the foliage affected, respectively (Table 1.).

Table 1. Percentage Incidence of various symptoms in foot rot/nematode affected Black pepper gardens

Score	Yellowing	Defoliation	Foliar infection	Collar infection
0	41.0	36.7	97.7	92.6
1	42.4	31.3	1.9	6.8
2	13.1	22.6	0.3	0.6
3	3.3	8.0	0.0	0.2
4	0.2	1.4	0.2	0.0

The correlations between these scores were also worked out to study whether there is any interrelationship between these symptoms. In general, defoliation had significant positive correlation with yellowing, foliar infection and collar infection.

The data from the pot culture experiment revealed that there exists a significant positive correlation between root rot index (RI) and foliar yellowing index (FI) while these indices have significant negative correlations with the growth parameters viz., Height (Ht), Root Volume (RV), Shoot Weight (SW) and Root Weight (RW) (Table-2).

Correlations between Root Index (RI), Foliar index (FI) and Growth factors

Factor	RI	FI	Ht	RV	SW	RW
RI	-					
FI	0.5124	-				
Ht	-0.4862	-0.3178	-			
RV	-0.7201	-0.4276	0.6651	-		
SW	-0.5181	-0.3518	0.8255	0.7085	-	
RW	-0.6758	-0.4232	0.6300	0.9108	0.6962	-

All the correlations are significant ($p < 0.01$).

The percentage distribution of these vines in relation to these indices were worked out and are given in Table-3.

Table-3 Percentage distribution of vines in relation to RI and FI

Index	Vines(%) showing expression on	
	Roots	Foliage
0	8.2	37.4
1	25.7	46.5
2	34.2	12.6
3	31.9	3.5

It is seen from the table that, even though, only 8.2% of the vines were free from the disease (root index = 0), 37.4% were apparently healthy (foliar index = 0), indicating that at the initial stages of infection at the roots, the vines do not express any external symptoms. This is more apparent in the case of vines with root rot index 3. While 31.9% of the vines are in the advanced stages of infection, only 3.5% of the vines are showing advanced stages of foliar yellowing. Hence, it is evident that there is a time lag between the root rot and its foliar expression as yellowing, leading to a delay in detecting the disease at the initial stages, which could be the reason for poor response of affected vines to control measures.

From the frequencies of incidence of the symptoms viz., foliar yellowing (FY), defoliation (DF), foliar infection (FI) and collar infection (CI), it was found that 59 and 64 percent of the vines showed mild to severe yellowing and defoliation, only 2.3 and 7.4 percent of the vines were showing foliar infection and collar infection respectively. Hence it was found that foliar yellowing and defoliation are the more prominent and persistent symptoms which could be scored for working out an index. Accordingly, scores from '0' to '4' were allocated for these two symptoms, depending on the percentage of the foliage affected, say, the score '0' for healthy, '1' for those vines showing up to 25% of the foliage affected, score '2' for 26 to 50%, '3' for 51 to 75% and the score '4' for those vines having more than 75% of the foliage affected. Scoring was done separately for yellowing and defoliation for all the selected vines based on the above criteria.

The frequencies of incidence of these scores were recorded for 8 rounds in different seasons and the average of these scores worked out with a view to get the ratio of occurrence of these scores. The percent distribution of these scores were obtained and are given in table-4.

Table-4. Percent distribution of different scores for FY and DF

Score	FY	DF
0	48.2	51.1
1	34.6	20.4
2	10.4	13.6
3	1.7	7.1
4	5.1	7.8

From the table it is seen that 48% of the vines were having score '0' for yellowing and 51% were having score '0' for defoliation. This means that the remaining 52 and 48 percent of the vines are having the symptoms of yellowing and defoliation respectively indicating that a 1:1 ratio exists in the expressions of these symptoms in the affected vines.

Further, the mean score for yellowing and defoliation works out to be 0.81 and 1.00 respectively, which is also closer to the ratio 1:1. Thus, giving equal weightage to these symptoms for obtaining a simple index for the disease is justified. Integrating these two scores by taking the total of these scores and converting to percentage of the total of maximum possible scores for these two symptoms (4+4 = 8), will give a simple index for the disease. Thus, if 'y' stands for the score for yellowing and 'd' for defoliation score, then the index 'I' for the vine is given by

$$I = \frac{y + d}{8} \times 100$$

Foot rot disease of black pepper, though, conventionally known as 'quick wilt' disease, it was observed that once the feeder roots get affected the process of decline of the vines are gradual and foliar symptoms express only after a substantial portion of the feeder roots are damaged. Sudden death of the vines occur only when the collar region of the vine is affected. Also, depending up on the root regeneration capacity of the vines and the favourable weather conditions, the remission of the symptoms are often observed.

SUMMARY AND CONCLUSIONS

For indexing the foot rot disease of black pepper, the visual symptoms of foliar yellowing and defoliation are scored separately from '0' to '4' depending on the percentage of the foliage affected. As these two symptoms are found to be the consequence of the feeder root damage and is directly related to the degree of damage occurred to the roots, the index derived by adding these scores and converting to percentage gives a realistic measure of the extend of damage caused to the vine. When the collar region of the vine is directly affected by the fungus, the death of the vine is faster and the symptoms of foliar yellowing and defoliation may not manifest on the foliage. However, the frequency of collar infection is only in 7% of the vines observed, while foliar

yellowing and defoliation was found in about 50% of the vines in the affected gardens. Hence, the index was developed based on the prominent and more persistent symptoms of foliar yellowing and defoliation. Also these are the two symptoms which can easily be visualized and assessed for allocating the score.

REFERENCES

- GEORGE, M.V. and RADHA, K. 1973.** Computation of disease index of root (wilt)disease of coconut.
Indian J. Agric. Sc. 43: 366-370
- GEORGE, M.V., JACOB MATHEW and NAGARAJ, B. 1980.** Indexing of yellow leaf disease of arecanut.
J. Plant. Crops 8: 82-85
- NAMBIAR, P.T.N. and PILLAI, N.G. 1985.** A simplified method for indexing root (wilt) affected coconut palms.
J. Plant. Crops. 13(1): 35-37.
- RAMA PANDU, S. and RAJAMANNAR, M. 1983.** Symptomatology and indexing of Tatipaka disease of coconut.
Indian Phytopath. 36: 608-612
- VIJAYAN, K.M and NATARAJAN, S. 1975.** Influence of fertilizer and manuring on the incidence and progress of coconut wilt disease of Tamil Nadu.. Cocon. Bull. 5: 1-5
- JACOB MATHEW, NAMBIAR, K.K.N., JOSE, C.T. and ANIL KUMAR, 1989.** Stem bleeding disease of coconut - a method for indexing the disease severity. J. Plant. Crops. 17(2): 80-84

13. Approximate expenditure incurred in the project (Give reasons for variation, if any, from original estimated cost)

Rs. 1.6 Lakhs.

14. Publications and material (one copy each to be supplied with this proforma)

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|---|-----|
| a) Research papers | Nil |
| b) Popular articles | Nil |
| c) Reports | one |
| d) Seminars and work shops(Relevant to the Project) in which the Scientists have participated) | Nil |
| e)Materials developed such as new varieties of crops or breeds of farm animals, implements, products etc. | N/A |

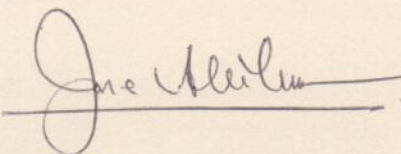
15. Details (Nos. etc.) of Field/Laboratory Note books final materials and their location
Kept in the Statistics Section of the Institute

16. Comments/suggestions of the Project leader regarding future possible line of work that may be taken up arising of this project

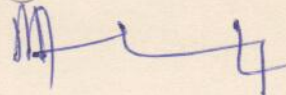
Similar studies are to be carried out for other spices.

17. Signature with name of Project Leader and Associates:

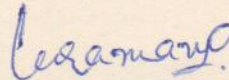
1. Jose Abraham (Project Leader)

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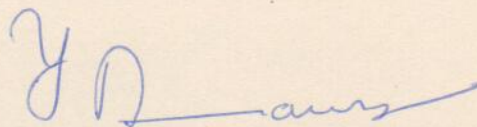
2. M. Anandaraj (Associate)

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3. K.V. Ramana (Associate)

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4. Y.R. Sarma (Associate)

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18. Signature (with comments, if any,) of Head of the Division/
Section/Station :

19. Signature (with comments, if any) of Director :



Prof. (Dr.) K.V. Peter
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