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37.4 Integrated Pest Management of Poplar Species[1]

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Silvicultural Practices

Proper site selection, good site preparation, correct planting practices, and 1st-year cultivation directly and indirectly affect survival rate of trees. Losses from canker fungi are minimized by cultural practices that increase tree vigor—poor tree vigor means more cankers per acre and greater mortality (Filer 1964, 1967).

Spacing

Tree spacing is dictated by the kind of wood—pulp or sawtimber—the plantation is producing. Regardless of initial spacing, fast-growing species such as

1. Discussion of pesticides here is not recommendation of their use. If pesticides are handled, applied, or disposed of improperly, they can harm humans, domestic animals, desirable plants, and pollinating insects, fish, or other wildlife, and may contaminate water supplies. Use pesticides only when needed and handle them with care. Follow directions and heed all precautions on the container label.

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cottonwood must not be allowed to become crowded or stagnant. The canopy must not close, or growth will decline and insect and disease problems will increase.

Mechanical Weed Control

Clean cultivation not only increases yield but also reduces effects of insect and disease. The accepted early cultivation practice in cottonwood plantations is cross-discing, which has increased cottonwood height-growth 300% over that of trees in mowed plots; d.b.h., has increased 140%.[3] Higher nutrient concentrations were evident in leaf samples from disced plots. Not only does weed control promote tree vigor and growth, but it also simultaneously reduces the impact of cottonwood twig-borer (*Gypsonoma haimbachiana* Kft.). Discing must not be so deep that it damages lateral roots. Such damage induces top-dieback, thin crowns, and tree death (personal communication, Ray Gascon, Trans/Match).

Chemical Weed Control

Herbicides are commonly used in the northern USA and southern Ontario. Raitanen (1978) reported the use of several directed herbicidal sprays on hybrid poplar plantations in Ontario. Herbicides used for weed control in plantations older than 2 years appeared most economical and least damaging to roots. Raitanen reported a threefold increase in growth rate over control plots and a reduction in cultural costs from $150/ha to $60/ha.

Research at Stoneville, Miss., shows that weed control reduces pupation sites for many insects such as twig borers, leaf beetles, and poplar tentmaker (*Ichthyura inclusa* Hbn). Weed control also enables predators such as birds, especially woodpeckers, to locate pest insects more easily.

Observations at Stoneville indicate correlation between vine growth on *Populus* trunks and degree of poplar borer (*Saperda calcarata* Say) infestation; when weed control has eliminated vine growth, few borers are present. But vine growth on tree trunks provides shading that helps the self-pruning process and reduces epicormic branching. So, the benefits of controlling vines have to be weighed against the benefits of retaining them.

3. Kennedy, H. E., Jr. Soil and hardwoods influenced by cultural treatments. Prog. Rep., Southern Hardwoods Laboratory, Stoneville, Miss.

4. Francis, J. K. 1978. Irrigation of cottonwood to improve tree growth and increase effectiveness of a systemic insecticide. Final Rep. No. FS-SO-1111-2.16, Southern Hardwoods Laboratory, Stoneville, Miss.

Sanitation

Cultural and sanitation practices can greatly reduce problems with insect and disease pests in *Populus* nurseries. All branch, terminal, and basal trimmings as well as cut stems from vegetative cutting operations should be burned (Cook and Solomon 1976; Filer 1976). This practice destroys many overwintering cottonwood twig-borers, clearwing borers (*Paranthrene* spp.), Oberea borers (*Oberea* spp.), and willow shoot-borers (*Janus abbreviatus* Say), and reduces the potential for infestation. Infested stumps and rootstocks serve as the principal reinfestation reservoir for the cottonwood borer (*Plectrodera scalator* F.) and clearwing borer. After three harvests, every stump in the infested nursery should be pulled and new borer-free cuttings planted. The stumps should be destroyed by burning before early April, so overwintering larvae of these borers are killed before they emerge as adults and reinfest the nursery (Cook and Solomon 1976; Solomon 1979). Clearing the entire nursery of all rootstocks before replanting eliminates the major source of reinfestation. The annual harvest of cuttings should be inspected, and infested cuttings should be culled and destroyed. Clean cultivation and destruction of fallen leaves eliminates hibernation sites for cottonwood leaf-beetles and removes much of the inoculum reservoir for leaf and canker diseases.

These practices will directly or indirectly affect many of the more important diseases and insects including leaf diseases and insect defoliators. In most cases, when trees are vigorous, pests present fewer problems. And vigorous trees can generally tolerate greater disease incidence and more insects.

Insect and Disease Control

Chemical Control

Chemical controls have been effective in control of cottonwood leaf-beetles and cottonwood twig-borers in nurseries and plantations (Morris 1960; Abrahamson et al. 1977). Carbofuran, a systemic insecticide that is applied to the soil and taken into the roots, may also reduce nematode infestation. Carbofuran improves growth response in the absence of insect manifestation.[4] Such increase could be due either to nematode control or to fertilizer effect. EPA-registered insecticides (carbaryl and chlorpyrifos), used in aerial or ground application, control cottonwood leaf-beetles and twig-borers. And control is not delayed as it is when systemic insecticides have been applied to the soil.

Pest control in stressed or weakened cottonwood stands can be important in reducing growth loss and mortality. Serious defoliation by *Septoria* leaf spot and poplar tent maker occurred in 1978 in 6- to 9-year-old plantations at sites in Arkansas and Mississippi. Some of these stands were already weakened from delayed or late thinning, dry weather, and heavy growth of vines and weeds. Defoliation at these sites caused serious crown thinning, dieback, and mortality exceeding 50% in some stands. Trees in plots sprayed with insecticide (carbaryl) and fungicide (copper oxide) for poplar tent maker and *Septoria* leaf spot control exhibited noticeably better crowns 1 year later than did unprotected plots. In 1 year, growth in sprayed plots averaged 0.45 inch d.b.h., compared to about half that in unprotected (defoliated) plots. Mortality ranged from 0-5% in sprayed plots, but was 3-38% in unprotected plots. Damage from defoliation is likely to persist even after defoliation has ceased; so we will continue to evaluate benefits of protection for 5 years.

Genetic Resistance

Selecting for pest resistance in *Populus* shows promise. *Melampsora* rust resistance, because of its high heritability, is perhaps the easiest resistance to obtain. A population of 1440 cottonwood clones collected from the lower Mississippi River and studied at Stoneville contained about 30 clones highly resistant to *Melampsora* rust (Cooper and Filer 1977), 10 clones resistant to *Septoria* leaf spot (Cooper and Filer 1976), and several clones with some apparent resistance to the cottonwood leaf-beetle (Oliveria and Cooper 1977). Abrahamson et al. (1977) and Caldbeck et al. (1978) also reported resistance to leaf beetle. Twig-borer resistance was found in a hybrid poplar by Woessner and Payne (1971). Genetic differences apparently exist among *P. deltoides* clones in their ability to recover from repeated defoliation by the poplar tent maker. Presumably, resistance to most other major pests can be found in *Populus*.

Jokela (1966) reported that some resistant clones of *P. deltoides* have been found that are not attacked by *Melampsora* or *Marssonina* in the central USA. He concludes that breeding for resistance to these diseases is both feasible and necessary.

Schreiner (1971) pointed out that, though *Populus* has many actual and potential disease and insect problems, its rich genetic diversity should provide the needed resistance. Finding individuals having necessary characteristics and resistance to the multitude of important pests is difficult. Repeated cycles of crossing and selection could be used to bring the desired characteristics together, but the time and expense required would be great. Today, we can select for the composite characteristic of sustained good growth under a range of conditions representing those likely to occur in commercial plantations. We should also retain several unrelated clones for genetic variety. Disease control must change the predisposition of hosts so they will be more resistant to a particular disease by (1) clonal selection for a particular site, and (2) implementation of appropriate silvicultural methods (Hubbes 1979).

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