INSECTICIDES FOR PINE SEED ORCHARD INSECT CONTROL

Edward P. Merkel, Entomologist
Southeastern Forest Experiment Station
U. S. Forest Service, Olustee, Florida

Today forest nurserymen and seed orchardists have an almost overwhelming array of insecticides from which to select. Despite the variety of available insecticides, many nurserymen understandably continue to use the time-tested chlorinated hydrocarbons, such as DDT, BHC, and chlordane. Even though these older pesticides have helped to solve many of your insect control problems, I should like to direct your attention to some of the newer insecticides, particularly systemics, and bring you up-to-date on our current research on the chemical control of seed orchard insects.

It may not be possible to formulate the "perfect" insecticide but systemics have many advantages that warrant continued intensive research and further development. A systemic insecticide is a chemical which is absorbed and translocated to other parts of the plant rendering certain untreated plant tissues insecticidal.

Some of the advantages of systemics are: (1) they are selective in their killing action and tend to minimize harmful effects on beneficial insects such as parasites, predators, and pollinators: (2) they usually do not leave long lasting residues in the soil or on the plant which could contaminate the environment; (3) they often render the treated plant insecticidal for long periods of time thus reducing the number of insecticide applications; (4) depending on the insect to be controlled, they can eliminate the need for precise timing of insecticide application; (5) they are subject to a wider variety of application methods than residual type insecticides; (6) they are less susceptible to weathering than ordinary insecticides; and (7) they are more subject to accurate dosage prescription.

Among the disadvantages of systemics are: (1) they are often highly toxic to humans and animals and require careful handling and application by trained personnel; (2) they usually cost more per unit weight of active ingredient than residual-type insecticides; (3) they do not lend themselves to use on large forested areas; and (4) the long term effects of continuous use on forest trees has not been studied intensively.

Research results with systemics on trees have often been inconclusive and erratic. Johnson (1965) sums up the problem as follows:

> The translocation and distribution of systemics in trees appears to vary according to the chemical and the species in

question. One chemical may work well on cone-infesting insects and yet fail miserably on bark-feeding aphids on the same tree. Fundamental work on the translocation of various systemics in trees is essential before marked progress in their use for tree protection is likely. In particular, knowledge on the following is required.

1. Pattern of translocation (from application to stem, root, or leaf).

2. Sites of accumulation.

3. Rates of movement.

4, Persistence.

5. Effect of season on translocation.

6. Effect of weather factors on translocation.

7. Effect of tree vigor on translocation.

8. Efficient and economical methods of application.

9. Effect of repeated application on the tree.

During the past year, basic research on the above problems has been initiated at our Forestry Sciences Laboratory, Research Triangle Park, North Carolina.

SYSTEMICS FOR CONE INSECT CONTROL

Field experiments and screening of systemics for cone insect control has been intensified at Olustee, Florida, this year. It is too early to give final results, but two chemicals, Shell Development Company's Bidrin and SD 9129 have given virtually complete protection to slash pine cones from Dioryctria coneworm attack as of mid-June. Both of these systemics were applied in mid-January as undiluted liquid concentrates in 3/4-inch x 3-inch drill holes in the tree trunks about 4 feet above ground-level. Dosage applied was 10 ml of systemic concentrate per inch of tree diameter at breast height. The trees ranged from 40 to 55 feet in total height and 10 to 16 inches in diameter. A Bidrin trunk-implant application in late April is also giving excellent cone protection from Dioryctria coneworms. The effects of these treatments on Laspeyresia seedworms will be evaluated in late fall. A single May 5 application of Bidrin on three slash pines last year gave excellent control of the slash pine seedworm and coneworms until cone harvest in mid-September.

A special tree injection device, known as the Mauget Tree Injector, is also being tested at Olustee for the application of Bidrin and other systemics to 80-foot-tall trees in a slash pine seed production area.

We are currently experimenting with mist blower applications of a systemic. The insecticide is dimethoate (American Cyanamid's Cygon). It has excellent residual insecticidal qualities and is only moderately toxic to warm blooded animals. This insecticide was applied with a John Bean "Rotomist" mist blower in a slash pine seed orchard at Olustee on April 5, May 4, and May 20. The 2.5 percent dimethoate water emulsion was applied at the rate of 100 gallons per acre, or slightly less than 1 gallon per tree. On June 5, 2 months after the initial application, attacks by Dioryctria spp. coneworms had been reduced 88 percent when compared with cone attacks on untreated trees. Additional applications are being made in late-June, July, and August at half the concentration of the first three applications. Slight needle burn resulted from the 2.5 percent concentration.

While high-volume insecticide application has proven effective for cone insect control (Merkel, 1964), it is limited to use on trees up to 50 feet in total height. This is why we are presently experimenting with low-volume application equipment. Merkel (1965) found that even though mist blower insecticide applications were more economical than hydraulic sprayer treatments, the low-volume applications were not as effective. However, in the mist blower experiment described above we are obtaining insect control comparable to that obtained with high-volume sprays, but at a cost of S10 per acre less than the standard 0.5 percent BHC hydraulic spray applications.

SYSTEMIC CONTROL OF PINE TIP MOTHS

Control of pine tip moths, Rhyacionia spp., is of primary concern to the forest nurseryman and seed orchardist who not only want insect-free planting stock for large scale reforestation projects but who are also responsible for the protection of grafting stock and grafted scions in their tree improvement programs. The question of the impact of tip moth-caused shoot damage on subsequent flower production has not been answered conclusively to date, but this problem is being studied presently at our Athens, Georgia, laboratory.

DDT has been the standard insecticide for tip moth control, but thorough and well-timed spray applications have been a prime requisite to the successful use of this chemical.

Cade and Heikkenen (1965) found that the systemic, phorate (Thimet), when raked into nursery bed soil prior to planting at the rates of 5, 10, and 15 pounds of actual insecticide per acre, gave 88, 98, and 99 percent control, respectively, of the second tip moth generation on loblolly pine seedlings. Cade and Heikkenen (1965) also reported that 4-year-old loblolly pines in a seed orchard received 96 to 100 percent protection from second- and third-generation tip moth infestation when 50 pounds per acre of actual phorate (Thimet) and disulfoton

(Di-Syston) granular were disced into the soil. These authors also found that 1-0 loblolly seedlings could be protected from tip moth infestation for 1 year after outplanting by dipping the roots of the transplants in clay slurries containing 1 percent by weight phorate or disulfoton.

Mason (1965) applied 20 grams of either phorate or disulfoton 10 percent granular to the soil surface at the base of loblolly and Virginia pines starting their fourth growing season. Both systemics gave good protection from tip moths for the remainder of the year.

The author sprayed sand pine, Pinus clausa (Chopm) Vasey, heavily infested by tip moth in a Florida seed orchard, with 0.25 and 1.0 percent, by weight, dimethoate sprays. Despite the fact that tip moth larvae were in their last feeding instar in the shoots, the lower concentration gave 94 percent control and the high concentration gave complete kill.

Although dimethoate has not been tested on a commercial scale, I would recommend that you try it when the opportunity arises. Dimethoate not only has the advantage of being safer to handle than most systemics, but spray applications do not have to be critically timed as with DDT. In other words, if you should get a little careless with your spray program, and the tip moth gets a head start in the nursery or seed orchard, dimethoate will give you good kill of larvae that have already penetrated the shoots.

I would also like to point out that dimethoate (Cygon) is currently being used against a wide variety of ornamental and shade tree insects such as mites, aphids, scales, thrips, white flies, mealybugs, bagworms, and needle miners. However, check insecticide labels carefully before assuming that this insecticide is a cure-all for all your nursery and seed orchard insect problems.

THE FUTURE OF SYSTEMICS

I believe that systemics will become an important tool for the control of nursery and seed orchard pests in the future. However, there are some major obstacles to overcome, some of which were mentioned earlier, before systemics are used extensively. The high mammalian toxicity of many systemics has created a fear complex among many potential users. Fear is unwarranted, but safety precautions and thorough awareness of health hazards are definitely a requisite to systemic usage. With properly trained personnel and close supervision, as is often found at nurseries and seed orchards, the hazards of handling systemics should not be a limiting factor.

Some of the methods of application of systemics presently being used in our experiments may not be practical in nurseries or large seed orchards, e.g., trunk injection with drill holes. Yet it must be

remembered that if a single application can protect a tree for an entire year or longer, one could afford to spend more time and money in what might appear to be an uneconomical application method.

In closing, I would like to offer a word of caution to potential users of systemics. We do not know what effects the continuous use of these chemicals may have on seed yields and seed quality, i.e., seed viability. Until we obtain the answer to this question, I recommend that systemics be used sparingly.

Cade, Stephen C. and H. J. Heikkenen
1965. Control of pine tip moths on loblolly pine with systemic insecticides. Ga. Forest Res. Council, Ga. Forest Res. Paper 32, 4 pp., illus.

Johnson, Norman E. and J. H. Rediske
1965. Systemic pesticides in woody plants. Bull. Ento. Soc. Amer. 11:190-195.

Mason, R.
1965. Systemic insecticides for pine tip moth control. Hiwassee Land Co. Forest Res. Note 17, 3 pp.

Merkel, E. P.
1964. Hydraulic spray applications of insecticides for the control of slash pine cone and seed insects. Southeast. Forest Expt. Sta., U. S. Forest Serv., Res. Paper SE-9, 7 pp.

1965. Mist blower applications of insecticides for cone insect control on slash pine. Southeast. Forest Expt. Sta., U. S. Forest Serv., Res. Note SE-52, 4 pp.

Discussion

Q. (Carter) Did you use Di-Syston and Meta-Systox R in your screening for cone insects?

A. (Merkel) I have not tried Meta-Systox R. I have Di-Syston under study, but results to date don't look very encouraging. Both Bidrin and Shell SD 9129 do look promising and I might mention that the same chemicals have been very effective against cone insects on Douglas-fir in the Pacific Northwest.

Q. (Carter) Are they organic phosphate compounds?

A. (Merkel) Yes, they are. I would like to mention one insecticide in passing which should be on the market next year. It's Shell compound SD 8447, which will probably appear under the name "Gardona.

This is a non-systemic phosphate, but it is a very safe material. It has a mammalian toxicity much lower than malathion. It looks very encouraging in our preliminary tests against coneworms and seed worms.

Q. (Williams) I thought all of these systemics were applied on the ground and taken up in the tree. What's the difference between the systemics and DDT?

A. (Merkel) Systemics can be put on in a variety of ways. If you apply them as granular materials you don't have much choice but to put them on the soil, either on the surface or disked in; but if they are in the liquid form, you can apply them in drill holes paint them, or spray them, to mention a few of the common methods of application.

Q. (Williams) Isn't there a hazard of applying it with a mist blower as far as drift and other problems of mist blower application of insecticides?

A. (Merkel) Yes, I haven't the nerve to try the more toxic chemicals with the mist blower. Dimethoate, which I am putting on with a mist blower this year, is a fairly safe material of moderate toxicity to warm blooded animals. It can be sprayed on the foliage and is directly absorbed into the trees. Some research has shown that you can paint it on a branch and it won't translocate to another branch either above or below it, but it has excellent penetrating qualities, plus the extra factor that it has very good surface residual action. In contrast, a systemic like phorate, when applied to the soil, will keep moving out into the new growing tips as the season progresses. Each systemic insecticide has very specific characteristics of absorption and translocation in trees--another word of caution, some systemics when applied as granules may work better on sandy soils than on heavy soils, or vica versa.

Q. (Engstrom) Have you tried any of these in DMSO?

A. (Merkel) No, they are dangerous enough without increasing the hazards. Mixed with DMSO, one drop on the skin would carry these insecticides throughout the body in seconds.

Q. (White) Is it safe to broadcast, due to the problem of runoff with heavy water applications?

A. (Merkel) It's probably better to disk into the soil. However, it only takes a tablespoon per tree with some systemics in young seed orchard trees.

Q. (White) I was thinking about nursery beds?

A. (Merkel) In the nursery beds your best bet would be to disk the granular systemics into the soil.