Oklahoma wheat producers are increasingly adopting conservation tillage practices such as no-till. As producers transition into conservation tillage, they may see shifts in the insect pest complex that infests their crops and will need to adjust their pest management strategies to account for them. Fortunately, control tactics are available regardless of the type of tillage used. What is important is to develop a management strategy based on fundamental principles of Integrated Pest Management (IPM).

How can conservation tillage affect insect pest populations? Tillage practices directly affect soil, which provides shelter and resources for many arthropods that live there, so tillage can affect insect populations as well.

1. Direct effects:
   a. Some insects live in or on the crop residue, or in the soil at some point in their lifecycle. Tillage can disturb these insects by killing them, by destroying the residue that the insects rely on for shelter, or by physically disturbing the soil habitat. For example, Hessian flies overwinter and over-summer as pupae on wheat stubble. If the wheat stubble is buried deep enough in the soil with tillage, emerging Hessian flies die in the soil.
   b. Some insects such as May/June beetles prefer to lay their eggs in fields that are covered with plant residue or weed seedlings, while others, such as the army cutworm, prefer bare soil.
   c. Soil temperatures are often cooler and soil moisture higher in fields with crop residue, which can affect the survival and development rate of insects that live in the soil. For example, Illinois researchers found that emergence of corn rootworm adults is delayed in no-till fields, and survival of rootworm eggs is actually increased in no-till because such fields tend to have less fluctuation in temperature during the winter.

2. Indirect effects:
   a. Tillage can change the type and density of weeds that are present, which in turn can affect the populations of both beneficial and pest insects. Poor weed management can make a field more attractive to insects such as the black cutworm or the May/June beetle. Volunteer crops may serve as reservoirs for pests. Wheat curl mite populations, the vector of wheat streak mosaic virus, often build in volunteer wheat, and then move into the wheat crop once it emerges from the soil. On the positive side, the presence of wheat stubble in the soil has been shown to deter greenbugs from colonizing and building in numbers compared to tilled fields. In general, increased diversity in the physical environment from crop residue may also add stability and diversity to the agricultural ecosystem, including a more diverse population of beneficial insects.
   b. Crop rotations are often an important component for successful crop production with conservation tillage. Rotations can affect the potential insect pests that might occur. For example, continuous cultivation of the same crop may allow pests of that crop to build.
The lifecycle of some pests can be disrupted by rotating into a non-host crop for one or more years. Some insects are pests of several crops and can cause problems if the crop rotation sequence is favorable for them. In general, crop rotations benefit crop production using conservation tillage, but producers should become aware of the pests associated with the rotation program they implement.

With a couple of exceptions, effective management tactics are available to control insect pests regardless of the tillage system. In fact, most control recommendations are not contingent on the type of tillage system in place. Tillage can be an effective management tactic for some insects, thus by removing it as a potential tool, other tactics need to be identified and used to compensate for that loss. Some tactics that are important for managing insect pests of small grains include:

- Biological control
- Crop rotation
- Planting date selection
- Resistant varieties
- Weed control
- Chemical control

The following section will discuss some of the more important insect and mite pests of individual crops as they relate to conservation tillage.

Winter Wheat

Aphids

Cereal aphids are the most important pests of winter wheat in Oklahoma (Figure 1). The most common include the greenbug, the bird cherry-oat aphid, and the Russian wheat aphid. Published research has provided mixed results with regard to the effects of conservation tillage. Oklahoma research has shown that the presence of crop residue inhibits greenbug infestations. Research in the northern Great Plains showed that bird cherry-oat aphids survived better in spring wheat grown under no-till. At best, we can say conservation tillage either has little effect or that aphid numbers will be less abundant in fields grown under conservation tillage. Fortunately, control recommendations for aphids in winter wheat are based upon the number of aphids present at any given time. Scouting procedures are not altered because of the tillage system. An area of research that needs attention is the effect of crop residue on some important natural enemies of cereal aphids, including the lady beetle complex and the parasitic wasp, *Lysiphlebus testaceipes*.

Armyworms

Several different insects are referred to as “armyworms.” There are three important armyworm pests in winter wheat, including the armyworm, the fall armyworm, and the army cutworm. Each has a different biology and habits, and conservation tillage has different impacts on each of them. Little research has been published on the effects of tillage systems as it relates to infestations by armyworms in winter wheat.

The armyworm over-winters in Oklahoma and typically causes problems during the spring after wheat has jointed (Figure 2). Adult armyworm moths prefer to lay eggs in fields with dense plant populations, or in fields with lodged plants. Tillage probably does not have much effect on armyworms.

Army cutworms occur during the winter and early spring. They are a pest of winter wheat and...
canola, which is being increasingly adopted as a rotational crop with winter wheat. Adult army cutworm moths prefer to lay eggs in bare fields, thus wheat grown under conservation tillage would probably be at less risk of being damaged by army cutworms.

Fall armyworms do not over-winter in Oklahoma. They typically infest wheat during the fall after it emerges. Populations die following the first killing frost in the fall. Little research-based information exists on what effects conservation tillage would have on fall armyworm infestations.

**Hessian fly**

The Hessian fly over-winters and over-summers in wheat stubble (Figure 3). Two major periods of egg-laying activity occur, one in the spring, and one in the fall. They seem to be stimulated by favorable temperatures and precipitation events. Hessian fly populations carry over in wheat stubble and can build from volunteer wheat. Therefore, they can be expected to be more of a problem in areas where continuous wheat is grown under conservation tillage. Since tillage can be a major factor in reducing Hessian fly, it becomes more important to utilize other management tactics to reduce the threat of Hessian fly damage. They include: use of resistant varieties, such as “Centerfield,” “Duster,” and “Gallagher;” destruction of volunteer wheat; and use of insecticide seed treatments. Recent research has shown that planting after the traditional “fly free planting date” is not effective in Oklahoma because we experience long stretches of warm weather in late fall and winter that allow Hessian flies to emerge long after winter wheat has emerged.

**Mites**

Three species of mites commonly attack winter wheat. The winter grain mite prefers cool, moist growing conditions and the brown wheat mite thrives in the hot, dry conditions seen in drought. Both mites are associated with continuous wheat cropping, and are likely to be found in conservation tillage. However, they can be controlled with insecticides regardless of the tillage system.

The wheat curl mite is a vector of wheat streak mosaic virus. They can live in other grasses, but thrive in corn and wheat. Of most concern is their potential to build in volunteer wheat in fallowed land. Since they can maintain themselves in volunteer wheat, they can be a source of virus disease in the fall. There is no effective chemical control of wheat curl mite, so they must be managed through control of volunteer wheat at least two to three weeks before the fall crop is planted.

**Wheat Stem Maggot**

Wheat stem maggot is not a serious pest of winter wheat in Oklahoma, but it does maintain populations in volunteer wheat and other grasses. It is not known how conservation tillage would affect wheat stem maggot infestations, but delayed planting is an option for decreasing infestations.

**Wireworms and White Grubs**

Wireworms, false wireworms, (Figure 4) and white grubs (Figure 5) are stand-reducing insects that are affected by tillage. Adults of these insects are attracted to fields with volunteer plants, germinated
weeds, and crop residue to deposit their eggs. Wireworm and false wireworm damage can be minimized with the use of insecticide seed treatments, and while white grubs are not effectively controlled with insecticide seed treatments, some research suggests that a seed treatment reduces feeding damage from white grubs. It becomes imperative to control volunteer plants and weeds during the egg-laying periods to minimize damage from these pests.

**Canola**

**Aphids**

Aphids are the most important pests of canola in Oklahoma. The most common include the cabbage aphid, the turnip aphid, and the green peach aphid. There is little published research on the effects of tillage on canola aphids. Published research with other aphid/crop systems points to mixed results with regard to the effects of conservation tillage. At best, we can say conservation tillage either has little effect or that aphid numbers will be slightly less abundant in fields grown under conservation tillage. Fortunately, control recommendations for aphids in canola are based upon the number of aphids present at any given time. Scouting procedures are not altered because of the tillage system. An area of research that needs attention is the effect of crop residue on some important natural enemies of canola aphids, including the lady beetle complex and the parasitic wasp, *Diaeretiella rapae*.

**Cutworms**

Cutworms damage seedling plants by cutting them below their growing point, which results in stand loss. Some cutworms, such as the army cutworm and the variegated cutworm over-winter as larvae. Other cutworms, such as the black cutworm, lay eggs in early spring. Crop residue in general provides suitable habitat for survival of over-wintering cutworm larvae. Generally, the risk of cutworm damage can be reduced by applying a burn-down herbicide application to a field three weeks before the field is actually planted.

Corn rootworms over-winter as eggs in soil. Most of the research on the effects of tillage on rootworm egg survival suggests that tillage, combined with cold dry winters may increase rootworm egg survival. Undisturbed soil may actually allow for increased natural enemy activity against rootworm eggs. Thus, rootworms would not likely be affected favorably or unfavorably by conservation tillage.

**Diamondback moth**

Diamondback moth is a key pest of canola. There is little information on the effects of tillage on diamondback moth populations. Research in Illinois suggests that use of a cover crop followed by application of glyphosate before planting reduced infestations of diamondback moth in cabbage compared to a conventional tillage system. The effects of crop residue on natural enemies of diamondback moth need research attention.

**Cotton**

In the mid-south, insect pests of cotton are favored by conservation tillage, with the exception of boll weevil, cotton fleahopper, and tarnished plant bug.
In the Southwest (Texas, New Mexico, and Oklahoma), there appears to be less of a buildup of thrips, cotton aphid, bollworm, and tobacco budworm associated with conservation tillage if cotton is planted into a winter grain crop that previously has been killed with an herbicide. Recently, boll weevil has been eradicated from Oklahoma through the area-wide boll weevil eradication program. Bollworms and budworms are effectively managed with transgenic cotton varieties that contain genes which allow the plant to produce toxins that protect them from damage caused by the bollworm/budworm complex as well as other foliage-feeding caterpillars.

**Cutworms**

Cutworm numbers appear to increase in conservation tillage. The increased incidence of injury from cutworms is likely related to the presence of winter cover crops and the presence of weeds in conservation tillage fields. A key practice for reducing cutworm injury in conservation tillage systems is to destroy the cover crop/vegetation at least three weeks before planting.

**Thrips**

Thrips can utilize other host plants that might be present in the field and enable them to invade seedling cotton as it emerges. Results from research in the southwestern portion of the Cotton Belt suggest that thrips populations are no more abundant in cotton grown in conservation tillage systems compared to conventional tillage systems. However, higher thrips populations may occur in cotton if the surrounding vegetation is destroyed through an herbicide application.

**Cotton Aphids**

In south Texas, research shows that early season aphid numbers were higher in conservation tillage cotton compared to conventional tilled cotton, but numbers of the more damaging late-season cotton aphid infestations were lower in conservation tilled plots.

**Soybean**

Considerable research regarding the influence of tillage practices on soybean insects has been conducted in the north central states. Results suggest that the densities of grasshoppers, Japanese beetles, and damsel bugs (a predator) were greater in mulch–till systems. Densities of potato leafhoppers were greater in plowed fields. Densities of green cloverworms were unaffected by tillage practices. Slug problems are known to increase in conservation tillage, although the Oklahoma climate does not foster slug survival.

Another study showed that cover crops and residues dramatically affected populations of seedcorn maggots. Population densities of seedcorn maggots did not increase in no-till systems, but more seedcorn maggots were found in tillage systems that incorporated live, green cover crops into the soil compared to systems that used dead crop residue.

**Grasshoppers**

Population densities of grasshoppers (Figure 6) vary widely from year to year and seem to be regulated primarily by weather, natural enemies, and diseases. Most grasshopper species over-winter as eggs buried about 2 to 3 inches in the soil. Most species deposit egg pods in the soil of uncultivated field margins, roadsides, ditch banks, fence rows, pastures, alfalfa, and clover fields in late summer and early fall. Eggs over-winter and hatch from late May through July. Grasshopper nymphs usually feed for two to three weeks near their hatching site. When their food source becomes scarce or when feeding sites are mowed or otherwise destroyed, nymphs move to nearby crops, where they feed and become adults. There is usually one generation of each grasshopper species each year. While tillage can affect grasshopper populations, such impact would have to occur over large areas to cause any significant reductions because grasshoppers are capable of migrating long distances as adults.

![Figure 6. Grasshoppers.](Photo courtesy USDA.)
**Seedcorn Maggot**

Seedcorn maggot adults (flies) emerge early in the season and seek decaying organic matter on which to lay eggs. The larvae (maggots) feed on seeds and underground portions of soybean seedlings. As stated previously, potential for seedcorn maggot injury increases if green cover crops and crop residues are incorporated into the soil or liquid or solid animal wastes are used as fertilizer.

**References**

