NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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Hessian Fly on Wheat

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This NebGuide discusses the life cycle and management of the Hessian fly, including risk reduction with planting date, volunteer control and resistant varieties.

The Hessian fly, *Mayetiola destructor* (Say), is one of the most destructive insect pests of wheat in the United States. Probably introduced into the U.S. by Hessian soldiers during the Revolutionary War, it was given its common name by Americans because of its damage on Long Island in 1779. Since then, the pest has become distributed throughout the United States wheat production areas.

Severe infestations are sporadic in Nebraska. The greatest damage potential occurs in the eastern half of the state, although severe infestations have been noted as far west as Ogallala. In recent years, the Hessian fly has become more common, possibly due to more wheat being grown in no-till situations.

Identification and Biology

The Hessian fly belongs to the family of insects known as gall midges (Diptera: Cecidomyiidae), a group noted for its habit of producing galls on many kinds of plants. Primarily injurious to wheat, the Hessian fly may also damage barley, rye and triticale, but does not attack oats.

It can be hosted by both native and introduced grasses, especially those closely related to wheat (e.g., genera *Agropyron, Elymus, Hordeum* and *Aegilops*), but it generally does not infest them severely.

Adult Hessian flies are about 1/8 inch long and resemble small mosquitoes (*Figure 1*). They are smoky gray, fragile, and

Figure 1. Adult Hessian flies.

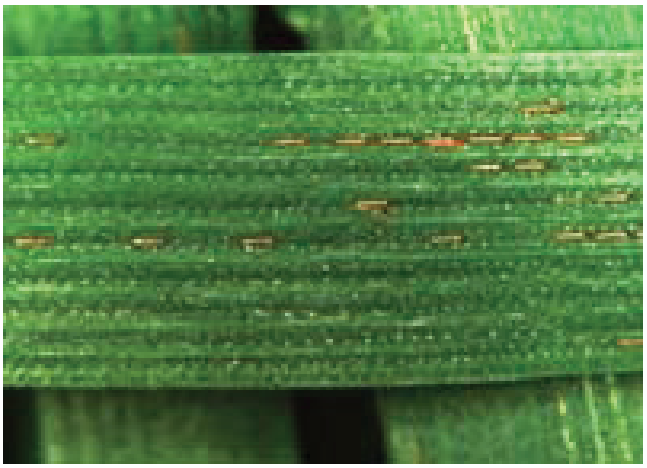

Figure 2. Hessian fly eggs on wheat.

have pointed abdomens. The female fly's abdomen is reddish in color, due to the presence of red eggs developing inside.

Adult flies are weak fliers and only live about three days. They emerge during the early morning hours with the males emerging first, followed shortly by the females. Newly emerged females cling to a plant leaf and extend their abdomens, releasing a sex pheromone that attracts the males for mating.

Shortly after mating, females deposit reddish, elongated eggs in rows on the upper surfaces of wheat leaves (*Figure 2*). Seedling wheat plants or young tillers are preferred for egg-laying in the fall, and plants in the early-jointing stage are preferred in the spring. A single female fly lays about 200 eggs that will hatch in three to 10 days, depending on temperature.

After hatching, the reddish, first-stage larva crawls to the base of the leaf, where, beneath the leaf sheath, the young larva initiates feeding with its head in a downward position. Larvae press their mouthparts against the plant, injecting their saliva into the plant, causing the tissue to release the cell contents. After the larvae begin to feed, they remain stationary on the plant. A single larva, feeding for just three days, is capable of permanently stunting a young wheat plant or tiller.

First-instar larvae gradually become white as they increase in size. After the first molt (or shedding of the skin), the second-stage larvae are white with no distinguishing marks. Third-stage larvae are white with an internal green

Figure 3. Hessian fly larval stages.

Figure 4. Hessian fly flaxseed stage.

gut coloration appearing as a dorsal stripe and reach approximately ¼ inch in length (*Figure 3*).

Larvae feed about two to three weeks prior to forming the puparium, or flaxseed (*Figure 4*). The shiny brown, seed-like flaxseed is actually the hardened, unshed skin of the third-stage larva. Inside this structure is the nonfeeding fourth-stage larva. The flaxseed is found behind the leaf sheaths of tillers (fall/winter) or at the base of old plant crowns and near the nodes behind the leaf sheaths (spring/summer).

Two generations of the Hessian fly occur during the growing season for winter wheat in Nebraska. The insect survives the summer in the flaxseed stage in wheat stubble. Within the flaxseed, the fourth-stage larvae do not resume development until late summer or early fall. This dormancy is broken by a combination of seasonal temperatures, shorter day lengths, and rainfall.

After about two weeks, development is completed, and the larvae pupate and emerge as adult flies. Most adult emergence will occur in September or by early October. However, in some situations, environmental conditions may result in later fly activity.

Emerging flies lay eggs in volunteer or early-planted wheat. These eggs hatch into the fall generation found on the wheat or volunteer crop. The larvae feed through the fall and develop into the flaxseed to overwinter. Some mortality of the flaxseed occurs each winter, depending on many factors, including temperature, moisture, and natural enemies.

The second generation occurs in the spring (March-April). Development resumes as the larvae transform into pupae inside the puparium, and spring emergence of adult flies occurs shortly thereafter. These flies deposit eggs on leaves of wheat plants in the jointing stage. The newly hatched larvae move to the nodes behind the leaf sheaths and initiate feeding. Development proceeds until the larvae reach the oversummering flaxseed stage, usually in early-to-mid June, prior to wheat ripening.

Damage

Damage is related to the degree of infestation by the Hessian fly larvae. Even a single larva can cause significant damage to a wheat plant because the salivary toxins it releases while feeding interfere with normal wheat growth. Seedlings attacked at the one-leaf stage may be killed outright. Wheat attacked later will be severely stunted, with perhaps the first tillers killed and plant growth delayed.

Plants infested in the fall can easily be recognized by their darker-than-normal bluish coloration (*Figure 5*) and leaves with unusually broad blades. Young plants or tillers infested in the fall often die during the winter.

Plants attacked in the spring have shortened and weakened stems that may eventually break just above the first or second node, causing plants to lodge near harvest. Heavily infested fields will have reduced yields and lower-quality grain caused by adverse physiological effects (reduced plant growth and kernel size and number) and mechanical damage (breakage due to weakening of stems).

Figure 5. Wheat damaged by Hessian fly.

Management

Even sporadic Hessian fly problems can be serious if favorable conditions exist for it. The risk of developing Hessian fly problems can be dramatically reduced with a combination of cultural practices including:

- controlling volunteer wheat in late summer and early fall;
- avoiding early planting; and
- using varieties resistant to the Hessian fly.

No-till practices increase the risk of Hessian fly damage because the stems where the flaxseeds are present are not disturbed, and survival will increase. In this case, it is important to minimize other risk factors.

Destruction of volunteer wheat in the late summer and fall will eliminate it as a potential host for the fly's fall

Table I. Estimated fly-safe planting dates for eastern Nebraska counties. These dates only reduce the risk of serious infestations and may not always be effective due to seasonal weather variations.

County	*Date*	*County*	*Date*	*County*	*Date*
Adams	Sept 26-27	Jefferson	Sept 29-30	Platte	Sept 23-24
Burt	Sept 24	Johnson	Sept 29-30	Richardson	Sept 30-Oct 1
Butler	Sept 25-26	Lancaster	Sept 27-28	Sarpy	Sept 27
Cass	Sept 27-28	Merrick	Sept 24-25	Saunders	Sept 25-26
Clay	Sept 26-27	Nance	Sept 24	Seward	Sept 26-27
Colfax	Sept 24-25	Nemaha	Sept 29-30	Thayer	Sept 28-29
Dodge	Sept 24-25	Nuckolls	Sept 28	Washington	Sept 25-26
Fillmore	Sept 27-28	Otoe	Sept 28-29	Webster	Sept 27-28
Gage	Sept 29-30	Pawnee	Sept 30-Oct 1	York	Sept 26-27
Hamilton	Sept 25-26	Polk	Sept 25		

Table II. Estimated fly-safe planting dates for central Nebraska counties. These dates only reduce the risk of serious infestations and may not always be effective due to seasonal weather variations.

County	*Date*	*County*	*Date*	*County*	*Date*
Buffalo	Sept 24-25	Gosper	Sept 24-25	Phelps	Sept 25-26
Custer	Sept 22-24	Harlan	Sept 26-27	Red Willow	Sept 25
Dawson	Sept 24	Howard	Sept 24-25	Sherman	Sept 23
Franklin	Sept 26-27	Hall	Sept 24-25	Valley	Sept 23
Furnas	Sept 25-27	Kearney	Sept 25-26		
Greeley	Sept 23-24	Lincoln	Sept 23-25		

generation. If flies are allowed to develop through the fall and overwinter in any volunteer wheat, they will move into the new wheat crop for the spring generation.

Delaying planting until after the fly-safe date also reduces the risk of serious infestation (see *Tables I* and *II*). Late summer rains, along with day length and temperature, trigger development of oversummering Hessian flies. Once the flies emerge, they will then infest available volunteer wheat or early-planted winter wheat.

Severe fall infestations usually result from two favorable conditions: (1) an earlier than normal planting date; and (2) a Hessian fly-susceptible variety of wheat.

If you must plant early, seriously consider using resistant varieties. Fly-safe dates only reduce the risk of serious infestations. They are not always effective because of seasonal weather variations, particularly rainfall and temperature, that affect fly development and activity.

Average fly-safe dates for eastern and central Nebraska are shown in *Tables I* and *II*. Fly-safe dates have not been established for the southwest counties and the Panhandle because their increased elevation requires earlier planting of wheat than fly-safe dates would allow. Also, the risk in western counties is lower due to the region's drier environmental conditions. Western Nebraska risks are greatest in its southwest counties.

Resistant wheat varieties are very effective in reducing Hessian fly damage. Before Hessian fly resistance in wheat was developed, tremendous yield losses occurred in Nebraska and other Plains states. The use of resistant varieties, and/or in combination with delayed planting dates and destruction of volunteer wheat, has greatly reduced Hessian fly as a major concern in most wheat-producing states. However, in 2006, only about 35 percent of the wheat acres grown in Nebraska were planted to varieties with high or moderate levels of resistance.

The primary resistance mechanism for Hessian fly is antibiosis. Antibiosis genes in a wheat variety result in poor survival of larvae as they initiate feeding on the resistant plants. However, even on resistant varieties, a small percentage of flies may survive to reproduce. These survivor types will gradually increase over a period of years, and eventually a new virulent biotype (strain) will develop that can overcome that plant resistance gene. Constant monitoring and research by farmers and scientists are necessary to prevent increased losses to Hessian fly.

Table III shows a listing of the resistance levels for most wheat varieties presently grown in Nebraska. While Hessian fly resistance is important, the cultivars must also be agronomically suitable. Consult state recommendations and variety trials for cultivars most likely to perform well in your area. Also, consider selecting varieties that simultaneously contain resistance to other important wheat pests. See the UNL 'Wheat Variety Selection Tool' *http://citnews.unl.edu/winter_wheat_tool/index.shtml* for more information.

Table III. Hessian fly resistance levels for winter wheat varieties commonly grown in Nebraska (W=white wheat). Due to the potential presence of different Hessian fly biotypes, resistance levels may vary between locations and years.

Resistant Varieties	*Moderately Resistant Varieties*		*Moderately Susceptible Varieties*
	Alliance	2137	Centura
Brule	Arapahoe	2145	Culver
Millennium	Buckskin		Coronado (AgriPro)
Vista	Goodstreak	(W) Trego	(W) NuFrontier (AgriPro)
	Harry		TAM 111
	Wahoo		
Susceptible Varieties			
Abilene (AgriPro)	Ogallala (AgriPro)		(W) Antelope
Above	Overly		(W) Arrowsmith
Akron	Pronghorn		(W) NuDakota (AgriPro)
AP502CL (AgriPro)	Sandy		(W) NuGrain (AgriPro)
Hallam	Scout 66		(W) NuHills (AgriPro)
Infinity CL	Siouxland		(W) NuPlains
Jagger	TAM 107		
Jagalene (AgriPro)	TAM 110		
Karl 92	TAM 200		
Lamar	Thunderbolt		
Longhorn	Wesley		
Mace	Windstar		
Nekota	Yuma		
Niobrara	Yumar		

Registered seed treatments (imidacloprid, thiamethoxam) can provide some control of the fall generation of Hessian fly. Foliar insecticides applied during the fly activity period have also shown effectiveness in some states, but effectively timing such applications is critical and exact timing is difficult to establish. Insecticide treatments for Hessian fly control are not recommended in Nebraska because of the sporadic nature of Hessian fly problems, the difficulty in determining the optimum timing, and the effectiveness of the cultural practices previously described.

Natural enemies may play a part in regulating Hessian fly populations. The Hessian fly has some natural enemies, including two species of parasitic wasps, but there is little recent information on the presence of these parasites in the region.

This publication has been peer reviewed.

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