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INSECT AND CANKER DISEASE IMPACT IN COTTONWOOD NURSERIES

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Abstract.—Insects (primarily cottonwood leaf beetle) reduced height growth in nurseries an average of 48.8 cm (19 in) per switch. Such a growth loss would mean a 20-25 percent drop in cuttings produced. In a survey of nine nursery plantings, cull due to borers (primarily clearwing borers) and disease cankers reduced the number of potential cuttings from 1.6 to 25.6 percent and averaged a loss of 17.3 percent.

Additional keywords: *Populus deltoides*, insect losses, growth reduction.

INTRODUCTION

Eastern cottonwood (*Populus deltoides* Bartr.) is a fast-growing forest species whose rapid growth and desirable wood have generated considerable interest in its intensive culture. Several large companies are now planting cottonwood on a commercial scale: an estimated 16,000-20,000 ha (40,000-50,000 a) have been planted in the lower Mississippi River Valley.

One of the problems of cottonwood monoculture, however, is the number of insects which are capable of considerable impact. Major enemies of the tree are the cottonwood leaf beetle, *Chrysomela scripta* F. (Morris 1956), the cottonwood twig borer, *Gypsonoma haimbachiana* Kft. (Morris 1967), and the clearwing borer, *Paranthrene dollii dollii* (Neum.) (Solomon and Abrahamson 1972). Other insects are capable of causing periodic damage, especially the cottonwood borer (*Plectrodera scalator* Fab.) and stem borers (*Oberea delongii* Knull and *O. schaumii* LeConte), as well as aphids, mites, and defoliators (Morris et al. 1975). Canker diseases, especially septoria canker, are also troublesome in nurseries and plantations (Toole 1963, Filer et al. 1974).

In several European countries, insect borers cause the greatest impact (Chaudhry et al. 1969, Arru and Cellerino 1975). For example, Arru (1970) estimated insect impact (growth loss, degrade, and cost of control) to poplar cultivation in Italy at $9.5 million per year (1970 figures), 98 percent of which was attributed to the borers, *Saperda carcharias* L. and *Cryptorhynchus lapathi* L.

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Insects, if uncontrolled, can cause sizeable losses of cuttings, now preferred over seedlings as planting stock: leaf beetles feed on the tender leaves and terminal tissue, and twig borers tunnel into the terminals. This damage reduces height growth and, in turn, the number of potential cuttings per switch. Clearwing borers and other borers tunnel into the stems and root-stocks. When the switches are harvested and sawn into 51-cm (20-in) long cuttings, those infested with borers are culled, reducing the number of salable cuttings. Also, cuttings having disease cankers are culled. Nurseries in Mississippi are not permitted to ship certified cuttings containing more than 7 percent infestation by borers and cankers.

In this paper, we report on studies of losses due to insects and canker diseases in nurseries.

METHODS AND MATERIALS

Height Growth.—A study was conducted by Solomon and Cook in 1974 at the Mississippi Forestry Commission Nursery at Winona, Miss., to estimate damage of insect defoliators to cottonwoods. The study was installed in a first-year planting of five Stoneville select clones (66, 67, 74, 92, 109). Insect impact was determined by comparing height growth in protected and unprotected plots. A plot consisted of eight rows 152 m (500 ft) long. Each row contained plantings 29 m (95 ft) long of each of the five select clones with spacings between clones of 1.5 m (5 ft). The protected plots were treated with 3.6 kg per ha (40 lbs per a) of 10 percent granular carbofuran[4/] (a systemic insecticide) applied with a tractor-driven subsoil applicator (Abrahamson et al. 1973). There were five replications of protected and unprotected plots arranged in a randomized complete block design.

The insect infestation during the growing season was recorded. Twenty-four switches were selected at random from each of the five clones in each plot (120 switches per plot) at the end of the growing season for height measurements.

In addition to the Solomon and Cook study, three insecticide evaluation studies in the same nursery yielded data on impact on both protected and unprotected plots.[5/] Each of the these studies (1) contained plots treated with 3.6 kg per ha (40 lbs per a) of 10 percent granular carbofuran per acre, which was the same as that used in the 1974 study and is the rate now registered for use in nurseries, (2) included the five select clones, and (3) recorded seasonal insect infestation.

[4/] This publication reports research involving pesticides. It does not contain recommendations for their use nor does it imply that uses discussed here have been registered. All use of pesticides must be registered by appropriate State or Federal agencies before they can be recommended.

[5/] Abrahamson, L. P., Overgaard, N. A., and McConnell, J. L. (1972); Cook, J. R., and Collins, R. J. (1973); Morris, R. C., and Newsome, L. (1973); and Solomon, J. D., and Cook, J. R. (1974). Study reports and/or data are on file at the Southern Hardwoods Laboratory, Stoneville, Miss. Further references to these studies will be identified only by authors' names.

In the study by Abrahamson, Overgaard, and McConnell, treatments were assigned to plots 8 rows wide and 9-30 m (30-100 ft) long. There were three replications arranged in a randomized block design. Twenty-four switches were selected at random from each clone in each plot for height measurements.

In the studies by Cook and Collins and by Morris and Newsome, treatments were applied to single plots consisting of 24 rows 152 m (500 ft) long. Eighteen switches were selected at random from each clone in each plot for height measurements.

Height growth means for protected and unprotected plots in each study were transformed (arcsin) and compared by an analysis of variance (0.05 level) with a randomized complete block design.

Cull by Rootstock Age.--Plantings of three rootstock ages (1, 2, and 3 years) were sampled in 1974 at the Winona Nursery for damage from insect borers and disease cankers. Each of the five select clones was divided into five blocks. Twenty-four switches were sampled in each of the five blocks (120 switches per clone) by randomly establishing a starting point, then systematically selecting every 10th, 15th or 20th switch, depending on the size of the block. The number of cuttings of saleable size per switch was determined with the aid of a measuring pole marked off in 51-cm (20-in) intervals. At the same time, the number of cuttings culled because of borers and/or cankers, was recorded.

Means for percent cull were transformed (arcsin) and comparisions made among the three rootstock ages by Duncan's New Multiple Range Test (DNMRT) at the 0.05 confidence level.

1975 Survey.--Damage from insect borers and disease cankers was surveyed in nurseries at Fitler, Huntington Point, Redwood, Stoneville, Vicksburg, and Winona, Mississippi, and Lake Providence, Louisiana. Four of the seven nurseries had block plantings of the five Stoneville select clones. One had three of the five clones, one had only one clone, and one did not identify its clones. Rootstock age varied from 1 to 4 years at the various nurseries; two of the seven nurseries had block plantings of two different rootstock ages, thus providing a total of nine samples. Sampling and counts of saleable and cull cuttings were done as described above. Means for percent cull were transformed (arcsin), and comparisons were made among locations for each variable by DNMRT at the 0.05 confidence level.

RESULTS AND DISCUSSION

Height Growth.--The study by Abrahamson et al. (Table 1) showed that switches in protected plots grew 0.8 m (2.7 ft), or 23 percent, more than those that were unprotected. At the other extreme, Solomon and Cook obtained a growth difference of only 0.2 m (0.7 ft), or 9 percent, between protected and unprotected plots. Differences in growth found in studies by Cook and Collins and by Morris and Newsome were intermediate.

Table 1.—*Impact of insects (primarily cottonwood leaf beetles) on height growth in nursery-grown cottonwood*

Treatment[a]	Mean height growth in meters (feet) by study[b] and year				
	Abrahamson Overgaard McConnell 1972	Cook Collins 1973	Morris Newsome 1973	Solomon Cook 1974	Overall mean height
Protected	3.57 (11.7)	3.26 (10.7)	4.02 (13.2)	2.32 (7.6)	3.29 (10.8)
Unprotected	2.74 (9.0)	2.87 (9.4)	3.53 (11.6)	2.10 (6.9)	2.80 (9.2)
Difference	0.83 (2.7)	0.39 (1.3)	0.49 (1.6)	0.22 (0.7)	0.49 (1.6)

[a] Protected plots treated with 9 kg (40 lbs) of 10 percent granular carbofuran per acre.

[b] Study reports and/or data are on file at the Southern Hardwoods Laboratory, Stoneville, Miss.

Growth differences in each study are in direct proportion to the degree of insect damage. For example, in the study by Abrahamson and others, the cottonwood leaf beetle almost completely stripped the tender foliage and killed most of the terminals in the unprotected plots during July and August. Additional damage occurred in September. The heavy leaf beetle damage in the unprotected plots accounts for the 23 percent growth difference. Solomon and Cook recorded only light defoliation by leaf beetles and leaf rollers (*Coleophitia* sp.), and less than 5 percent of the terminals were killed, thus explaining the growth difference of only 9 percent between protected and unprotected plots. In the other two studies, unprotected plots sustained moderate defoliation by leaf beetles: 24 and 31 percent of the terminals were killed, resulting in intermediate growth losses.

Average growth loss for the four studies was 0.49 m (1.6 ft) per switch, or approximately one 51-cm (20-in) cutting, a significant difference between protected and unprotected plots. Therefore, if a nursery averaged 4–5 cuttings per switch and sustained comparable insect damage, the resulting growth loss could represent a 20–25 percent reduction in the production of cuttings.

Cull by Rootstock Age.—At the Winona nursery in 1974, clearwing borers were responsible for most of the cull—accounting for a 9 percent loss, if averaged for the three rootstock ages (Table 2). Borer damage was significantly higher in switches produced on 1st- and 3rd-year rootstocks than in those on 2nd-year rootstocks. This difference was attributed largely to better growth on 2nd-year rootstocks and, in turn, an increase in total cuttings which provided a larger base for calculating percent of cull.

Table 2.--*Impact of clearwing borers and disease cankers by rootstock age on production of cuttings in cottonwood nursery at Winona, Miss., in 1974*

Age of rootstock	No. cuttings salesable size	Mean percent of cuttings culled due to: Borers	Cankers	Borers and cankers	Total
1 year	1532	9.7 a[a/]	1.3 a	0.5	11.5 a b
2 years	2314	5.7 b	1.6 a	0.6	8.0 b
3 years	2417	11.8 a	2.4 a	1.1	15.3 a
Overall mean percent loss		9.1	1.8	0.7	11.6

[a/] Within a column, means followed by the same letter are not significantly different at the 0.05 level as judged by Duncan's New Multiple Range Test.

Disease cankers accounted for a loss of almost 2 percent annually when averaged for the three rootstock ages. Average cull from disease cankers did not differ significantly among rootstock ages.

Cutting losses for 3rd-year rootstocks were significantly greater than those for 2nd-year rootstocks when average cull due to borers and cankers was combined. However, neither was significantly different from loss on 1st-year rootstocks. The overall cull for all three age groups averaged 11.6 percent.

1972 Survey.--Cull due to borers in the nine nurseries surveyed was significantly greatest at Vicksburg (23.2 percent) and Huntington Point (19.7 percent) and least at the Lake Providence site (1.3 percent) (Table 3). Rootstock age did not appear to be a significant factor in borer incidence. However, at Winona and Huntington Point, where there were rootstocks of more than one age, cull averaged greater in switches from 1st- and 3rd-year rootstocks than from 2nd-year rootstocks, which supports the 1974 findings (Table 2).

Losses due to disease cankers were significantly highest at Stoneville (11.3 percent) and lowest at Lake Providence (0.3 percent). The high incidence of cankers at Stoneville was in switches on 4-year-old rootstocks--the oldest sampled in the survey. Moreover, canker incidence was generally highest in nurseries maintained at the same site for several years. For example, average canker was next highest on 3rd-year rootstocks at Winona (5.3 percent) and Fitler (4.9 percent), sites where nurseries had been maintained for several years. At Lake Providence, where a new nursery was established in 1975 near the middle of a large 405-ha (1,000-a) cleared site, cull from cankers and from borers was the lowest of all sites. This finding was expected because on such a new site both the canker inoculum and borer reservoir would be minimal.

Table 3.—*Impact survey of insect borers (primarily clearwing borers) and disease cankers on the production of nursery-grown cottonwood cuttings in 1975*

Location	Rootstock age (Yrs.)	Mean percent of cuttings culled due to: Borers	Cankers	Borers and cankers	Total
Vicksburg, Miss.	2	23.2 a[a/]	1.9 b	0.5	25.6 a
Huntington Point, Miss.	1	19.7 a	3.4 b	0.9	23.9 a
Fitler, Miss.	3	14.9 b	4.9 b	2.4	22.2 ab
Winona, Miss.	3	11.6 bc	5.3 b	0.9	17.7 bc
Huntington Point, Miss.	2	11.2 bc	2.8 b	0.0	14.0 c
Winona, Miss.	2	10.5 c	2.8 b	1.1	14.4 c
Stoneville, Miss.	4	9.2 c	11.3 a	1.6	22.1 ab
Redwood, Miss.	2	8.8 c	4.1 b	0.8	13.8 c
Lake Providence, La.	1	1.3 d	0.3 c	0.0	1.6 d
Overall means		12.3	4.1	0.9	17.3

[a/] Within a column, means followed by the same letter are not significantly different at the 0.05 level as judged by Duncan's New Multiple Range Test.

When cull from both borers and cankers was combined for each sample, the proportion of cull varied greatly from 1.6 to 25.6 percent and averaged 17.3 percent for all nurseries.

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