Evaluation of Potato Leafhopper Injury Among *Acer rubrum* Progenies[1]

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Abstract

Significant variation in injury from potato leafhopper (*Empoasca fabae* (Harris)) was found among red maple (*Acer rubrum* L.) progenies grown from seed collected in 48 stands scattered throughout the species range. Both the stand of origin and one-parent families within stands were highly significant sources of variation in degree of injury. Seedlings from far northern areas generally sustained less injury than did seedlings from more southerly sources. The broad geographic pattern of injury paralleled that found in growth initiation in previous studies, and suggests that resistance to potato leafhopper injury is at least partially phenological in nature—with those trees initiating growth earliest in the spring sustaining the least injury.

Index words: insect resistance, *Empoasca fabae*, flushing, geographic variation, red maple

Introduction

Potato leafhopper (*Empoasca fabae* (Harris)) causes injury to a wide array of plants (3), including maples and other tree and shrub species growing in large production nurseries (5). This small insect overwinters along the Gulf of Mexico and migrates northward in the spring. Eggs are laid in young maple leaves. Both the wingless nymphs and adults have piercing-sucking mouthparts and feed on the new shoot and leaf growth, often resulting in death of apical tissue, multiple tops, stunting of shoots, and dwarfing of leaves. Damage caused by potato leafhopper feeding prolongs the time maple seedlings must be kept in nursery beds, requires extra pruning, and results in poor aesthetic appearance.

Varying levels of potato leafhopper resistance have been found and exploited (through breeding) in such crops as alfalfa (1, 8), soybeans (2), potatoes (10), peanuts (9), and beans (4). Conjecture exists as to what degree the resistance in these crops is physical (2, 6, 7) or chemical (4, 10), but genetic control appears to be strong and adequate to carry out successful breeding programs.

Although pesticides can be used to control the potato leafhopper on maples, the identification and utilization of genetic resistance would be less expensive and less threatening to the environment. Variability among red maple (*Acer rubrum* L.) progenies from seed sources throughout the species' range has been found for many traits in previous studies of stock in Ohio nursery beds (11) and in field plantings in Ohio, Michigan, Indiana, Wisconsin, and Minnesota (12, 13). The objective of this study was to assess whether red maple has identifiable sources of genetic variation in the degree of injury sustained by potato leafhopper feeding.

Materials and Methods

Seed was collected in 1971 from one to five individual parent trees in each of 48 stands (seed sources) throughout the natural range of red maple. The locations of origin of the seedlots are listed in Table 1. Seedlings were established in replicated nursery beds in 1972 at Delaware, Ohio (latitude 40°21′; longitude 83°04′; elevation 271 m). Nursery grown seedlings were used in 1974 to establish a progeny test at the Delaware, Ohio location. Seedling identity in this test was maintained not only by stand of origin but also by parent tree within stands, the latter representing open-pollinated "families" within stands. The plantation followed a randomized block design with 6 blocks; and open-pollinated families served as the experimental unit randomized in each block. With few exceptions, the number of seedlings per family in each block was five. Spacing between trees was 3 m (10 ft).

Weed control after planting was accomplished by cultivation in two directions. Neither insecticides nor fungicides were used to maintain the trees. Pruning of trees to a height of 1.5 m (5 ft) commenced in 1979, and continued yearly thereafter.

In June 1985, 11 years after final plantation establishment, individual trees were assessed for percentage of potato leafhopper injury on new leaves. The leaf injury assessment reflected the degree to which new leaves were curled, deformed, dwarfed, chlorotic or necrotic as an average for each tree. Over 3,000 trees from 48 stands and 110 open-pollinated families within stands throughout the eastern U.S. and Canada were included in the assessment. Analysis of variance was carried out with the "least squares" programs used in a previous study (13).

Results and Discussion

Analysis of variance of data showed highly significant (0.01 level) variation in potato leafhopper injury both among stands and among families within stands. Variation showed a broad geographic pattern; seedlings from far northern (e.g., 155 WI, 161 VT, 159 MN, 145 WI, 165 NF, 162 MI) or high elevation (e.g. 140 WV, 116 NC) areas generally sustained less injury than did seedlings from central and southern sources (Table 1). The 21 most susceptible accessions were south of 44° North Latitude. Exceptions occurred, but this pattern of injury paralleled the sequence of growth initiation, or flushing, found earlier (12); with time of budbreak generally occurring first in northernmost or high-elevation

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Table 1. **Evaluation of Potato Leafhopper Injury on Red Maple from 48 Stands.**

Stand No. and State or Province	°Latitude	°Longitude	Elevation (m)	Average Injury[z]
				(%)
140 WV	38.2	80.4	1067	36
155 WI	45.6	89.8	488	37
116 NC	35.7	82.8	549	38
161 VT	44.5	72.4	518	39
159 MN	47.4	94.2	396	39
145 WI	45.6	89.8	488	40
139 MN	44.9	93.6	290	42
165 NF	48.3	54.2	46	43
162 MI	46.7	89.8	225	43
117 KY	37.6	84.9	274	44
160 NY	42.7	76.0	558	45
166 QU	46.6	71.4	91	45
156 ON	47.3	79.8	274	45
167 NB	46.0	66.4	61	45
157 MN	48.0	91.6	397	46
110 AL	32.7	85.5	15	46
112 AR	35.7	93.2	427	46
146 CT	41.7	72.3	244	47
149 PA	41.9	78.8	658	47
138 NJ	40.5	74.5	290	47
136 TN	36.0	85.0	559	48
152 ME	43.4	70.7	79	49
164 ON	44.2	80.0	219	49
120 MO	37.3	91.0	366	49
153 ON	46.0	77.4	152	49
115 AR	34.3	93.6	168	49
163 ME	44.4	70.8	225	49
119 VA	38.0	78.5	154	50
118 TN	35.3	84.5	337	51
127 DE	39.7	78.5	213	51
135 WV	39.1	79.7	671	51
123 TN	36.1	82.7	610	52
122 VA	37.9	76.8	6	52
151 NH	43.1	71.1	76	53
141 MI	42.4	85.3	274	53
106 MS	33.3	88.8	82	53
143 PA	40.7	77.9	305	53
158 VA	36.9	82.5	853	54
154 PA	40.0	77.5	427	54
133 IN	39.0	86.3	229	54
113 NC	35.7	78.5	132	54
121 NC	35.0	84.0	1067	55
142 PA	40.7	77.9	518	55
128 OH	39.4	82.5	274	56
124 NC	35.1	84.1	507	58
144 RI	41.7	71.7	61	58
137 MI	42.7	84.5	265	59
134 OH	40.6	82.2	305	62
			x =	49
			LSD[y] =	11

[z]Average percent injury was assessed on individual trees and reflected the average injury on new leaves throughout the tree.

[y]LSD is based on an average of 63 individual trees per stand. Actual number per stand ranged from 14 to 116.

progenies. Leafhopper injury data in the present study was negatively correlated ($r = -0.46$) (significant at 0.01 level) with flushing data from the previous study. It appears, therefore, that earlier flushers generally sustained less injury than did those seedlings which initiated growth last.

It is well known that the potato leafhopper prefers newly initiated, young, succulent leaf and stem tissue for feeding. Red maple progenies that begin growth earliest would have less succulent, more woody stem tissue and more fully developed, leathery, leaves by the time of potato leafhopper migration and subsequent egg-laying and feeding. Resistance to potato leafhopper feeding appears, therefore, to be at least partly phenological in nature, with those trees initiating growth the earliest having a decided advantage. The presence of succulent tissue in the late-flushing progenies apparently coincides with the time of maximum leafhopper reproduction and subsequent stages of nymphal development; their tissue is preferred to the less succulent tissue of earlier flushers.

Average leafhopper injury for families within stands showed an even wider variation than that among stands (Table 2). A pattern similar to stand variation was repeated, with families from far northerly (Wisconsin, Minnesota, Maine, Ontario, Northern New York) or high elevation (West Virginia) parents sustaining less injury than the late flushing, mid-latitude (i.e. Ohio, Pennsylvania, southern Michigan, southern New Hampshire) or southern (North Carolina, Tennessee) progenies. Individual tree variation was also pronounced. About 6% of the total number of trees showed 10% injury or less, and 0.3% of the trees had no injury. These individuals could be candidates for selection and breeding work.

Further research is needed to understand why some groups are more susceptible to injury than other groups. Chemical, physical, as well as phenological factors need further exploration. With the variation found in this study, prospects appear good for successfully increasing the level of potato leafhopper resistance in red maple through selection and breeding.

Significance to the Nursery Industry

Potato leafhopper injury on red maples currently must be controlled by chemical sprays. Results of this study offer the possibility that genetic resistance could eventually sub-

Table 2. **Evaluation of Potato Leafhopper Injury on Red Maple: Summary of the Ten Least Susceptible and the Ten Most Suceptible Open-Pollinated Families.**

Stand No. Family, and State or Province	Average Injury[z] (%)
Least Susceptible:	
160 C NY	31 ± 3
145 A WI	32 ± 3
155 C WI	34 ± 3
155 D WI	34 ± 2
157 C MN	34 ± 3
163 D ME	35 ± 2
164 A ON	35 ± 2
140 B WV	36 ± 2
145 C WI	37 ± 2
153 C ON	37 ± 3
Most Susceptible:	
134 D OH	68 ± 3
141 A MI	65 ± 3
134 C OH	65 ± 3
124 B NC	65 ± 4
137 A MI	64 ± 2
142 A PA	61 ± 3
137 C MI	60 ± 4
123 A TN	59 ± 3
128 A OH	59 ± 3
151 C NH	59 ± 2

[z]Average percent injury was assessed on individual trees and reflected the average injury on new leaves throughout the trees.

stitute for pesticide treatments of this troublesome nursery pest. Seedlings grown from seed collected in far northern areas sustained less leafhopper injury in Ohio than did seedlings derived from more southerly native seed. Future research will be needed to identify which clones and progenies are most leafhopper-resistant in different regions of the country. Growers and plant breeders should consider utilizing this apparent variation in resistance in selecting and breeding improved red maple cultivars, or in choosing seed for seedling red maples.

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Effect of Hydrophylic Polymer Amendment on Growth of Container Grown Landscape Plants[1]

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Abstract

Four experiments were conducted over 3 years to determine the influence of a water-absorbing polymer (hydrogel), Mizuace[4], on the growth of container grown landscape plants. Amending the 100% pine bark growth medium with 0, 0.9, 1.8, 2.7, or 3.6 kg/m^3 (0, 1.5, 3.0, 4.5, 6.0 lb/yd^3) hydrogel did not affect irrigation frequency. Foliar and growth medium nutrient levels were minimally affected, and shoot and root growth were reduced or not affected by increasing rates of hydrogel.

Index words: hydrogel, soil additive, starch copolymer

Species used in this study: 'Sherwood Red' azalea (*Rhododendron* × 'Sherwood Red'); 'Hino Crimson' azalea (*Rhododendron obtusum* Planch. 'Hino Crimson'); privet (*Ligustrum japonicum* Thunb. 'Aureo-marginatum'); Korean boxwood (*Buxus microphylla koreana* Nakai 'Wintergreen'); dwarf yaupon (*Ilex vomitoria* Ait. 'Stoke's Dwarf').

Introduction

Water-absorbing polymers (hydrogels) are a group of compounds capable of absorbing many times their weight in water. Research has shown hydrogels to reduce watering requirements of container grown plants (4, 6, 15, 16), enhance plant growth (4, 17), increase nutrient retention of media (10, 17), lessen transplant shock to trees and shrubs (19), improve seed germination and seedling vigor (3, 14), and increase the shelf-life of pot crops (4, 6, 8, 15). Conflicting results have also been reported in hydrogel tests (1, 2, 5, 7, 9, 11, 12). For example, addition of hydrogel did not affect or suppress plant growth (1, 7, 12) and nutrient content of growth medium leachate was minimally influenced (5), tissue levels of macro- and microelements were less with hydrogel addition than in untreated media (9), root dips in hydrogels were not advantageous at transplanting

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