

# EPIDEMIOLOGY OF 'KATTE' VIRUS DISEASE OF SMALL CARDAMOM-II: FOCI OF PRIMARY DISEASE ENTRY, PATTERNS AND GRADIENTS OF DISEASE ENTRY AND SPREAD

R. NAIDU\* and M.N. VENUGOPAL

Central Plantation Crops Research Institute Research Centre, Appangala, Heravanad Post,  
Kodagu, Madikeri-571 201, Karnataka\*\*

## ABSTRACT

Monitoring of forty nurseries raised through seed and voluntary seedlings and twenty two plantations situated at 6-9 Km from the source of inoculum revealed that voluntary seedlings collected from infected plantations and the nurseries located in the vicinity of diseased crop from the primary foci of disease spread. Entry of disease also occurs in contiguous and nearby plantations up to 1,000 m from the external inoculum source. Further centrifugal influx was recorded around primary foci due to secondary spread by the vector. Spatial pattern of spread is concentrated within 40 m radius with occasional introduction of disease up to 90 m distance. Sharp difference in the pattern of spread was observed between the plots with and without roguing. The gradient of the disease decreases steeply near the source of inoculum and less steeply at great distances.

## INTRODUCTION

Wide spread prevalence of 'Katte' disease (Mayne, 1951; Venugopal and Naidu, 1981) has been responsible for lower yields in South India. The disease spread in nature occurs by the banana aphid, *Pentalonia nigronervosa* Coq. (Uppal *et al.*, 1945) in a non-persistent manner (Rao, 1977; Naidu and Venugopal, 1982). Within the plantations 'Katte' disease spreads internally (Deshpande *et al.*, 1972) and it tends to be concentrated in patches with occasional new infections. In an attempt to determine whether the foci of infection are from inside or outside the crop and whether any influx is followed by

secondary spread the present studies were undertaken.

## MATERIALS AND METHODS

The studies were conducted in forest based pure cardamom plantations with Malabar type, in Kodagu District, Karnataka State.

To assess the role of nurseries in the epidemiology of 'Katte' disease forty primary and secondary nurseries raised through seeds and voluntary seedlings were surveyed. All the seedlings were examined and number of 'Katte' infected plants were recorded. The possibilities of inoculum introduction from external and

---

\*Present address: Director of Research, Indian Cardamom Research Institute, Myladumpura, Kailasanadu - 685 553.

\*\*Presently, National Research Centre for Spices, Appangala.

internal sources was studied in twenty two plantations of various age groups located at different distances from virus source over a period of two years (1981-82). The plantations were surveyed at quarterly intervals and the number of independent outbreaks and secondary infections around primary source were recorded. By critical evaluation of pattern of symptom expression and stage of symptoms as suggested by Naidu and Venugopal (1984), the source and age of infection was determined.

The pattern of spread within the plantation was studied by selecting three blocks of 0.5 ha within the radius of 2 Km. In all the 3 blocks the primary infection sources were located and in two blocks the primary and secondary infections were rogued out at monthly interval to study the impact of plant sanitation on the pattern of secondary spread. In all the three blocks new infections were plotted at monthly intervals for a period of three years from 1981-83.

To study the gradient of infection within the plot, five blocks were selected in different locations. After identifying

primary source of infection the disease at different distances were plotted to know the gradient of infection from the primary inoculum source.

The gradient of infection due to multiple infection was studied in an isolated infected block of 6 ha. The infection at different distances from initial inoculum source was plotted upto the other terminus of the plantation.

## RESULTS AND DISCUSSION

### *Role of nurseries in epidemiology of 'Katte' disease*

It is seen from Table I that nurseries raised adjacent to infected plantations invariably were infected with 'Katte' disease. As high as 90% infection was recorded in such nurseries. In South India, it is very common that most of the small growers depend on the voluntary seedlings for their planting requirement. Although the 'Katte' disease is not seed transmitted, after germination the seedlings were exposed for infection for a period of 3-4 months in the infected plantation. Out of 14 nurseries raised through voluntary seedlings, six were infected with 'Katte' disease. Such

Table I. 'Katte' infection in nursery

Seedling source	No. of nurseries examined	Distance from inoculum source(m)	Age of Seedlings (months)	No of seedlings	No of infected nurseries	Infection range (%)
Voluntary	5	100 - 200	6-10	38,000	4	0.04 to 0.2
- do -	9	More than 200	6-18	32,000	2	0.01 to 0.2
Seeds	7	10 - 100	6-18	32,000	6	0.05 to 90.0
- do -	2	101 - 200	6-18	14,500	1	0.00 to 32.0
	17	More than 200	6-18	10,24,000	1	0.00 to 0.2
Total	40	-	-	11,40,500	14	-

Table II. *Primary entry and secondary spread of 'Katte' disease in different plantations*

Sl. No.	Area (Ha.)	Age of the plantation (Yr)	Distance from virus source (m)	No. of primary infections	No. of secondary infections at various distances (m)					Total No. of infected plants	Source of virus entry
					5	10	20	40	100		
1	2	3	4	5	6	7	8	9	10	11	12
1.	10.00	4	500	2	5	4	2	1	-	12	Planting material
2.	12.00	4	800	2	5	-	-	-	-	5	Planting material
3.	2.00	3	1000	1	1	-	-	-	-	1	External
4.	1.00	2	2000	0	0	0	-	-	-	0	Healthy
5.	4.00	4	2000	1	8	5	-	-	-	13	Planting material
6.	3.00	3	300	1	10	1	2	-	-	13	External
7.	4.00	4	500	2	3	-	-	-	1	4	External
8.	1.50	3	1000	0	-	-	-	-	-	0	Healthy
9.	6.00	18.	500	0	-	-	-	-	-	0	Healthy
10.	0.80	4	200	0	-	-	-	-	-	0	Healthy
11.	10.00	4	500	0	-	-	-	-	-	0	Healthy
12.	1.50	1	50	1	-	2	2	1	1	6	External
13.	90.00	15	8000	0	-	-	-	-	-	0	Healthy
14.	10.00	13	9000	0	-	-	-	-	-	0	Healthy
15.	4.00	13	5000	0	-	-	-	-	-	0	Healthy
16.	10.00	4	100	8	18	7	2	4	4	35	External
17.	3.00	5	500	0	0	0	0	0	0	1*	External
18.	5.00		1000	0	0	0	0	0	0	2*	External
19.	6.00	3	6	0	0	0	0	0	0	5*	External
20.	62.00	4-10	120	0	0	0	0	0	0	8*	External
21.	3.00	4	120	0	0	0	0	0	0	3*	External
22.	8.00	3	68	0	0	0	0	0	0	5*	External

\*No of independent infections in to years.

infected seedlings form the initial source of disease in disease-free plantations.

#### *Entry and spread of 'Katte' disease in plantations*

The results presented in Table II clearly show that in many cases, in isolated plantations the disease entry occurs through infected planting material. The initial spread in the contiguous and nearby plantations occurs through the alate viruliferous aphids. The fresh entry in disease free plantations located at 6 to 9 Km from virus sources suggests that the source of infection is external and alate

aphids are playing a role in the external spread. Though 'Katte' is non-persistent and persistence with aphids is only for 2-3 hours, the alate aphids either actively or passively can travel quite distance within this interval and can play important role in external spread. The new infections around primary foci were found within 5 m radius and number of infections decreased as the distance increased. However, out of 22 plantations observed eight isolated plantations located at 200 to 9,000 m from virus source were found to be free from infection, though they were exposed for

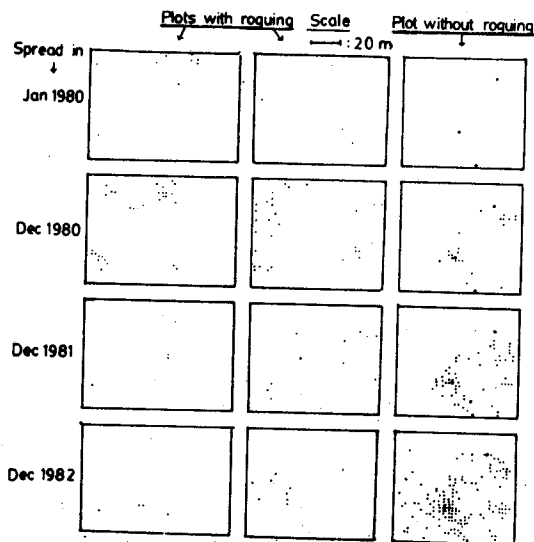


Fig. 1. The pattern of 'katte' disease spread in field experiments with and without roguing of infected plants.

natural infection for a period of 2-18 years.

#### *The pattern of 'Katte' spread in the plots with and without roguing.*

The regular tracing of infections around primary foci over a period of 3 years indicated that the disease spread is mainly centrifugal and it is concentrated around 20-30 m from inoculum source

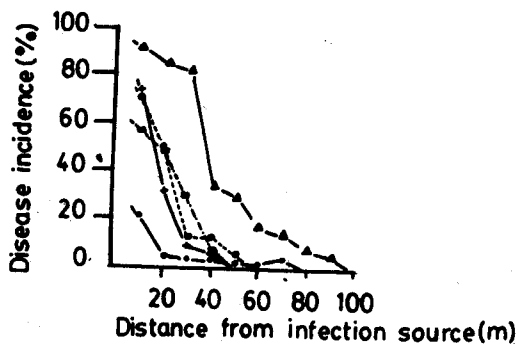


Fig. 2. The gradients of 'katte' virus spread within the plots at five locations.

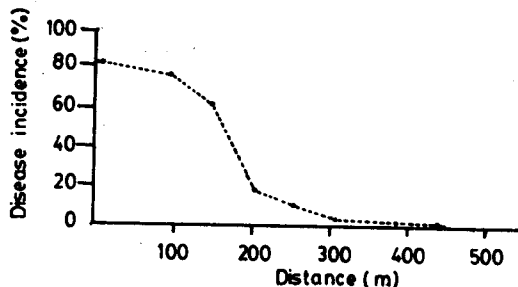


Fig. 3. The gradient of 'katte' disease spread in cardamom with four years infection on one side of the plantation.

(Fig-1). The spread of 'Katte' is more in the plot where no roguing was followed. Progressive decreased infections in the plot with roguing suggests that continuous elimination of inoculum source is having profound impact on the management of the disease. Naidu and Venugopal (1982) reported the benefits of roguing in minimising the 'Katte' disease spread. This study further confirms that pattern and number of new outbreaks are directly influenced by the amount of internal inoculum source.

#### *Gradient of 'Katte' disease spread*

It is seen from Fig-2 that the gradient of infection is steep within 40 m from virus source and it flattens thereafter. The influence of multiple infections on the gradient of disease spread is shown in Fig-3.

Though the test plantation was exposed to infection for over 4 years, the intensity of the disease was more in one end which was infected earlier. Thereafter, the disease gradient decreased steeply and it flattened as the distance increased. In spite of access to virus for over 4 years, no infection was noticed beyond 450 m from the initial inoculum source. On the basis of the above results,

the following recommendations are made for avoiding entry and secondary spread of 'Katte' Virus: (i) Raising nursery in isolated places away from infected plantations, (ii) Total avoidance of voluntary plants from infected plantations for propagation, (iii) Inspection of all plants in disease free plantations once a year to eliminate primary infections which spread from external sources, and (iv) Regular roguing to reduce internal inoculum and secondary spread.

#### ACKNOWLEDGEMENTS

Authors thank Dr. K.V.A. Bavappa, Director, CPCRI, Kasaragod for encouragement, Kodagu planters for co-operation and Dr. K.K.N. Nambiar, Head (Plant Pathology) CPCRI, Kasaragod for critically going through the manuscript.

#### REFERENCES

DESHPANDE, R.S. SIDDAPPAJI, C. and VISWANATHA, S. 1972. Epidemiological studies on 'Katte' disease of cardamom (*Elettaria cardamomum* Maton.) *Mysore J. Agri. Sci.* 6: 4-9.

MAYNE, W.W. 1951. Report on cardamom cultivation in South India, ICAR, Bulletin, 50: 62pp.

NAIDU, R. and VENUGOPAL, M.N. 1982. Management of 'Katte' disease of small cardamom. pp. 563-671. In Proc. PLACROSYM V 1982, eds. Iyer *et al* PLACROSYM Standing Committee, CPCRI, Kasaragod 670 124, Kerala, India.

NAIDU, R. and VENUGOPAL, M.N. 1984. Epidemiology of 'Katte' disease of small cardamom. I. Disease incubation period and role of different host parts as a sources of inoculum in relation to disease spread. Paper presented in PLACROSYM VI: 121-127

RAO, D.G. 1977. 'Katte' disease of small cardamom. *J. Plant Crops.* 5: 23-47.

VARMA, P.M. 1962. Control of 'Katte' or mosaic disease of small cardamom in North Canara. *Arecanut J.* 13: 79-89.

UPPAL, B.N., VARMA, P.M. and CAPOOR, S.P. 1945. A mosaic disease of cardamom. *Curr. Sci.* 14 208-209.

VENUGOPAL, M.N. and NAIDU, R. 1981. Geographical distribution of 'Katte' disease of small cardamom in India. Paper presented in IIIrd International Symposium on Plant Pathology held at IARI, New Delhi. Dec. 14-18. 1981.