Natural Resistance of Birch, Cherry and Crabapple Taxa to Feeding by Adult Japanese Beetle

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Nature of Work: Since introduction into the United States, early in this century, the Japanese beetle *(Popillia japonica* Newman) has become a destructive pest throughout much of Eastern North America. Although this insect is known to have preferences for certain host plants, there has been little research on variations in beetle preference for host plants within specific genera. The purpose of this study was to evaluate a range of plant taxa, within taxa of birch, cherry, and crabapple for susceptibility and possible resistance to Japanese beetle feeding.

Three separate experimental plots were established, one for each genus of plants studied. Individual plots were arranged in randomized complete block designs, located at the Mountain Horticultural Crops Research Station in Fletcher, N.C.

Crabapple plot. Three replicates of 33 taxa of flowering crabapples (Table 1) were planted over the period of March 1990 to March 1991. Trees were planted in rows spaced 6.1 m (20 ft) apart, with 4.6 m (15 ft) between trees within rows.

Cherry plot. Eight taxa of flowering cherries (Table 2) were planted in April 1991, in a plot approximately 100 m (330 ft) from the crabapple plot. Trees were planted in rows spaced 6.1 m (20 ft) apart, with 3.6 m (12 ft) between trees within rows.

Birch plot. Nine taxa of birch (Table 3), with seven replicates, were grown in 19 liter (#7) containers, outdoors, on a gravel bed located approximately 0.4 km (0.25 mi) from the cherry and crabapple plots.

Injury ratings. Two observers visually rated each tree for foliage injury during the period of July 15 to July 19, 1991. The rating system was based on an 11 point scale corresponding to feeding injury (skeletonization) from 0 to 100 percent, in 10 percent increments. The ratings from both observers were averaged, adjusted using an arcsine transformation, and subjected to an analysis of variance and separation of means by LSD (4). Statistical differences among means were determined on the transformed data; percentage data are presented for ease of interpretation.

No choice feeding. Four taxa, two resistant and two susceptible, were selected for further testing in a no choice feeding study. On July 17, 1991, nylon mesh netting was used to enclose the terminal portion of one well-lit branch (with similar leaf areas) from each of three trees of the four taxa. Ten beetles of unknown age and sex were released into each cage. Damage was evaluated after 1 week.

Results and Discussion: Average feeding injury on flowering crabapples ranged from 0% for several taxa to as high as 83% for 'Red Splendor' (Table 1). Eighteen of the taxa had minor injury with ratings of s 14% skeletonization, with none of these ratings being significantly greater than0%. The ranking of these taxa based on percent feeding injury was similar with the ranking for 21 of the same taxa evaluated at an experimental plot in Raleigh, N.C. (Dr. D.M. Benson, personal communication), with one exception. In the Raleigh plot, M. *floribunda* was found to have substantial injury (2.5 on a 5 point scale), while the same species had no injury in our evaluation. Feeding injury among the flowering cherries varied from 46% for 'Akebono' to 93% for P. *sargentii* (Table 2). Although there were significant differences among taxa in the amount of injury sustained, none of these plants were sufficiently free of injury to warrant selection of taxa resistant to Japanese beetle. Of the birches evaluated, *B. jacquemontii* was the only taxa that had significant injury from Japanese beetles, with a mean skeletization of 16% (Table 3). The number of beetles found at the birch plot may have been less than at either of the other two plots resulting in low injury ratings for many of the species. Reports by Ladd (3) and Fleming (2) indicate that *B. populifolia* and *B. pendula* are fed on extensively under certain conditions. Our results do, however, identify *B. jacquemontii* as a preferred host plant compared with the other taxa of birch evaluated. Observations made by the senior author in nurseries in N.C. support the findings that *B. jacquemontii* is a favored host and can be completely skeletonized, while other birches are less effected .

Evaluation of the feeding response of beetles caged on branches of selected *Malus* taxa was conducted to evaluate the degree of antixenosis among these plants under conditions where the beetles had no choice of host plants. Despite the presence of the enclosures, beetles continued to feed extensively (>40 % skeletonized) on the two cultivars, 'Liset' and 'Radiant', observed to be preferred in the early evaluation (Table 4). The feeding response of beetles on the two taxa found to be resistant showed that the beetles would feed extensively on *M. hupehensis* (50% skeletonized), but did little damage to *M. baccata* 'Jackii' (1% skeletonized). Although there was little overall injury on the leaves of *M. baccata* 'Jackii', there were signs of feeding on 40% of the leaves, suggesting that beetles began to feed on leaves but found them unpalatable.

Preference of the beetles for various taxa under field conditions depends first on the ability of the beetle to locate/choose a host and secondly on palatability. Ahmad (1) found that Japanese beetles rely to a large degree on olfactory senses for locating host plants. In fact, many plants that are rarely attacked by the beetle, such as ginkgo *(Ginkgo biloba),* will be fed-on if the leaves are coated with juice pressed from cherry leaves (5). In the case of the crabapple taxa evaluated, it appears as though some taxa are more attractive to Japanese Beetle than others. Although *M. hupehensis* showed little injury in the initial field evaluation, the beetles fed extensively on it when they were enclosed with its foliage, suggesting that this plant may not have extensive injury in the field because it attracts fewer beetles. In the case of *M. baccata* 'Jackii', however, beetles refrained from feeding even under the caged conditions. These results suggest that *M. baccata* 'Jackii' is less palatable to the insect.

Significance to Industry: With increasing limitations on the use of pesticides in nursery and landscape settings, there is a need for more information on landscape plants that are naturally resistant to insect pests. This research explored the degree of preference of Japanese beetles for selected taxa of crabapple, cherry and birch. Results demonstrate that considerable variation exists in the preference of adult Japanese beetles for different taxa within the *Malus* and *Betula* genera, suggesting that natural resistance to feeding by this insect is a useful selection criterion.

Literature Cited

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Table 1. Feeding preference of Japanese beetle among 33 taxa of flowering crabapple *(Malus* spp. *).*

Taxa	Common/trade name	Leaf area skeletonized (%)[z]
M. baccata Borkh. 'Jackii'	Siberian	O
M. hupehensis Rehd.	Tea	O
M. floribunda Siebold	Japanese	O
'Branzam'	Brandywine	O
'Louisa'	'Louisa'	O
'Strawberry Parfait'	'Strawberry Parfait'	O
'Golden Raindrops'	'Golden Raindrops'	O
'Mazam'	Madonna	1
'Hargozam'	Harvest Gold	1
M. sargentii Rehd.	Sargent	1
'Silver Moon'	'Silver Moon'	1
'Ormiston Roy'	'Ormiston Roy'	2
' Baskatong '	' Baskatong'	2
'Candy Mint'	'Candy Mint'	2
'Molazam'	Molten Lava	3
'Glen Mills'	'Glen Mills'	4
'Mary Potter'	'Mary Potter'	7
'Narragansett'	'Narragansett'	14
M. x *zumi* Rehd. 'Calocarpa'	Redbud Crab	17
'Sutyzam'	Sugar Tyme	21
'Callaway'	'Callaway'	21
'Donald Wyman'	'Donald Wyman'	23
'Pink Princess'	'Pink Princess'	28
'Robinson'	'Robinson'	32
'White Angel'	'White Angel'	33
'Snowdrift'	'Snowdrift'	33
'Doubloons'	'Doubloons'	33
'Sinai Fire'	'Sinai Fire'	36
'Adams'	'Adams'	45
'Sentinel'	'Sentinel'	52
'Liset'	'Liset'	77
'Radiant'	'Radiant'	78
'Red Splendor'	'Red Splendor'	83
		LSD 0.05 = 14

[z]Values are means (n=3).

Table 2. Feeding preference of Japanese beetle among taxa of flowering cherries *(Prunus spp.).*

Taxa	Common/trade name	Leaf area skeletonized (%)[z]
P. x yedoensis Matsum. 'Akebono'	'Akebono' Yoshino	46
P. serrulata Lindl. 'Kwanzan'	'Kwanzan' Japanese	48
Px yedoensis 'Afterglow'	'Afterglow' Yoshino	55
P. serrulata 'Tai Haku'	'Tai Haku' Great White	73
P. serrulata 'Mt. Fuji'	'Mt. Fuji' Japanese	76
P. subhirtella Miq. *' Autumnalis Rosea'*	'Autumnalis Rosea' Autumn Flowering Higan	82
P. x incamp 'Okame'	'Okame'	89
P. sarDentii Rehd.	Sargent	93
	$LSD_{0.05}$=24	

[z]Values are means (n=3).

Table 3. Feeding preference of Japanese beetle among nine taxa of birch *(Betula spp.).*

Taxa	Common name	Leaf area skeletonized (%)[z]
B. papyrifera Marsh.	Paper	0
B. platyphylla var. *japonica* Hara'Whitespire'	'Whitespire' Japanese	0
B. platyphylla var. *szechuanica* Rehd.	Szechuan	0
B. populifolia Marsh.	Gray	0
B. pendula Roth.	European	0
B. ermanii Cham.	Erman's	0
B. nigra L.	River	1
B. nigra'Heritage'	'Heritage' River	1
B. jacquemontii Spach.	Himalayan	16
	$LSD_{0.05}$=	4

[z]Values are means (n=7).

Table 4. Feeding response of Japanese beetles caged on btanches of four crabapple taxa for one week.

Taxa	Leaves fed upon (%)[z]	Leaf area skeletonized (%)
Resistant		
M. baccata 'Jackii'	40 a	1 a
M. hupehensis	100 b	50 b
Susceptible		
'Liset'	89 b	47 b
'Radiant'	79 b	42 b

[z]Means (n =3) within columns followed by the same letter are not significantly different, $LSD_{0.05}$.

Insect Problems and Insecticide Effectiveness as seen by Nursery Growers in the Southeast

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Nature of Work: In November 1990, the EPA requested the USDA Extension Service to conduct a biologic and economic assessment of Dursban and Diazinon. The purpose of the assessment was to describe the benefits of these compounds and their usages in agricultural production and the economic ramifications of their discontinued use. We were contacted to conduct this assessment for ornamental and sod production in the United States.

A questionnaire was developed to address insecticide/acaricide usage, pest occurrence, effectiveness of pesticides against pest, use of alternatives to conventional pesticides, phytotoxicity associated with chemical application, and method of application for pest management. The American Association of Nurserymen was contacted and with their cooperation the questionnaire was distributed to their membership. Questionnaires were distributed to l,115 nurseries and 217 or 19% were returned. In this paper we will report on a portion of the information gathered in this study and