

1976

CHEMICAL CONTROL OF COTTONWOOD INSECTS

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Abstract.—Systemic insecticides provide the safest and most effective chemical control of defoliators, borers, and sapsucking insects of *Populus* sp. Carbamates and organo-phosphate sprays are good contact and stomach poisons for defoliators, adult borers, some miners, and immature borers. In many countries chlorinated hydrocarbons are still being used because they are economical and persistent. Chemical control of insects causing economic losses in poplar plantations and nurseries is most effective when combined with good cultural practices.

Additional keywords: Insect pests, poplar insects, *Populus deltoides*, *Deltoides* derivatives, cultural control.

Various defoliators, borers, and miners are serious insect pests of intensively cultivated poplars throughout the world. Severe outbreaks of these pests can significantly reduce production of cottonwood (*Populus deltoides* Bartr.) in plantations and nurseries. As increasing amounts of land are cleared and planted to cottonwood, managers are seeking effective chemical means of pest control. Although much information is available about chemical control of cottonwood pests, many of the methods and chemicals recommended during the past 50 years have been revised or are neither legal nor available commercially. This paper discusses chemicals and means of application available for use against cottonwood pests.

INSECTICIDES

Fumigants.—Fumigants are used more frequently in Europe than in the United States. A classical method of controlling cottonwood borers in Europe is to introduce calcium carbide, carbon disulphide, benzene, or zinc phosphide into the larval galleries. However, this type of control is expensive and time consuming since each gallery must be treated individually, and some products such as calcium carbide cause necrosis of the tree tissues (daFauce 1966).

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In areas where intensive cultivation of poplars is essential, cerambycids can be controlled by placing small sticks impregnated with a volatile insecticide in the entrance holes to kill the larvae.^{3/}The Pakistan Forest Institute has reported injecting dicrotophos (Bidrin^R),^{3/} an organo-phosphate systemic, into *Populus nigra* L. on a small scale for control of grubs feeding inside the tree. This treatment provides protection for several months. In countries where these insecticides are not readily available, the entrance holes are plugged with cotton wool impregnated with carbon disulfide or with crystals of paradichlorobenzene (Chaudhry et al. 1969).

Sprayables.—In Europe Dieldrin, BHC, DDT, heptachlor, and other chlorinated hydrocarbons have long provided good control of defoliators and adult borers of young cottonwood (daFauce 1966). However, in the United States and most foreign countries, many chlorinated hydrocarbons are no longer available without special permits, even though their long residual activity is often desirable.

In Europe most cottonwood insect pest control is accomplished with one of the organic phosphates (OP) or with carbamate insecticides such as parathion, azinphos-methyl (Guthion^R), malathion, methomyl (Lannate^R) and carbaryl (Sevin^R). In Italy *Gypsonoma aceriana* Dup. is controlled by spraying the foliage with organic phosphates in autumn before the larvae move to the stem for hibernation (deBellis 1960). Additional organic phosphate insecticides also provided good control for *Cryptorrhynchus lapathi* L., *Saperda carcharias* L., and *Nycteola asiatica* Kurl. in Italy (Cavalcaselle and deBellis 1966, 1968). A tenthredinid miner (*Heterarthrus ochropodus* Klug.)—economically harmful to poplars in Northern Italy—may be satisfactorily controlled during the fourth instar by spraying infested trees with malathion (Arru 1965). In the United States insecticides such as malathion and chlorpyrifos (Dursban^R) have been applied on experimental plots as low volume or ultra low volume (ULV) sprays for control of cottonwood leaf beetle (Morris 1976). Page and Lyon (1976) conducted a contact toxicity test of 21 insecticides on adults and larvae of the cottonwood leaf beetle *Chrysomela scripta* F. Their results indicated that several insecticides already registered for use against major agricultural pests and other forest insect pests were suitable candidates for field tests. Continuing work in Mississippi shows that 2 oz. active ingredient (a.i.) per acre of chlorpyrifos provided good control of the cottonwood leaf beetle in plantations when applied with a low volume tractor-mounted applicator. A ULV mist blower is often used in nurseries for applying contact and stomach poisons. Most OP and carbamate insecticides cause little environmental contamination problems since they are relatively shortlived and do not accumulate in the food chain.

Systemics.—Recently, increasing interest has developed in the use of systemic insecticides. Systemics provide several months protection, can be applied safely, and offer little hazard of environmental pollution—especially when applied as subsoil treatments in the root zone of target plants. Phorate (Thimet^R) has been used as a dip or band application. Wetting cuttings with

^{3/} Mention of trade names is solely for identification and does not constitute endorsement by the USDA. The symbol ^R signifies trade mark registration of the materials' name only and does not imply registration by EPA.

water and then dipping them into a dust containing activated carbon and 44 percent phorate immediately before planting provided good control of the cottonwood twig borer *Gypsonoma hainbachiana* (Kearf.), *C. scripta*, *Metachroma* sp., *Paranthrene dolli* (Neum.), and leafhoppers, mostly *Homalodisca coagulata* (Say.) (Morris 1960). Crown Zellerbach Corp. and Champion Paper Co. have also used cottonwood cuttings powdered with Thimet^R immediately before planting for control of cottonwood twig borers (Anonymous 1962). Lavigne and Stevens (1965) reported testing several systemic insecticides for effectiveness against the clearwinged cottonwood leaf aphid, *Chaitophorus populellus* Gillette and Palmer. They found oxydemeton-methyl (Meta-Systox-R^R) to be the most effective material tested when injected into the tree both through the root and trunk. Systemic insecticides (aldicarb, carbofuran, disulfoton and phorate) have also been tested for control of the poplar tentmaker *Ichthyura inclusa* Hübner. Ten percent granular formulations were placed in four holes 8 inches deep equidistant around the tree. Trees treated with carbofuran sustained no defoliation (Coster 1972). Recently, other studies have shown that carbofuran (Furadan^R) effectively controls the cottonwood leaf beetle, cottonwood twig borer (*G. hainbachiana*), a clearwing borer (*P. dolli*), and various other insects that either defoliate or feed on the sap of cottonwood trees such as leafhoppers and aphids in cottonwood nurseries and plantations (Abrahamson et al. 1973; Abrahamson and McCracken 1971; Neel 1969; Coster et al. 1972; Abrahamson et al., Morris and Abrahamson (unpublished mss)).

In 1969-70 Abrahamson found that carbofuran (Furadan^R 10% granules) was far superior to phorate (Thimet^R 10% granules), disulfoton (Di-Syston^R 15% granules), aldicarb (Temik^R 10% granules), and propoxur (Baygon^R 15% granules) in protecting cottonwood trees from the cottonwood leaf beetle, cottonwood twig borer, and the cottonwood clearwing borer.^{4/}

Morris (1972) reported that systemic insecticides, especially carbofuran, must be transported from the soil into the young tree's roots and systemically translocated throughout the entire tree to be effective. In midsummer, when dry weather prevents adequate systemic transport, leaf beetle populations may become large and other control strategies may be necessary. Arru and Lapietra (1971) and Lapietra (1971) reported cutting protection in Italy during the first months of growth from attacks by insects that feed on leaves and young shoots by treating the cuttings with systemic insecticides.

Lapietra (1975) concluded that carbofuran can be effectively used in Italy for the control of *G. aceriana*, *Paranthrene tabaniformis* Rott. and *Phyllocnistis suffusella* (Zell.) in 1-year-old poplar nurseries; however, in many cases the cost may be prohibitive. Particular care must be taken to consider soil type and date of application.

At Stoneville, Mississippi, a combination of a systemic insecticide and a slow release polymer is being tested as a pre-plant dip technique against cottonwood nursery and plantation pests. Preliminary indications are that a single 4-inch dip coating on the planted end of a cutting may provide protection for 1 year or more against defoliators and sapsucking insects.

^{4/} Abrahamson, L. P. 1971. Establishment and Final Report FS-SO-2251-2.5.

METHODS OF APPLICATION

Aerial Application.--When a cottonwood plantation is located in a site not readily accessible by ground equipment or when weather conditions prohibit the use of ground equipment in a plantation or nursery, aerial application of insecticides may be feasible. However, few documented examples of the use of this method exist. Aerial applications of endrin and dieldrin were successful in controlling cottonwood leaf beetles in two commercial plantations in the Mississippi River Delta (Morris 1956). When chlorinated-hydrocarbons and a carbamate were tested at varying concentrations in 3 gallons of water per acre, most of the formulations provided over 95% control. Oliveria and Solomon have achieved 95% mortality of cottonwood leaf beetles in Mississippi after fixed-wing aircraft applications of chlorpyrifos at rates as low as 1 oz. a.i./acre (unpublished data). At this rate approximately one-third of the ladybird beetles, *Coleomegilla maculata* (DeGeer), a major natural predator and population density regulator, survived the spraying.

Hepburn (1961) reported the aerial spraying of insecticides on 50-foot high *P. deltoides* in South Africa for control of the defoliating caterpillar *Lobobunaea epithyrena* (Saturniidae). Aerial treatments against expanding populations of *Lymantria dispar* L. and *Hyphantria cunea* (Drury) in willow and poplar plantations were reported from Bulgaria (International Poplar Commission 1975).

Subsoil and Paint-on Application.--Immersion of cuttings in a concentrated systemic insecticide emulsion before planting is a simple application method that holds little danger of soil pollution. However, the cost of obtaining satisfactory results is higher than that of applying sprayable insecticides (Lapietra 1971). Morris (1960) coated the lower 10 inches or more of 20-inch cuttings, which were planted 15 inches deep, with 44% phorate and activated carbon. This treatment protected the treated trees throughout the first growing season. Lapietra (1971) reported that dimethoate, phorate, and schradan are very phytotoxic if the cuttings are allowed to absorb the insecticide through prolonged immersion in a concentrated emulsion of systemic insecticide.

Subsoil applications of granular insecticides are often necessary in nurseries and are not hazardous to operators once the hopper of the applicator has been filled. The chemical falls to the bottom of the slits cut by the blades and is covered as the slits close. Humans, birds, or animals are therefore very unlikely to come into contact with it (Abrahamson et al. 1973). Experiments at Stoneville have revealed the importance of careful timing of subsoil applications of carbofuran for control of either early or late season buildups of cottonwood leaf beetle populations. Lapietra (1975) found that in Italy carbofuran and disulfoton must be applied before mid-June to control *G. aceriana*.

Paint-on applications of systemic insecticides are approximately four times more efficient than subsoil applications, but paint-on treatments involve greater hazards of exposure and pollution.^{5/} Applications are made directly

^{5/}Personal communication, Howard L. Anderson, Union Carbide Corp.

to the cottonwood tree stem, absorbed through the bark, and translocated systemically throughout the tree. Paint-on treatments are very similar to preplant dipping except that paint-on treatments can be applied to the trunk after the tree is established.

Ground Spraying.--Hydraulic sprayers have been used for many years to control cottonwood insects in nurseries in the United States. Several companies use ULV mist blowers for control of nursery pests. Cottonwood leaf beetle infestations have not been widespread enough to require extensive chemical control in large plantations of several hundred acres or more. Some experimental applications of Dursban^R for control of the cottonwood leaf beetle have been made with a tractor mounted ULV Span-Sprayer (Morris 1976). The use of tractor-mounted spray equipment in cottonwood plantations is currently being evaluated at Stoneville.

In Europe trunk spraying with longlasting residual insecticides (endrin, dieldrin, lindane) is limited to control of insects with long oviposition periods such as *P. tabaniformis*. Contact poisons such as parathion and methyl parathion are now considered to be too hazardous for trunk sprays. Despite their high cost, phenthoate, trichlorphon, phenthion, tetrachlovinphos, and chlopyriphos are being used increasingly (International Poplar Commission 1975).

An automatic unmanned sprayer has been perfected in Italy; it permits accurate spraying of poplar trunks, but hazards to the operator are reduced, and one operator can treat two rows of poplars simultaneously (International Poplar Commission 1975).

INTEGRATED CONTROL

Chemical control of poplar insect pests is only a partial and temporary solution to insect problems in plantations. Some pests of poplar, such as *Aegeria tibialis*, a root borer of poplar nursery beds, are very difficult to control chemically. Peterson and Worden (1964) reported that heavy applications of heptachlor to the soil were not effective and recommended removing old beds and establishing new ones.

Maisenhelder (1960) reported that insects tend to attack poor sites and weak trees; therefore, any practices such as cultivation that help produce healthy, vigorous trees reduce the likelihood of economic damage. Field observations by scientists at Stoneville indicate that although trees on poor sites do not necessarily experience higher attack rates or higher insect populations than those on good sites, the damage from a given number of insects is much greater in a poor site. Therefore, reduced growth on such sites is noticeable. Maisenhelder (1960) recommended that infested stumps in nurseries and all refuse from the production of cuttings should be destroyed. It is common in Mississippi to remove and burn nursery rootstock after three growing seasons to help control populations of *P. dolli*.

Eleven species have been reported as predators of the cottonwood leaf beetle in Mississippi.^{6/} *C. maculata*—a ladybird beetle—was by far the most common; a pteromalid and a tachinid were the only parasites reported.

Biological and environmental factors alone are sometimes sufficient to keep peak attacks of such insects as *C. scripta* below the level of economic significance. Artificial control during the spring and early summer should be initiated only if trees would otherwise sustain economic losses. Decreases in late summer populations of predators—especially the ladybird beetles—often allow a build-up of cottonwood leaf beetle populations; artificial control may be desirable during this period.

In April 1960, the Lion Match Company reported that caterpillars (*Lobobunaea epithyrena* (Saturniidae)) were defoliating *P. deltoides* on their Sheepmoor farm near Ermelox, South Africa. During May to September, an attempt was made to destroy the pupae by placing seven pigs in the 20 acres affected. Although the pigs ate large numbers of pupae, they failed to control the pest. Large numbers of pupae were found 5 inches below ground level between the densely matted roots near the bole of the tree (Hepburn 1961).

Several cultural methods that help reduce the incidence of insect attack in Italy are careful soil cultivation, early irrigation where necessary, and the choice of clones having vigorous root systems (Arru 1960, Chaudhry et al. 1969). DaFauce (1966) reported that cottonwood nurseries on plantations should not be planted near coppice poplars or poplar stands that are in poor condition or near locations where insect control is not possible; because of the possibility of infestation from stored logs, he recommends that plantations and nurseries not be located near sawmill log yards.

Sidor (1971) discusses the importance of virus diseases for control of insect pests of poplar. Virus diseases have reportedly caused populations of some poplar insect pests in Yugoslavia to decline abruptly to levels below economic significance.

Extensive programs have been set up to increase populations of insectivorous birds in Bulgaria and Spain by providing artificial nests. Increases in the incidence of parasitic insects is being promoted by planting nectar-producing weeds for food (International Poplar Commission 1975).

The removal of ground weeds in poplar plantations was the best control of the Japanese swith moth (*Phassus excrescens* Butler) in the Republic of Korea (National Poplar Commission of the Republic of Korea 1975).

SUMMARY

Chemical pesticides should be used only when insect pest population densities are great enough to cause economic damage to cottonwood plantations and nurseries. The type of control used will vary according to geographic location, pest species,

^{6/}Head, R. B. 1972. Ph.D. dissertation. Mississippi State Univ., State College, Miss.

weather conditions, pesticide availability, cost of both the insecticide and the application, and to some extent, with the personal preference and previous experience of the manager. Despite the environmental advantages of systemic insecticides, they are more expensive than spray-applied insecticides.

In the Mississippi River Valley, insect control is often essential in cottonwood nurseries; in plantations, however, the margin of profit is often so small that many growers feel chemical control to be justified only when insect pests threaten stand establishment and early growth.

A recent publication by the U. S. Forest Service (Morris et al. 1975) discusses insect damage and lists the chemicals registered by the Environmental Protection Agency for control of insects that attack *Populus deltoides* in the United States.

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