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RESEARCH NOTE

VECTORING POTENTIALS OF THREE APHID SPECIES FOR PAPAYA RINGSPOT VIRUS[1]

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ABSTRACT

Three aphid species, *Hysteroneura setariae* (Thomas), *Lipaphis erysimi* Kaltenbach and *Toxoptera citricidus* (Kirkaldy), were studied for their potentials as vector of papaya ringspot virus (PRSV) under greenhouse conditions.

This study confirmed the vector capabilities of the three species for PRSV. The nymphs of *H. setariae* and *T. citricidus* were more effective vectors than the adults. For *L. erysimi*, the nymphs and adults performed equally. *H. setariae* proved to be the most efficient among the three, with 22% vector efficiency, followed by *T. citricidus* at 19% and *L. erysimi* at 16%. One month old test plants appeared to be best for transmission studies. It was also observed that the combined tı nsmission setting of one minute Acquisition Access Period (AAP), one insect vector per test plant and one minute Inoculation Access Period (IAP), expressed as 1 min AAP – 1 vector – 1 min IAP, was more effective than 24 hrs AAP – 5 vectors – 24 hrs IAP in all the transmission trials.

Key words: *Hysteroneura setariae, Toxoptera citricidus, Lipaphis erysimi,* aphid vectors, papaya virus disease, PRSV

Abbreviations: PRSV-Papaya Ringspot Virus, AAP-Acquisition Access Period, IAP-Inoculation Access Period, PRS – Papaya Ringspot.

Papaya (*Carica papaya* L) is a popular fruit among Filipinos, with domestic consumption taking up more than 92% of production (BAS 2003). The rest of the produce, either fresh or dried, is exported to countries like Japan, Australia, Hongkong, and Germany. The papaya crop is beseiged with a serious problem—the papaya ringspot (PRS) disease, caused by the papaya ringspot virus (PRV). The disease was first observed in Silang, Cavite (Opina, 1986). The disease affects papaya from seedling to maturity (Sumalde, et al., 1995) The Papaya ringspot virus is naturally spread by aphid vectors, and the identification of major vector species is imperative in devising a strategy for vector management. In turn, this will contribute to effective management of the disease. Its symptoms can be observed on the foliage, petiole, fruit and stem of the plant. The symptoms appear from 9 to 39 days after inoculation (Jensen, 1949).

Solo papaya, a variety susceptible to PRSV, was used in this experiment. Seeds were sown in plastic bags, watered regularly and allowed to germinate under partial sunlight in the greenhouse of the former Department of Entomology, now the Crop Protection Cluster, U.P. Los Baños. The ages of the papaya plants used in the transmission experiments were 2 weeks, 1 month and 2 months after germination. The species of aphids tested as vectors were *Hysteroneura setariae* (Thomas), *Lipaphis erysimi* Kaltenbach, and *Toxoptera citricidus* (Kirkaldy).

Adults of the three aphid species mentioned were collected from the field, then transferred to their respective hosts, *Eleusine indica* (goosegrass), *Brassica chinensis* (pechay) and *Citrus madurensis* (calamansi), respectively (Figure 1). They were allowed to reproduce on their respective host plants, then the resulting nymphs of each species were reared separately in cages in the greenhouse.

To test the vector potentials of the three aphids, aviruliferous nymphs and adults of each species were first starved for 15 minutes prior to acquisition access period (AAP) by placing them in separate petri dishes free of food plants. The starved aphids were given access to the inoculum sources (young leaves of PRS-diseased papaya plants) for predetermined periods of 1 min, 5 min, 30 min, 1 hr and 24 hrs (Figure 2). After presumably feeding on the infected leaves, the aphids were then considered viruliferous and ready for the transmission studies. Predetermined numbers of viruliferous aphids, segregated into adults and nymphs, were transferred to healthy test papaya seedlings, and allowed inoculation access periods (IAP) similar to AAPs (Figure 3).

A B C

Figure. 1. Host plants of aphid species used as vectors, A, goosegrass for *H. setariae*. B, pechay for *L. erysimi*. C, calamansi for *T. citricidus*

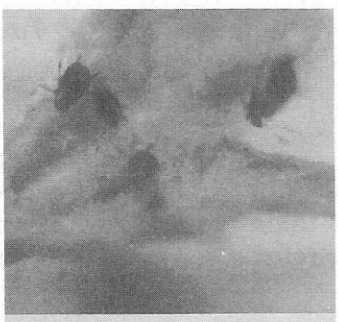

Figure. 2. Previously starved aphids, feeding on inoculum source

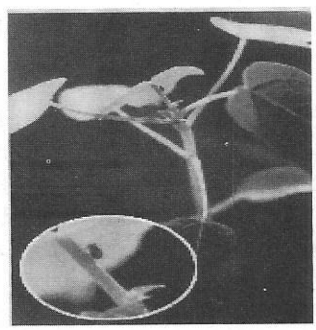

Figure. 3. Viruliferous aphid feeding on papaya test plant

The different combinations of AAP - number of test vectors – IAP (referred to as Transmission Settings used) were 1 min-1 aphid-1 min, 0-1-1, 0-5-5, 5-5-5, 0-10-10, 10-10-10, 0-5-30, 30-5-30, 0-5-60, 60-5-60, 0-5-24hrs and 24-5-24. Transmission settings with 0-AAP served as experimental controls (0-5-5, 0-10-10, 0-5-30, 0-5-60 and 0-5-24 hrs). Two-week old, 1-month-old and 2-month-old healthy papaya seedlings were used as test plants. The inoculated plants were placed in cages and observed daily for disease symptom development. Plants exhibiting the symptoms of PRS disease prior to the 41st day from inoculation were considered infected, thus, indicating that the aphid used was capable of vectoring PRSV.

Results showed that the nymphs and adults of the three aphid species were able to transmit PRSV at various transmission settings (Tables 1-3). The nymphs of the three aphid species were all effective in transmitting PRSV to papaya test plants of different ages in the transmission setting of 1-1-1. Some variations were observed in the other settings. The use of nymphs of *T. citricidus* resulted in the highest number of infected test plants (25) followed by *H. setariae* (23) and *L. erysimi* (15). In the case of adult aphids, although *H. setariae* infected the highest number of test plants (18), none got infected among the 2-week old papaya test plants (only older plants) in all the transmission settings. (Table 2)

Table 1. Vectoring capability of *Toxoptera citricidus* at different transmission settings and ages of papaya seedlings.

Transmission setting[1]	No. of infected plants[2]											
	Adult						Nymphs					
	2 wks[3]	%	1 mo.	%	2 mos.	%	2 wks	%	1 mo.	%	2 mos.	%
0-1-1												
1-1-1	3	60					3	60	4	80	1	20
0-5-5												
5-5-5	3	60			1	20	2	40			5	100
0-10-10												
10-10-10			3	60			5	100				
0-5-30												
30-5-30							3	60	5	100		
0-5-60												
60-5-60												
0-5-24												
24-5-24												
Total	60/30	20	3/30	10	1/30	3.33	13/30	43.33	9/30	30	3/30	20

[1] Combination of Acquisition Access Period (AAP), No. of aphid per test plant and Inoculation Access Period (IAP). AAP and IAP of 1-60 are in minutes, those with 24 are in hours. All transmission settings with 0 AAP are experimental controls, that is, the aphids were not allowed access to PRSV.

[2] Empty cells in the table means no infection; total number of test plants per transmission setting = 5.

[3] Age of papaya test plant.

Table 2. Vectoring capability of *Hysteroneura* setariae at different transmission settings and ages of papaya seedlings.

Transmission setting [1]	No. of infected plants [2]											
	Adult						Nymphs					
	2 wks [3]	%	1 mo.	%	2 mos.	%	2 wks	%	1 mo.	%	2 mos.	%
0-1-1												
1-1-1			2	40	2	40	5	100	2	40	3	60
0-5-5												
5-5-5			3	60	2	40					3	60
0-10-10												
10-10-10					3	60			4	80		
0-5-30												
30-5-30			4	80					4	80		
0-5-60												
60-5-60			2	40							2	40
0-5-24												
24-5-24												
Total	0		11/30	36.66	7/30	23.33	5/30	16.7	10/30	33	8/30	26.7

1 Combination of Acquisition Access Period (AAP), No. of aphid per test plant and Inoculation Access Period (IAP). AAP and IAP of 1-60 are in minutes, those with 24 are in hours. All transmission settings with 0 AAP are experimental controls, that is, the aphids were not allowed access to PRSV.
2 Empty cells in the table means no infection; total number of test plants per transmission setting = 5.
3 Age of papaya test plant.

Table 3. Vectoring capability of *Lypaphis erysimi* at different transmission settings and ages of papaya seedlings.

Transmission setting [1]	No. of infected plants [2]											
	Adult						Nymphs					
	2 wks [3]	%	1 mo.	%	2 mos.	%	2 wks	%	1 mo.	%	2 mos.	%
0-1-1												
1-1-1	1	20	2	40			3	60	3	60	1	20
0-5-5												
5-5-5			4	80					3	60	2	40
0-10-10												
10-10-10	1	20	3	60								
0-5-30												
30-5-30	3	60										
0-5-60												
60-5-60					1	20			2	40	1	20
0-5-24												
24-5-24												
Total	5/30	16.66	9/30	30	1/30	3.33	3/30	10	8/30	26.7	4/30	13.33

1 Combination of Acquisition Access Period (AAP), No. of aphid per test plant and Inoculation Access Period (IAP). AAP and IAP of 1-60 are in minutes, those with 24 are in hours. All transmission settings with 0 AAP are experimental controls, that is, the aphids were not allowed access to PRSV.
2 Empty cells in the table means no infection; total number of test plants per transmission setting = 5.
3 Age of papaya test plant.

The susceptible stage of papaya seedlings varied with vector species. With *T. citricidus,* it was 2 weeks while with *H. setariae* and *L.erysimi,* it was one month. The most susceptible age of papaya test plants to PRSV was one (1) month, wherein 50% of the test plants got infected, followed by two weeks (32%), then 2 months (24%). At adult stage, *H. setariae* was the most effective in transmitting PRSV (18%), followed by *L.erysimi* (15%), and the least was *T. citricidus* (10%). At nymphal stage, the most effective was *T. citricidus.* Regardless of stage, the best vector was *H. setariae.*

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