MINUTES

Seventh Annual Southern
Forest Insect Work Conference

Auburn University, Auburn, Alabama
November 7-8, 1962

Bernard H. Ebel and Edward P. Merkel
Naval Stores and Timber Production Laboratory
Olustee, Florida
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ANNOUNCEMENT

The Eighth Annual Conference
Raleigh, North Carolina
August 27 to 29, 1963
RECENT DEVELOPMENTS IN AERIAL SURVEY TECHNIQUES

By
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Beltsville, Maryland

Technological developments during the past 20 years in aerial sensors, films, airborne recorders, computers, and in the aircraft themselves have been far too numerous to mention. The advances in aerial reconnaissance techniques have made it necessary for us to examine each in the light of our own requirements to get the best answer for the money that we can afford to spend.

The aerial survey technique research project at the Beltsville Forest Insect Laboratory in attempting to do this, has devoted a major portion of its time during the past few years to aerial photographic methods for detecting and appraising forest insect outbreaks. These efforts have resulted in the following recommendations and findings:

Aerial color photography recommended for southern pine beetle pre-control surveys: Tests made near Asheville, N. C. in 1955 proved that 1:7920 scale aerial color photography could be used with greater accuracy of spot detection (80 percent) and appraisal than visual plotting methods. This greater accuracy would result in more efficient and thus more economical ground control. The cost of the aerial photographic method was $0.10 per acre as compared to $0.009 per acre for an aerial sketch-mapping survey. The method is recommended for pre-control surveys where timber values are high enough to warrant the higher cost of the method.

White pine weevilled leaders estimated with 90 percent accuracy on large-scale aerial color photography: A white pine weevil control test in up-state New York from 1956 through 1958 afforded an opportunity to try large scale aerial color photography as a means of determining levels of weevilling before and after spraying to better evaluate the control tests made. A scale of 1:600 was found to be necessary to pick out individual weevilled leaders. This made it necessary to use a camera with a fast shutter coupled with a fast color film to stop image motion at this low altitude. As a result, a Hulcher 70 mm camera and Anscochrome Color film (ASA 32) were successfully used for 2 years. From this test we found that photo estimates were accurate enough for evaluating the effects of spray. The photographic method had certain advantages over conventional ground methods: (1) it samples tall trees and dense stands where weevilling is difficult to see from the ground; (2) it samples more trees per plantation; and (3) it samples remote areas in large plantations that require too much time to reach on the ground. The cost of the photo method is almost the same as for that of ground methods; however, it takes only about one-third the time to complete.

Estimating spruce budworm defoliation from 70 mm color: Since 1960, a Hulcher 70 mm camera and Super Anscochrome (ASA 100) film have been used to photograph 35 one-acre plots at 12 locations in a going spruce budworm epidemic in northeast Minnesota. Estimates of defoliation on 1:1584 scale (2 chains to the inch) photography were correlated with ground estimates of defoliation based on the amount of foliage removed from ten 15-inch sample branches on each plot. Regression lines for the first 2 years were very promising. The relationship between the photo and ground defoliation estimates was .9 or better for both years.
Measuring stand deterioration caused by balsam woolly aphid on 70 mm color:
Tests to date in southeast Maine show that 1:1188 scale 70 mm Super Anscochrome photography can be used to accurately identify balsam fir killed by stem attacks of balsam woolly aphid. Four interpreters identified from 96-100 percent of all stem-killed trees. Healthy trees were identified on the average 87 percent of the time and top gouted trees 70 percent of the time. The greatest discrepancies in interpretation occurred in calling healthy trees gouted (20 percent) and gouted trees healthy (35 percent). Some of these errors have since been found to be errors in ground identification. In an effort to reduce the photo misclassification of gouted trees, 45 degree forward oblique photography was taken this fall after the hardwood leaves had fallen. Theoretically, this should give us a side view of the trees and improve our chances of seeing top gout.

A stratified photographic sample to measure the trend of an insect outbreak:
In 1960, and each year since, a gross area of 22,000 acres in the vicinity of Mt. Mitchell, North Carolina has been photographed at a scale of 1:7920 with Super Anscochrome film. The area was stratified into five timber types and five mortality classes directly on the color photographs. The acreage in each strata was determined by photo plot counts using a 20 one-acre plot template within the effective area of the photographs. A systematically selected sample of the plots falling in each host type--mortality class was used to interpret total spruce-fir tree counts and fir mortality. A total of 199 photo plots were interpreted in this way. After adjusting for photographic scale difference and interpretation error using regressions based upon a ground sample of 30 plots, the final expanded 1960 spruce-fir estimate was within a calculated standard error of ± 5.5 percent. The final adjusted fir mortality estimate was 219 thousand fir trees ± 6.7 percent.

Each year since 1960 the 199 photo plots have been transferred to new photography and the total spruce-fir and fir mortality re-estimated. A comparison of results for 12 plots retallied each year on the ground, are very encouraging. Mortality by point sampling showed a 2-percent increase each year on these 12 plots for a total increase of 4.18 percent for the 2 years. The corresponding figures for the photo estimate showed an increase in mortality of 5.18 percent for the 2-year period. The cost per acre for this type survey is 10 cents for the original survey and approximately half this for each subsequent resurvey.
FOREST ENTOMOLOGICAL AND RESEARCH FACILITIES IN UNIVERSITIES 
AND COLLEGES LOCATED IN THE SOUTH AND THE CENTRAL STATES

By
R. F. Anderson, Duke University, Durham, North Carolina

During the summer of 1962 a survey was made to obtain some information on the 
two subjects indicated in the above title. Eighteen education institutions 
were sent questionnaires and, of these, 15 replied by sending some to all of 
the information requested.

These 15 institutions reported that 30 investigators were engaged in conducting 
a total of 44 current research projects. The number of projects per investi­
gator varied from 0 to 6 with an average of 1.47. When these data were 
classified on the basis of type of insect being studied the number of projects 
for each class was as follows: defoliators 7, bark beetles 8, borers in 
living trees 5, wood products insects 8, terminal boring insects 10, and sap-
sucking insects 2. Based on the type of approach being used the number of 
projects for each was as follows: general biology and unspecified types of 
control 21, effect of physical environmental factors 3, food and host relations 
5, parasites and predators as controlling agents 2, surveys and evaluation 5, 
insecticidal control 2, taxonomy 2, and population dynamics 1.

The research facilities were harder to evaluate partly because incomplete 
information was returned on so many of the questionnaires; nevertheless, a few 
points will be presented here. The amount of taxonomic material available 
in the form of pinned specimens varied from "yes" to 1,500,000. Five 
schools with each having more than 100,000 pinned specimens were Oklahoma, 
300,000; Georgia, 500,000; Purdue, 750,000; and Ohio State, 1,500,000. The 
data regarding the number of liquid preserved specimens and the number of 
damage specimens were inadequate because on only a few of the returns were 
the groups specified which would be of interest to forest entomologists.

The research facilities available for work on ecological, physiological, and 
insecticidal problems were reported to be available at most institutions. Here 
again, however, several schools did not answer the questions adequately. Nine 
institutions indicated that they were well equipped with physiological equip­
ment were Auburn, Clemson, Duke (In Zoology), Georgia, Florida (in another 
Department), Illinois, Missouri, Ohio State, Purdue, and Virginia Polytech. 
Those whose reports indicated that they were well equipped with insecticidal 
research equipment included Auburn, Clemson, North Carolina State, Ohio State, 
Oklahoma, Purdue, and Virginia Polytech.
FOREST INSECT RESEARCH AT STATE EXPERIMENT STATIONS IN THE SOUTH

By

Dr. R. C. Fox
Clemson College, Clemson, South Carolina

VIRGINIA

Dr. H. M. Kulman - V.P.I. * Nantucket Pine Tip Moth Biology and Control
Dr. Marvin Bobb - V.P.I. - with Virginia Division of Forestry
* Parasites of Virginia Pine Sawfly
Mr. Caleb Morris - Virginia Division of Forestry
* Biology and Control of Virginia Pine Sawfly
* Identification and Control of Cone and Seed Insects in Loblolly Pine

NORTH CAROLINA

Dr. M. H. Farrier
*Mites and Their Effect on Decomposition of Debris
Mr. Moore
*Biology and Ecology of the Powder Post Beetle Complex

SOUTH CAROLINA

Dr. Richard C. Fox
*Ecology of the Nantucket Pine Tip Moth
*Parasites and Predators of the Nantucket Pine Tip Moth
*Insects on the Forest Floor
*A Survey Technique for the Nantucket Pine Tip Moth
*The Relationship of Stand Density to Attack by the Southern Pine Beetle
*Taxonomic Studies in Selected Groups of Immature Insects

GEORGIA

Dr. Ching Tsao
*The Biology and Chemical Control of the Elm Spanworm
Dr. H. Lund
*Southern Pine Beetle Control Methods in Standing Trees

FLORIDA

Dr. R.C.Wilkinson
*Biology of Ips Beetles in Slash and Longleaf Pine

ARKANSAS

Dr. L. O. Warren
*Biological Control of the Pine Tip Moth

TEXAS

No Project in Forest Entomology.

LOUISIANA

Mr. Abe Oliver
*Biology, Speciation and Control of the Fall Webworm
*Pine Tip Moth
*Biology of the Pine Colaspis
*Evaluation of Forest Tent Caterpillar Control Methods
BIOLOGICAL CONTROL OF THE BALSAM WOOLY APHID IN NORTH CAROLINA

By

Charles F. Speers, Entomologist
Southeastern Forest Experiment Station
Asheville, North Carolina

The balsam wooly aphid was introduced into this country from Europe about 1908. It was discovered on Mt. Mitchell in 1957. Since that time it has killed thousands of trees annually and threatens all remaining stands of Fraser fir in the southern Appalachians.

A predator introduction program was initiated in 1959 and has continued at an increased rate annually. In 1959 two predators were introduced from Germany. Both the beetle Laricobius and the fly Aphidoletes wintered over successfully and were recovered the following year.

In 1960 additional Laricobius were introduced as well as four more species. In 1961, eleven additional species were introduced from India, Pakistan, and Germany. Aphidecta, released in 1960, was apparently recovered in 1962. None of the other introduced predators, released in prior years, were recovered in 1962.

In 1962 releases of Leucopis, Chrysopa sp., and Hemerobiids were made. In addition, over 12,000 Laricobius beetles were released in lots of 800 to 1,000 at about mile intervals at 13 locations along the Black Mountain Range in a pilot test.

To date, the predators received from Europe show most promise while those from Pakistan and India show little hope for establishment. Native predators, in studies to date, have not been very effective in preventing the increase of aphid populations.
SUMMARY OF BARK BEETLE WORK GROUP DISCUSSIONS

By

Dr. R. C. Wilkinson
Florida Agricultural Experiment Station
Gainesville, Florida

1. Taxonomy: Ips calligraphus Germ., Ips grandicollis Eichh., and Ips avulsus Eichh. in Florida each have three distinct larval instars based on head capsule width measurements. Third instar Ips calligraphus larval head capsules are very significantly wider than the capsules of the two other Ips species. Ips grandicollis and Ips avulsus larvae commonly occur in intimate mixture in the field and cannot be separated by width of the head capsules. Ips avulsus larval head capsules are distinguished, however, by the presence of two frontal tubercles lacking in either Ips grandicollis or Ips calligraphus. The frontal tubercles in Ips avulsus larvae can be seen in dorsal silhouette through a 15- to 20-x hand lens.

A complication may arise in that Ips avulsus appears to be closely related to Ips pini (Say) in which larval frontal tubercles also are present. Professor J. N. Knoll of Ohio State University has identified Ips adults taken from slash pine, Pinus elliottii, in southeastern Alabama during 1962 as Ips pini (Say). Further work will be done on the distribution and identification of Ips pini, according to Ed. Hazard and Dale Vandenburg. The Ips pini specimens presently are in the U.S.F.S. collection, Federal Building, Valdosta, Georgia.

The current lack of specialists in Coleoptera in the National Museum is a definite handicap to forest entomology. Robert E. Woodruff, coleopterist with the Florida Division of Plant Industry, Gainesville, suggested that bark beetle specimens would receive accurate determination if sent to Dr. Stephen L. Wood, Zoology and Entomology Department, Brigham Young University, Provo, Utah.

2. Sex Ratio, Adult Feeding, Adult Longevity: Ips species in Florida occur in a 1:1 sex ratio in the teneral adult stage. Ips exhibit a variety of feeding behaviors; during some phases of tunneling the pine host tissues are chipped away and do not enter the buccal cavity; in fresh phloem the tissue may be gathered into a "cud" in the buccal cavity before being ejected and passed to the rear as a pellet—which sometimes is consumed by other beetles; Ips adults tunneling into fresh phloem periodically consume some tissue; the feces formed by Ips males commonly are consumed by females.

3. Mode of Adult Attack: All three Ips species in Florida were attracted in significantly greater numbers to pine bolts artificially infested with male Ips than to uninfested pine bolts. Ips grandicollis adults of both sexes attacked male-infested pine bolts exposed at the ground, and at the 7, 21, 35, 49, 63, 77, and 91-foot levels in a firetower, but did not attack uninfested bolts simultaneously exposed at the ground, and at the 14, 28, 42, 56, 70, 84, and 98-foot levels in the same firetower. This behavior is in agreement with recent findings in California and with the earlier work of Roger Anderson in Minnesota that Ips of a given species are attracted to fresh phloem shortly after it has been infested by male beetles of the same species.
SUMMARY OF BARK BEETLE WORK GROUP DISCUSSIONS -- Continued

4. MATING; TIME, LOCATION, FREQUENCY: Ips bark beetles have been observed to mate in the nuptial chamber and in the egg gallery.

5. OVIPosition: NUMBER OF EGGS, DURATION, INCUBATION PERIOD: The suggestion was made that bark beetles sometimes will oviposit in host material "unsuitable" for brood development. Ips species eggs are flooded and killed by oleoresin during hot, rainy weather. Ed Hazard reported that Southern Pine Beetle, Dendroctonus frontalis Zimm., infested Hemlock, Tsuga sp., under some conditions, but that hemlock did not appear to be suitable for brood development. Eben Osgood reported a similar situation for Red Spruce, Picea rubens; Sarg.

6. LARVAL FEEDING: LOCATION, TEMPERATURE, AND MOISTURE LIMITATIONS: Ips larvae are flooded and killed by oleoresin during hot, rainy weather. Mortality is especially high when log ends are waxed; this offers a possible means for protecting freshly cut logs which are to be held in storage.

7. PREPUPAL STAGE: FEEDING, LOCATION, DURATION: A non-feeding ultimate larval stage was reported to exist in most bark beetle species. Dendroctonus frontalis larvae may be particularly susceptible to natural control factors during this period.

8. PUPAL STAGE: LOCATION, DURATION: NO REPORT

9. PREMERGENCE ADULT STAGE: FEEDING, MATING, LOCATION, DURATION: This stage was reported to be one in which young bark beetle adults in general become infested with mites, nematodes, fungi, and other organisms. Ips adults move about freely before emerging and become contaminated with Ceratocystis ips (Rumbold) Hunt spores which are contained in a viscous drop at the tips of perithecia extending into the beetle chambers and galleries. The drop is replaced from within the perithecia as the extruded spores are removed during passage of a beetle. It was felt that most teneral bark beetle adults probably do not mate before emerging from host material; conclusive data apparently is lacking with respect to this important point.

10. SYMBIOTIC ORGANISMS: Bill Yearian, University of Florida Graduate Student, showed techniques and equipment used in working with blue stain, Ceratocystis spp., fungi. Interrelationships between Pinus, Ceratocystis, and Ips are being investigated. Ips females have been observed to consistently transport blue-stained phloem pellets from heavily stained areas into unstained tunnels under construction.

11. SAMPLING METHODS WITH HAND OR POWER TOOLS: Dale Vandenburg discussed use of a personally designed, heavy duty steel bark-sampling device with chisel-type cutting edges. Rectangular 9 square-inch samples are obtained by driving the sampler into the bark with a mallet (mfr. cost about $15.00). Bob Thatcher also obtained satisfactory bark samples using the circular arch punch described by Furniss, 1962. (Can. Entomol. 94: 959-953). The serrated "cooky-cutter" type blade cuts 1/10 square foot samples (available at $22.50). Bob Lee mentioned use of a sharpened pipe as a simple and readily available
Circular bark samples can be obtained with a high-speed saw mounted in an electric hand drill. The hardened cylindrical blades (to 4" diameter) are used for cutting holes in sheet metal or wood and are adapted to an electric drill chuck by means of a mandrel (Clemson Bros., Inc., Middletown, N.Y.). The question was raised whether the large number of plots under perennial observation in survey-control did not warrant use of a punch card data recording system. The question also was raised whether insect data could be correlated or incorporated with existing Continuous Forest Inventory punch card data.

12. SAMPLING METHODS WITH LIGHT TRAPS, X-RAYS, AND SOUND: Larry Hetrick found ultra-violet light to be very effective for trapping *Dendroctonus* terebran40liv.) of both sexes, provided evening temperatures were 70°F or above. The presence of certain other pine-associated insects was indicated by use of the U-V traps. Jack Dixon stated that hospital X-ray equipment will detect the number of live forms of *D. frontalis* in infested bark; the method is approximately 18 times faster than hand dissection, but somewhat limited by present inability to differentiate between certain life stages. A microsound detector has been demonstrated to be effective in detecting infestations of termites and powderpost beetles in structural timbers according to Larry Hetrick. Two P.C.O. students of John Osmun at Purdue developed the amplifying instrument which is battery-operated, transistorized, and employs a headphone set. A nail is driven into the material to be sounded out. (Sonitrol Corporation, Anderson, Indiana; about $50.00)

13. SAMPLING WITH CHEMICAL ATTRACTANTS: The chemical nature of attractant "pheromones" associated with male *Ips* was reported to be under investigation by Boyce-Thompson Institute chemists.

14. PREDICTING HOST SUSCEPTIBILITY OR RESISTANCE TO ATTACK: Recent research in California has shown that the oleoresin exudation pressure (O.E.P.) in pine is negligible or virtually nil at the time of successful bark beetle attack. Both external and internal water relationships in turn affect O.E.P. Pressure has been measured with Bourdon guages and with small hypodermic needle-capillary glass tube manometers. The latter were developed by Bourdeau and Schopmeyer to measure O.E.P. in slash pine at the Olustee, Florida, U.S.F.S. Experiment Station. The extent and role of intraspecific pine root-grafting in maintaining O.E.P. is virtually unknown. It was speculated that tree-class or risk-ratings as developed for *Pinus ponderosa* Laws. probably would never be developed for Southern *Pinus* species since stand conditions are not comparable in the two regions.

15. SAMPLING TREE MORTALITY BY MEANS OF AERIAL SURVEYS: Nearly all states and agencies report use of aircraft in some phase of survey and control work. A lack of trained observers has limited the use of aircraft according to Dick Fox. A factor apparently given little attention is that 8 percent of U.S. males are color-blind to one degree or another. (Females -0.5%) Large-scale cultural maps are needed to make more effective use of aircraft; however, such maps probably will not become available for 25 years or more, according to Bob Heller.
16. **SAMPLING TREE MORTALITY BY MEANS OF GROUND SURVEYS:** Green infested trees often may be overlooked in *D. frontalis* survey and control programs, according to "Buck" Buchanan. Single infested green trees are especially difficult to spot with the unaided human eye. Differences in transpiration and reflection may be detectable with infrared film, or other devices.

17. **CONTROL BY CHEMICAL AGENTS:** The suggestion was made that bark beetle resistance to control by BHC may result from treatment of given spots for several successive years. Effective residues of BHC were estimated to persist for 6 to 8 months for BHC-oil solutions. Fred Whitfield reported extensive phytotoxicity occurred in ornamental plants in a yard where BHC-oil solutions were applied. It was suggested that safer formulations such as water emulsions be recommended for application to yard trees.

18. **CONTROL BY BIOLOGICAL AGENTS:** A hard and fast policy of cutting all "red-top" pine infested by one or more *D. frontalis* was questioned. Data showed numerous predators and parasites may be destroyed in order to control a negligible number of bark beetles. The suggestion was made that a means is needed for recognizing the stage at which red-tops should be left untreated. Quantitative sampling methods for adult predators are lacking. Parasitic mites were reported to attack *D. frontalis* and *Ips* eggs.

19. **CONTROL BY SILVICULTURAL MEANS:** *Ips* grandicollis in Florida initially were found to infest only suppressed and intermediate slash pine two weeks after a hot fire. Removing or spraying such trees may protect the residual stand. Long-term studies relating insect-caused mortality to stand cutting methods in ponderosa pine have been summarized by Eaton, 1959 (U.S.F.S. Tech. Paper 43). Recognizing and getting to the susceptible trees before the beetles did was considered to be more important than the cutting method used. The 20-acre replicated plots were too small and too close together for the purposes of the study; the results indicate that large-scale, long-term thinking and planning are required for successful silvicultural-control studies.

20. **WHAT TYPE OF INFORMATION IS MOST URGENTLY NEEDED FROM BARK BEETLE RESEARCH?**

   A. Detailed life history information with emphasis on the reproductive processes.

   B. Methods for rearing selected bark beetle populations through "x" generations.

   C. Faster, mechanical, sampling methods.

   D. Methods for determining the degree of host susceptibility or resistance to successful bark beetle attack.

Bark beetle control with chemical insecticides was given the lowest priority. It was recommended that other additional means of control be investigated, wherever possible.
INTRODUCTORY REMARKS AT THE WORK GROUP ON PINE AND HARDWOOD DEFOLIATORS

By

C. L. Morris
Virginia Division of Forestry, Charlottesville, Virginia

With increasing interest in forest pests and their control, more emphasis must be placed on basic studies to determine just what has been lost as the result of defoliation by the spring cankerworm, pine sawflies, or a host of other defoliators. When does loss of vigor become a factor in recovery? How much growth is actually lost and how can we most readily measure it? How do the vagaries of weather affect our measurements?

Certainly this basic information is a necessary part of any biological evaluation and should be available for each important forest defoliator. It is basic to the decision of "control" vs. "noncontrol."

As a portion of the investigation of the biology and control of the Virginia pine sawfly (N. pratti pratti) a series of 10 growth study plots were established in 1959 during the second consecutive year of severe defoliation in the Piedmont by this sawfly. With data from increment cores obtained in 1961 we hoped to determine growth loss and mortality resulting from sawfly defoliation.

PINE AND HARDWOOD DEFOILIATORS: INFLUENCE ON GROWTH LOSS

By

R. J. Kowal, Entomologist
Southeastern Forest Experiment Station, Asheville, North Carolina

During the past 15 years there has been increasing concern among foresters about the growth impact caused by insect defoliators of pine and hardwood. Most of the defoliators cause increment loss, others cause a loss and subsequent deterioration. There is urgent need to develop techniques for accurately estimating these losses. Decisions regarding insect research and control, changes in management practices, and other problems in forest economics depend upon sound loss estimates.

Control of loblolly pine sawfly infestations in Arkansas is justified on the basis of growth-loss studies made by the Southern Forest Experiment Station in cooperation with industries during 1947-1949. Trees with different degrees of defoliation were sampled by various means. Analysis of data taken revealed a direct correlation between degree of defoliation and amount of growth loss and reasonable figures on monetary losses incurred were determined. This study was just a start toward developing an accurate method.

There has been little or no study of growth impact caused by other defoliators, some of which have been epidemic over millions of acres during the past 10 years. The elm spanworm and the forest tent caterpillar are known to cause losses, but no method has yet been devised to provide accurate estimates. The confounding influence of other growth-inhibiting factors such as site and drought and the impact of deterioration, as related to defoliation by these insects, has not been measured. Millions of acres of infestation by the Virginia pine sawfly and Neodiprion excitans have been allowed to continue uncontrolled, despite the alarm and concern of forest industries, largely because their real impact was unknown. In many instances even mortality estimates are vague and unrealistic.
Estimates of present timber resources and projections into the future must consider losses due to fire, diseases, and insects. Certainly past estimates have been unrealistic; many of us believe insect losses are much greater than portrayed. Until techniques are developed which yield accurate and realistic data, the forest industry will continue in a state of uncertainty. Progress in forest practices, insect control programs, and even research on biology and control of insects will depend to a considerable extent upon progress made in developing sound techniques of loss estimation.

PROBLEMS ASSOCIATED WITH FOREST INSECT DEFOLIATORS

By

Dr. A. D. Oliver
Louisiana State University, Baton Rouge, Louisiana

The economic value of wildlife resources in the United States amounts to several billion dollars. The greatest difficulty in assessing the importance of wildlife stems from our inability to measure it and forest and agricultural resources with the same yardstick.

Reduction of wildlife by various agricultural disciplines causes alarm to much of the public; yet hunting and fishing generally take a second seat because they are recreational activities. It is believed, at present, that pesticides are only minor influences on wildlife when compared to other factors in land and water development and use. Urbanization, industrial pollution, drainage of wetlands, land reclamation to mention a few, constitute a greater hazard to wildlife survival than do the use of chemicals. Where loss to chemicals is apparent, it can usually be traced to improper procedures in chemical recommendations and use. There is no place in forest entomology, for "indiscriminate" and "insurance" applications of pesticides. To me, the research and discussions on the impact or loss of growth, etc., as caused by insects is of prime importance. Only after we have these data, can we wisely appraise economic damage and initiate proper control programs.

Some basic considerations we need to make relative to any forest pest control program:

1. There should be an economic need for control before such a program is undertaken. We need considerable research aimed at this phase of forest entomology.

2. Silvicultural and biological means of control should be our primary methods; chemical control should be a strict emergency measure.

3. When it is decided that control is necessary, the most selective pesticide should be employed. The minimum effective dosage should be applied. Non-phytotoxic materials are necessary.

4. Application should be in accordance with state and federal recommendations.
5. Field biologists should participate in these control programs.

6. Suspected hazards from the pesticide should be investigated thoroughly.

7. Chemical control applications should be stopped after the pest population has been reduced sufficiently to cause no further damage.

Some factors governing hazards to wildlife and fish.

I. The chemical used and its method of application.

   a. The toxicity of the pesticide to various species is probably the most important of all problems concerning wildlife and fish kill.

   b. The influence of the adjuvants also play a part. We have not concerned ourselves enough with the differences in performance between formulations in use.

   c. Method of application, e.g., high or low volume spraying, dusting etc. Baits and high volume sprays are probably most hazardous to wildlife.

   d. Concentration of chemicals applied. The minimum effective concentration should always be applied.

   e. Persistance of the chemical after application. We know too little about the long range effects of pesticide residues on wildlife.

II. Species of animals in the treated area.

   a. The greatest lack is toxicological information on wild species.

   b. Feeding and drinking habits of the different species.

   c. Age and weight. Young animals are usually more susceptible than adults.

   d. Movement of the species. (Daily, seasonal or none at all).

III. The Environment.

   a. Type and abundance of pests in the area to be treated and their influence on wildlife. Pest control in some instances will result in more food for wildlife.

   b. Features in area favorable to animal life, e.g., for nesting, shelter, etc.
IV. Climate and Season.

a. Seasons of year as an influence on alternate food sources, migration, etc.

b. Weather conditions during the spraying which affect chemical persistence. High humidity and temperature tend to accelerate decomposition of residues, thus chemicals may respond differently in one area from another.

Insecticides evaluated in Louisiana for control of Forest Tent Caterpillars, 1961-1962:

I. SE-3562--Bidrin: Bidrin is a water miscible systemic phosphate insecticide toxic to a wide spectrum of insects and mites. It acts systemically as a trunk injection, bark treatment, soil treatment, seed treatment or foliage treatment on trees, and shrubs. It does not require activation by the plant to be insecticidally active. The technical product weighs 10 lbs./gal. and contains 70-80% (7.0-8.0) lbs. of isomer--3562. This insecticide has been evaluated for control of the forest tent caterpillar in Louisiana.

Tests in 1961-1962 gave good (85%+) control of the forest tent caterpillar (¼ - ½ lb./acre) without apparent detrimental effects on fish, crayfish, frogs and other wildlife. This insecticide also gave very good control of the pine Calaspis, buck moth, aphids and spider mites in 1961-1962. I have never observed any phytotoxicity after using this material.

II. Phosphamidon (Dimecron): This is a 49% (4#/gal.) water miscible systemic organic phosphate insecticide which was evaluated for control of the forest tent caterpillar in Louisiana in 1961-1962. Good control was obtained without apparent detrimental effects on fish and wildlife at one pound actual per acre.

Both of these materials killed, for a short duration after application, considerable numbers of beneficial insects in the area treated. Lady beetles, syrphid flies, tachinid and sarcophagid flies were those most numerous on the catch nets. The direct contact made during application is believed to be responsible for this kill.

The general conclusion drawn from these tests is that SD-3562 (Bidrin) and phosphamidon applied at ¼ and one pound, respectively, by aircraft in 3 gallons of water per acre presented no danger from an acute oral, dermal or inhalation standpoint to the wildlife and fish inhabiting the sprayed areas. As you know the systemics are taken into the plant tissue, thus eliminating any long residual contact effects. Also, the inability of a plant to translocate these systemics into flower buds and fruits is in favor of their use in control of defoliating insects.
Regardless of the situation at hand, it is my belief that we in forest insect work should never submit to the indiscriminate use of highly toxic chemicals in insect control—save them for the emergency treatments when and where they arise, i.e., the southern pine beetle epidemic in east Texas.

Biological Control Aspects of Defoliater Control:

I do not believe entomologists have taken full advantage of the free insect control that is so apparent when we give thought to the tremendous biotic potential of our insect pests.

After working with the fall webworm two seasons, I find it very amazing, the tremendous detrimental effects the various biological control factors impose on the population.

As an example the biotic potential of one pair of fall webworm moths at the beginning of the fourth generation in a season, is about 16,200,000,000 larvae.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Number</th>
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<tbody>
<tr>
<td>1st</td>
<td>600</td>
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<tr>
<td>2nd</td>
<td>180,000</td>
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<tr>
<td>3rd</td>
<td>54,000,000</td>
</tr>
<tr>
<td>4th</td>
<td>16,200,000,000</td>
</tr>
</tbody>
</table>

In actuality, the carry over from one brood to the next is generally a very little greater than at the beginning. (1 to 2.5 pairs). What are the culprits responsible for this reduction in the biotic potential? There are many. Some of the major ones follow:

Disease:

There are two viruses which we came up with in fall webworms and reported in North America for the first time this year. These are the nuclear polyhedrosis virus *Borrelinavirus hyphantriae* M. & L. and the granulosis virus *Bergoldiavirus kovachevici* S. & P. They were described in Hungary about 1945. We found that one gram of these diseased larvae, macerated and suspended in one gallon of water will give 100% control of apparently healthy larvae of any size when sprayed onto the foliage adjacent to the colonies. The work by Swirnoff et al. (1962), McIntyre et al. (1961) and Dowden et al. (1953) on control of various species of pine sawfly with virus diseases are good examples of the potential we have with these biological control organisms.

Parasites are numerous among the fall webworm colonies.

Brachonids, Achneumonids, and tachinids are three which play a major role in holding the populations in check. Predators apparently play the greatest role in holding the population below the threshold of epidemic
proportions. The Polistes wasp (at least 6 species) are known to take a heavy toll of webworms through the first three generations. The spined soldier bug, Podisus, the preying mantis, Mantis, several species of Reduviids, as Arilus and Sinea, as well as the yellow-billed cuckoo are very helpful in checking webworm build-ups. In some areas the red-eyed verio is apparently the number 1 destructor of this caterpillar.

The failure to mate is not too uncommon among webworm moths. This may be a result of scarcity, weather or adult predators. The weather exerts a certain degree of control at times, I often find adult moths which are caught in the teneral stage during a rain. They become flight-immobile because they do not get the wings expanded properly. Many times they are beaten and drawn by rain.

There is always a part of the eggs which do not hatch. These eggs are probably infertile, some being parasitized by a hymenopteran.

As for the forest tent caterpillar, we have limited data relative to biological control. It seems that most good is done by a sarcophagid fly. In this case, it may be that the aquatic understory prevents sufficient survival of predators and parasites to really reduce the population as a whole and thus prevent our annual ½ million acres of hardwood defoliation.

SUBTERRANEAN TERMITES

By

H. R. Johnston
Forest Insect Laboratory, U.S. Forest Service
Gulfport, Mississippi

Surface Treatment of Wood to Prevent Attack by Subterranean Termites

Results of these tests after about three years, using 3-minute soak applications, indicate that (1) the insecticides—chlordane, dieldrin, aldrin, and heptachlor—aid in preventing termite damage; (2) a combination of any one of these insecticides and 5 percent pentachlorophenol is more effective against termites than 5 percent pentachlorophenol alone; (3) 2 percent paraffin (water repellent) has no apparent influence on the insecticidal action of the various formulations; and (4) 2 percent copper naphthanate is more effective against termites than 5 percent pentachlorophenol. Only four treatments remain in the soil burial tests. These are: (1) 2 percent copper naphthanate in mineral spirits; (2) 2 percent copper naphthanate, 1 percent dieldrin in mineral spirits; (3) 2 percent copper naphthanate, 2 percent paraffin in mineral spirits; and (4) 2 percent copper naphthanate, 2 percent chlordane, and 2 percent paraffin in mineral spirits.
All other tests were closed after 3 years due to heavy decay. A ready-mixed formulation (Cuprinol 10-52544) that contained 2 percent copper naphthenate failed because of decay. As a whole, damage by termites and decay is considerably lighter in boards placed slightly above the ground than in the soil burial tests, but, in general, the board tests show trends similar to the soil burial tests.

Study of Soil Treatments for Control of Subterranean Termites

By

R. H. Beal
Southern Forest Experiment Station
Gulfport, Mississippi

Testing of insecticides for use as a soil treatment to prevent termites from entering wooden structures first began at Gulfport, Mississippi, in 1938 with the use of some of the standard wood preservatives such as penta, sulfur, borax, etc. These wood preservatives afforded little or no protection.

In 1944, with the advent of some new insecticides, DDT was used as a soil treatment at rates of 2, 4, and 8 percent in fuel oil. Ten years' protection was afforded with 8 percent DDT at 1 quart per cubic foot of soil.

Between 1946 and 1953, soil treatments were established in cooperation with the Army Engineers to protect wood that is laid directly on the ground (ammunition boxes). The platform method was developed where a 2-square foot area is wet down with an insecticide.

Many insecticides were used in this period. A few of the outstanding ones are:

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Percent</th>
<th>Carrier</th>
<th>Dosage</th>
<th>Years of 100% protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrin</td>
<td>0.50</td>
<td>Water</td>
<td>1 pint/sq. ft.</td>
<td>13</td>
</tr>
<tr>
<td>BHC</td>
<td>0.8</td>
<td>Alpha Beta</td>
<td>Crystals 1 oz.</td>
<td>14</td>
</tr>
<tr>
<td>Chlordane</td>
<td>2.0</td>
<td>Water</td>
<td>½ pint/sq. ft.</td>
<td>14</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>0.50</td>
<td>Water</td>
<td>1 pint/sq. ft.</td>
<td>13</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>1.0</td>
<td>Water</td>
<td>½ pint/sq. ft.</td>
<td>10</td>
</tr>
<tr>
<td>Toxaphene</td>
<td>8.0</td>
<td>Fuel oil</td>
<td>½ pint/sq. ft.</td>
<td>14</td>
</tr>
</tbody>
</table>
Some of the other materials that were tested but failed within a few years were:

- Copper ammonium fluoride
- Creosote
- Methoxychlor
- Orthodichlorobenzene
- Pentachlorophenol
- Sodium arsenite

By 1956, the least effective materials for control of termites were eliminated and the more effective ones were installed in test. Low dosages and rates were used to determine where the lower limit of protection is, and higher dosages (up to 8 percent) were used to see if longer protection would result. Now, after six years, chlordane, heptachlor, endrin, isodrin, and heptachlor epoxide at about 0.5 percent in water are still giving protection from termite attack.

In 1958, aldrin, chlordane, dieldrin, and heptachlor were used in test at rates as low as 1/2000 percent in water to determine the range of protection. Most of the lower dosages are failing, as expected.

In recent years, soil treatment tests have been established in the heavy soils in the Mississippi River bottom, and also in limestone soils of central Mississippi, to determine the effect of soil type on protection. To date, no conclusive results are available.

Studies of Resistance of Plastics and Joint Fillers to Subterranean Termites

By

R. H. Beal

In 1955, the Department of the Navy became interested in determining the resistance of some of their wire insulation materials to attack by termites. Because these insects have caused extensive damage to electrical cables underground in tropical and subtropical areas, field tests were installed in the Panama Canal Zone, as well as in south Mississippi where laboratory tests were installed. About the same time, joint filler materials were established in the laboratory to test their resistance to termites.

Wire Insulation Material

Electrical wire insulation materials and plastic vapor barrier materials have been tested which include products made of polyethylene, neoprene, polyvinyl chloride, butyl rubber, natural rubber, cloth fiberglass, and combination of fiberglass and plastics. Termites have been able to penetrate the above materials. In 1960, dieldrin was incorporated with some of the
polyethylenes, neoprene, and polyvinyl chloride with hopes of deterring the termites. This has not appreciably affected penetration.

**Joint Fillers**

This has been laboratory tests only. Materials tested have included coal-tar pitch, asphalt, and various combinations of asphalt and rubber.

To test the joint fillers, they have been poured in the mouth of jars filled with sawdust infested with termites. When penetration has occurred in three of five samples, the test is closed and the material classed as failed.

Dieldrin, heptachlor, and chlordane have been incorporated in some of the better joint fillers to give prolonged protection, but this does not prevent attack.

None of the materials tested in the laboratory have proved to be immune to attack by termites including the ones with insecticide added.

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**LYC'TUS POWDER-POST BEETLES**

By

H. R. Johnson

**Surface Treatment of Wood to Prevent Attack by Lyctus Powder-Post Beetles**

Studies were established in 1957 under simulated storage conditions to determine the value of several chemicals in preventing attack by Lyctus powder-post beetles. Oil solutions containing 5 percent DDT, 2 percent chlordane, 5 percent toxaphene, 0.5 percent BHC, 5 percent pentachlorophenol, and 2 percent (metallic) copper naphthenate were applied as 10-second and 3-minute dips. All treatments were highly effective after a period of about 5 years, except pentachlorophenol and copper naphthenate. The latter two chemicals gave some degree of protection as compared to untreated controls, but they were much less effective than were the chlorinated hydrocarbons.

In the same studies, water emulsion containing 0.5 percent gamma BHC applied to green ash lumber as a 10-second dip was highly effective.
The Seventh Annual Session was called to order by the chairman, Dr. Larry Hetrick, of the University of Florida. The nominating committee composed of Les Orr, Lacy Hyche and Joe Kowal reported a list of nominees for consideration as officers of the conference.

Following appropriate introductions and statements of welcome, the program began. Following the completion of the program on November 8, the final business session was conducted. L. O. Warren was elected chairman, E. P. Merkel as secretary-treasurer and Lacy Hyche as 3-year counselor. Clemson College and North Carolina State College were nominated as meeting sites for 1963. No strong preference for time of meeting was indicated. This year's program arrangement was discussed and the general attitude seemed to favor organizing at least part of future programs along similar lines.

Following adjournment, the counselors held a brief meeting with the other newly elected officers. North Carolina State College was selected for the next meeting site with the last week in August as the preferred date. E. A. Osgood was appointed program chairman, Maurice Farrier and Fred Whitfield as a committee on local arrangements.

REGISTRATION LIST
Seventh Annual Southern Forest Insect Work Conference
November 7-8, 1962
Auburn, Alabama

Aldrich, Robert C.--U.S.F.S., Forest Insect Lab., Beltsville, Maryland
Anderson, Roger F.--Duke Univ., School of Forestry, Durham, North Carolina

Beal, Raymond H.--U.S.F.S., Southern Forest Expt. Sta., Gulfport, Mississippi
Boyer, Raymond G.--U.S.F.S., Southern Forest Expt. Sta., Gulfport, Mississippi
Buchanan, W.D.--U.S.F.S., R-8 Forest Pest Control, Asheville, North Carolina
Buttram, James--Auburn Univ., Agric. Ext. Serv., Auburn, Alabama

Cambre, L.A.--U.S.F.S., R-8 Forest Pest Control, Alexandria, Louisiana
Cordell, C. E.--U.S.F.S., R-8 Forest Pest Control, Asheville, North Carolina
Cralley, E. M.--Agric. Expt. Sta., Univ. of Arkansas, Fayetteville, Arkansas
DeVall, W. B.—Auburn Univ., Dept. of Forestry, Auburn, Alabama
Dooling, Oscar J.—U.S.F.S., R-8 Forest Pest Control, Alexandria, Louisiana
Dowden, Philip B.—A.R.S., Ent. Res. Div., Beltsville, Maryland


Flora, Robert L.—U.S.F.S., R-8 Forest Pest Control, Asheville, N.C.
Fox, Richard C.—Ent. Dept., Clemson College, Clemson, S.C.
Franklin, R. T.—U.S.F.S., R-8 Forest Pest Control, Atlanta, Georgia

Galusha, Henry—U.S.F.S., R-8 Forest Pest Control, Alexandria, Louisiana
Gibson, Lester P.—U.S.F.S., Central States Forest Expt. Sta., Delaware, Ohio

Hammer, A. L.—Ent. Dept., Miss. State Univ., State College, Mississippi
Heller, Robert C.—U.S.F.S., Forest Insect Lab., Beltsville, Maryland
Hetrick, L. A.—Ent. Dept., Univ. of Florida, Gainesville, Florida


Lambert, Hoover L.—U.S.F.S., R-8 Forest Pest Control, Asheville, N.C.
Ledbetter, Roy T.—Auburn Univ., Auburn, Alabama
Lee, Robert E.—Union Bag-Camp Paper Corp., Savannah, Georgia
Livingston, Knox—Auburn University, Forestry Dept., Auburn, Alabama

Morris, Caleb L.—Virginia Division of Forestry, Charlottesville, Virginia
Muller, Carl A.—State of Alabama, Atmore, Alabama

Oliver, A. D.—Ent. Res. Dept., L.S.U., Baton Rouge, Louisiana

Padget, W.—U.S.F.S., R-8 Forest Pest Control, Alexandria, Louisiana
Pearson, Allen M.—Ent. Dept., Auburn, Univ., Auburn, Alabama
Smith, C. V.--Auburn Univ., Auburn, Alabama

Tsao, Ching H.--Ent. Dept., University of Georgia, Athens, Georgia

Van Denburg, Dale O.--U.S.F.S., R-8 Forest Pest Control, Valdosta, Georgia

Warren, Lloyd O.--Ent. Dept., Univ. of Arkansas, Fayetteville, Arkansas
Weber, F. P.--U.S.F.S., Forest Insect Lab., Beltsville, Maryland
Whitfield, Fred--North Carolina State College, Raleigh, North Carolina
Williamson, Leroy--Texas Forest Service, Woodville, Texas

Yearian, William C.--Florida Agric. Expt. Sta., Gainesville, Florida