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Early Impact and Control of Aphid (*Chaitophorus populicola* Thomas) Infestations on Young Cottonwood Plantations in the Mississippi Delta

J. D. Solomon

SUMMARY

A very heavy infestation of the aphid *Chaitophorus populicola* Thomas developed primarily on growing shoots in commercial cottonwood plantations and caused serious injury to terminals. Terminal mortality in heavily infested fields averaged 92.5 percent, and shoot dieback averaged 4.3 inches. Many of the surviving terminals were weakened to the extent that slow growth allowed lateral bud growth to become dominant. After one growing season, trees in heavily infested fields generally had more stem deformities in the form of heavy branches and forks than did those in lightly infested fields. Four insecticides, acephate, carbaryl, chlorpyrifos, and diazinon, gave excellent control of the aphids.

Additional keywords: *Populus deltoides,* terminal mortality, dieback, stem deformities, insecticides.

INTRODUCTION

Cottonwood (*Populus deltoides* Battr. ex Marsh.) is a good source of veneer, lumber, and pulp and is the fastest growing tree species in the South (Krinard and Johnson 1984). Several companies and individuals are planting and growing cottonwood on a commercial scale. More than 50,000 acres of cottonwood plantations have been established in the South-mainly in the lower Mississippi River Valley (Krinard and Burkhardt 1984). Establishment costs for cottonwood plantations, including site preparation (with land clearing), planting, and first-year cultivation, are estimated at between $300 and $400 per acre (Anderson and Krinard 1985), compared to about $100 per acre in 1970 (Dutrow et al. 1970). These large early investments demand that losses from pests be controlled.

One of the little known pests of cottonwood is the aphid, *Chaitophorus populicola* Thomas (Morris and Oliveria 1976). This aphid is widely distributed from Canada south to the Gulf Coast and west to the Rocky Mountains (Richards 1972). It has caused noticeable leaf drop in aspen stands (Furniss and Carolin 1977). But little information has been documented on this insect, and even less is known of its potential for injury and impact in commercial cottonwood plantations.

Light aphid populations have been observed often in cottonwood plantations and moderate populations sometimes occur, but heavy, threatening infestations have occurred infrequently. However, in 1976 a very heavy aphid infestation occurred in young cottonwood plantations in the lower Mississippi Delta. This heavy infestation provided an opportunity to study the effects of aphid feeding on terminal mortality and subsequent tree form. In 1980, small scale trials with selected insecticides were conducted to control aphid infestations in cottonwood.

MATERIALS AND METHODS

The study was conducted in first-year commercial cottonwood plantations in Issaquena County, Mississippi. The plantations were established with a random clone mixture of five Stoneville select clones (clones 66, 67, 74, 92, and 109). The plantations were cultivated four to five times during the first growing season for weed control.

The study plantations were visited periodically, beginning in early spring. After the aphid population began to build up in late summer, the plantations were visited at 1- to 2-week intervals to assess the aphid infestation. During each visit, the number of aphids was counted on single leaves selected from the terminals of 10 or more randomly selected trees per field.

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During the following spring on April 1 and 2, just after growth had begun, the plantations were sampled to estimate terminal mortality and extent of dieback. Eleven fields that had been lightly to heavily infested the previous year were selected for sampling.

Five lo-tree plots were randomly established in each field. Thus, a total of 50 trees was sampled in each field. The terminal of each tree was examined and recorded as dead or alive. Also, the extent of terminal dieback was measured. Because shoot growth had just begun and was 2-6 inches long when the examinations were made, an assessment was made of trees having live terminals but obviously weakened and with laterals showing evidence of becoming dominant.

During the following winter, one full growing season after the aphid infestation, the same 11 fields (but not the same trees) were again evaluated to assess the effect of aphid-caused terminal mortality on developing tree form. Once again, five plots were randomly chosen in each field, and 10 trees were selected in each plot for examination. Sample trees were examined for evidence of the previous year's terminal mortality (junction of first- and second-year growth), bole crooks, heavy branching, and forking. Crooks were rated 1 or 2 based on degree of crook, where 1 = crook deviating 1 to 3 inches from a straight line, and 2 = crook deviating 3 to 5 inches from a straight line. Degree of branching was rated 1 or 2, where 1 = heavy branch(es) l/2-3/4 the diameter of the adjacent trunk, and 2 = heavy branch(es) more than 3/4 the diameter of the adjacent trunk. Extent of forking was rated as 1 or 2, where 1 = fork with one branch becoming dominant, and 2 = fork with no evidence of one branch becoming dominant.

Four widely used insecticides were tested in 1980 for efficacy in controlling aphid populations. Two rates of acephate, carbaryl, and chlorpyrifos and one rate of diazinon were evaluated. The trees were in their first growing season and were 3-5 feet tall. Ten aphid-infested trees were selected at random for each treatment and untreated check. Foliar applications were made with a 2-gal hand sprayer calibrated at 20 lb/in^2 to deliver 11 gal per acre. Prespray counts were made of all living aphids on 3 randomly selected leaves collected from the terminals of each of the 10 trees in each treatment. Postspray counts of surviving aphids were made 24 hours after spray application to evaluate efficacy of insecticide treatments.

All percentage data were transformed by arcsin before an analysis of variance was performed. Duncan's new multiple range test was used to compare treatment means for significance at the 0.05 level.

RESULTS AND DISCUSSION

An aphid, C. *populicola,* infestation began to build up in mid-summer of 1976 and became very heavy in some fields during late summer and early fall. Sample counts of aphids per terminal leaf, made from late August through early October, averaged 360 $\pm$ 102 ($\bar{x} \pm$ SD) in four fields designated as heavily infested; 210 $\pm$ 64 in six fields designated as moderately infested; and 70 in a single field designated as lightly infested. Also, the number of aphids on the terminal stems was estimated at over 200 per linear inch of stem in heavily infested fields, 100 in moderately infested fields, and under 40 in the lightly infested field.

The highest aphid population occurred on the young leaves and tender shoot growth of the apical 6-12 inches of terminals and branch ends (fig. 1 A). Honeydew excreted by the aphids, and subsequently black sooty mold, became very noticeable on the foliage and particularly on the lower leaves. Injured shoots became heavily blistered, scabby, pitted, and rough. Heavily injured terminals dropped their leaves prematurely, 4 to 8 weeks before the end of the growing season. Toward the end of the growing season, in October and November, some shoots exhibited signs of drying and shriveling.

When growth started the following spring, dead terminals became very noticeable (fig. 1 B). Terminal mortality assessed in the 11 infested fields ranged up to 98 percent and averaged significantly higher in heavily infested fields, followed by the moderately and lightly infested fields (table 1). The extent of terminal dieback ranged from 2.0 to 4.7 inches among the 11 fields and averaged significantly greater in the heavily infested fields. It was interesting to note that the three fields having the highest terminal mortality, 96, 94, and 98 percent, also had significantly greater terminal dieback, 4.5, 4.4, and 4.7 inches, respectively. Many of the terminals that were not killed were weakened to the extent that slow growth during early spring allowed lateral bud growth to quickly become dominant. The percentage of trees (those having live terminals) with laterals become dominant on them ranged from 0 to 24 percent among fields. But there were no significant differences in lateral branch response among fields, probably because of the wide variation in counts or the early timing of the observations. Thus, lateral branch response was not a reliable measure of aphid injury.

Evaluation of the plantations one full growing season after the aphid infestation revealed generally poor tree form in the heavily infested fields (table 2). The proportion of trees with crooks ranged from 18 percent in the lightly infested field to 52 percent in the heavily infested fields, yet the wide variation in the amount of crook among fields prevented any significance. One of the heavily infested fields mentioned above, which had 96 percent terminal mortality the previous year, had the highest total crook (68 percent), including 14 percent of the more serious (degree 2) crook. The proportion of trees developing heavy branches ranged from 22 to 66 percent among individual fields and averaged significantly greater in heavily infested fields than in the moderately and lightly infested fields. The two fields having the highest terminal mortality, 96 and 98 percent, also

J. D. Solomon is Entomologist at the Southern Hardwoods Laboratory, maintained by the Southern Forest Experiment Station, Forest Service—USDA, in cooperation with the Mississippi Agricultural and Forestry Experiment Station and the Southern Hardwood Forest Research Group.

Table 1 .-*Mean terminal mortality, dieback, and lateral branch dominance caused by heavy aphid infestation in young cottonwood plantations in the Mississippi Delta* [1 2]

Degree of infestation	Trees with dead terminals (%)	Extent of terminal dieback (in)	Trees having live terminals, with lateral branch becoming dominant (%)
Light	22.0 a	2.30 a	9.0 a
Moderate	64.0 b	2.65 a	16.0 a
Heavy	92.5 c	4.25 b	10.0 a

'Trees were examined on April 1 and 2, when new shoot growth was 2-6 in long, following late season aphid infestation the previous year.

*Means within a column followed by the same letter are not significantly different (P = 0.05) as determined by Duncan's new multiple range test (DNMRT).

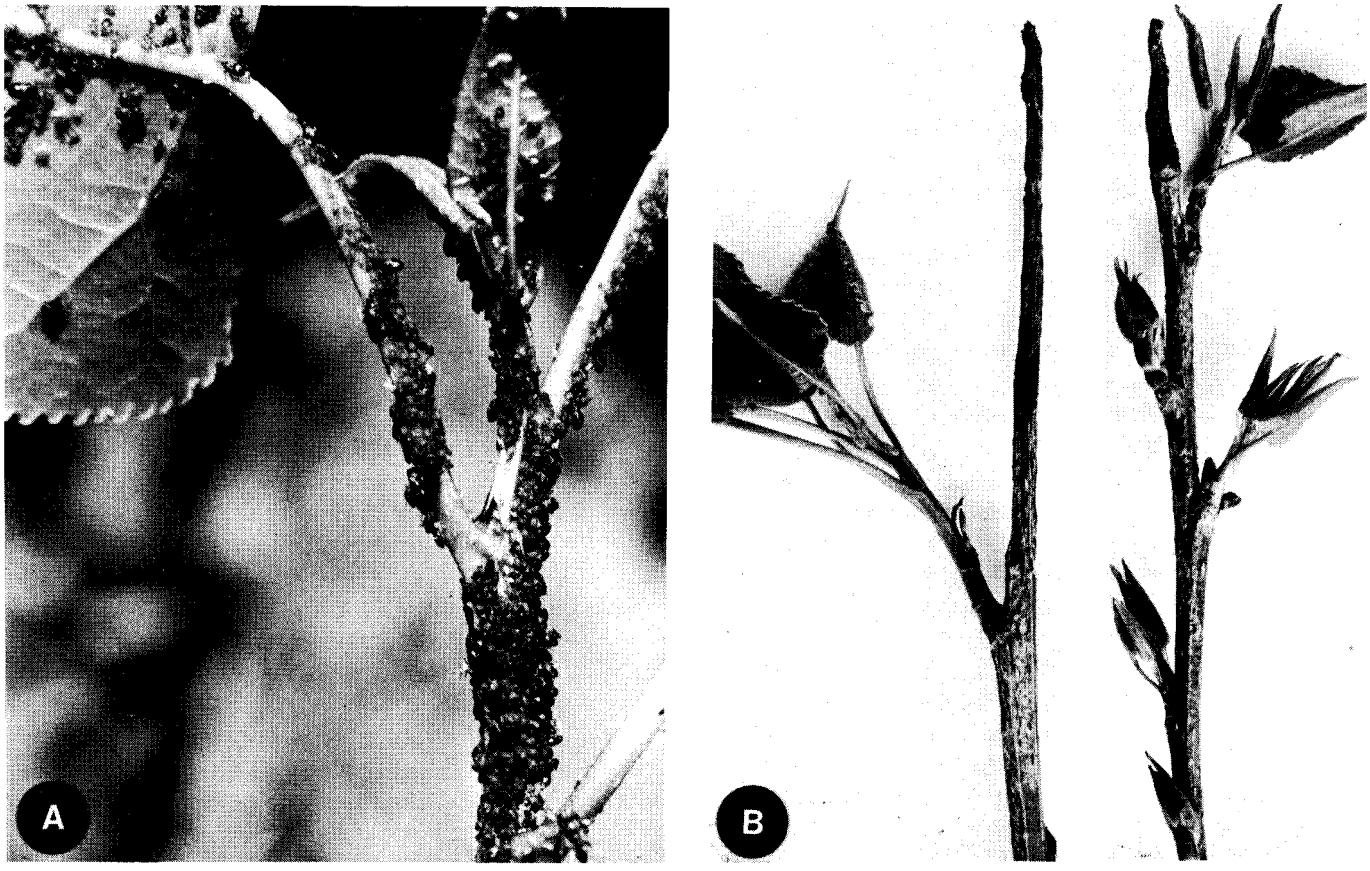

Figure 1 .-*Aphid* (Chaitophorus populicola) *infestation and injury to cottonwood. (A) Terminal heavily infested with aphids. (B) Terminals with dieback. Note the rough, scabby, pitted bark.*

exhibited the most total forking (22 and 20 percent), including the most degree 2 forking (6 and 10 percent). Forking appears to be the most serious stem deformity affecting bole form in young cottonwood plantations (Solomon 1985).

Because this study was pursued for only 1 year after the aphid-caused terminal mortality, the question arises-would these stem deformities be sustained, worsen, or become less significant in subsequent years? A recently completed 5-year study on insect impact indicates that the response of trees to these stem deformities depends on whether the pest injury is repeated in subsequent years, site quality, rainfall, and other factors (Solomon 1985). Given optimum combinations of these conditions, a high proportion of trees will outgrow or overcome many of these stem deformities, while poor combinations of the same conditions will result in the stem deformities being sustained or worsened in a high proportion of trees. Although of minimal importance in pulpwood production, bole form assumes great importance to landowners producing sawlogs and veneer logs.

Each of the four insecticides, acephate, carbaryl, chlorpyrifos, and diazinon, gave excellent control of the aphids (table 3). There were no significant differences in percentage of aphid reduction among insecticides and rates, but all were significantly different from the check. No phytotoxicity was observed for any of the treatments.

Table 2.-*Effects of aphid-caused terminal mortality on tree form evaluated one growing season after aphid infestation in young cottonwood plantations in the Mississippi Delta* [1]

Degree of infestation	Mean percentage of trees with—								
	Crook (degree)[2]			Heavy branching (degree)[3]			Forking (degree)[4]		
	1	2	Total	1	2	Total	1	2	Total
Light	18.0	0.0	18.0 a	8.0	14.0	22.0 a	2.0	2.0	4.0 a
Moderate	39.3	1.3	40.6 a	19.3	18.7	38.0 a	7.0	3.0	10.0 a
Heavy	52.0	3.5	55.5 a	25.0	27.5	52.5 b	11.5	6.0	17.5 b

[1]Means within a column followed by the same letter are not significantly different (P = 0.05) as determined by DNMRT.

[2]Degree 1 = Crook deviating I-3 in from a straight line; degree 2 = crook deviating 3-5 in from a straight line.

[3]Degree 1 = Heavy branch(es) 1/2–3/4 the diameter of the adjacent trunk; degree 2 = heavy branch(es) more than 3/4 the diameter of the adjacent trunk.

[4]Degree 1 = Fork with one branch becoming dominant; degree 2 = fork with no evidence of one branch becoming dominant.

Table 3.—*Insecticides tested for control of aphids on young cottonwood trees in their first growing season in the Mississippi Delta*

Chemical and formulation	Rate (lb ai/acre)	Mean number of aphids per leaf		
		Prespray	Postspray	% reduction'
Acephate 75S	0.75	491.5	0.0	100.0 a
Acephate 75S	0.50	268.1	0.0	100.0 a
Carbaryl 80S	1 .00	267.0	0.0	100.0 a
Carbaryl 80S	0.50	402.0	0.0	100.0 a
Chlorpyrifos 4E	0.25	311.8	2.9	99.1 a
Chlorpyrifos 4E	0.125	417.0	2.2	99.5 a
Diazinon AG-500	0.50	400.5	1.2	99.7 a
Check		188.0	257.8	0.0 b

'Means within a column followed by the same letter are not significantly different (P = 0.05) as determined by DNMRT.

CONCLUSIONS

The results show that high aphid infestations averaging over 300 aphids per terminal leaf and 200 per inch of terminal stem can cause high rates of terminal mortality in young cottonwood plantations. Heavy terminal mortality, in turn, can result in more crooks, heavy branches, and forks that adversely affect bole form, which is so important to landowners producing sawlogs and veneer logs. Efficacy tests show that acephate, carbaryl, chlorpyrifos, or diazinon can be used to control heavy populations of aphids.

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