PESTICIDES—MERE DO WE STAND

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Where do we stand? We stand blindfolded at the plate trying to hit one of Vida Blue's fast balls. The teletype message came 3 years ago--"Stop using nine persistent chlorinated hydrocarbon insecticides." No more DDT, BHC, aldrin, dieldrin, endrin, chlordane, lindane, toxaphene or heptachlor. My first reaction was, "What do we have left to control hardwood insects?" We had some organo-phosphates such as parathion, methyl parathion, guthion, and malathion. The first three were highly toxic and hazardous to man, and the fourth, available as a water emulsion spray, was effective for only 1 or 2 days after application. The systemic insecticide phorate (as Thimet 44% dust)[1/] protected young cottonwoods for 1 year but its application was hazardous and its toxicity to humans was very high. The safer 10% granular form only provided protection for about 1 month in our tests. The carbamate insecticide carbaryl, or Sevin, could be used as a wettable powder, but it gave variable results and was toxic to honeybees. Some research on cottonwood was in progress, that on other hardwoods was being planned. New, environmentally acceptable materials and application methods had to be found and tested, not only to replace the restricted chemicals, but to provide adequate, practical means for protecting nurseries, producing high-quality planting stock, and assuring successful plantation establishment.

Somewhat the same conditions existed for hardwood diseases in nurseries and plantations. The expensive soil fumigation method to control weeds, nematodes, and diseases could be continued with the registered fumigant methyl bromide, but safer, easier, and less expensive methods were needed. No fungicides were as effective as the mercury compounds in use but these were soon prohibited. Without the mercurials, we could not control the damping-off diseases, blight (Phomopsis) and the leaf spot and dieback diseases of hardwoods. No materials were registered for the serious leaf diseases of cottonwood and the anthracnoses of sycamore and other trees.

1/ Mention of trade names is solely for identification, and does not constitute endorsement by the U.S. Dept. of Agriculture.

Relatively few new insecticides and fungicides were being developed. Testing, determining toxicity, and complying with regulations raised costs, and market competition and public resistance to pesticides reduced returns. A manufacturer could ill afford to invest a million or more dollars in what was at best a risky venture. Funds for company research were sharply curtailed and everyone waited for something to happen.

But insects and diseases were not waiting. As new and larger nurseries and plantations provided pure stands of cottonwood, sweetgum, sycamore, oaks and other hardwoods, pest populations grew and concentrated. Nuisance species such *as* the cottonwood leaf beetle rather suddenly became major pests in nurseries and 1- and 2-year-old plantations. Little-known pests severely damaged sycamore plantations, and the familiar fall webworm appeared in young sweetgums. Endemic leaf-spot diseases in natural areas became epidemic in some nurseries, especially where a tree species was grown in the same bed for successive years. Worse yet, a leaf-spot fungus in association with stem boring insects caused a stem canker disease. Damping-off diseases became more serious in large nurseries, and infected seedbeds had to be replaced. Naturally occurring fungi and bacteria of no present concern may suddenly assume importance as planted acreages increase. We have efficient insect vectors for viruses, bacteria, and fungi. Little *is* known of the effects of nematodes on young trees, and unrecognized bacterial and virus problems may develop.

Establishing hardwood nurseries and plantations is expensive--$40 to $100 per acre for cottonwood plantations. Research must find better ways to protect these investments from damage by insects and diseases.

Studies on cottonwood insects in 1958-1961 demonstrated that conventional control methods were not effective. Foliar sprays protected existing leaves and branches, but unsprayed new growth was the target of new insect attacks by twig borers and leaf beetles, and sprays did not reach the trunks to prevent damage by aegeriid clearwing borers. The early studies with phorate (Thimet) demonstrated the value of systemic insecticides, so new materials of this type were sought.

Testing new systemic insecticides was started in 1967 ang expanded in 1969-1971. The chemicals included Thimet[R], Di Syston[R], Temik[R], Baygon[R], and Furadan[R] [2/] Furadan, the most effective of the five, was highly satisfactory. A carbamate insecticide, it is fairly toxic to humans but safer than Thimet and less dangerous on the skin. It has controlled cottonwood leaf beetles, twig borers, and clearwing borers for a full growing season and reduced eriophyid mite damage. A 10-percent granular formulation can be safely applied in the soil in slits made by sub-soiler blades. Application depths are varied for different soils to place the chemical near the roots. Rapid uptake occurs if sufficient soil moisture is present. Once the applicator hopper is loaded, there is almost no hazard to the operator, and placement in the soil minimizes environmental effects and hazards to wildlife. Beneficial insects, including predators, do not touch the insecticide, which affects only organisms feeding on the plant tissues. Test results to date are very good. The manufacturers of Furadan are seeking its registration by the U.S.D.A. for use in cottonwood nurseries and plantations for control of the cottonwood leaf beetle, Chrysomela scripta; the cottonwood twig borer, Gypsonoma haimbachiana; two aegeriid trunk and branch borers, Paranthrene dollii and P. tricincta; and associated detrimental insects. The insecticide is widely used for control of pests of corn and rice, and its registration is pending for control of other agricultural pests. It may well have value for control of many other hardwood insects.

The systemic insecticide must move from the soil into the young tree's roots and throughout the plant to be effective. Dry weather may reduce soil moisture and limit this movement to roots in midsummer when leaf beetles build up large populations. At this time, other chemical controls may be necessary. Our tests show that ultra-low-volume sprays of concentrated chemicals can kill beetle larvae and adults. Tractor rigs with high-pressure ultra-low-volume equipment can apply as little as 8 fluid ounces of material per acre. Experimental sprays of malathion (Cythion[R]) and Dursban[R] were effective. Both need U.S.D.A. registration before we can recommend their use. This method of control should be used only when serious damage will otherwise result. The spray kills all insects present in the area--beneficial as well as harmful. In one study, we collected over 100 species of dead insects and spiders on the ground beneath young cottonwoods the day after the spraying. We did kill the leaf beetle, however, some of our cooperators have sprayed high dosages of methyl parathion on their cottonwoods from the air. Who knows the complete effects of this stop-gap approach?

2/ The Symbol [R] signifies trade mark registration of the material's name only and has no connection with its registration by the U.S.D.A.

I want to emphasize that we do not have any registered material for cottonwood insect control--and we cannot recommend anything--even though we have the above information.

We are exploring use of biological controls. We are learning about natural enemies, diseases, parasites, and predators of the insects of young hardwoods. We know of wasp parasites of cottonwood leaf beetle pupae and several lady beetle species which feed on the eggs, larvae, and pupae. Some predacious bugs and spiders feed on the leaf beetle larvae and adults. Wild turkeys pick leaf beetles off the young cottonwoods.

Dr. Filer and his workers are making considerable progress on disease controls. Soil fumigation with methyl bromide requires a soil temperature of 60° F and prearranged gas-tight covers on the beds. A 72-hour planting delay after treatment is mandatory. An improved method uses Brozone injected 5-8 inches into the soil and covered after application, Dowfume MC-33 can be used similarly. A newer material, Vorlex,3/ can be applied to moist soil without covering after application. This material effectively controls weeds, nematodes, and seedling diseases at less cost and is much easier to use. Nursery bed treatments for control of the soil-inhabiting white grubs and white fringed beetle larvae require the insecticide chlordane, which can be used until a satisfactory substitute is found and developed. This chemical is also permitted for soil poisoning against termites.

In the past damping-off diseases, blight (Phomopsis), leaf spot, and stem dieback of hardwoods have been controlled with mercury compounds. These are now considered environmentally unacceptable, and the registered chemicals being used are Captan, Thiram, and Arasan 50-red. These materials are not as effective as the mercurials, and better chemicals are needed. Recent studies are demonstrating the value of Vitavax and Terraclor Super .X for control of damping-off organisms. Protection is comparable to that with the mercury compounds, and U.S.D.A. registration is being sought by the manufacturers.

Leaf-disease organisms of cottonwood, such as Septoria and Melampsora, are being treated with the copper compound Kocide 101, for which no tolerance levels are established. This and two other fungicides, Benlate and Difolatan, are being tested, and sufficient data to support their registration may be available after the 1972 growing season.

3/ Methyl isothiocyanate.

SUMMARY

We do not now have much that can be recommended for insect and disease control in hardwood nurseries and plantations, but new registrations will release some very effective controls. For insects we presently can recommend the carbamate Sevin and the organo-phosphate malathion for spray applications, and chlordane for soil insects. The registrations of Furadan systemic insecticide and the ultra-low-volume malathion (Cythion^{R}) and Dursban^{R} for spraying will provide very effective controls of many insect pests.

Soil fumigation for controlling diseases, weeds, and nematodes will be less expensive and easier with new chemicals that do not require a plastic tarp. If registered, Benlate and Vitavax fungicides will effectively replace undesirable mercurials for disease control. Benlate, Difolatan, and Kocide 101, when they are registered, will provide new weapons against the leaf diseases and stem cankers.

Where do we stand? We are struggling through with what we can presently recommend, and looking to the near future when we can use exciting weapons in our new arsenal.