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CONTROL OF SEED AND CONE INSECTS IN A LONGLEAF PINE SEED PRODUCTION AREA WITH A FIXED PIPE SPRAYER SYSTEM - FINAL EVALUATION

By

W. M. Ciesla, J. L. Rauschenberger and J. C. Bell, Jr.

U. S. Forest Service
Asheville, North Carolina

INTRODUCTION

Insects which destroy seed crops of the southern yellow pines have received considerable attention in recent years due to the need for high quality pine seed for reforestation. Seed production areas, set aside specifically to produce volumes of high quality seed have thus far produced only sporadic crops. This has caused tree improvement foresters to raise the question of the need for regularly scheduled spray applications to control infestations of seed and cone insects in these areas.

The following is a final evaluation of a pilot test designed to suppress infestations of seed and cone insects in longleaf pine, *Pinus palustris* Mill., particularly coneworms of the genus *Dioryctria*, using a fixed pipe sprayer system. This pilot test was conducted on the Brick Church Seed Production Area, a 55-acre area located on the Witherbee District of the Francis Marion National Forest, South Carolina.

METHODS

Method of Application - A fixed pipe sprayer system was used to apply the chemical to crowns of selected seed trees. This system, which consists of several lengths of one-half inch galvanized pipe strapped to the bole of the tree with an irrigation sprinkler mounted approximately 12 inches above the crown, was adapted from a system described by Grigsby (1964) designed to protect cone crops of superior loblolly pines in Arkansas. Details of this system and its installation in the seed trees are described in an earlier report (Ciesla and McConnell, 1965).

Spray Formulation and Schedules - A 0.5 percent Lindane emulsion was applied in three spray schedules as follows:

Two applications - Mid-May and mid-October

Three applications - Mid-May, mid-August and mid-October

Four applications - Late March, mid-May, mid-August and mid-October

Sprays were applied over two growing seasons; 1965 and 1966.

Three hundred seed trees were selected for the pilot test. Trees which appeared to have a history of high cone yields were selected to the extent possible. Seventy-five trees were included in each spray schedule and 75 trees were left as unsprayed checks.

A Briggs and Stratton slip-on pump with a 240 gallon capacity tank mounted on a stake body truck was used to apply the spray. Approximately six gallons of spray were applied to each tree per application. No spraying was done when winds exceeded ten miles per hour. This generally permitted four - five hours of spraying per day. All trees in the three spray schedules could be sprayed during a period of 1 1/2 weeks.

Evaluation of Spray Deposits - Spray deposits were evaluated by adding a small quantity of a liquid fluorescent dye (Leucophor C-6208) to the spray at the rate of 8 oz. per 100 gallons spray. Branch and cone samples were taken from trees immediately after spraying was completed and examined with a Spectroline long-wave ultraviolet handlamp. Trees were examined after dark with a high intensity ultraviolet flood lamp to obtain empirical data on spray deposits. Generally speaking, cones and branches were well covered with spray and coverage within the crowns was adequate.

Evaluation of Insect Populations - A Mobile Aerial Towers "Hi Ranger" was used for mid-summer observations on insect populations in the test trees. This vehicle permitted observers to go into the crowns and make detailed examination of seed and cone insect activity. Approximately ten first-year conelets and ten second-year cones were examined for coneworm damage from each of 21 trees in 1965 and 27 trees in 1966.

Final evaluation of the effectiveness of the spray program was made in conjunction with the Forest's operational cone collection. Cones were collected from all trees producing a minimum of one bushel of cones. The number of cones and incidence of *Dioryctria* infestation was recorded on a per tree basis. In addition, five apparently sound cones were collected from each tree and examined in the laboratory to obtain estimates of seed loss due to seedworms of the genus *Laspeyresia*.

RESULTS

First-Year Conelets - Mid season "Hi Ranger" surveys revealed a low incidence of first-year conelet damage due to *Dioryctria* sp. in all treatments and check trees during 1965 (Table 1). However, a high incidence of conelet mortality was observed. The cause of this mortality was not determined. Conelets were dry and readily detached from the shoot when touched. Conelet mortality and abortion was in excess of 70 percent on the check trees (Table 1), and its incidence was significantly higher at the .05 level than on sprayed trees when a Chi-Square test was applied to the data (Table 3).

Similar observations were made the following year although the incidence of conelet mortality and abortion was considerably lower (Table 2). The difference in levels of conelet mortality between treatments and checks was again significant at the .05 level. In addition, there was a statistically significant difference in the level of *Dioryctria* activity in trees having received one spray (May) vs. the checks (Table 3) but levels of insect infestation were too low to be of any practical significance.

Most of the insects infesting first-year conelets were the coneworm, *D. clarioralis* (Wlk.).

Second-Year Cones - There was a low incidence of *Dioryctria* infestation in second-year cones in both sprayed and check trees during 1965 (Table 4). The possibility that spray drifts may have had an impact on *Dioryctria* populations in the check trees was considered although spot checks of spray deposits with ultraviolet light indicated that this did not occur. However, *Dioryctria* populations were also measured in the Hoodtown longleaf pine seed production area during 1966. Coneworm activity remained at a low level in 1966 although a slightly higher level of activity occurred in the Hoodtown seed production area (Table 5). There was no indication of *Dioryctria* suppression due to the spray program.

D. amatella (Hulst) was the coneworm most frequently reared from second-year cones.

Seedworm Infestations - A high incidence of infestation by the seedworm, *Laspeyresia toreus* Heinrich, was found in cones collected during 1965 (Table 6). An average of 67 percent of the cones in all treatments were infested by *Laspeyresia*. Up to five larvae were collected per cone and an estimated average seed loss of 12.7 percent was attributed to this insect. There was no practical difference in incidence of *Laspeyresia* infestation between sprayed and unsprayed trees. This was as anticipated since studies by Merkel (1964) indicate that BHC or Lindane is not effective against this insect. A one percent Sevin spray was substituted for the May Lindane spray

Table 1 - First-year conelet mortality on sprayed and unsprayed trees, Brick Church Seed Production Area, Francis Marion N.F., S.C. - July 1965.

Treatment	Trees Sampled (Number)	Cones Sampled (Number)	Percent mortality by causal agent 1/		
			Dioryctria sp.	Conelet Abortion	Total
2 Sprays	4	35	5.7 2/	14.3	20.0
1 Spray	10	110	2.8	14.5	17.3
Check	7	67	2.9	71.6	74.5

Table 2 - First-year conelet mortality on sprayed and unsprayed trees, Brick Church Seed Production Area, Francis Marion N.F., S.C. - August 1966.

Treatment	Trees Sampled (Number)	Cones Sampled (Number)	Percent mortality by causal agent 1/		
			Dioryctria sp.	Conelet Abortion	Total
2 Sprays	8	111	1.8	0.9	2.7
1 Spray	11	174	0.6	0.0	0.6
Check	8	133	3.8	9.8	13.6

1/ Damaged cones resulted in 100 percent seed loss.

2/ Damage was due to a *Dioryctria* infestation in the stem which indirectly killed the cones.

Table 3 - Chi-Square analysis of first-year conelet mortality, Brick Church Seed Production Area, Francis Marion N.F., South Carolina - 1965-66.

Test	D.F.	2 Sprays vs. 1 Spray	2 Sprays vs. Check	1 Spray vs. Check
		July 1965		
Level of *Diorictria* and Conelet Abortion	2	0.73	35.43*	60.13*
Level of *Diorictria*	1	0.73	0.42	0.10
Level of Conelet Abortion	1	0.00	34.41*	59.95*
		August 1966		
Level of *Diorictria* and Conelet Abortion	2	2.25	9.99*	22.44
Level of *Diorictria*	1	.90	.83	3.93*
Level of Conelet Abortion	1	1.51	8.92*	18.53*

* Levels of damage significantly different between treatments at the .05 level where Chi-Square = or > 6.0 for two degrees of freedom and 3.8 for one degree of freedom.

Table 4 - Cone production and incidence of *Dioryctria* infestation by treatments, Brick Church Seed Production Area, Francis Marion N.F. - 1965

Treatment	Trees Sampled (Number)	Mean Cones Collected/Tree	Mean *Dioryctria* Infested Cones/Tree	% *Dioryctria* Infestation
Check	16	140.5	5.1	3.6
1 Spray	27	126.2	7.0	5.5
2 Sprays	15	115.6	5.7	4.0
3 Sprays	23	116.4	4.6	4.9

Table 5 - Cone production and incidence of *Dioryctria* infestation by treatments, Brick Church Seed Production Area, Francis Marion N.F. - 1966

Treatment	Trees Sampled	Mean Cones Collected/Tree	Mean *Dioryctria* Infested Cones/Tree	% *Dioryctria* Infestation
Check	18	86.3	2.2	2.5
Check (Hoodtown)	27	84.3	3.2	3.8
2 Sprays	13	74.4	2.2	2.9
3 Sprays	16	93.5	2.1	2.3
4 Sprays	16	107.6	2.3	2.1

in 1966 in order to reduce seed loss by *Lasperesta*. Spray application was timed with adult *Lasperesta* emergence which occurred sporadically from early May to early June in 1966 (Fig. 1). The spray was applied in early May. Analysis of 1966 data indicate that this treatment was ineffective in reducing *Lasperesta* activity (Table 7).

DISCUSSION

Results of this pilot test indicate a failure to reduce seed and cone insect populations in this area. *Dioryctria* populations were very low throughout the two year period, however, and it is probably not valid to discount this control method on the basis of a test directed against a low insect population. A number of interesting leads were obtained as a result of this pilot test in spite of the failure to reduce seed and cone insect populations. First-year conelet abortion was found to be the major factor responsible for the reducing cone crop during the two years this study was carried out. Examination of climatological records of the coastal South Carolina area revealed a rainfall deficit of over two inches during May 1965. This is the time conelet abortion is believed to have occurred. Perhaps an application of moisture during this period prevented conelets from aborting on the sprayed trees. The causes and prevention of longleaf pine conelet abortion is certainly worth further investigation. The "High Ranger" proved to be an excellent tool for seed and cone insect surveys. We hope to use it more extensively for this purpose in the future. The sporadic emergence of *Lasperesta* adults in this area indicates the necessity of several applications of a non-persistent pesticide such as Sevin during the period of adult emergence if effective control is to be attained.

RECOMMENDATIONS

1. Low incidence of seed and cone insect activity in this area makes further control action questionable. No control measures are recommended for 1967.

2. Detailed surveys of seed and cone insects in the Brick Church Seed Production Area should be conducted in 1967. These would provide data on factors affecting the cone crop and local life history data which would improve timing of spray applications.

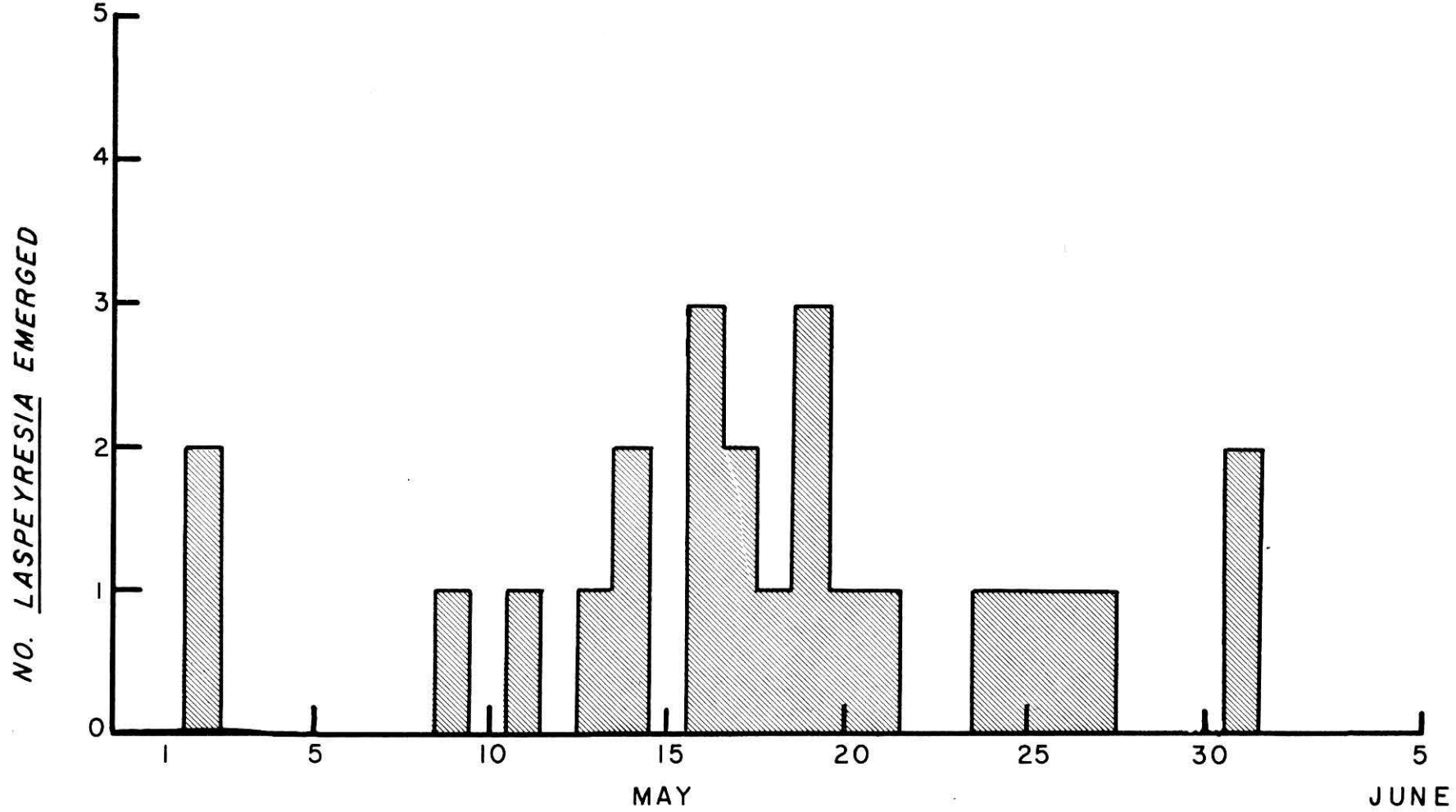

Fig. 1 -- Field emergence of adult *Laspeyresia* sp. from infested longleaf pine cones, Brick Church Seed Production Area, Francis Marion, N. F. - 1966.

Table 6 - Level of *Laspeyresia* infestation by treatments, Brick Church Seed Production Area, Francis Marion N.F. - 1965

Treatment	Cones Infested (%)	Mean Larvae per Cone	Mean Seeds/ Face	Mean *Laspeyresia* Damaged Seeds/ Face	Seed Loss by *Laspeyresia* (%)
Check	61.1	1.3	9.6	1.2	12.3
1 Spray	66.7	1.3	10.2	1.3	12.5
2 Sprays	67.5	1.5	10.2	1.8	17.2
3 Sprays	72.1	1.6	9.6	1.5	15.0
All Treatments	66.9	1.5	9.8	1.3	12.7

Table 7 - Level of *Laspeyresia* infestation by treatments, Brick Church Seed Production Area, Francis Marion National Forest - 1966

Treatment	Cones Infested (%)	Mean Larvae per Cone	Mean Seeds/ Face	Mean *Laspeyresia* Damaged Seeds/ Face	Seed Loss by *Laspeyresia* (%)
Check	71.1	1.1	14.5	2.1	14.6
Check (Hoodtown)	55.3	0.7	14.0	1.4	9.9
Sprayed with Sevin	75.5	1.1	13.8	2.2	15.5