

Bean Leaf Beetle as a Vector of the Cowpea strain of Southern Bean Mosaic Virus

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Beetles transmit several plant viruses. Dale (1) showed that the leaf beetle *Ceratoma ruficornis* transmitted the Trinidad cowpea mosaic virus for 14 days following an acquisition feeding, and that the percentage of transmission increased with the increased amount of feeding on recipient test plants. Freitag (2) reported that the striped cucumber beetle, *Acalymma trivittata*, retained squash mosaic virus for 17 days following a 6-day acquisition feeding, and the spotted cucumber beetle, *Diabrotica undecimpunctata*, retained virus for 20 days following a 13-day acquisition feeding. Walters (3) showed that the bean leaf beetle, *Ceratoma trifurcata* Forst., transmitted the cowpea strain of southern bean mosaic virus (CP-SBMV) from naturally infected cowpea, and retained the virus for 6 days. We report further studies on the vector relationships of the bean leaf beetle and CP-SBMV.

To determine the length of time bean leaf beetles retained CP-SBMV following varying periods of acquisition feeding, individual beetles were fed on leaf tissue of infected cowpea, *Vigna sinensis* (Torner) Savi 'Blackeye', in a 25- × 150-mm plastic petri dish containing a virus-infected leaf with its petiole in a vial of water. Following the acquisition feeding, beetles were transferred daily to individual test plants. Beetles allowed acquisition feedings of 30 min, and 1, 4, and 24 hr, were test-fed for 10, 10, 14, and 21 days, respectively. Fifteen beetles were used for each test. Table 1 gives the results of these tests. Increased length of acquisition feeding increased retention of the virus. After the 30-min, 1-, 4-, and 24-hr acquisition feedings, virus was retained for periods of 5, 9, 14, and 19 days, respectively. Since transmissions occurred near the end of the test-feeding periods, it is possible that the beetles with 1-, 4-, and 24-hr acquisition feedings still retained virus at the completion of the tests. Efficiency of the beetles to transmit virus decreased with time, with the greatest number of infections occurring in the first 5 to 8 days after the acquisition feeding. The number of transmissions effected by individual beetles varied from 1 to 7. Moreover, transmissions of the virus were irregular, and long periods between infections occurred with those beetles transmitting after the 5th and 6th day.

Dale (1) showed that the percentage of test plants infected with Trinidad cowpea mosaic virus increased as the amount of tissue consumed by the beetle *C. ruficornis* increased. Similar results were obtained with CP-SBMV and the bean leaf beetle. This was assessed

by measuring both the area of tissue eaten during the acquisition feeding and that consumed after confining beetles on the test plants for 24 hr. Beetles were transferred daily following the acquisition feeding, and the test was conducted for 21 days. The amount of acquisition test plant tissue consumed was divided into four groups: 1-50 mm²; 51-100 mm²; 101-150 mm²; and over 150 mm². The results (Table 2) show that, except for beetles that consumed from 1-50 mm² of tissue, there was no increase in percentage transmission as greater amounts of virus-infected tissue were consumed. However, increased amounts of tissue consumed during subsequent test feedings were correlated with increased percentage of virus transmission. It has generally been assumed that when beetles damage test plants excessively, they destroy previously infected tissue, and fewer transmissions may be expected (1). There was no evidence of such an effect in this test.

The effect of feeding beetles on plants resistant to CP-SBMV for various periods of time between the acquisition feeding and the test feeding was determined. Beetles given a 24-hr acquisition feeding on cowpea systemically infected with CP-SBMV, were then transferred to plants of *Phaseolus vulgaris* L. 'Great Northern', which are resistant to the virus. Each day for 9 days, 10 beetles were removed and placed on individual healthy cowpea plants, allowed to feed for 24 hr, and discarded. Transmissions were effected

TABLE 1. Retention of cowpea southern bean mosaic virus by individual bean leaf beetles when given varied acquisition feeding periods and transferred daily to healthy cowpea plants^a

Transfers ^b days	Transmissions after acquisition feeding periods ^c			
	30 min	1 hr	4 hr	24 hr
1	3/10 ^d	5/11	14/15	6/12
2	3/12	3/13	10/15	4/12
3	0/14	1/12	7/15	3/15
4	2/12	3/12	6/14	6/15
5	2/14	2/13	5/13	2/14
6	0/11	0/8	3/12	2/15
7	0/8	0/10	4/11	0/15
8	0/8	0/9	1/10	0/15
9	0/8	1/10	0/9	0/12
10	0/8	0/12	2/12	0/14
11			0/10	4/12
12			0/8	2/14
13			0/9	1/15
14			1/8	4/13
15				4/12
16				4/13
17				0/11
18				2/10
19				1/14
20				0/13
21				0/10

^a Fifteen beetles were used for each acquisition feeding, but all beetles did not feed every day of the test.

^b First transfer to healthy cowpea plant made immediately following acquisition feeding. Subsequent transfers made at 1-day intervals.

^c Beetles given acquisition feedings of 30 min. and 1 hr were test-fed for 10 days, those of 4 hr for 14 days, and those of 24 hr for 21 days.

^d Numerator indicates no. plants infected; denominator, no. plants beetles fed upon.

TABLE 2. Transmission of cowpea southern bean mosaic by bean leaf beetles allowed to consume varying amounts of source plant and test plant tissue

Source plant tissue eaten (mm ²)	Test plant tissue eaten (mm ²)				Transmission %
	1-50	51-100	101-150	>150	
1-50	3/24 ^a	5/32	2/6	0/2	12.5
51-100	0/5	6/28	5/21	1/2	21.4
101-150	1/6	7/25	0/7	1/3	21.9
>150	0/11	3/10	7/26	2/6	22.6
% transmission	8.7	22.1	26.4	30.7	

^a Numerators indicate no. plants infected, and denominator, no. plants beetles fed upon.

only by groups of insects that fed on resistant plants the first 3 days. Since the virus was retained 19 days by the bean leaf beetle following a 24-hr acquisition feeding, it appears that bean plants must contain some substance which inhibits the virus in the beetles when they feed on them for periods greater than 3 days.

These results show that the bean leaf beetle is an efficient vector of CP-SBMV, that considerable variation exists in the ability of individuals to transmit CP-SBMV, that transmission was increased with increased amounts of test plant tissue consumed, and that some

inhibitive substance appears to be present in the virus-resistant plants.

LITERATURE CITED

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