Problems Involved in the Control of Cone Insects by Aerial Spraying

By:

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Entomologists at the Southeastern and Southern Forest Experiment Stations are currently engaged in research aimed at developing methods for the control of insects destructive to pine flowers, cones and seeds. In order to attain the goals of entomological soundness and economical practicability in control methods, we are striving to obtain essential information on the identification, life histories, habits, and ecological relationships of the major cone-and seed-insect pests. This basic knowledge is the prerequisite to any biological, chemical, or silvicultural control method.

We naturally look to chemical control as our immediate line of defense. This is to be expected when one observes the spectacular insect control which has been obtained with the great variety of new insecticides developed since 1946.

Several authors have already published on the chemical control of southern cone and seed insects. Allen and Coyne (1) have reported satisfactory protection of longleaf and slash pine cones with hydraulic-spray applications of a 0. 5-percent gamma BHC (Benzene hexachloride) water emulsion applied in April, June, August, and October. Coyne (3) also reported that pines in southern Mississippi, in preliminary trials, were successfully and economically protected from cone-insect attack with a 0. 5-percent gamma BHC water emulsion applied by means of a turbine mist blower. Cole (2) used an airplane to apply 12 ounces of 36-percent gamma BHC per gallon of fuel oil at the rate of 1 gallon per acre to a slash pine seed production area in Long County, Georgia. Differences in the protection of 1-year-old and new cones on sprayed and check trees were not statistically significant when sprays were applied on February 25 and June 15, 1957. However, mortality of new cones was significantly reduced in 1958 when sprays were applied earlier; i. e. , on February 17 and May 10.

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Although these references to chemical control are encouraging, there are still many obstacles to be overcome. Despite the fact that benzene hexachloride is very toxic to Dioryctria "coneworms" in laboratory and field tests, we should not rely on this single chemical to solve all our control. problems. Entomologists at the Gulfport, Mississippi, and Lake City, Florida, laboratories are continuing the search for chemicals that are cheaper and less phytotoxic than BHC. Laboratory insecticide-screening tests, conducted at Lake City during the past year, indicate that aldrin, DDT, and Sevin are potentially effective chemicals when tested against half- to fully-grown Dioryctria abietella (D. & S.) larvae. Considerable testing of these and other promising insecticides under field conditions is needed; and studies of the effects of weathering on the residual longevity of insecticide deposits on flowers and cones should be undertaken.

Because of the scarcity of available information on the life histories and habits of major southern cone and seed insects, most of the field applications of insecticides, to date, have been made largely on an arbitrary timing basis or by guesswork. Although this approach, has yielded some promising results, there is much to be gained by determining the optimum time for insecticide applications. If we know the insects we want to control, considerable time, effort, and money can be saved when insecticides are applied to correspond with the most vulnerable stage of insect development or with a period when the insect is most likely to contact, or be contacted by, the chemical.

Other problems arise when we consider where chemical control is to be applied" i. e. , in seed production stands, in seed orchards, or on individual trees or single branches of trees of high genetic value. Seed production areas usually contain very tall trees and generally are not accessible to heavy, ground spray equipment. In such areas, fixed-wing and helicopter aircraft, or specially designed ground equipment, will probably be the most feasible means of spray application. On the other hand, in seed orchards, similar in appearance and accessibility to commercial fruit and nut orchards, insecticides could be applied readily by conventional hydraulic sprayers and mist blowers. When we consider the protection of individual trees or parts of trees, as in special tree-improvement studies, the cost of chemical application may not be a critical factor; but special equipment or application. techniques may be required to obtain the desired control.

With this background discussion, we will consider next an exploratory, aerial-spray study conducted near Perry, Florida, in 1958 by the Buckeye Cellulose Corporation, with technical assistance from the Lake City Research Center.

A field test was instituted in three Buckeye Cellulose Corporation seed production areas to determine the effect of one and two applications of BH C upon survival of slash pine conelets. Stands (25, 38, and 56 acres in size)

were chosen on the basis of similarity of site, age class, and thinning history. Consistent with the gross nature of the test, a simple experimental design was used whereby each seed production area was set up as a block containing three plots. Spray treatments were one application, two applications, and the check. Five trees were marked in each plot to serve as sampling units for later statistical evaluation.

Insecticide sprays consisting of 3-percent gamma isomer of BHC in 1 gallon of diesel oil per acre were applied on March 13 and July 1, 1957 by Scott Air Service of Savannah, Georgia, using a Piper Cub aircraft. Dye card analysis of the spray deposit made during the March treatments indicated an average application rate at the forest floor of 0.54 gallons per acre with a coefficient of variability of 67 percent.

Binocular counts were made of the conelet crops of sample trees during the period of rapid shoot elongation in late April and early May 1957. All visible conelets were counted by two observers using 7 x 35 mm. binoculars while standing at a fixed point approximately 2 chains from each tree. Deductions were made at the time of counting for rusted conelets, which in this instance amounted to 18 percent of the observed crop.

A followup binocular inventory of mature cones on sample trees was carried out in September 1958, after which cone and conelet data were adjusted for full crop by the use of regression equations developed by P. E. Hoekstra. Subsequent statistical analysis of corrected data failed to show significant differences between treatments.

Although the results of the Buckeye aerial-spray study were not conclusive, valuable experience was obtained which would serve as a guide in the planning, design, and conduct of future aerial-spray tests. What are some of the factors to be considered in the design and evaluation of aerial-spray tests for the control of cone and seed insects?

First, it should be re-emphasized that all available information on the biology of the insect or insects should be utilized. This may be important particularly with reference to timing of spray applications.

The statistical design of the experiment should be kept as simple as possible; i. e. , the number of variables introduced into the test should be held to a minimum. This is particularly necessary because aerially sprayed stands are not sufficiently large generally to permit treatment replications within each forest stand. Each treatment replication must consist of a full-area-treatment; and each treated area should be preferably at least 1/4 mile from the next nearest area to prevent contamination from spray drift.

Every effort should be made to secure the services of reliable aerial contractors with experienced pilots. Contracts that are carefully prepared

and rigidly adhered to will reduce the chances of test failures due to poor insecticide application. Contracts should state the insecticide and formulation, type of aircraft, rate of application, time, pattern, and altitude of flight, minimum acceptable dosage, etc. The type of aircraft to be used for the test will frequently determine the details of the contract specifications.

It is of paramount importance that the pilot fly over the test areas prior to spraying in order to avoid possible safety hazards and to become familiar with the plot locations. Spray areas should be clearly delineated on the ground by means of balloons, flags, tree markers, or other devices so that they may be seen readily by the pilot as he maneuvers his plane into position for the spray suns.

When oil-base sprays are used provisions should be made to assess the distribution and dosage of the spray deposit. Davis and Elliott (4) have described a rapid method of estimating aerial-spray deposits by means of oil-sensitive dye-cards. With this technique, however, you must have sufficient time and manpower to adequately distribute the dye-cards just prior to spraying.

Finally we come to the most difficult and time-consuming task of evaluating the effects of the treatments. Flower or conelet and second-year cone counts must be made on sample trees before the first spray is applied and again after the last spray in order to obtain cone-survival data. The actual tagging of sample flower-and cone-clusters is the most accurate method of making counts because it permits the examination of the cones to determine the cause of insect damage. This procedure is very slow and costly. Another method is to make binocular counts and estimates of the numbers of conelets and cones on sample trees. Although this technique is fast and can be quite accurate, it does not permit the close examination of the flowers and cones. The solution to the problem of evaluating treatment effects may be a combination of binocular cone-counts on sample trees supplemented by periodic examinations of actual flowers and cones on additional sample trees.

In order to appraise the effects of aerial sprays in protecting cones during a complete cycle of development, the study areas should be sprayed during two consecutive seasons. Such experiments should indicate plans for evaluating the insect-caused mortality of overwintering conelets.

The evaluation of aerial or ground spray tests are further complicated when more than one spray application is made in a given season. Theoretically, direct or indirect measures of the insect populations should be made prior to and following each spray application so that the effect of each spray can be determined. Such an evaluation is not possible when simple cone-counts are made at the beginning and end of the season. Availability of time and manpower will, of course, determine the feasibility of making frequent pre-and post-spray appraisals of the insect damage.

In the preceding discussions we have shown that progress is being made toward developing chemical control methods for cone and seed insects in the South. Aerial spraying of seed production areas, and possibly seed orchards, would appear to be the most practical control method for such areas. The difficulties involved in conducting and evaluating aerial spray tests have been described, but the problems are not insurmountable.

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