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Characterisation of Virus Affecting Weeds II - Leaf Curl Disease

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The weeds *Acanthospermum hispidum* D. C., *Blainvillea rhomboidea* cass. and *Flaveria australasica* HK., harboured the leaf curl disease and the disease was transmitted by the whitefly *Bemisia tabaci* and by graft inoculation. The virus-vector relationship was studied in detail and single insect transmitted the disease successfully. The disease was transmitted to tomato and tobacco. The results indicate that these weeds could serve as the sources of the virus disease in the field.

Several weeds have been reported to harbour viruses causing leaf curl diseases serving as sources of inoculum for the spread of the disease to the cultivars C. Pruthi and Samuel, 1939; Lann, 1940; Nariani and Pathanian, 1953; Pathak and Raychaudhuri, 1967; Mariappan and Narayanasamy, 1972). Tomato crop cultivated around Coimbatore was often affected by a leaf curl disease even when the crop was raised in isolated areas. Hence an attempt was made to identify such of those weeds which might harbour the disease and serve as source of inoculum.

MATERIALS AND METHODS

Weeds showing typical symptoms of leaf curl were collected and established in the glasshouse for detailed study. The transmission tests by sap and graft inoculations and through seed were made following the standard procedures. Four species of aleyrodids *Bemisia tabaci* Genn. from brinjal, *Dialeuropora decempuncta* Q & B from *Polyalthea longifolia* H.R.F. & T, *Trialeurodes ricini* Misra from *Ricinus communis* L. and *T. rara* Sing from *Phyllanthus acidus* Skeels and three species of jassids *Hishimonas phycitis* Dist. from brinjal, *Orosius albicinctus* Dist. from gingelly and *Nephotettix virescens* Dist. from rice bred on their respective host plants were tested for their ability to serve as vectors of this disease. The host range study was made by using the insect vector.

RESULTS AND DISCUSSION

Among the weeds growing around the garden lands, 23 species exhibited symptoms of virus diseases (mosaic, yellow vein mosaic and leaf curl). Out of these, three species of weeds *Acanthospermum hispidum* DC., *Blainvillea rhomboidea* cass., and *Flaveria australasica* HK, exhibited symptoms of leaf curl disease. The disease was not transmissible by sap inoculation but it was transmitted successfully by graft

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inoculation. Among the insects tested, *B. tabaci* alone was able to transmit all the three isolates successfully. The insect acquired the virus successfully from the leaves of the diseased plants but failed to acquire the virus from the petiole or stem. Even a single viruliferous insect was found sufficient to transmit all the three isolates of the leaf curl virus disease successfully. Maximum transmission (79.2 per cent) of the disease from diseased *A. hispidum* was obtained by using 16 - 20 viruliferous insects. Groups of 11 - 15 viruliferous insects were required to obtain maximum transmission of 50 per cent only from the diseased plants of *B. rhomboidea* and *F. australasica* (Table I).

TABLE I. Effect of number of *B. tabaci* on the transmission of leaf curl disease

No. of viruliferous whiteflies per plant	Percentage of transmission of the virus isolate to their natural host plant species		
	A*	B	C
1	8.3	6.7	8.3
2	8.3	8.3	8.3
3-5	33.2	16.6	8.3
6-10	40.0	30.0	24.9
11-15	66.4	50.0	50.0
16-20	79.2	49.8	50.0
21-25	70.0	50.0	50.0

* Leaf curl virus isolates from A. *A. hispidum* B. *B. rhomboidea* C. *F. australasica*

The insect did not require any pre-acquisition starvation for acquiring and transmitting the disease (Table II). But, a six hour fasting prior to acquisition of the virus enhanced the percentage of transmission. One hour acquisition feeding was necessary for the insect to become viruliferous and 3 - 4 hour acquisition feeding increased the percentage of transmission. After 4 hour acquisition feeding, a minimum of 3 hour interval was required by the insect to become viruliferous. One hour inoculation feeding by the viruliferous insect was found necessary for successful transmission and 4 – 6 hour inoculation feeding resulted in high percentage of transmission (Table II).

The adult viruliferous white flies *B. tabaci* were allowed to lay eggs on brinjal seedlings. The newly hatched adults (20 - 25 day old) were released on the test plants and none of them was infected.

The ability of *B. tabaci* to acquire the virus from the extracted sap through para film was tested. The insect was able to feed on the sap kept in a beaker through the parafilm and survived for 72 hours. But they failed to transmit the disease.

Host range: The three virus isolates from *A. hispidum*, *B. rhomboidea* and *F. australasica* were found to have a common host range. (Table III). They infected *Hibiscus rosasinensis*, *Lycopersicon esculentum* and *Nicotiana tabacum* var. White Burley and produced vein thickening and enation symptoms. However the leaf curl symptom was produced on *L. esculentum* and *N. tabacum* only.

Tne transmission properties of the three isolates of leaf curl disease described in this paper were characteristic and similar to the other white fly-

TABLE II. Relationship of leaf curl virus isolates with the vector (*Bemisia tabaci*)

Pre-acquisition starvation Period	Percentage of transmission A*	B	C	Acquisition feeding Period	Percentage of transmission A	B	C	Inoculation feeding Period	Percentage of transmission A	B	C
No starvation	6.66	6.66	6.66	0 control	0	0	0	5 minutes	0	0	0
15 minutes	6.66	6.66	6.66	5 minutes	0	0	0	10 minutes	0	0	0
60 minutes	13.33	13.33	13.33	30 minutes	0	0	0	30 minutes	0	0	0
2 hours	20.00	20.00	20.00	45 minutes	0	0	0	60 minutes	33.33	26.60	26.66
4 hours	60.00	46.66	40.00	60 minutes	6.66	6.66	13.00	2 hours	40.00	26.60	26.66
6 hours	66.66	53.33	46.66	2 hours	20.00	13.33	20.00	3 hours	46.66	33.33	40.00
								4 hours	66.66	46.60	46.66
								6 hours	66.66	53.33	46.66
								8 hours	66.66	53.33	46.66
8 hours	66.66	54.33	46.66	3 hours	53.33	46.66	40.00				
				4 hours	66.66	46.66	46.66	Post acquisition fasting 4 hours			
				6 hours	53.33	46.66	46.66				

* Leaf curl isolates from *A. hispidum* (A), *B. rhomboidea* (B) and *F. anstralasica* (C)

borne viruses which according to Costa (1969), have the following properties in common : (i) white fly borne viruses are not acquired as rapidly as aphid transmitted viruses (ii) the transmission efficiency of the vector increases with longer feeding periods upto several hours on virus sources and (iii) in most cases there is a definite but relatively short incubation period. As there was a demonstrable incubation period in all the three virus isolates they may be considered as circulative types. The whitefly (*B. tabaci*) did not carry the leaf curl virus isolate from *A. hispidum* transovarially. The absence of transovarial transmission of the cotton leaf curl virus by Kirkpatrik (1931) and tomato yellow leaf curl by Cohen and Nitzany (1966) has been demonstrated. This may possibly indicate the absence of virus multiplication in the vector.

Though *B. tabaci* was able to feed through parafilm on the sap expressed from infected plants and remained alive for 72 hours, it failed to transmit the virus possibly because of the virus inactivation in the expressed sap or inability of the vector to acquire the virus from the extracted sap. Such failure of transmission by whitefly fed on plant extracts was reported by Kirkpatrik (1931), Costa and Bennet (1950) and Nene (1972). The whitefly was able to transmit the disease from

TABLE III. *Host range* of leaf curl virus isolates

Source of leaf curl virus isolate	Symptoms produced on						
	Acanthospermum hispidum	*Blainvillea rhomboidea*	*Flaveria australasica*	*Lycopercicon esculentum*	*Hibiucus rosasinensis*	*Nicotiana tabacum*	*Zinnia elegans*
A. hispidum	VT, C, CR, E, RL, LC, CU, MRU	VT, CR, E, RL, LC, MR	VT, RL, LC, CU	VT, CR, E, RL, LC, MR	VT, E	VT, E, CR, RL, LC, D, MR	VT, E, RL, LC, MR
B. rhomboidea	VT, CR, E, RL, LC, MRU	VT, CR, RL, LC, E, D, MR	VT, RL, LC, CU	VT, CR, E, RL, LC, MR	VT, E	VT, E, CR, RL, D, MR	VT, E, RL, LC, MRU
F. australasica	VT, CR, RL, LC, MRU	VT, CR, RL, LC, MRU	VT, RL, D, CU	VT, CR, E, RL, LC, MR	VT, E	VT, E, CR, RL, LC, D, MR	VT, E, RL, LC, MRU

C = Chlorosis
CR = Crinkling
CU = Cupping
D = Distortion
E = Enations
LC = Leaf curl
MR = Rolling of margins of the leaf on either side
MRU = Upward rolling of the leaf margins
RL = Reduction in leaf size
VT = Vein thickening

A. hispidum at a higher rate (79 2 per cent) than from the other two hosts indicating the influence of the host plants on the acquisition of the virus by the vector. The above observation is in agreement with Costa (1969) who has stated that the ability of white flies to acquire the same virus from different host plant seemed to be more at variance than in the cases of other insects.

The three virus isolates had similar host range. Mariappan and Narayanasamy (1972) reported the tomato leaf curl virus infection on *A. hispidum*. The tomato leaf curl virus was reported earlier to have been caused by tobacco leaf curl virus (Nariani, 1968). The above evidences possibly indicate that the three leaf curl virus isolates occurring on the weeds might be strains of tobacco leaf curl virus. The occurrence of tobacco leaf curl virus on *B. rhomboidea* and *F. australasica* is reported for the first time.

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