Transmission of Peanut Mottle and Peanut Stripe Viruses by *Aphis craccivora* and *Myzus persicae*

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ABSTRACT

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From singly infected peanut plants, *Myzus persicae* was more efficient in transmitting peanut stripe virus (PStV) (29%) and peanut mottle virus (PMV) (14%) than *Aphis craccivora* (17 and 4%, respectively). Peanut stripe virus was transmitted more efficiently (16%) than PMV (9%) by *M. persicae* from PStV/PMV doubly infected plants. *Aphis craccivora* also tramsmitted PStV more efficiently (7%) than PMV (3%) from doubly infected plants. In sequential feeding trials (aphid fed first on a PMV-infected leaf and then on a PStV-infected leaf, and vice versa), PStV was transmitted to healthy peanut plants at a higher percentage than PMV, regardless of the sequence of feeding. Peanut stripe virus transmission was enhanced to 35% with *A. craccivora* and 45% with *M. persicae* when the aphid vectors fed on PMV-infected plants before feeding on PStV source plants. Simultaneous transmission of both viruses by a single aphid from doubly infected plants or sequential feeding trials did not occur with *A. craccivora* and at 3% or less for *M. persicae*.

Peanut mottle virus (PMV) was first reported naturally infecting peanut (*Arachis hypogaea* L.) in the United States in 1965 (10). Subsequent reports confirmed that PMV infects peanuts in all the peanut-producing areas of the United States, and a 20% disease incidence may be normal (6). Peanut mottle virus is a seed-transmitted potyvirus that is aphid-transmitted in a nonpersistent manner (3). Additionally, PMV has been reported to infect peanut naturally in Africa, Asia, Australia, and South America (1,2,8,14). Worldwide distribution of PMV is probably due to its seed-transmitted nature and the occurrence of vector aphids wherever peanuts are grown.

Peanut stripe virus (PStV) was first observed naturally infecting peanut in the United States in 1982 (5). Currently, PStV is restricted to institutional and breeders' seed/plants in the United States (4). Peanut stripe virus also is a potyvirus and is seed-transmitted in peanut (7). It has been identified in peanut in Thailand, China, the Philippines, Malaysia, and Indonesia (15,18,19; J. W. Demski, *unpublished*) and is considered the most prevalent virus disease of peanut in Southeast Asia. Although PStV and PMV are both potyviruses, they are serologically distinct (5).

As seed of peanut are commonly exchanged, the distribution of PStV throughout the United States and other areas of the world is expected. Samples of peanut leaf tissue sent to the Georgia Agricultural Experiment Station for virus identification have often exceeded 30% double infection with PMV and PStV (J. W. Demski, *unpublished*). Peanut mottle virus and PStV are vectored by common aphids, two of which are *Aphis craccivora* Koch and *Myzus persicae* Sulzer.

The purposes of this work were to determine the efficiency of transmission for PMV and PStV by *A. craccivora* and *M. persicae*, if a preference for transmission occurs from doubly infected plants, if sequential aphid feeding affects transmission efficiency, and if one virus interferes with the transmission of the other.

MATERIALS AND METHODS

Virus cultures. The PMV isolate was the mild strain (PMV-M) and was obtained from C. W. Kuhn (10). The isolate was maintained by biweekly mechanical transfer in peanut cv. Florunner and *Pisum sativum* L. 'Little Marvel'.

The PStV isolate was obtained from a naturally infected peanut in Georgia and its identity was documented in 1984 (5). The isolate was maintained by biweekly mechanical transfer in peanut and *Lupinus albus* L. Both the PMV and PStV isolates were occasionally (every 4 mo) transferred with aphids.

Aphid cultures. The *M. persicae* culture was obtained from a naturally colonized *Capsicum annuum* L. (pepper) plant growing in Georgia. Progeny from the original culture were identified by C. Smith (North Carolina State University, retired). *Myzus persicae* were maintained on pepper in a growth chamber.

The culture of *A. craccivora* was obtained from L. R. Nault (Ohio State University at Wooster) and was maintained in a growth chamber on *Vigna unguiculata* (L.) Walp. subsp. *unguiculata* (cowpea).

Aphid transmission. Source plants for aphid transmission were aphid-inoculated peanuts (cv. Florunner) that were maintained in a greenhouse. One leaflet of the first fully opened terminal leaf showing typical virus symptoms was removed from a source plant and either floated on water in a petri dish or taped to a rubber stopper.

Aphids (adult apterae) were removed from the culture plants with a camel's-hair brush and placed overnight in a glass vial for an approximate 15-hr starvation period. The aphids were then placed on a source leaflet and observed under a dissecting microscope. When an aphid began to feed (no body movement, labium pressed to the leaf, and antennae laid back over its body), it was given a 1-min acquisition access period. The aphid was then transferred with a camel's-hair brush to a healthy peanut plant and given a 1- to 2-hr inoculation access period. Test plants were then sprayed with malathion insecticide to kill the aphids before the plants were returned to the greenhouse. Single aphids were used for all transmission trials. For sequential aphid-feeding trials, the aphids were given a 1-min acquisition access on the first virus source and then immediately given a 1-min acquisition access on the second virus source before being placed on a healthy plant.

Virus identification. Both source and test plants were individually tested 3 wk after inoculation by the enzyme-linked immunosorbent assay (ELISA), as previously reported for PMV and PStV (5). Visual observations of the inoculated plants were also recorded. Further, the doubly infected plants were confirmed by sap inoculation on *Phaseolus vulgaris* L. 'Topcrop' for PMV and on *Chenopodium amaranticolor* Coste & Reyn. for PStV.

RESULTS

Both *A. craccivora* and *M. persicae* transmitted PMV and PStV from peanut to peanut. Both aphids transmitted PStV more efficiently than PMV, and *M. persicae* was a more efficient vector than

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A. craccivora for both viruses (Table 1). From singly infected plants, *M. persicae* and *A. craccivora* transmitted PMV at 14 and 4% and PStV at 29 and 17%, respectively.

Each aphid species transmitted each virus at lower percentages from doubly infected plants than from singly infected plants (Table 1). The percentage transmission of PMV by *A. craccivora* was 3 vs. 4%, and for *M. persicae* was 9 vs. 14%, respectively, from doubly vs. singly infected source plants. Peanut stripe virus transmission percentages from doubly vs. singly infected plants were 7 vs. 17% and 16 vs. 29% for *A. craccivora* and *M. persicae*, respectively.

Peanut mottle virus was transmitted similarly when the two aphid species fed on PMV-infected leaflets only (Table 1) or when they first fed on PStV-infected leaflets and then on PMV-infected ones (Table 2). However, when the aphids first fed on a PMV-infected leaflet and then on a PStV-infected leaflet, the percentage transmission of PStV was significantly greater (35 and 45% for *A. craccivora* and *M. persicae*, respectively) (Table 2) than when these two species of aphids fed on a PStV-infected leaflet alone (17 and 29%, respectively) (Table 1).

After feeding on doubly infected plants, simultaneous transmission of both PMV and PStV did not occur with *A. craccivora*, but one of 138 *M. persicae* did transmit both viruses to one plant. In sequential feeding studies, simultaneous transmission of both viruses did not occur with *A. craccivora*, but did occur at a low efficiency (1–3%) with *M. persicae* (Table 2).

Table 1. Transmission of peanut mottle (PMV) and peanut stripe (PStV) viruses by single aphids of *Aphis craccivora* and *Myzus persicae* from singly and doubly infected peanut plants (cv. Florunner) to healthy peanuts

Virus source	Aphid	Number infected/number inoculated		
		PMV	PStV	PMV & PStV
PMV	*A. craccivora*	5/133 a[z]	···	···
	M. persicae	20/148 b	···	···
PStV	*A. craccivora*	···	24/139 a	···
	M. persicae	···	41/141 b	···
PMV & PStV	*A. craccivora*	4/133 a	9/133 a	0/133 a
	M. persicae	12/130 b	21/130 b	1/130 a

[z] Numbers followed by the same letter within each virus source are not significantly different at $P = 0.05$, according to the proportional t test.

Table 2. Transmission of peanut mottle (PMV) and peanut stripe (PStV) viruses by single aphids of *Aphis craccivora* and *Myzus persicae* with sequential feeding on infected peanut plants (cv. Florunner) to healthy peanuts

First virus source	Second virus source	Aphid	Number infected/number inoculated		
			PMV	PStV	PMV & PStV
PMV	PStV	*A. craccivora*	2/138 a[z]	48/138 a	0/138 a
		M. persicae	4/138 a	62/138 a	1/138 a
PStV	PMV	*M. craccivora*	5/140 a	12/140 a	0/140 a
		M. persicae	19/142 b	33/142 b	4/142 a

[z] Numbers followed by the same letter within virus sources are not significantly different at $P = 0.05$, according to the proportional t test.

DISCUSSION

A total of 1,382 individual aphid transfers from infected to healthy peanut plants was made with either *A. craccivora* or *M. persicae*. Average transmission, regardless of the source (from singly or doubly infected plants or by sequential feedings on singly infected plants), was 3 and 9% for PMV and 17 and 29% for PStV when *A. craccivora* and *M. persicae* were tested, respectively. Thus, *M. persicae* is the more efficient vector for both PMV and PStV, and both vectors transmit PStV more efficiently than PMV.

Peanut mottle virus and PStV are serologically unrelated potyviruses (5), and cross protection between the two viruses has not been reported. A nucleic acid hybridization study has shown some chemical relationship between PMV and PStV (16). Potyviruses require a viral-induced helper component to be aphid-transmissible, and this component may help the virus to bind to receptor sites of the aphid (9). Lecoq and Pitrat (11) reported that different viruses may have specific helper components. Therefore, the availability of specific helper components could increase or decrease the rate of transmission of different viruses by different vectors.

Numerous factors influence the rate of virus spread and subsequent disease incidence (17). Peanut mottle virus is the most prevalent virus infecting peanut in Georgia, infecting about 20% of the plants yearly (12). The percentage of seed transmission of PMV in commercial peanut seed is less than 1% (13). Peanut stripe virus has a higher percentage of seed transmission (5), and this study shows that two vectors can transmit PStV more efficiently than PMV. If PStV becomes established in commercial peanuts in the United States, we believe that the combination of high seed transmission and vector efficiency provides the potential for PStV to become the most prevalent virus infecting peanut in the United States.

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