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EVALUATION OF ADULT COTTONWOOD LEAF BEETLE, *CHRYSOMELA SCRIPTA* (COLEOPTERA: CHRYSOMELIDAE), FEEDING PREFERENCE FOR HYBRID POPLARS[1]

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ABSTRACT

Foliage from the *Leuce* section of *Populus* was rejected for feeding by *Chrysomela scripta* adults in a choice test involving 12 hybrid poplar clones. Adults showed a feeding preference for the foliage from the *Tacamahaca* clones when compared to the *Aigeiros* clones.

The cottonwood leaf beetle, *Chrysomela scripta* Fabricius, is one of the most serious defoliators of hybrid poplars in the north central United States. Nursery and plantation trees often are severely stunted and deformed as the adults and larvae consume the immature foliage and kill the terminal shoots.

A number of recently developed hybrid poplar clones are currently being evaluated for use with intensively managed forest systems. One aspect of these evaluations deals with the susceptibility of these clones to insects and diseases. Recent reports by Caldbeck et al. (1978) in Iowa, and Wilson (1979) in Michigan suggested that a degree of resistance to the cottonwood leaf beetle exists in some clones. Outplantings examined following high beetle populations showed wide variations in the severity of damage.

At the University of Wisconsin, a tissue-culture process was used to develop *Populus* × *euramericana* (Dode) Guinier trees from callus tissue. Although these trees are considered to be genotypically identical, differences occur in their growth rates, branching characteristics, and leaf traits (Lester and Berbee 1977); preliminary examinations indicated some variation in their susceptibility to the cottonwood leaf beetle also existed (Burkot 1978).

Hybrid clones have been derived from each of the three major sections of the genus *Populus;* i.e. *Leuce,* the aspens and white poplars; *Aigeiros,* the black poplars; and *Tacamahaca,* the balsam poplars. These crosses have involved many native as well as exotic species. The leaf beetle is known to feed on species in the sections *Aigeiros* and *Tacamahaca* (Brown 1956), but it has not been reported in natural situations feeding on species of *Leuce.*

Studies by Caldbeck et al. (1978) and Wilson (1979) identified the more resistant hybrid poplar clones among those included in their studies, but their analyses did not allow extrapolation to clones not included or not yet developed. By relating the degree of resistance of a clone to the parentage of the clone this extrapolation is possible, and such information concerning cottonwood leaf beetle adult feeding preference is presented here.

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MATERIALS AND METHODS

The adults used in this study were the progeny of *C. scripta* adults collected in 1979 from a planting of tissue-cultured *Populus* × *euramericana* at the F. G. Wilson Nursery, Boscobel, Wisconsin. The insects were reared in the laboratory on the immature foliage of tissue-cultured subclone no. 13 of *P.* × *euramericana* "Wisconsin no. 5."

Twelve hybrid poplar clones currently under study at the North Central Forest Experiment Station, Forestry Sciences Laboratory, Rhinelander, Wisconsin, were selected for this study based on the findings by Caldbeck et al. (1978), and on the availability of the clones from the Forest Experiment Station; an attempt was made to select clones representing a broad range of susceptibilities to the leaf beetle (Table I). In addition, eight tissue-cultured subclones (nos. 4, 6, 7, 13, 15, 4H, 7H, 17H) of *P.* × *euramericana* "Wisconsin no. 5" were selected to represent subclones derived from different calli produced both from heat-treated and untreated meristematic tips of the parent clone.

Leaf discs 11 mm in diameter were cut from each of the 12 clones and eight subclones, and these were soaked in water to promote saturation. Immature foliage was chosen because of the preference for this shown by *C. scripta* adults (Harrell 1980). One leaf disc from each of the 12 clones was placed randomly around the perimeter of a 9-cm-diameter Petri dish. The discs were kept in their position and slightly raised using minuten pins and a paraffin base. A moistened filter paper lining was used to prevent desiccation. One adult beetle was placed in the covered dish and allowed to feed for 24 hours. The area consumed from each leaf disc was recorded at the end of the feeding period. This design was replicated 12 times using the 12 NCFES clones and 12 times using the eight tissue-cultured subclones and their parent clone.

The leaf areas consumed were determined using a 1.5-mm-interval dot grid and the mean of three counts. The areas consumed from the leaf discs of groups of parentages were compared using Student's t-test (Sokal and Rohlf 1969). Leaf water levels were calculated for each of the clones from the fresh and dry weights of samples. Nitrogen levels were determined using a micro-Kjeldahl technique. Correlations were examined between the total leaf areas consumed and the leaf water and nitrogen levels determined in this study, and also the nitrogen and carbohydrate levels as found by Dickson and Larson (1977).

Table 1. *Populus* clones from NCFES used in the study of *C. scripta* adult feeding preference.

NCFES clone no.	Defoliation[a] Level (%)	Parentage	Sectional composition
5339	0	*Populus alba* × *P. grandidentata*	100% *Leuce*
5272	22	*P. nigra* × *P. laurifolia*	50% *A.*, 50% *T.*[b]
5331	33	*P. betulifolia* × *P. trichocarpa*	50% *A.*, 50% *T.*
5322	41	*P.* × *euramericana*	100% *Aigeiros*
5260	47	*P. tristis* × *P. balsamifera*	100% *Tacamahaca*
5332	49	*P. betulifolia* × *P. trichocarpa*	50% *A.*, 50% *T.*
5266	51	*P. angulata* × *P. trichocarpa*	25% *A.*, 75% *T.*
5262	52	*P. candicans* × *P. berolinensis*[c]	25% *A.*, 75% *T.*
5377	65	*P.* × *euramericana* "Wisconsin no. 5"	100% *Aigeiros*
5334	66	*P. angulata* × *P. trichocarpa*	50% *A.*, 50% *T.*
5263	68	*P. candicans* × *P. berolinensis*	25% *A.*, 75% *T.*
5264	78	*P. angulata* × *P. plantierensis*	100% *Aigeiros*

[a] Level of defoliation reported by Caldbeck et al. (1978).
[b] *A.* = *Aigeiros*; *T.* = *Tacamahaca*
[c] *P. berolinensis* = *P. nigra* × *P. laurifolia*

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RESULTS AND DISCUSSION

Adult beetles showed a significant ($P < 0.01$) non-preference for the *Leuce* foliage when compared to the *Aigeiros* and *Tacamahaca* foliage (Table 2). Adults also showed preferences for pure *Tacamahaca* foliage when compared to pure *Aigeiros* ($P < 0.05$), and for clones of 75% *Tacamahaca* when compared to 50% *Tacamahaca* ($P < 0.06$). No differences were found within any other comparisons, including those made among the tissue-cultured subclones and their parent clone. In no replicate did an adult consume an entire leaf disc, and in each replicate the wandering of the adult was more than sufficient to allow repeated encounters with each type of foliage.

The non-preference shown by the leaf beetle for the *Leuce* foliage was expected since the aspens and white poplars that comprise this section are not reported hosts of the beetle. Caldbeck et al. (1978) and Wilson (1979), however, showed a small amount of attack for *Leuce* clones such as 5339. The difference in the relative feeding preferences found between the *Aigeiros* and *Tacamahaca* foliage suggests that variations in susceptibility to the leaf beetle exist also among the clones derived from the beetle's natural hosts.

The foliar components responsible for the differences in feeding intensity on the *Aigeiros* and *Tacamahaca* clones have not been determined. No correlations were found between the total leaf areas consumed and either the moisture, nitrogen, or carbohydrate levels of the clones, and there were no apparent differences in leaf thickness, toughness, or surface characteristics. It also is not clear why a significant difference was apparent between leaf beetle activity on the *Aigeiros* and *Tacamahaca* clones in this study, but not in the reports by Caldbeck et al. (1978) and Wilson (1979). Differences among the studies that could account for this include the conditions under which the studies were carried out, the ways in which feeding was measured, and the methods of analysis.

The data presented here and in the reports by Caldbeck et al. (1978) and Wilson (1979) suggest that hybrid poplar clones with *Leuce* parentages have a high degree of resistance to the cottonwood leaf beetle. The differences in beetle activity on the *Aigeiros* and *Tacamahaca* clones found in this study suggest that greater resistance to *C. scripta* might be achieved by increasing the *Aigeiros* component of the hybrid clones.

Table II. Comparisons of *C. scripta* adult feeding intensity on leaf samples in a 12-clone test.

Parentage of Clones	Mean leaf area consumed (mm ± SE)
Leuce[a]	0.7 ± 0.45
Aigeiros & Tacamahaca[b]	41.1 ± 4.22[g]
100% Aigeiros[c]	36.8 ± 8.72
100% *Tacamahaca*[d]	76.3 ± 14.63[h]
50% *Tacamahaca*[e]	32.7 ± 5.20
75% *Tacamahaca*[f]	54.0 ± 11.22[i]

[a] NCFES clone 5339.
[b] NCFES clones 5260, 5262, 5263, 5264, 5266, 5272, 5322, 5331, 5332, 5334, and 5377.
[c] NCFES clones 5264, 5322, and 5377.
[d] NCFES clone 5260.
[e] NCFES clones 5266, 5272, 5331, 5332 and 5334.
[f] NCFES clones 5262 and 5263.
[g] level of significance ($P < 0.01$)
[h] level of significance ($P < 0.05$)
[i] level of significance ($P < 0.06$)

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