

EPIDEMIOLOGY OF 'KATTE' VIRUS DISEASE OF SMALL CARDAMOM. I. DISEASE INCUBATION PERIOD AND ROLE OF DIFFERENT HOST PARTS AS A SOURCE OF INOCULUM IN DISEASE SPREAD

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ABSTRACT

The incubation period of 'Katte' virus disease was studied by inoculating grown up clumps under field conditions over a period of three years. The disease incubation period varied from 20 to 114 days during different months of incubation. However, the number of leaves produced during the incubation period remain more or less constant. Symptom expression was directly influenced by the growth of plants as indicated by early expression in the active growing period (May to November) and late expression in dry period (December to April). Higher transmission of the virus was obtained when young growing parts were used as a source of inoculum as against low transmission with mature and old parts. The old leaf sheaths which are the natural breeding sites of the vector were found to be a poor inoculum source. The various forms of aphid found naturally colonising on the old drying parts may not play a significant role in disease spread.

INTRODUCTION

'Katte' or Mosaic disease of cardamom has been responsible for low yields in South India (Mayne, 1951; Varma, 1962). Experimental transmission of the disease through banana aphid was first established by Uppal et al. (1945). The disease spreads pri-

marily through rhizomes used for propagation. Secondary spread in the field occurs through aphid vector. Deshpande et al. (1972) made pioneering efforts to understand epidemiological factors involved in the spread of this disease. They observed negative correlation between the vector population and disease incidence. Their conclusions suffered mainly due to lack of information on the disease incubation period which is essential for predicting and for critical analysis of new outbreaks. Knowledge on the disease incubation period in different seasons, the role of inoculum factor and various forms of aphid naturally colonising on an infected plant, in disease spread is essential to evolve realistic disease management strategy. Since no published information is available on these aspects the following investigations were undertaken.

MATERIALS AND METHODS

Disease incubation period

The incubation period for the disease was defined as the number of days between inoculation of a healthy plant by viruliferous aphid and the appearance of visible symptoms in the newly emerged leaf. To study 'Katte' disease incubation period, inoculations were conducted for three years (1980 to 1982) in an isolated block situated in CPCRI, Research Centre, Appangala farm. The experimental block was located at 1,000 m MSL and receives an annual rainfall of 3,200 mm. Nearly 80 per cent of the rain precipitates in the months of June, July and August. The temperature also varied considerably in different months. The lowest and the highest temperatures under field conditions were 8° C (December) and 32° C (March), respectively. Grown up clumps of five years were inoculated in the first week of every month in 10 replications. The inoculation was done through viruliferous aphids of four to five leaf stage young tiller. Apterate adults of *Pentalonia nigronervosa* f. *caladii* Van der Goot reared on cardamom plants were used for inoculation. Initially aphids were starved for two hours, then fed for 30 minutes on young symptomatic leaves of cardamom carrying local 'Katte' isolate (K-1). Viruliferous aphids were released in groups of 25 per funnel made by rolling and the tying of two youngest leaves. After overnight inoculation access the aphids were killed

by spraying with 0.05 per cent Quinalphos. Data on the number of days taken to express visible symptoms and the number of leaves produced during the incubation period were recorded.

Role of inoculum factor on natural spread of disease

Different host parts namely, unopened leaf, young opened leaf, mature leaf (fourth leaf), old leaf (sixth to eighth leaf from the top), lower-most old leaf, leaf sheath, inflorescence, young capsule, mature capsule, ripe capsule, young suckers (seven to nine cm length), young symptomatic pseudostem and partially dried pseudostem were collected from two-year-old 'Katte' infected plants. These host parts were tested separately as a source of inoculum through adult alate aphids as described earlier. Healthy cardamom seedlings raised in insect-proof conditions were used as test seedlings.

Role of various forms of vector naturally colonising on 'Katte' infected clumps

Partially drying pseudostems harbouring natural colonies were collected from two-year-old 'Katte' affected plants. The aphids in different stages of development namely, nymphs of one to two instar, nymphs of three to four instar, apterate and alate adults were collected and released separately in groups of 10 per test plant. After four hours of inoculation access the inoculants were sprayed with 0.05 per cent Quinolphos to kill the vector. The inoculated test plants were kept in a green house for observations.

RESULTS AND DISCUSSION

'Katte' disease incubation period

It is clear from Table 1 that the effect of climatic variation is profound on the 'Katte' disease incubation period which varied from 20 to 114 days during different months. An early expression of symptoms was seen in the active growing season (May to November) and it took more time during the dry months (December to April). The incubation period is directly influenced by the temperature, soil moisture and other edaphic factors. In spite of variations, the number of leaves produced during the incubation period in different months of inoculation remain

*Table 1. 'Katte' disease incubation period under field condition
(Mean of 10 replications)*

Months	Number of leaves produced during incubation period (Mean for three years)	Number of days taken for symptom expression (Mean for three years)
January	3	81
February	4	75
March	4	77
April	3	50
May	3	39
June	4	47
July	4	42
August	3	37
September	3	41
October	4	39
November	4	51
December	4	77

more or less constant. Symptoms first appear as chlorotic flecks in the fourth leaf produced after the inoculated leaf. The succeeding leaves show granular mosaic followed by clear mosaic. This pattern of symptoms expression remains clear till the inoculated pseudostem dries up (more than one year). This character can be taken as a key in predicting latent infections in epidemiological studies.

Deshpande et al. (1972) tried to correlate the vector population and activity and new outbreaks of disease in corresponding observations. Our studies have shown that actual infection occurs much earlier and it will be under incubation for a considerable period. By using the information on the disease incubation period in different months the correct assessment between vector population and new infections can be worked out.

Roguing has been suggested as a practical measure to manage 'Katte' disease of cardamom (Varma, 1962; Deshpande et al., 1972; Naidu and Venugopal, 1982; Naidu, 1983). The success of roguing has been attributed to locating infected plants at an early stage of disease. Data obtained in the present investigations are of practical value in fixing the interval and frequency of inspection during the plant sanitation operation.

Role of inoculum factor in the spread of disease

A higher transmission was recorded with the young leaves and a lower transmission was observed when the old and matured plant parts were used as inoculum source (Table 2). It is interesting to note that the old leaf sheaths which normally harbour an aphid colony are a poor source of inoculum. These results show that even non-symptomatic young host parts like panicles and capsules can also serve as a source of inoculum. In the light of the above results it is more appropriate to use young leaves to obtain higher transmission in screening trials for 'Katte' disease resistance.

Table 2. Effect of different host parts as a source of inoculum of transmission of 'Katte' disease

Sl. No.	Host part used for acquisition	No. of test seedling		Transmission per cent
		Inoculated	Infected	
1.	Unopened leaf	18	4	22.22
2.	Young opened leaf (1st leaf from top)	25	23	92.00
3.	Mature leaf (4th)	21	11	52.38
4.	Old leaf (6th-8th)	15	5	33.33
5.	Lower-most old leaf	20	2	10.00
6.	Leaf sheath (unopened)	13	1	7.69
7.	Inflorescence	14	1	1.14
8.	Young capsule (peanut size)	20	3	15.00
9.	Mature capsule	20	2	10.00
10.	Ripe capsule	20	0	0.00
11.	Young suckers (7-9 cm)	19	3	15.79
12.	Young pseudostem symptomatic	20	2	10.00
13.	Partially dried pseudostem	25	0	0.00

Role of various forms of aphid found colonising on 'Katte' affected plant

The results presented in Table 3 indicate that aphids colonised on the old leaf sheaths of 'Katte' affected plants play a negligible role in the disease spread. Under natural conditions, aphids are found in colonies of 30 to 50 comprising nymphs, apterate and alate adults. These colonies are formed in between the pseudostem

and loose leaf sheaths especially of old partially decayed, drying or damaged plants. The migration of aphids occurs only when the pseudostem starts drying and becomes unsuitable for food and shelter. This study suggests that aphids migrating from natural breeding sites may not be viruliferous and intermittent migration and probing on young host parts may be responsible for the natural spread of the disease. This study also indicates the low concentration of virus in the older parts which is a common feature in virus affected plants (Bartels, 1954). As there are remote chances of spread with the old parts, the prevailing disposal procedure can be simplified. Instead of disposing the entire 'Katte' infected clump as suggested by Deshpande et al. (1972) and Rao (1977) the aerial portion can be detopped and placed gently around the basin and only the rhizome portion can be eliminated, so that the labour involved in the roguing operation can be minimised.

Table 3. Role of various forms of vector naturally colonising on diseased clumps in transmission of the disease

Sl. No.	Form of aphid vector tested	No. of test seedlings		Transmission per cent
		Inoculated	Infected	
1.	Nymphs (1-2nd instar)	150	0	0.00
2.	Nymphs (3-4 instar)	146	1	0.68
3.	Apterous adults	150	0	0.00
4.	Alate adults	40	0	0.00
Total		486	1	0.20

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DISCUSSION

Q : What is the effect of shade trees on the spread of Katte disease?

Ans: Studies on this aspect have not been conducted so far.

Q : How does agro-ecological conditions affect the spread of the disease?

Ans: The disease spreads at faster rate under condition of low rainfall, higher temperature and lower altitude. Higher vector population and their migratory activity are noticed under these conditions.

Q : Why is that the capsules are not affected by the Katte disease?

Ans: Katte virus does not affect capsules. The affected capsules act as symptomless carriers of the virus.