AN UPDATE ON THE SOUTHWIDE CONEWORM SURVEY

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Abstract.--Since 1981, sticky traps baited with synthetic pheromones have been used in seed orchards across the South to monitor the activity of four species of coneworms: *Dioryctria amatella, D. clarioralis* (Walker), *D. disclusa* Heinrich and *D. merkeli* Mutuura and Monroe. The Southwide Coneworm Survey provides site-specific and regional information on insect distribution, abundance and seasonal activity which can be used in making pest management decisions and planning research studies.

Keywords: Cone and seed insects, *Dioryctria,* insect abundance, insect distribution, insect sampling, IPM, pest management, pheromone traps.

INTRODUCTION

Since 1981, a survey has been conducted using sticky traps baited with synthetic pheromones to monitor populations of four species of coneworms in pine seed orchards throughout the South. The survey is a cooperative effort between the USDA Forest Service Southeastern Forest Experiment Station (SEFES); USDA Forest Service Forest Pest Management - Region 8 (FPM); and cooperating industry, state and federal orchards. The Southwide Coneworm Survey provides site-specific and regional information on the distribution, abundance and seasonal activity of the coneworm species. This information can be used to assist in pest management and research work on coneworm biology.

Moths of the Genus *Dioryctria* attack and kill cones of conifers throughout the Northern Hemisphere. Commonly called coneworms, the adults are small, gray or brown-orange moths with crossbands on the forewings. Four sympatric species infest pines in the South: the southern pine coneworm, *D. amatella* (Huslt); the blister coneworm, *D. clarioralis* (Walker); the webbing coneworm, *D. disclusa* Heinrich; and the loblolly pine coneworm, *D. merkeli* Mutuura and Monroe. Coneworm larvae feed in the conelets, cones and stems of pines. Infested conelets and cones are destroyed making coneworms major pests in seed orchards (Ebel et al. 1980).

Mating behavior in *Dioryctria* species, as in most lepidopterans, is based on the release of a pheromone by the female. This pheromone is a volatile chemical that is very attractive to male moths. The male can locate the female by following the pheromone plume which she produces; enhancing the chances for successful mating (DeBarr and Berisford 1981).

Damage to pine seed production by coneworms has long been known (Ebel 1965, Neunzig et al. 1964, Sartor and Neel 1971). As the seed orchards established in the 1960's began to come into full production, the effects of coneworm damage became increasingly important.

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However, the trigger for a serious survey was the severe outbreak of *D. disclusa in* the late 1970's and early 1980's. Additionally, this outbreak coincided with the development of the synthetic pheromone for the webbing coneworm. Presence of a pheromone in *D. disclusa* was confirmed in 1981 (DeBarr and Berisford 1981); and the compound was soon isolated and identified as (Z)-9-tetradecenyl acetate (Meyer et al. 1982). The isolation and synthetic production of the pheromone were the essential steps for survey feasibility. The survey began in 1981, the third year of the outbreak, when USDA Forest Service personnel held training sessions, loaded pheromone baits and distributed pheromone traps to orchards throughout the South (DeBarr 1991, DeBarr et al. 1982).

Subseqent work and trapping revealed that the synthetic pheromone was attractive, not only to *D. disclusa,* but also to *D. clarioralis* and *D. merkeli* (Hanula et al. 1984, Meyer et al. 1984). The final piece of the puzzle was put into place with the development of the synthetic pheromone complex for *D. amatella* (Meyer et al. 1986). Since that time, the survey has collected information on all four species.

This paper summarizes the status of the survey. Additionally, possibilities for future development of the survey are discussed.

METHODS AND PROCEDURES

Since 1982, the survey has been a cooperative effort of SEFES; FPM; and cooperating industry, state and federal orchards. The pheromone baits, traps and specific trapping procedures are described in Weatherby et al. (1985). Each year FPM sends out a request for participation to orchards in the South; in the meantime, SEFES loads the rubber septa baits with the pheromone and forwards them to FPM. After the cooperators respond, FPM, in turn, sends baits, data sheets and instructions. The cooperators are responsible for obtaining, installing and checking the traps. Cooperators check the traps twice weekly from March through November. The orchard managers can base their pest management decisions on the trap counts; however, they are also requested to forward the completed data sheets to FPM where the data are entered into a computer database (Weatherby et al. 1985).

RESULTS AND DISCUSSION

There is now a significant database on the abundance, phenology and geographical distribution of the four species of *Dioryctria* in the South. The database spans the 12 years from 1981 to 1993. Since 1985 the number of participating orchards has been, respectively: 1985 - 49, 1986 - 53, 1987 - 49, 1988 - 45, 1989 - 33, 1990 - 33, 1991 - 28, 1992 - 17. The number of orchards trapped is usually higher than the number of participants because several of the cooperators trap more than one orchard. For example, in 1993 there are 21 participants with 30 orchards being trapped. All states in the South have been represented at some time since the survey started. The cumulative numbers of participants from each state are as follows, respectively: AL - 13, AR - 4, FL - 11, GA - 11, LA - 9, MD - 1, MS - 6, NC - 10, OK - 1, SC - 7, TN - 2, TX - 5, VA - 3. Loblolly pine sources are by far the most frequently surveyed; however, slash, shortleaf, longleaf and sand pine sources have also been surveyed.

As with any cooperative project, there are some problems. It is difficult, due to personnel limitations, to provide timely feedback to participants. Additionally, maintaining a consistent database has been difficult because cooperators may not participate each year or may not trap equal durations from year to year. Participation does cost the cooperator; consequently, the yearly survey must compete with other management items that change from year to year. However, these difficulties and the usual minor coordination and communication problems have not prevented the loyal participation of several cooperators for a number of years. This has resulted in much useful data.

Data from the survey have verified and refined knowledge of the distribution and phenology of the four coneworm species. This information has been made widely available in publications such as Ebel et al. (1980). For example, *D. amatella* has several generations per year with much overlapping of life stages and is present from late April through November throughout the South. *D. clarioralis*, has three distinct generations per year in the Middle to Deep South (Ebel et al. 1980).

Much more can be done. The survey data will be useful in refinement of degree-day models that have been developed by SEFES (DeBarr, unpublished). The degree-day models will enable managers to optimally time control operations. Statistical and mathematical analyses of the data collected will help determine those factors responsible for population fluctuations of the species. Additional analyses will assess the effect of control efforts. Many of the orchards surveyed conduct routine control programs. These orchards can be compared to those where little or no control is done and the long-term effects of control measures can be assessed.

Several improvements to the survey are planned. Most immediately, the database is to be moved into a new software program. This will ease data entry and manipulation and hopefully enhance timely summaries back to cooperators.

A major change will come in the future when the survey is incorporated with the RAIN (Remote Automated Intelligence Network) computer network. RAIN consists of stations at various locations. At each location, portable computers equipped with sensors record meteorological information and automatically send the information to the central computer where it is incorporated in a database. In turn, the central computer provides this and other databases to users. Besides databases, users can access models and site-specific pest control recommendations. For example, RAIN can automatically advise managers when to apply control sprays for the Nantucket pine tip moth. Direct communication from station to station in the network is possible (Pickering et al. 1990).

Incorporation of the Southwide Coneworm Survey into the RAIN network will have several advantages. There will be more flexibility; direct communication among participants and coordinators will be possible. Cooperators will be able to directly enter their data into the database. This will eliminate the need for sending forms through the mail. Automated database updates and summaries will be possible. Consequently, responses to cooperators will be immediate, overcoming one of the most vexing problems with the present survey. RAIN will allow the correlation of trap catch data with meteorological data and degree-day models. This

will enable automated recommendations for timing of control measures. Ultimately, an expert system can be developed which uses the RAIN system to combine the survey, models, data analysis and communications software to provide orchard managers with a valuable tool to assist in management decisions.

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