

March 1971

1. General

The "Newsletter" is over 10 years old. It was started in July 1960 with three contributors and a distribution list of 10 recipients. The first release was entitled "Progress in Cone and Seed Insect Research - July 1960" (Johnson - North Carolina).

Two Douglas-fir cone and seed insect research projects have been initiated at Oregon State University under Dr. W. P. Nagel's direction. One project is part of the International Biological Program, Western Coniferous Biome Study, and will support one graduate student, Evan Nebeker. Project objectives are (1) to identify those insect species which exert a dominant influence as cone and seed consumers, (2) to assess the role of these insects in the overall energy budget, (3) to follow population changes of these species, and (4) to determine the causes of the population changes. The second project, more applied in emphasis, is supported by the School of Forestry and will employ one graduate student, Malcolm Russell. Project goals are (1) to study the causes of cone and seed insect population increases, especially Barbara sp. and Mega-stigmus sp. in Douglas-fir stands and seed orchards and (2) to incorporate the knowledge about these courses into programs to help manage these insects in both preventative and curative techniques (Nagel - Oregon).

Mrs. Barcia, Secretary, Seed Orchard Insects Research Work Unit, has completed compilation of a Bibliograph of Insects Affecting the Seed Production of North American Conifers which covers the literature through 1970. She is presently working on manuscript organization and if all goes well, this might be published in 1971 (Merkel - Florida).

The 1970 spruce cone crop was very good in most regions (Hedlin - British Columbia, Canada).

The 1971 west side Douglas-fir cone crop in Oregon looks very good (Meso - Oregon).

In Washington we are heading for a year with a lot of flowering Douglas-fir trees (Stoszek - Washington).

Dr. R. N. Coulson has moved from Georgia to Lufkin, Texas (Franklin - Georgia). He has joined the Texas Forest Service as Principal Entomologist in the Pest Control Section (Coulson - Texas).

A new technician, James M. Reeves, has been added to the Entomology Program at New Mexico State University. He will work half time on cone and seed insects (Kinzer - New Mexico).

1/Contributions submitted by cone and seed insect research workers, resource managers, and tree improvement specialists. These unpublished data cannot be used without contributor's approval. Items assembled by S. W. Meso, U.S. Forest Service, Portland, Oregon.

Howard Dew, 1970 Forestry graduate of Oregon State University, has been added to the Timber Service Company staff. His prime responsibilities will involve tree improvement, reforestation, and timber stand improvement (Barringer - Oregon).

New equipment has been added at the University of Georgia. Entomologists now have a new Pitman MN-50 Hotstik 50-foot, 2-man bucket aerial device. This unit gives outstanding mobility and ease of sampling (Franklin - Georgia).

2. Insect Identification and Biology

We collected 11,700 Douglas-fir cones from 13 areas in Montana and Yellowstone National Park this past summer. Three-fourths of these were dissected and the other fourth placed in rearing containers. This was the third and final year of an evaluation designed to inventory Douglas-fir cone and seed insects and measure the level of injury. A total of 52,500 cones were collected in the three years. Insects from the 1970 collections are still at the National Museum being identified. To date, we have had 39 species of insects identified from these cones. Fourteen of these are cone feeders, 22 are parasites and predators, and the role of three species is unknown. We have reared three new species plus some new state and host records. The species are a thrip Oxythrips sp., a tachinid Actia sp., and a gelechiid Chionodes sp. The western spruce budworm Choristoneura occidentalis Free. was the most important insect each of the 3 years, followed by cone midges Contarinia washingtonensis Johnson and C. oregonensis Foote, cone worms Dioryctria abietivorella (Grote) and D. pseudotsugella Munroe, and the cone moth Barbara colfaxiana (Kft.) (Ciesla - Montana).

Alan Hedlin is working on cone insects in spruce with main emphasis on Picea glauca. Observations are also being conducted on Picea engelmannii, P. sitchensis, and P. mariana. Biological studies are being conducted on Hylemya anthracina, the main seed destroyer in spruce (Hedlin - British Columbia, Canada).

The Pest Control Section is currently involved in cone and seed insects in seed orchards and production areas. The Dioryctria spp. of east Texas have recently been surveyed and Dioryctria amatella, D. zimmermani, and D. clarioralis are the three most important representatives (Coulson - Texas).

Two new species of midges (Diptera:Cecidomyiidae) were reared from ponderosa pine cones collected in Idaho. One is a Cecidomyia sp. which Dr. R. J. Gagne^{1/} is describing and which will appear in a supertribal revision. The other is a Profeltiella sp. that belongs in a group of midges also being revised by Dr. Gagne (Parker - Utah).

^{1/}Systematic Entomology Laboratory, Entomology Research Division, Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C.

Cone and seed insect problems are hardly recognized in the Rocky Mountain area of Colorado. Consequently, there has been little work done in the past. At Colorado State University, Judy Bodenham, a graduate student in entomology, is rearing ponderosa pine cone insects in order to determine what complex is involved. She is making an intensive study of a weevil, presumably Conotrachelus sp., which is common in Front Range ponderosa pine stands. Dr. T. O. Thatcher at the University has also made a weevil observation in the past. The outcome should be a review of the insect complex in ponderosa pine for this region and the identification, description, and bionomics of the weevil prepared mostly by Judy Bodenham and aided by Dr. Thatcher (Stevens, Colorado).

A study of the responses of "walking" Conophthorus ponderosae to volatile attractants is in progress. The walking beetles readily respond to attractive volatile substance in an olfactometer similar to the one designed by Klieforth, 1964, probably indicating that a mandatory flight is not required before host selection is possible as in some Scolytids.

Females showed a significant increase in response to 1% ponderosa pine resin and 1% β -pinene. Males showed no significant increase in response to either 1% resin or other oleoresin fractions. Myrcene caused a slight (not statistically significant) negative response in both males and females.

Males were significantly attracted to trap vials containing cone-fed females plus a source of oleoresin, but to a lesser degree to fed females only, perhaps indicating that a pheromone is involved. This possibility needs confirmation (Kinzer - New Mexico).

Studies are in progress to locate the sex pheromone gland of female Dioryctria abietella moths. An enlarged glandular area suspected to be the sex pheromone gland was located in the intersegmental fold between the eighth and ninth abdominal segments. This enlarged region is in the shape of a "ring gland" and large, columnar epithelial cells are visible in sagittal sections of the gland.

An active feeding stimulant for larvae of D. abietella was extracted from first-year slash pine conelets of a tree previously noted to be highly susceptible to attacks by Dioryctria spp. This same fraction of the extract also appears to contain an ovipositional stimulant for female moths (Fatzinger - Florida).

3. Damage

A paper entitled "Impact of Dioryctria amatella on Seed Yields of Maturing Slash and Loblolly Pine Cones in Mississippi Seed Orchards." A screening program was conducted in 1969-1970 in an attempt to locate possible clones resistant to this pest in three Mississippi seed orchards (Strator and Neel - Mississippi).

About all that the Genetics Institute here in Gulfport can report in the way of forest tree seed-destroying insects is that a very low yield of control-pollinated seed was collected in fall 1970, mainly due to cessation

of our spraying program in the aftermath of the moratorium on the use of hard pesticides. In previous years, we normally realized about 75% collectable cones from those pollinated - this year it was about 28%. Dioryctria sp., mainly amatella and abietella, were the chief species responsible. In all fairness to the bugs, however, it must be noted that hurricane Camille was pretty rough on the first year conelets last year (Coyne - Mississippi).

Eight hundred ponderosa pine cones were collected from six locations in Montana for dissecting and rearing during 1970. Over a third of these cones were deformed by insects. Some of the insects reared are still at the National Museum being identified. The most common insects found were Laspeyresia sp., Dioryctria auranticella (Grote), and midges probably Contarinia sp. One area had 97% of the cones examined infested with Laspeyresia. Most of the seeds were destroyed in these cones. Our future plans are to expand sample size and increase sampling points in 1971 to more accurately survey the insects present and evaluate injury (Ciesla-Montana).

Pinyon pine, Pinus edulis, cones were collected from five areas near Panguitch, Utah to determine seed loss caused by insects and to compare cone length with seed number. A total of 1,000 cones were collected and analyzed. Cone and seed damage was caused by one insect a pine seed moth, possibly Hedulia injectiva Heinrich.^{1/} This larva caused damage by boring through cone scales and seeds. An ichneumonid parasite, Erachus turgidus Holmger,^{2/} was reared from the damaged cones. A high correlation was found ($r=0.934$) between cone length and seed number.

The results of the pine seed moth damage are summarized below.

Condition and percent of pinyon pine seed from
cones collected near Panguitch, Utah, 1969

Area	Seed Condition					
	Sound		Hollow		Insect Damaged	
	Undamaged	Damaged	Undamaged	Damaged	Undamaged	Damaged
	: Cones	: Cones	: Cones	: Cones	: Cones	: Cones
- - - Percent - - -						
Panguitch Creek	69.8	41.7	29.2	42.2	1.0	16.1
Sand Wash	81.9	51.5	16.2	20.7	1.9	27.8
Limestone Creek	47.0	22.6	42.1	25.3	10.9	52.1
Five Mile Creek	70.8	33.6	21.2	17.6	8.0	48.7
South Canyon	68.8	33.3	29.8	26.9	1.4	39.8
Total	68.6	33.6	27.2	25.0	4.2	41.4

^{1/}Larvae identified by D. M. Weisman, Systematic Entomology Laboratory, Entomology Research Division, Agricultural Research Service, USDA, Washington, D.C.

^{2/}Identified by R. W. Carlson, Systematic Entomology Laboratory, Entomology Research Division, Agricultural Research Service, USDA, Washington, D.C.

The total percent of hollow seed is approximately the same for both insect damaged and undamaged cones. This would indicate that the pine seed moth larvae have the ability to distinguish between sound and hollow seed (Stipe - Utah).

In 1970, a relatively heavy cone yield year, over 56% (range 7-97% among plots) of the cones examined were deformed by insects. Budworm infested 34% (range 2-79%) of the cones; midges infested 21% (range 0-78%) of the cones; cone moths were found in 21% (range 0-79%) of the cones; and coneworms infested 14% (range 0-41%) of the cones. All other species found occurred in less significant numbers (Ciesla - Montana).

At least 90% of a small 1970 Douglas-fir cone crop at the Timber Service Company's David T. Mason Seed Orchard was heavily infested with Dioryctria spp. and/or Contarinia spp. (Barringer Oregon).

A joint study is being carried out between Tom Koerber, Pacific Southwest Forest and Range Experiment Station, and Insect and Disease Control Branch in Portland to determine Leptoglossus occidentalis impact on control pollinated western white pine cones. Study site is the Dorena Seed Orchard, where white pine seedlings are being screened to determine what crosses show resistance to white pine blister rust. Heavy blackbird populations last spring decimated adult Leptoglossus populations at the seed orchard (Meso - Oregon).

4. Control

Two 6-acre white spruce plantations in Voluntown, Connecticut consistently produce cone crops which are destroyed by a cone maggot Pegohylemia anthracina. Nurseryman C. G. Merrill tried a 0.25% dimethoate hydraulic spray for control after pollination was completed. The results are as follows:

	:: Treated	:: Untreated	:: Total
Cones infested	21	34	55
Cones uninfested	39	26	65
Total	60	60	120

Chi Square: Computed = 5.67
 Tabular = 3.84 5.0% level
 = 5.02 2.5% level
 = 6.63 1.0% level

Future spray treatments will be applied earlier and treatment effectiveness will be determined in terms of viable seed amount (Ford - New Hampshire).

Spray applications of insecticides with low mammalian toxicity and bark applications of systemic insecticides have been tested as replacements for broadcast applications of Thimet for control of Dioryctria spp. in loblolly pine seed orchards.

In late August 1970, systemic insecticides (Bidrin, Thimet and Meta Systox-R) mixed with liquid plastics (Estab and Poly Em 40) were applied to the bark of 2- to 3-inch d.b.h. noncone-bearing trees in a loblolly pine seed orchard. These tests were designed to determine phytotoxicity to foliage and bark before application to cone-bearing trees. No phytotoxicity has yet been indicated. A bioassay using Lambdina athasaria pellucidaria on branches cut from the treated trees indicated that Bidrin (40 ml technical material only, or 40 ml technical in combination with 100 ml of either Poly Em 40 or Estab) was translocated to the needles in sufficient quantities to kill 32% to 90% of the test insects. None of the other treatment caused appreciable insect mortality. Tests will continue in 1971 to evaluate phytotoxicity of spring treatments and some applications will be made on cone-bearing trees.

In another series of tests, hydraulic sprays of 0.125% Gardona and 0.125% Sevin were applied by hydraulic sprayer on June 15 and July 1, 1970, to each of three trees in a loblolly pine seed production area. In the fall the trees were felled and examined for Dioryctria damaged cones. The results are presented below. Very small damaged cones were not included in the counts since they were attacked before the first spray was applied.

	<u>0.125% Gardona</u>	<u>0.125% Sevin</u>	<u>Check</u>
Total cones (3 trees)	405	168	699
Percent <u>Dioryctria</u> damaged	21.0%	30.3%	47.5%

Both treatments were significantly different than the checks at the .05 level.

Hydraulic sprays in 1971 will involve slightly stronger solutions and will be applied earlier in the growing season in hopes of improving the effectiveness of these low-toxicity insecticides (Copony - Virginia).

Three systemic organophosphates have been used in a test designed to study the control of Dioryctria amatella in a Mississippi slash pine seed orchard. It appears that Azodrin is more effective than Bidrin and the latter more effective than Meta Systox-R in control of this pest when the toxic materials are pipetted into holes bored in the tree trunks (Ray and Neel - Mississippi).

A study was made in 1970 to compare on an operational basis several insecticides for their efficiency in controlling several insect species attacking slash and loblolly pine cones. The results are as follows.

Chemical :	Rate of Application :	Frequency of Application :	Damaged : Cones :	Sound : Cones :	Basis :
			%	%	# cones
Thimet	80#10G/acre	Once, 2/15/70	11 ¹ / ₂	89	4,079
Thimet	80#10G/acre	Once, 2/15/70			
BHC	- - plus - - 0.5% spray	Once, 8/5/70	7 ¹ / ₂	93	14,078
BHC	0.5% spray	Every other week	2 ¹ / ₂	98	4,136
Alternating with Guthion	0.125% spray	5/13 - 9/5/70			
Azodrin (One side of tree)	0.3% spray	Once, 5/20/70	6 ² / ₃	94	2,863
Azodrin (Two sides of tree)	0.3% spray	Once, 5/20/70	4 ² / ₃	96	2,149
Average - - -			6	94	5,461
No spray			29 ² / ₃	71	2,759

¹/₂/Loblolly pine

²/₃/Slash pine

Azodrin applied once as a 0.3% spray gave nearly as good control of insects in slash pine cones as did BHC and Guthion when they were sprayed on loblolly pine every other week. The advantages of a single or possibly two sprays over spraying each week are obvious. If these results are repeatable, insect control in the North Carolina orchard should be reduced to about one-fifth of current costs. Although Azodrin is more toxic than BHC, (350 mg/kg vs. 900 mg/kg dermal) it is less toxic than Thimet and, once mixed, would not be particularly dangerous. In fact, it is less toxic than Guthion. There is a possibility that because of its toxicity to birds, Azodrin will not retain its label. Last year it was sold in North Carolina for aphid control on several agricultural plants (Johnson - North Carolina).

Exploratory work with Daphnia water fleas and laboratory-reared Dioryctria abietella larvae showed promise for the use of these animals in bioassay tests to determine the speed of uptake into slash pine cones and duration of toxicity of trunk-implanted Bidrin. We expect to expand this research in 1971 (Merkel and Fatzinger - Florida).

A 2.5% water suspension of carbaryl plus Miller's Mu-Film 17 extender was applied by mist blower to longleaf pine. Sprays were applied seven times: 10/14/69, 4/9/70, 5/7/70, 6/4/70, 7/2/70, 7/30/70 and 8/21/70. Analysis of data has not been completed but reduction of attacks by Dioryctria spp. on first and second-year cones was very low. Seedworm infestation data has not yet been taken (Merkel - Florida).

Bidrin and closely related Azodrin were implanted into drill holes in the trunks of slash pine seed production trees on May 11, 1970. Trees averaged 40 years of age, 75 feet in height, and 16 inches d.b.h. Both systemics were applied at the rate of 3 grams active toxicant per inch of stem diameter at waist height. Untreated check trees sustained an average of 27% *Dioryctria* attacks on second-year cones at cone harvest; whereas cone infestation per tree in the Bidrin treatment averaged 12% and averaged only 6% in the Azodrin treatment. Bidrin implants performed considerably below earlier tests. This may have been caused by excessively heavy rainfall for two months following implant (Merkel - Florida).

Dicrotophos, (Bidrin) technical liquid, was implanted into the trunks of 40-year-old slash pine seed production trees at Olustee, Florida in 1969. The systemic was applied in early February, March, April and May into holes drilled in the trunks at the dosage rate of 5 g/in diam. of actual dicrotophos. Twenty trees were treated on each of the implant dates and 20 additional trees served as untreated checks; i.e., they received drill holes in early May but no chemical was implanted.

Table 1.--Incidence of slash pine seedworm infestation and degree of control on slash pines implanted with dicrotophos at monthly intervals--Olustee, Florida, 1969

	:Untreated:	Dicrotophos implanted on			
	: check :	2/5	3/5	4/3	5/7
Percent mature cones infested ^{1/} 2/	18.8a	11.2a	6.2a	2.2b	0.0b
Percent seedworm control	--	40	67	88	100

^{1/}Average percent cones infested per 20 study trees in each treatment.

^{2/}Any two means followed by the same letter are not significantly different at the 5% probability level by Duncan's multiple-range test.

Table 2.--Incidence of *Dioryctria* spp. infestation on mature cones and degree of control on slash pines implanted with dicrotophos at monthly intervals--Olustee, Florida, 1969

	:Untreated:	Dicrotophos implanted on			
	: check :	2/5	3/5	4/3	5/7
Percent mature cones infested ^{1/} 2/	11.8a	0.9b	0.7b	0.5b	0.3b
Five <i>Dioryctria</i> spp. control	--	91	94	96	98

^{1/}Average percent cones infested per 20 study trees in each treatment.

^{2/}Any two means followed by the same letter are not significantly different at the 5% probability level by Duncan's multiple-range test.

The percentage mature cones infested by the slash pine seedworm, Laspeyresia anaranjada Miller, at harvest time (mid-September) was 11-, 6-, 2-, and 0- percent on trees implanted on 2/5, 3/5, 4/3 and 5/7, respectively (table 1). Cones from untreated trees averaged 19% infested. The early April and May implants were the only treatments which reduced seedworm infestation significantly ($P=0.05$) below that of the check trees.

An unexpected encouraging result of the study was the better than 90% control of Dioryctria spp. coneworms on mature cones at harvest time in all of the treatments. All implants (dates of application) resulted in significantly ($P=0.05$) fewer coneworm attacks when compared with checks in September. Coneworm infestation averaged 12% on check trees and less than 1% in all treatments (table 2) (Merkel - Florida).

The Pest Control Section of the Texas Forest Service plans to initiate an insect management program in their seed orchards in 1971 utilizing systemic insecticide basal tree injections (Coulson - Texas).

Future plans for Douglas-fir cone and seed insect control in Montana are to field test some chemical control methods with an emphasis on systemics. Whether this will occur in 1971 or the coming years depends on job priorities (Ciesla - Montana).

A test was made in 1971 to determine whether Meta Systox-R exhibits cytogenetic effects on Douglas-fir seed. A 1% spray was applied on a sunny day to conelets after they were pollinated and turned down. Cones were sprayed to the point of runoff. Both treated and untreated cones were on different branches of the same mature tree. Branchlets containing cones were covered with bags before and after treatment. Conelets under study were later bagged with mesh screen to prevent insect attacks. The recorded results are as follows.

	Treated	: Untreated
Number of flowers		
pollinated	46	77
Number of cones collected	2	48
Cone set percent	4	62
Total seed count	111	2,469
Filled seed count	52	862
Filled seed percent	47	35

In addition to the above study, cross-pollinated strobili on Douglas-fir grafts were also treated at our seed orchards. A 0.75% Meta Systox-R spray was applied. St. Helen stock 1969 conelets were bagged with pollination bags before treatment and were not sprayed. Since no problems were anticipated all remaining conelets were sprayed.

The following results were recorded.

	:: Untreated	:: Treated	
	:: St. Helens	:: St. Helens:: Springfield	
	:: stock, 1969	:: stock, 1970:: stock, 1970	
Number of flowers pollinated	572	169	193
Number of cones collected	253	0	27
Cone set percent	44	0	14
Total seed count	9,421	0	1,290
Filled seed count	2,006	0	394
Filled seed percent	21	0	30

The results indicate strongly that conelet abortion was related to the insecticide treatment. Thus, it appears that under certain, as yet unaccounted for, factor interaction, application of Meta Systox-R at 0.75-% concentration is unsafe. We suspect that the weather condition at time of application has affected the results. We are contemplating a study to test this and other possibilities.

If anybody experiences a similar "happening" please let me know; I will appreciate suggestions as to other possible causes (Stoszek - Washington).

Fifty acres of grafted cone-bearing Douglas-fir will be treated this spring at the Timber Service Company's Mason Seed Orchard near Sweethome, Oregon. Dimethoate will be used. Project control effectiveness will be evaluated this summer and reported in the next newsletter (Barringer - Oregon).

A pilot study has been developed to use tree-injected dimethoate on an operational basis here in the Northwest. Since all Douglas-fir seed in Oregon and Washington is now certified, particular attention is given to seed sources from specific zones and elevation bands. The Siskiyou National Forest in southern Oregon has found their reforestation program for specific sites in jeopardy because of low or nonexistent seed inventories. Dimethoate is registered for Douglas-fir cone and seed insect control only when applied with hydraulic equipment. Because of tree size and limited accessibility, hydraulic equipment cannot be effectively used on this Forest. The pilot program has been stalled until American Cyanamid Company secures registration for tree injecting dimethoate. Registration procedures are progressing smoothly and we hope to continue the project this spring (Meso - Oregon).

5. Publications

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