Relative Transmissibility of Two Strains of Tobacco Etch Virus by *Myzus nicotianae* Blackman (Homoptera: Aphididae)

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**ABSTRACT** The relative transmissibility of two strains of tobacco etch virus (TEV) to two varieties of flue-cured tobacco, *Nicotiana tabacum* L., by apterous tobacco aphids, *Myzus nicotianae* Blackman, was examined. *M. nicotianae* proved to be an efficient vector of both TEV-OX (Oxnard strain) and TEV-W (a North Carolina isolate) for both the tobacco varieties, 'NC 2326' and 'Coker 176.' TEV-OX, however, was statistically less transmissible than TEV-W to 'Coker 176.'

**KEY WORDS** Tobacco aphid, *Myzus nicotianae* Blackman, Homoptera, Aphididae, tobacco etch virus, TEV, Oxnard, vector, transmissibility.

Tobacco etch virus (TEV) was first described from tobacco, *Nicotiana tabacum* L., in Kentucky (Valleau and Johnson 1928). It is common in North and South America, and has also been reported from several other parts of the world, including Germany, India, Russia, and Taiwan (Lucas 1975, Purcifull and Hiebert 1982). TEV causes disease in tobacco, pepper, and tomato. In 1986, the North Carolina tobacco crop suffered a loss of approximately $285,000 from TEV (Main and Byrne 1987). TEV can also cause significant losses in tomato and pepper (Zitter 1972, Debrot 1976). Several strains of TEV have been described which differ in virulence in various hosts, aphid transmissibility, and nuclear inclusion morphology (Smith 1970, Zitter 1972, Christie et al. 1974, Christie and Edmundson 1977).

TEV is non-persistently transmitted by at least twelve species of aphids (Eckel 1990). The green peach aphid, *Myzus persicae* (Sulzer), is an important vector of many viruses, including TEV and other viruses in the potyvirus group (Kennedy et al. 1962, Laird and Dickson 1963, Gray 1984). Recently, Blackman (1987) described an anholocyclic tobacco-feeding form of this aphid which can be distinguished morphologically. He has named this aphid *Myzus nicotianae* Blackman (the tobacco aphid). Little is known about the role of this aphid as a vector, though it has been demonstrated to transmit TEV to tobacco and sicklepod, *Cassia obtusifolia* L. (Lampert et al. 1988) and potato virus Y (PVY) to tobacco (Lampert et al. 1990). Though *M. nicotianae* is the only aphid which commonly colonizes tobacco (Blackman 1987), most vector studies in tobacco have been conducted using *M. persicae* prior to *M. nicotianae* being recognized as a distinct species.

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1 The use of trade names in this publication does not imply endorsement by the North Carolina Agricultural Research Service of the products named, or criticism of similar ones not mentioned.

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The role of this newly designated aphid species as a virus vector needs further documentation. Aphid transmissibility is known to differ between virus strains in TEV as well as many other viruses (Hollings 1955, Badami 1958, Swenson et al. 1964). These differences can aid in elucidating the epidemiology of viruses and the importance of different aphid vector species. The objective of this test was to compare the relative transmissibility of two strains of TEV to two varieties of flue-cured tobacco by *M. nicotianae*.

**Materials and Methods**

*M. nicotianae* used in these tests were all topotypes (from the same laboratory colony as the holotype) (Blackman 1987, Lampert et al. 1988). Previous to Blackman’s description of *M. nicotianae*, this colony was reported as *M. persicae* (Throne and Lampert 1985, 1986, Lampert and Dennis 1987). Aphids were reared on ‘McNair 944’ flue-cured tobacco in Lumite (20.5 strands per cm, Chicopee Manufacturing, Gainesville, Georgia) cages (1.8 by 1.0 by 1.2 m) in a greenhouse at ca. 30°C with a 16:8 L:D photoperiod, maintained through the use of artificial lights (500 watt, Norelco quartz floodlight, Hightstown, New Jersey). The colony was started 23 August 1983 with aphids collected from ‘McNair 944’ flue-cured tobacco growing at the Central Crops Research Station, Clayton, Johnson County, North Carolina. Voucher specimens are deposited in the North Carolina State University Insect Museum Collection.

The North Carolina isolate of TEV used for this test (TEV-W) was collected from a naturally infected ‘Speight G-28’ flue-cured tobacco plant in Duplin County, NC, on 16 August 1985 (Lampert et al. 1988). The isolate was serologically verified as TEV (Gooding 1975, Lampert et al. 1988). Examination of nuclear inclusion bodies showed square inclusions characteristic of the common strains of TEV (Christie and Edwardson 1977).

The Oxnard strain of TEV used for this test (TEV-OX) was provided by W. G. Doughtery (originally acquired from D. E. Purcifull, University of Florida, Gainesville, Florida). This strain was also serologically verified as TEV. TEV-OX produced bi-pyramidal nuclear inclusion bodies similar to those produced by the TEV-5 strain in ‘V20’ tobacco (Christie and Edwardson 1977).

TEV-W and TEV-OX were maintained in burley tobacco (‘B-21’) by periodic aphid transfer (using *M. nicotianae*). Infected plants were grown in Lumite cages (46.5 by 60.5 by 60.0 cm) in a greenhouse under natural light conditions at ca. 25°C. Virus source plants for these tests (‘B-21’ tobacco) were aphid inoculated 15 September 1987. After these plants began to show symptoms, the virus strain was verified via nuclear inclusion body observation.

Two varieties of flue-cured tobacco, ‘NC 2326’ and ‘Coker 176’, were used in these experiments. ‘Coker 176’, a tobacco mosaic virus (TMV)-resistant variety, was chosen because it is often used when investigating aphid-borne viruses in the field. It is also frequently grown commercially in North Carolina where TMV is a problem. ‘NC 2326’ is a commonly planted flue-cured tobacco variety. Certified tobacco seed of both varieties were sown in trays filled with sterilized loam soil and covered lightly with vermiculite. Plants were grown in a greenhouse as described above. Seedlings were transplanted into clay pots (10.5 by 10.3 cm) containing Metro Mix 220 (Grace Horticultural Products, Cambridge, Massachusetts) 1 wk prior to the test date.
Separate tests were conducted to determine the transmission efficiency of *M. nicotianae* to each of two tobacco varieties. Test 1 evaluated the transmissibility of TEV-W and TEV-OX to ‘NC 2326’ tobacco. Test 2 similarly evaluated transmission efficiency to ‘Coker 176’ tobacco. In both tests, a randomized complete-block design with six replications was used. Test 1 was conducted on 11 November (reps. A, B, and C) and 12 November (reps. D, E, and F) 1987. Test 2 was conducted similarly on 20-21 November 1987.

Apterous adult aphids were starved in Petri dishes (5 cm) at room temperature (ca. 25°C) for 5.0 to 5.5 h prior to being given a 30 s acquisition access period on virus-infected ‘B21’ leaf tissue. Leaves used as virus sources in these tests were the second or third fully expanded, symptomatic leaves from the top of a source plant inoculated at the 5-6 leaf stage. Single aphids were transferred to 10 plants of each variety per test and given an overnight inoculation access period (at ca. 25°C). Afterwards, plants were treated with acephate (Orthene TIS®, 75%SP, Valent USA Corp., Carmel, California) and moved to the greenhouse (30°C) where each was treated with 0.1 g aldicarb (Temik®, 15G, Rhone-Poulenc, Research Triangle Park, North Carolina) and spaced far apart on the bench so as to preclude any possibility of mechanical transmission. After 17 d, the number of symptomatic plants was determined by visual inspection. The presence of TEV was verified serologically (Gooding 1975) and via nuclear inclusion body inspection (Christie and Edwardson 1977).

The probability of virus transmission by a single aphid (pt) was calculated as the number of infected plants divided by the number of test plants. Analysis of variance (PROC ANOVA, SAS Institute 1985, 113-137) was used to analyze pt for both tests. Tests 1 and 2 were conducted separately and no attempt was made to compare the two tobacco varieties as recipients of TEV strains.

**Results and Discussion**

In test 1, using ‘NC 2326’ there was not a significant difference (*P* > 0.05) in the mean probability of virus transfer (*F* = 4.93; df = 1, 5; *P* = 0.08). Pt was 0.58 (SEM = 0.070, n = 6) for TEV-W and 0.30 (SEM = 0.073, n = 6) for TEV-OX. In test 2, using ‘Coker 176,’ the mean pt was 0.67 (SEM = 0.080, n = 6) for TEV-W and 0.33 (SEM = 0.067, n = 6) for TEV-OX. This difference was significant (*F* = 8.47; df = 1, 5; *P* = 0.03).

Transmission differences have been found in comparing strains of a related virus, potato virus Y (PVY) (Simons and Eastop 1970). Harrington et al. (1986) found differences in transmissibility of different strains of PVY under field conditions. When Lampert et al. (1988) established *M. nicotianae* as a vector of TEV, no differences in transmissibility to three varieties of flue-cured tobacco, including ‘NC 2326’ and ‘Coker 176’ were found.

These results indicate that *M. nicotianae* is an efficient vector of TEV. Efficiency differs, however, between the two virus strains tested with TEV-W being approximately twice as transmissible as TEV-OX under laboratory conditions. This sort of difference underscores the importance of specific, accurate virus identification in field and laboratory studies. The importance of *M. nicotianae* as a field vector of TEV requires further investigation.
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References Cited


