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Role of *Stephanitis typicus* Distant in the spread of coconut root (wilt) pathogen

THOMAS JOSEPH[1], P. SHANTA[2] and S. B. LAL[3]

Regional Station, Central Plantation Crops Research Institute, Kayangulam

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ABSTRACT

Banana lace-wing bug (*Stephanitis typicus* Distant) transmitted the pathogen associated with the root (wilt) disease of coconut. Preliminary studies on the vector-pathogen relationship, with cowpea (*Vigna sinensis* (L.) Savi ex Hassk) as an indicator host, revealed that effective transmission was accomplished by groups of 10 bugs. They needed acquisition feeding of 2 hr and transmission feeding of 16 hr. The infectivity was lost after 24 hr. Affected palms in the age group of 25–35 years, which were in the middle stage of disease and had flaccidity alone as the symptom, were the most efficient sources of inoculum. At least 16 per cent of the field population of the bugs actively transmitted the disease.

Shanta and Menon (1960) reported the banana lace-wing bug (*Stephanitis typicus* Distant) as possible vector of the pathogen associated with the root (wilt) disease of coconut (*Cocos nucifera* L.). The disease was transmitted to healthy coconut palms under field conditions and also to a small percentage of coconut seedlings in the insect-proof screen-house by feeding infective adults of the bugs (Nagaraj and Menon, 1956; Shanta *et al.*, 1960, 1964). As successful transmission of the pathogen to cowpea (*Vigna sinensis* (L.) Savi ex Hassk) was regularly obtained, it was used as an indicator host in all routine tests for studying the relationship of the bug with the root (wilt) pathogen and its possible role in the spread of the disease. Results of investigations carried out during 1962–66 are presented in this paper.

MATERIALS AND METHODS

Laboratory-bred adults of *S. typicus* were used. Green leaflets from the wilt-affected palms, whose infectivity was proved by mechanical transmission, formed the source of the pathogen. Infectivity of the bugs was tested on 6-day-old healthy *V. sinensis*. Infective bugs in numbers of 10 or as suited, were caged on the test plants during transmission feeding. The number of cowpea plants developing the typical symptoms was taken as the criterion for successful transmission (Shanta and Menon, 1960). Different periods of feeding mentioned pertain to the actual time the bugs spent on the test materials.

To determine the minimum number required for transmission of the pathogen, infective adults in numbers of 1, 2, 3, 4, 6 and 10 were transferred to test plants. Pathogen-free bugs were allowed to feed on the source for 15 min to 24 hr, to find out the acquisition feeding period. Viruliferous adults in groups of 10 were allowed to feed for 15 to 48 hr for the determination of transmission feeding period. Retentive ability of the infective bugs was also examined. With a lapse on healthy cocohut leaflet for 20, 22 or 24 hr after the acquisition feeding, the bugs were tested for infectivity. The age of diseased palms that is most conducive to the spread of inoculum was determined. Palms in age groups of 3–5, 10–15 and 15–35 yr formed the source material for the tests. Palms in the early, middle and advanced stages of the disease were tested separately to find out which among the

[1]Research Assistant, [2]Virologist, [3]Former Joint Director.

three offered the maximum inoculum. Similarly, the source material having 3 different symptoms, viz. flaccidity alone, necrosis alone and flaccidity+necrosis, were tested to determine the most infective group. Infectivity of the field population of the bugs collected separately from healthy and diseased palms was tested separately as well as after mixing together.

RESULTS AND DISCUSSION

It was found that the minimum number of bugs required for the transmission of disease showed that single insect could accomplish it. Still the efficiency increased with an increase in the number of viruliferous insects, and the maximum infection was obtained with those in the groups of 10 (Table 1).

Table 1. Minimum number of *Stephanitis typicus* required for successful transmission of the pathogen to cowpea

No. of insects used	No. of cowpea		Infection of cowpea (%)
	tested	infected	
1	93	5	5·38
2	138	18	12·46
3	146	26	17·80
4	76	16	21·05
6	60	20	33·33
10	80	44	55·56

Virus-free adults in the groups of 10 did not get the infection when fed on the diseased leaflets for for 105 min. Although successful transmission occurred after a 2-hr acquisition feeding, it was highest after a 6-hr feeding. Transmission decreased afterward. Prolonged feeding beyond this period seemed to decrease the efficiency of transmission (Table 2).

Viruliferous insects failed to transmit the disease during 15-hr feeding. Though feeding for 16 hr seemed to be sufficient for the transmission, that for 18 hr resulted in the highest infectivity (Table 3).

Table 2. Minimum period required for acquisition of the pathogen by *Stephanitis typicus*

Period of acquisition feeding	No. of cowpea		Infection of cowpea (%)
	tested	infected	
15 min	7	0	0
30 min	9	0	0
45 min	6	0	0
60 min	10	0	0
75 min	10	0	0
90 min	15	0	0
105 min	12	0	0
2 hr	18	3	16·67
4 hr	10	2	20·00
6 hr	9	3	33·33
24 hr	10	3	30·00

Table 3. Minimum period of feeding required for successful transmission of the pathogen by *Stephanitis typicus*

Period of transmission feeding (hr)	No. of cowpea		Infection of cowpea (%)
	tested	infected	
15	30	0	0
16	94	14	14·89
18	75	17	22·67
20	71	14	19·86
24	106	20	18·87
48	196	31	15·61

Since the transmission feeding exceeds 1 hr, the pathogen involved may be grouped in with the semi-persistent category of Broadbent (1959).

The pathogen was lost during the lapse feeding. Infectivity was 4 out of 32 plants tested with the insects that had the lapse feeding of 22 hr, but only 1 out of 83 after 24 hr (Table 4).

Table 4. Period of retention of the pathogen by *Stephanitis typicus*

Period of retention (hr)	No. of cowpea tested	No. of cowpea infected	Infection of cowpea (%)
20	90	36	40·00
22	32	4	12·50
24	83	1	1·20

Of the 3 groups of palms tested, those between 15 and 35 years were the best source of infectivity (Table 5).

Based on visual observations of the symptoms, stages of disease were classified as early, middle and advanced. Tests showed that palms in the middle stage of the disease were most efficient source of inoculum, showing the infection of 6 out of 39 plants (Table 6).

Table 5. Infectivity of palms in relation to age

Age of palms (yr)	Condition of palms tested	No. of palms tested	No. of cowpea tested	No. of cowpea infected	Infection of cowpea (%)
3 to 5	Healthy	3	48	0	0
3 to 5	Diseased	4	63	12	19·05
10 to 15	Healthy	3	30	0	0
10 to 15	Diseased	3	46	10	21·74
15 to 35	Healthy	2	30	0	0
15 to 35	Diseased	2	45	25	55·56

Table 6. Infectivity of palms in relation to intensity of disease

Condition of palms tested	No. of palms tested	No. of cowpea tested	No. of cowpea infected	Infection of cowpea (%)
Healthy	5	45	0	0·00
Diseased early	7	78	7	8·97
Diseased middle	4	39	6	15·38
Diseased advanced	4	48	4	8·33

The diseased palms showing only the flaccidity symptom behaved most efficient in the spread of pathogen. Infectivity was 20 among 168 test plants when these were used as the source of inoculum (Table 7). Shanta *et al.* (1964) reported that flaccidity is reproduced in the transmission trials, and Radha and Lal (unpublished data) observed it to be the diagnostic symptom of the disease in the field. The present finding is in conformity with these observations.

At least 16 per cent among the field population of the insects were active transmitters of the disease. Insects collected separately from the healthy and diseased palms, after being mixed together, infected 37 out of 235 plants. Tests using exclusive collections from the healthy and diseased palms also induced infection. Infectivity was 7 in the healthy and 29 in the diseased plants out of 65 plants (Table 8). Although sluggish in nature,

Table 7. Infectivity of palms in relation to symptoms of the disease

Condition of palms tested	No. of palms tested	No. of cowpea tested	No. of cowpea infected	Infection of cowpea (%)
Healthy	4	48	0	0
Diseased with flaccidity and necrosis	6	140	4	2·86
Diseased with flaccidity alone	6	168	20	11·90
Diseased with necrosis alone	7	144	12	8·33

Table 8. Infectivity of *Stephanitis typicus* in relation to the source of collection

Condition of the palm from which collected	No. of palms	No. of cowpea tested	No. of cowpea infected	Infection of cowpea (%)
Healthy	6	65	7	10·77
Diseased	6	65	29	44·69
Healthy and diseased	6+6	235	37	15·74

the few infective bugs collected from the healthy palms might have acquired the pathogen during an earlier feeding on diseased palm. The high degree of transmissibility of bugs collected from the diseased palms point to the efficiency of the vector.

The symptoms produced on cowpea are identical to those obtained by Shanta and Menon (1960) during mechanical transmission, and do not fit in with the characters of toxemic diseases described by Leach (1940) in that the symptoms produced are not reversible and that the degree of symptoms is not proportionate to the length of feeding period and the number of insects.

One limitation of this experiment is that the determination had to be made using an indicator host because of the delay in the expression of symptoms in the original host coconut. The results are hampered because cowpea is not a natural host of the bug. As the bugs are subjected to rather forceful feeding, it is quite possible that they may not initiate feeding until the lapse of a considerable time, resulting in slight variations in the rate of infectivity observed throughout the experiment. But these are unavoidable in the absence of a better indicator host or a quick-responsive original host.

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