LIGHT TRAPPING IN SEED ORCHARDS UNDER A PEST MANAGEMENT SYSTEM

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Abstract. --Blacklight traps provide the seed orchard manager with a valuable tool for assessing insect populations that damage pine seed and cones. The identification, relative abundance, and biologies of insect species can be determined by operating only one light trap during the growing season. This information provides a basis for determining when controls are warranted and at what time they should be applied. Although the effect of using large numbers of light traps in a seed orchard has not been tested, such use might be valuable in depressing insect populations. If so, use of light traps might become useful as a control component in a pest management system for seed orchards.

Additional keywords: Insects, pine.

The first recorded use of light as an insect attractant was in Europe about 1787, when insect infestations were controlled in vineyards. Although the setup was very crude, the method used was essentially the same as the one used by present-day entomologists: the particular insect's positive reaction to light is taken advantage of to bring about its capture and destruction. More recently, light trapping has been used in attempts to control several agricultural pests attacking tobacco (Lam et al. 1968) and pecans (Teciders, Hartsock, and Osburn 1972).

PREVIOUS STUDIES IN SEED ORCHARDS

In 1968, work was begun at the Forestry Sciences Laboratory in Athens, Georgia, on the use of light traps in studying the adult activity periods, relative abundance, and geographic distribution of insects that infest pine seed and cones. These traps were operated during the same time that seed and cone insects were being sampled on selected trees throughout Clarke County, which surrounds Athens.

A light trap, based on the design of Barnes, Wargo, and Baldwin (1965), was selected for use in these studies. This trap consists of a 12-inch-high sheet-metal funnel 10 inches in diameter at the top and tapering to a 2-inch diameter at the base. A 10-inch square vertical baffle is attached to the top of the funnel. A 6-watt blacklight fluorescent light, horizontally mounted inside the funnel, projects light rays upward only.

Live specimens were captured in a polyethylene plastic bag designed to fit at the base of the light trap (Powers 1969). This bag was of sufficient size so that captured moths could move about with minimum injury and live, undamaged specimens could be used for further biological study. The traps were tied to a cord on a pulley attached to the lower tree crown and were lowered for collection of the nightly catches. If we did not desire to keep the insect

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specimens alive, the plastic bags were taken to the laboratory and placed in a chest-type freezer. Frozen specimens were in excellent condition for separation and identification.

We concentrated our trapping in a mixed plantation of loblolly (Pinus taeda L.) and shortleaf (P. echinata Mill.) pines in a residential development. The trees were about 40 feet tall and exhibited good growth and excellent yearly cone crops.

Each light trap was monitored for nine species of Lepidoptera that damage pine seed and cones. These included the phycitids Dioryctria amatella (Hulst), D. clarioralis (Walker), D. disclusa (Heinrich), and Dioryctria n. sp.; the olethreutid s Laspeyresia toreuta (Grote), L. ingens Heinrich, Eucosma cocana Kearfott, and Rhyacionia spp.; and the geometrid Nepytia semiclusaria (Walker).

Similar light trapping studies have been conducted at Olustee, Florida, by Merkel and Fatzinger (1971). They have determined adult activity periods in northern Florida for D. amatella, D. clarioralis, and L. ingens. They have also determined the activities of two species--D. abietella (Denis & Schiffermuller) and L. anaranjada Miller--not found in The Georgia Piedmont.

Of the major insects known to attack pine seed and cones in the South (Ebel 1963, Goolsby et al. 1972), all have proven to be readily captured by light traps except for the seedbugs Leptoglossus corculus(Say) and Tetyra bipunctata(H.-S.), the cone midges of the family Cecidomyiidae, and the pine flower thrips of the order Thysanoptera.

During 1968, we also tested six commercially available fluorescent light sources to determine which was the most attractive to seed and cone pests (Yates 1973). These sources were designated as blacklight, blacklight-blue, white, warm-white, cool-white, and daylight. The blacklight and blacklight-blue sources were almo st equally attractive to all the Lepidoptera that attack pine seed and cones. *We* have, however, standardized our trap light source in order to conform with that recommended by the Entomological Society of America: blacklight (ordering code F6T5/BL).

We have also studied the influence of trap height on insect catch and have determined at what hours during the night different species are trapped. Traps operated at 30 feet and 5 feet above the ground captured different insect species. Moths of the family Phycitidae, Dioryctria spp., were primarily captured in the 30-foot-high traps (D. amatella, 76 percent; D. clarioralis, 77 percent; D. disclusa, 74 percent; and Dioryctria n. sp., 76 percent). However, moths of the family Olethreutidae were captured primarily in the traps at the 5-foot level (L. ingens, 81 percent; L. toreuta, 89 percent; E. cocana, 65 percent; and Rhyacionia spp., 62 percent). The geometrid moth Nepytia semiclusaria showed no preference as to trap height (48 percent at the 30-foot level and 52 percent at the 5-foot level).

Insect catches were also recorded as to species during six 2-hour periods, beginning at 8:00 p.m. and ending at 8:00 a.m. each day. The olethreutids L. ingens and L. toreuta were captured primarily during the period from 8:00 p.m. until midnight. All four Dioryctria species showed peak periods of adult activity after midnight. For example, 84 percent of the D. amatella were captured between midnight and 8:00 a.m. This behavior is consistent with the

results of studies which show that, for Dioryctria spp., female "calling"--that is, the period when the females release their pheromone to attract the males--occurs about 2:00 a.m.

Light trapping has also been helpful in identifying the seasonal activity of cone and seed insects. Figure 1 summarizes the seasonal periods of adult flight for eight species of insects found in seed orchards in the Georgia Piedmont. The proportion of yearly catch is plotted above and below a base-line to emphasize the seasonal occurrence of the adults. These diagrams were developed by adding together the total number of each species trapped during the same weeks for 3 years. It should be emphasized that these individual diagrams were developed from 3 years' data and, because of yearly variations in seasonal weather, tend to be more dispersed in time than would diagrams for single years. However, the viewer can form an estimate of the likelihood of activity by a particular moth by referring to the relative thickness of its diagram at a given date.

These diagrams of adult catches provide a quick scan of the periods when adults are active and can be used as a guide to the timing of detection or control efforts. Second, they provide a ready reference to the adult biology of each insect, particularly by indicating the likely periods of greatest abundance and the number of generations each season.

LIGHT TRAPPING IN A PEST MANAGEMENT SYSTEM

The concept of pest management implies two things: first, that no attempt is made to eradicate a target pest and, second, that some damage to the protected crop is to be expected. This concept should not be hard for the seed orchard manager in the South to accept because, in some cases, his insect control efforts involving weekly or biweekly applications of large doses of pesticides have proven futile. The reasons for these all-too-frequent failures might include improper timing of spray application, use of untested pesticides or formulations, poor coverage, and an unfamiliarity with the pest fauna and the relative impact each insect species has on the ultimate crop.

In a pest management system, the manager does not generally rely on one method but rather integrates two or more methods to maintain a pest population at a tolerable level. Just how might light traps be used in a seed orchard under a pest management system? In many instances, the insect fauna which is a potential threat to seed production in a particular area is incompletely known. Yet specific insect determinations are essential in order to fully understand what menace exists and what course of action might be prescribed.

To illustrate, specific insect determinations based on the differences in cone damage caused by the olethreutid E. cocana and that caused by any one of the four phycitids D. clarioralis, D. disclusa, D. amatella, and Dioryctria n. sp. are difficult to make, even for those familiar with the damage symptoms. It would be futile to apply controls for E. cocana, which has one generation per year, when indeed the insect causing the damage is D. clarioralis, an insect species with three generations per year. Furthermore, E. cocana overwinters as a pupa in the duff under the trees, whereas D. clarioralis overwinters as a young larva on the shoots and cones.

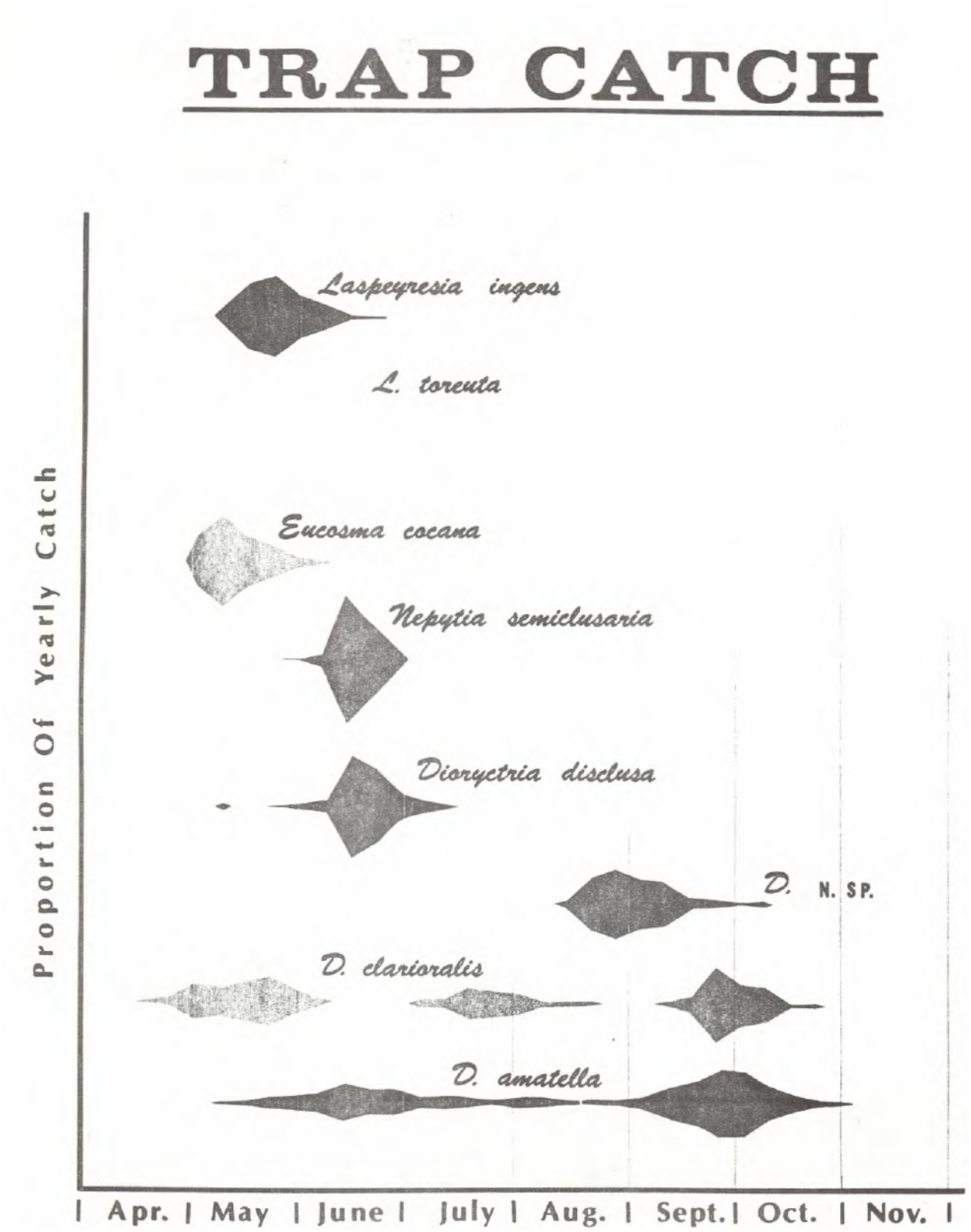

Figure 1.--Adult activity periods of eight species of cone and seed insects in the Georgia Piedmont as based on seasonal catches in light traps over a 3-year period.

Strategies to control these two species are for the most part incompatible, and a misidentification of the target species would result in wasted effort and money. Nightly light trapping would provide the seed orchard manager with adult specimens of the moths which attack the fruiting structures of pines in his area. He could then make tentative determinations by comparing specimens with colored illustrations, or he could submit suspect specimens to an entomologist for identification.

Similarly, once the insect complex in a particular area is known, an evaluation of each insect's potential impact may be made. On the basis of this information, a decision can then be made as to whether any action should be taken to manage a particular insect species. For instance, the work of Ebel (1971) indicates that the presence of the seedworms L. toreuta and L. ingens in seed orchards may be completely ignored: it is questionable whether a 3.8-percent gain in seed production would be sufficient to justify routine control efforts, even in a seed orchard.

Although extensive use of light trapping over a period of years has been demonstrated to reduce damage to agricultural crops (Tedders et al. 1972, Lam et al. 1968), this use has yet to be tested in seed orchards. The main obstacle to such an experiment appears to be financial. Over a period of 5 years, our light trapping in the same area of Georgia has shown that, for several species, there is a gradual yearly reduction in the overall numbers trapped each night. Unfortunately, no damage evaluations have been made that might relate these reduced insect captures to reduced damage to the seed crop. If the use of large numbers of light traps could be demonstrated to reduce damage to a tolerable economic level, then more direct control measures involving pesticides might be abandoned.

CONCLUSIONS

After 5 successive years of trapping seed and cone insects in the Georgia Piedmont, we are now able to verify observational knowledge about the biology of these insects. We also have gained considerable knowledge on how each insect species reacts to light sources and trap heights and on the periods of the evening when the various species are active.

Hopefully, these studies will lead to the incorporation of light trapping for insect detection in a pest management system for seed orchards. Reductions in catches during successive years of trapping in some instances suggest that population depression has occurred as a result of the trapping. If such population depression can be shown to result in reduced crop damage, then light traps might well become an important control component in a pest management system for seed orchards.

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