Kansas State University Agricultural Experiment Station and Cooperative Extension Service
KANSAS CROP PESTS
K-STATE Research and Extension

Hessian Fly

The Hessian fly is often ranked as the most important insect pest in winter wheat production, but this small, gnat-like fly and the injury it causes, frequently goes unnoticed until harvest.

Figure 1. Adult

Infestations are fairly common in all but the extreme southwestern portions of the state. Wheat is the preferred host, but barley and rye may become infested to a lesser extent. This insect can devastate wheat when conditions are favorable for development. Damaging losses are becoming more common in Kansas. Staggering losses from large, multi-county outbreaks have occurred several times during the fly's nearly 140-year existence in the state. Growers should know that *no remedial measures* are available to save an infested crop. Proper management of the Hessian fly should focus on practices that decrease its ability to survive and reproduce. To be practical, techniques must be compatible with other production objectives.

Historical Importance

The Hessian fly, *Mayetiola destructor* (Say), was first observed in New York in 1779 near a Hessian soldier encampment, hence the common name. From there it spread rapidly throughout the United States. It was first detected in Kansas in 1871. From 1900 to 1970, only about one out of every four years was designated as being free of serious fly injury. Infestations were lower from the 1970s to the 1990s, but have increased in recent years. Localized areas of economic damage occur in Kansas almost every year.

Life History and Development

The adult Hessian fly is a tiny, dark-colored insect about ⅛-inch long that resembles a gnat (Figure 1). The tiny, fragile flies emerge on warm days from August through November, often after a rain. After mating, females deposit eggs in the leaf grooves of fall-seeded (preferably seedling) wheat. Though tiny, eggs can be seen with the unaided eye and resemble early stages of wheat leaf rust (Figure 2).

Figure 2. Eggs

Within three to 10 days, the oblong, reddish eggs hatch into tiny larvae that migrate downward during the night when humidity is high. Larvae cannot survive exposed on the leaf surface. They move down the plant between the sheath and stem stopping just above the crown, generally just below the soil surface.

Larvae feed by withdrawing sap from the plant for eight to 30 days. Temperature influences development, and most larvae mature before the onset of cold weather. Mature larvae are shiny, whitish, legless and headless maggots about 3⁄16-inch long (Figure 3). Full-grown larvae gradually form brown, ⅛-inch long capsule-like cases (puparia) commonly called "flaxseeds" (Figure 4). The insects pass the winter in this flaxseed stage.

Fall infestations are not always conspicuous at first. Infested shoots are stunted and sometimes killed. The entire stand may be lost, especially if significant infestation occurs shortly after germination while plants are in the seedling stage. If tillering has begun at the time of infestation, only individual tillers may actually be killed. Examination of an infested tiller usually reveals an undeveloped central shoot with an unusually broad and thickened, bluish-green leaf. To confirm the diagnosis, carefully remove the plant and roots from the soil. Look closely for maggots or flaxseeds by gently pulling the

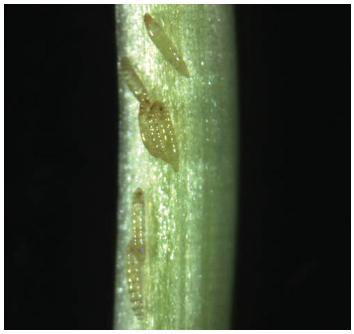

Figure 3. Fall infestation

Figure 4. Puparia (flaxseeds)

Fall damage

Spring damage

Figure 5

leaf sheath away from the stem and inspecting to the base of the plant.

Spring Infestation

Overwintering pupae produce the spring brood and may become adults in late March, although peak emergence usually occurs in April. Females prefer young leaf blades for egg laying. By this time, plants usually are jointing, much larger, and better able to withstand infestation. Spring maggots may attack the base of the plant below the soil surface or just above nodes higher on the stem. Stem tissue appears to stop growing at the point of attack, but surrounding tissue continues to develop, forming a niche for the feeding maggot. The injury may be overcome, but as plants mature, weakened stems break just above infested nodes and result in partially filled heads. Severe infestations may kill stems and cause heads to turn white. Mild infestations are not obvious and are frequently overlooked or attributed to hail or wind damage.

Supplementary Broods

The Hessian fly life cycle includes a main spring brood, followed by flaxseeds that lie dormant in the stubble until they emerge to produce the main fall brood. Notably, a portion of the population fails to emerge as adults at any one time. Some flaxseeds survive in a dormant stage for weeks, months, or even years. This makes the exact source of an infestation difficult to document and allows additional broods to develop. Under favorable weather conditions, volunteer wheat present in or adjacent to infested fields can support development of a summer brood. Injury to volunteer wheat is of little consequence, but the individuals arising from this brood may produce a secondary fall brood that is likely to injure the planted crop. Secondary broods can develop from other sources as well. Damage is likely even though the best pest-management planting date was followed at planting time. An additional brood may be produced in the spring. It usually occurs later than the main infestation, and the attack often occurs higher on the stems (Figure 5).

Management Tips

Determine extent of infestation. Identifying a problem and determining its severity is the first step in Hessian fly management. Fields should be checked in early October and November for signs of infestation, paying particular attention to early-planted fields of susceptible varieties. Infestations may be greater in field margins adjacent to volunteer or stubble fields. In early spring, damage may not be obvious unless significant infestations existed the previous fall.

Spring infestations are best evaluated when wheat is mature, just before harvest. At this time, look mainly for signs of stem breakage. Stems broken above the node are particularly suspect. Closely examine behind the leaf sheath, just below the break, for larvae or flaxseeds. Also look for short, undeveloped heads and tillers that are stunted or dead.

Infestations of less than 5% of stems are not unusual in the eastern two-thirds of the state. Infestations that average less than 10% with one flaxseed per stem will probably result in less than one bushel lost per acre. Losses increase rapidly at higher infestation levels and strongly signal the need to modify production practices.

Destroy infested stubble. Flies pass the period following harvest as flaxseeds in the stubble. Undisturbed stubble favors survival. Where soil management practices allow, thorough incorporation of the stubble can be a useful management technique. Thorough incorporation must be stressed, however. In one study, flaxseeds buried 1 inch below the surface of the soil allowed 26% of the population to emerge, at 2 inches only 6% emerged, and none emerged where stubble was buried to a depth of 4 inches. In another study, it was determined that double discing was five times more effective than single discing.

What about burning and grazing? Studies have shown that burning destroys flaxseeds present on the above-ground portion of the stem. A slow-moving fire is best, but stubble fires are often fast moving and affect top growth instead of burning out the crowns at or below the soil line where the majority of flaxseeds exist. The effect from grazing seems to be somewhat similar.

Destroy volunteer wheat. Volunteer wheat that is allowed to grow for two to three weeks, especially in wet summers, can enable the fly to produce an extra brood and infest the planted crop in greater numbers. Volunteer wheat not only increases the population but also may render other practices, such as planting after the fly-free date, less effective. The adult fly is capable of dispersing to adjacent fields to lay eggs, so it is vital to destroy volunteer wheat in the area at least two weeks before the planted crop germinates. This

practice also helps reduce the incidence of wheat streak mosaic virus.

Crop rotation. Avoid planting wheat back into wheat fields that were noticeably infested with Hessian fly at harvest. The Hessian fly has a limited host range and is not a migratory pest, so populations can be reduced by not planting wheat directly back into infested stubble.

Use the "best pest management planting date." This means not planting until that date is reached in your location (Figure 6). In theory, waiting until this date allows time for the main fall brood of adult Hessian flies to emerge and die before wheat is planted. Without live wheat plants, emerging females are deprived of a place to lay eggs, minimizing fall infestation. There is still some risk if a nearby infestation exists and a secondary fall brood develops.

Observance of the planting-date guidelines does not always prevent spring infestation, although in most cases it does help. The risk of fall infestation is almost always greater where wheat is planted before the fly-free date, and especially during years favorable for fly development. Observance of the planting-date guidelines also reduces the incidence of wheat streak mosaic and barley yellow dwarf viruses. This strategy is based on studies conducted from 1918-1935 and updated in 2007-2015.

The relatively mild fall weather in recent years, along with a slight increase in average fall temperatures over the last 30 years, has reduced the effectiveness of using this date as a planting guide. In studies conducted in Sedgwick County, Kansas, during 2006 and 2007 using a Hessian fly pheromone trap, adult flies were active until early December. It seemed that more adult flies were trapped after a rain. The impact of this extended Hessian fly activity on wheat or on fly population density is not known, but it is interesting to note that potential for Hessian fly infestation exists longer into the fall than historical data indicate. In addition, the planting-date strategy may not always present the best planting date for optimum yield, but on average, it correlates well. The strategy can be used on an individual-field basis but will probably be more effective when it is practiced area wide.

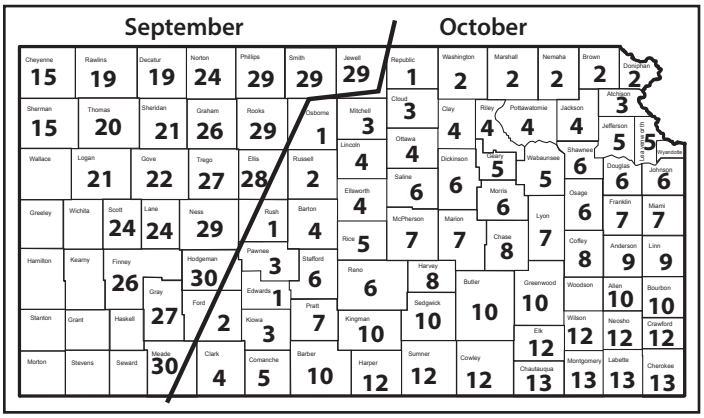

Figure 6. Approximate Hessian fly best pest management planting date.

Planting too late is also risky. Growers may be surprised to learn that delaying planting too late in the fall can actually increase the risk of Hessian fly infestation. While late planting dates may protect the field against fall infestation, the result is smaller plants in the spring. When the spring brood of flies is active in March or April, those females prefer younger plants for egg laying. Thus, if a source of infestation is nearby, late-planted wheat of a susceptible variety may suffer extensive damage from spring infestations.

Use insecticide-treated seed. Studies have shown that systemic seed treatments provide some control of Hessian fly larvae for up to 30 days. Depending on when the wheat is planted, this may protect plants through the egg-laying period in fall or at least shorten the period of vulnerability before cold weather stops adult emergence and larval feeding. In either case, Hessian fly impact is reduced.

Plant resistant varieties. Often, the best practice is to consider planting a resistant variety, but there may be reasons for not doing so. For example, resistant varieties may not have the same yield potential as more susceptible varieties, or they may be more susceptible to common diseases. Yet growers should consider this option carefully during times when fly populations appear to be increasing, especially when the intention is to plant early for fall pasture and where other options are limited. A number of factors must be considered in making varietal selections.

Several varieties are fly-resistant. Consult with your local K-State Research and Extension agent for more information on performance of varieties in your area. Or see K-State Research and Extension publication *Kansas Wheat Variety Guide*, MF991, for the latest information on disease and Hessian fly ratings.

Recently, Hessian fly activity has been increasing in several states. This is thought to be related to the increased adoption of no-till and reduced-till farming, which allows for increased summer survival of the Hessian fly. These changes, combined with growing continuous wheat, planting before the best pest management planting date, and limited access to resistant varieties creates ideal conditions for Hessian fly populations. Recent outbreaks should signal growers to avoid allowing these conditions to occur together. Growers and plant breeders should know that well-adapted, high-yielding, resistant varieties are needed in order to take full advantage of the soil- and moisture-saving opportunity of no-till agriculture.

Photo Credits

Figure 1 - Jimmy Hatchett (deceased), USDA

Figure 2 – Holly Davis, formerly Kansas State University

Figure 3 – Xuming Liu, Kansas State University

Figures 4 and 5 – Phil Sloderbeck, Kansas State University

Figure 6 – Leroy Brooks (deceased), Kansas State University

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