INSECT RELATIONSHIPS IN NO-TILLAGE CROPPING

J. N. ALL

Insect relationships in several types of no-tillage (NT) cropping systems have been studied in Georgia for the past 5 years. UGA and USDA-SEA agronomists and plant pathologists have been involved in this research and their cooperation is acknowledged. Cultural practices such as various planting dates, irrigation, subsoiling, pesticides (including herbicides, insecticides, and nematocides), fertilization, etc. were studied in NT systems to determine their influence on insect populations. These were primarily noncontinuous types of NT systems, and a tillage operation usually occurred every 1-2 years during a multicrop sequence. Usually the NT system was compared directly to a conventional tillage (CT) program that differed only in the tillage operation. Research also has been conducted to determine the causes responsible for the phenomena observed in NT.

We found that various insects are enhanced, deterred, or not affected in NT ecosystems. Over the last 2 years, infestations of the Southern corn billbug, Spenophorus callosus (Oliver), have been much higher in NT than CT in early season plantings of corn, Zea mays L. Practices such as irrigation and subsoiling did not influence infestations in the NT and CT plots, but selected insecticides reduced damage in both tillage systems. However, no insecticide treatment reduced infestations below economic thresholds in NT. It is known that these types of severe infestations often occur in fields having nutgrass, Cyperus rotundus L. (this was present in our tests) and other weeds, thus growers should be concerned about billbug infestations in these type areas when using NT.

Anotner problem in NT corn is the insect transmitted virus diseases maize chlorotic dwarf (MCD) and maize dwarf mosaic (MDM). Epiphytotics of either disease often are associated with johnsongrass, Sorghum halepense (L.)(Pers.), since the virus overwinters in rhizomes of the weed. Even when johnsongrass is in low levels the diseases can be severe in NT fields because johnsongrass seedlings are often present at the time NT corn is planted. In NT many contact herbicides do not suppress johnsongrass seedlings as well as planting time tillage operations and inoculum is available in NT for vector transmission even as corn is germinating. We have found that suppression of johnsongrass with certain systemic herbicides decreases the diseases in NT. Also systemic insecticides carbofuran and aldicarb control leafhopper vectors of MCD and reduce virus transmission in NT. Use of disease resistant hybrids is another method that can be used to suppress virus damage. However, integrated use of all these techniques has proven the best procedure for managing virus diseases in NT and can result in substantial yield increases.

J. N. All is Associate Professor of Entomology, Department of Entomology, University of Georgia, Athens, Georgia.

We are concerned about increased damage in NT by certain stored grain insects, especially in corn planted in the stubble of small grains. Sampling indicates that field infestations of sap beetles (Nitidulidae), maize weevil complex (Sitophilus spp), and grain beetles (Tenebrionidae) occur in unharvested small grains (NT residue) and these populations move into corn prior to harvest. Other insects that have higher infestations in NT include spittlebugs, Prosapia spp, (nymphal feeding on brace roots) and the ring-legged earwig, Euborellia annulipes (Lucas), (in harvest stage ears of corn), but damage appears negligible.

One of our most interesting findings is that infestations of lesser cornstalk borer, Elasmopalpus lignosellus (Zeller) are consistently reduced in NT. This has been observed in corn, sorghum, and soybeans by us and others. Research suggests that this occurs primarily from diverse behavior of larvae in NT as compared to CT rather than a detrimental effect on its biology. Several types of experiments all indicate that larvae are facultative pests in NT. They feed on the residues of former crops and don't attack corn unless it is encountered in their migrations. Thus, NT crop residues act as a diluting system for lesser cornstalk borer populations by providing an abundance of an alternate food source on which larvae can survive. In CT fields no feeding material other than corn is available and larvae must find and attack the seedlings or they will perish.

Fall armyworm, Spodoptera frugiperda (J. E. Smith), infestations of late planted corn and sorghum are reduced in NT as compared to CT. This occurs only for a short period when seedlings have not yet grown above the NT residues. Research indicates that two factors are involved (1) reduced oviposition by fall armyworm moths in NT and (2) increased predation of young fall armyworm larvae in NT. However, the infestations greatly increase as seedlings grow above NT residues and damage ultimately becomes nearly as great as in CT when fall armyworm populations are high.

This short lag in population buildup by fall armyworm in NT corn/sorghum may have practical importance for controlling infestations. We currently are investigating insecticide strategies that utilize reduced spray schedules and rates in NT in order to de elop more economically efficient management systems for fall armyworm in late planted crops.

Most insects that attack older corn have similar populations in NT as in CT. This includes stalk borers European corn borer, Ostrinia nubilalis (Hubner), and the Southwestern corn borer, Diatraea grandiosella (Dyar). We have noted no significant differences between NT and CT in the number plants attacked or lodging by either insect in several tests conducted over the past 4 years. Ear damage by the corn earworm, Heliothis zea (Boddie), fall armyworm, and European corn borer in NT has also been similar to CT.

We have been studying the influence of NT on beneficial insect populations including predators such as ground beetles (Carabidae), tiger beetles (Cincindelidae), and others. These biological control agents are important regulators of pest insects and our sampling indicates that their populations often are several fold higher in NT than CT. A major objective of most pest management systems in agriculture is to develop ways to enhance activities of biological control agents and our results indicate that NT promotes development of favorable environments for many predatory insects.

Observations indicate that higher predator populations in NT reduce fall armyworm levels on young corn and we are currently investigating this on other pests also.

Our research to date emphasizes the fact that insect relationships in NT cropping systems often differ from CT and that each species must be studied individually in order to develop a collective conclusion on overall pest potential in NT. In general, noncontinuous NT systems that have some form of tillage operation within a 1 or 2 year cropping sequence do not appear to develop greater insect infestations than CT systems planted at the same time. However, our research indicates that insect pest management will be a primary concern in multicrop NT systems where crops are planted later than normal.

Pest management in NT must be based on sound knowledge of pest bionomics in NT ecosystems. Direct control methods should be used only when necessary and be precluded by use of cropping practices in NT that, if are not detrimental to pests, are at least not conducive to population buildups. Use of NT practices that enhance biological control factors should be encouraged. When direct suppression of pests is necessary, the control strategies should be founded on an understanding of (1) effective techniques for pest suppression and their costs, (2) rapid sampling procedures that accurately define current pest levels, (3) damage potential and economic impact of specified pest levels, and (4) impact of pest control methods on biological control agents and other factors in NT ecosystems. With this knowledge, action thresholds can be defined for specified pest populations and the most effective and efficient control methodology recommended.