Texas Cooperative
EXTENSION
The Texas A&M University System

E-350
07/05

Hessian Fly In Texas Wheat

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The Hessian fly, *Mayetiola destructor*, originally came from Russia and was first reported in the United States in 1779. Hessian fly is thought to have been introduced into the United States in wheat bedding-straw used by Hessian troops during the Revolutionary War. Within 120 years of its introduction into New York state, this insect had spread into most of the eastern and midwestern United States and as far west as Washington state. In the northern Blacklands of Texas, the pest first was collected and identified in 1880. A widespread outbreak of Hessian fly occurred along the Red River in 1978; the fly spread south through the Blacklands during the following years. Since 1986, the Hessian fly has continued its westward spread into other Texas wheat-growing regions (Rolling Plains and ConchoValley). By 2005, more than 67 counties in Texas reported Hessian fly infestations (Fig. 1).

Life Cycle

The Hessian fly belongs to the family Cecidomyiidae, which also contains the sorghum midge. Illustration 1 shows the Hessian fly life cycle.

Figure 1. Progression of Hessian fly across Texas wheat-producing regions.

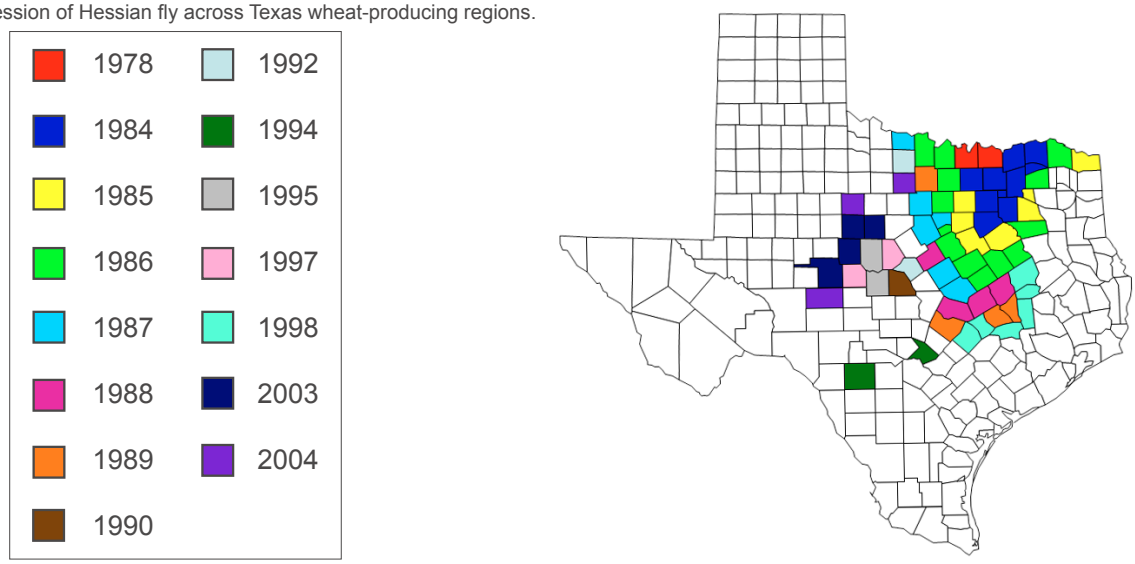
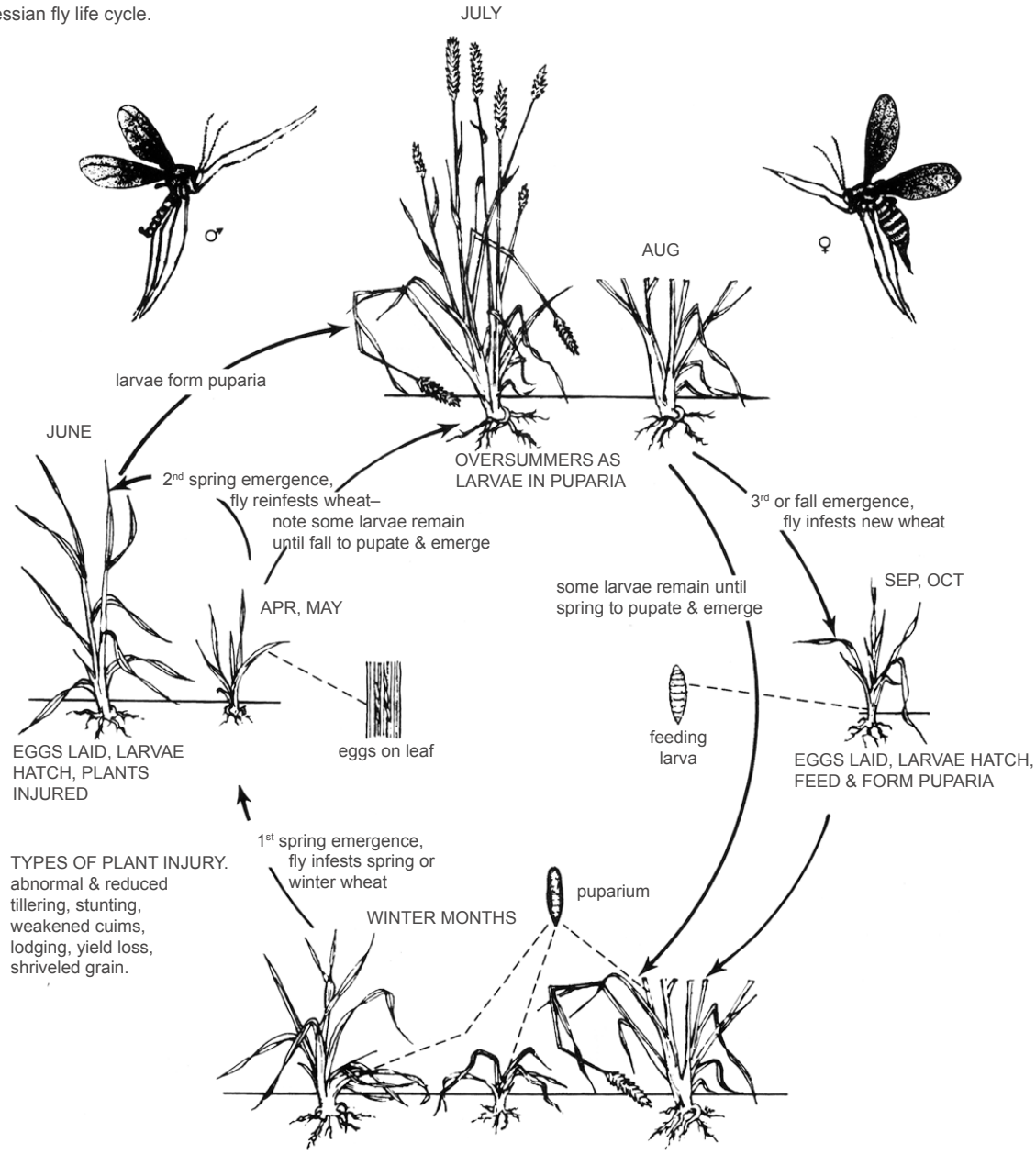


Illustration 1. Hessian fly life cycle.



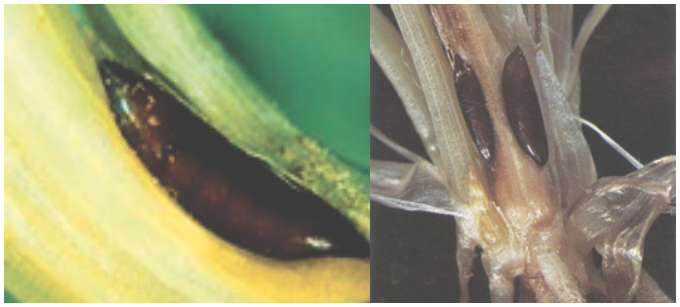


Figure 2. Hessian fly puparium.

Larval Stage

Hessian fly survives hot summers and cold winters in the larval stage within a protective puparium (Fig. 2) on stubble, volunteer wheat, early-planted wheat and other host grasses. Because they resemble flax seed, puparia often are referred to as the pest's "flaxseed" stage. Puparia also can become part of soil-surface organic residue from infested seedlings killed by the larvae.

Hessian Fly Generations

In Texas, there usually are three to five major fly generations each year (one or two in the fall and one to three in the spring), constituting at least three (and, more commonly, five) partial generations annually. No single Hessian fly generation ever uniformly completes its development; emergence from puparia of at least some individuals of each generation is delayed. This delayed emergence indirectly aids species survival; that is, larvae that remain in the flaxseed stage are protected from most environmental conditions and can survive long-distance transport.

With favorable weather, many larvae pupate within a short time and emerge as adults between March and May; then these adults initiate second and partial third spring generations. Some larvae of the first spring generation always aestivate (over-summer) or diapause (over-winter) and do not emerge from their puparia until the fall or the following spring. An increasing percentage of second and third spring generations aestivates (or diapauses) in the flaxseed stage to ensure summer survival. **A good rain (about 1.0 inch) in early fall typically terminates aestivation, and adult flies can be expected to emerge about 12 days later.**

The main fall emergence normally takes place between late August and mid-October. These emerged adults then lay eggs on volunteer wheat and on early seeded wheat, or if these are unavailable, they may oviposit on some of the other host grasses. Larval activity ceases about mid-December, with onset of cold weather. Larvae that fail to pupate and emerge by late summer or early fall will over-winter as diapausing larvae.

Emergence and Reproduction

In late summer and fall, adult Hessian flies begin to emerge from puparia in response to cooler temperatures and a significant rain (about 1 inch). Other generations of adult flies emerge from their puparia as temperatures warm in the spring (mean temperature of 45 to 50 degree F) and after spring rains. Hessian flies emerge over several spring weeks, protecting the insect against substantial population destruction should weather become unfavorable.

Regardless of the season in which they appear, adult Hessian flies will emerge from puparia approximately 12 days after a rainfall event, mate, and deposit eggs on wheat leaves. **In early-planted wheat fields (August and September), several generations of Hessian fly may occur in the fall before cold temperatures slow their reproduction.** All adult flies will not emerge from puparia at the same times, and adults will continue to emerge and lay eggs throughout the fall until cold weather halts their activity in early winter. **Texas does not have a "fly-free planting date" as do its neighboring states to the north. However, delaying planting until after onset of cold temperatures can reduce substantially incidence of fall Hessian fly infestations.**

Figure 3. Adult Hessian fly.

The adult Hessian fly (Fig. 3) looks like a small mosquito. The life span of an adult generally is no more than 3 days. After emergence, males quickly find receptive females; actual mating requires only 10 to 20 seconds. Adult females begin to deposit eggs within 1 to 2 hours after mating and continue to do so for 1 to 2 days. They prefer to oviposit on newly emerged young wheat plants or on newly emerged leaves, rather than on older wheat plants or on other host grasses.

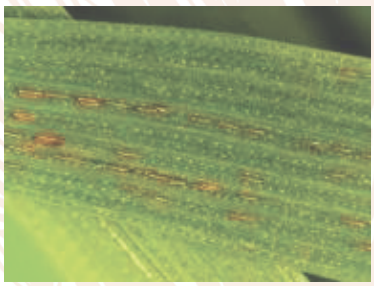


Figure 4. Hessian fly eggs.

Each female can deposit an average of 200 elongated (about 0.5 mm), reddish eggs, with the range from 40 to more than 450 eggs per female. Eggs usually are laid on the upper surface of wheat leaves (Fig. 4). Depending on temperature, eggs hatch after 3 to 10 days. Upon hatching, red to orange larvae migrate down leaf grooves and begin to feed; they do not move from their original location on the plant once feeding begins. Larvae feed on stems in the crown and on jointed wheat and may be found just above the node. After feeding, larval color changes from red or orange to white or nearly transparent (Fig. 5). Larvae feed for about 2 weeks, then transform to the puparia stage. Puparia can crowd plants if infestation levels are high (Fig. 5).

Figure 5. Hessian fly larvae.

Figure 6. Infested wheat plants with a darker green color and wider leaves.

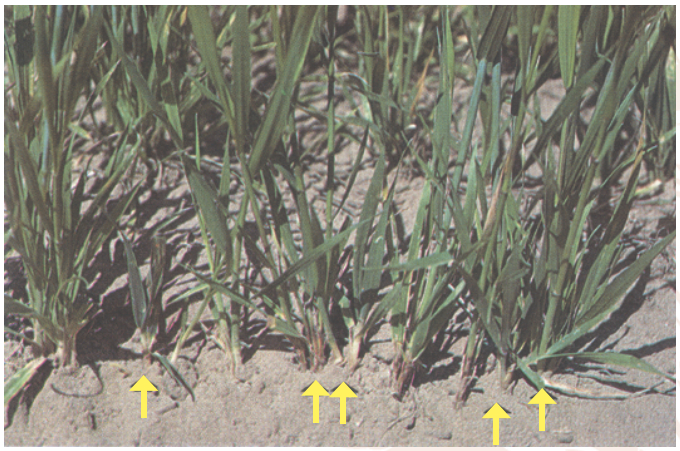


Figure 7. Infested wheat plants are stunted, have darker green color, wider leaves.

Host Plants

Wheat is the **preferred** host, but infestations have been found on barley, rye, spelt and emmer. **Oats are not a host for Hessian fly.** Occasionally, Hessian fly has been found on wild grasses such as quackgrass, western wheatgrass, little barley, goatgrass and timothy, and Texas likely has other grass hosts.

Wheat Injury

Injury to wheat is caused by Hessian fly larvae feeding on stem tissue at the crown of young plants or just above the nodes on jointed wheat. The extent of injury generally is greater in newly emerged or younger seedling than in older, established plants. **Larval feeding stunts infested tillers, broadening leaves and turning them a darker green** (Fig. 6). Although color change and plant stunting are relatively distinctive, infested plants still may be easily overlooked. For example, at first glance, the young wheat plants shown in Figures 6 and 7 may appear normal, but closer observation reveals that about 50 percent of the tillers have been stunted by larval feeding. Infested tillers are less than half the size of uninfested, healthy ones. Figure 8 shows a four-tillered seedling with one tiller dwarfed as a result of larval infestation.

Stunted tillers, particularly those found on younger plants, usually wither and die, resulting in thin stands in fall, with reduced forage production and greater winter-kill. If infested

Figure 8. Infested wheat tillers are stunted (top left).

Figure 9. Dwarfed heads and incomplete seed set due to Hessian fly (top right).

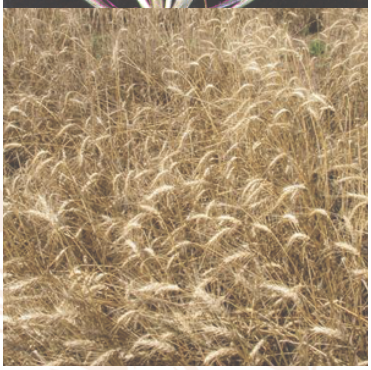


Figure 10. Lodging and thin wheat stands due to high Hessian fly infestations. (left).

tillers survive, their growth and yield will be reduced (Fig. 9). **Significant grain losses can be expected when the number of stems infested exceeds 5 to 8 percent in fall or 20 percent in spring.** Serious infestations may lead to thin wheat stands with poorer yields and more weed problems (Fig. 10) than in healthy stands. Additionally, Hessian-fly feeding weakens wheat stems at feeding sites and **may cause significant lodging** or stem breakage, resulting in harvesting difficulties. Larval feeding also can interfere with nutrient flow to wheat heads during kernel formation, resulting in reduced grain quantities and quality.

Biotypes

Some wheat varieties are resistant to certain Hessian fly populations but are susceptible to others. Unique populations (or races) of Hessian flies are called biotypes; biotypes result from genetic changes that allow flies to feed and survive on different varieties of wheat. Sixteen Hessian fly biotypes are known to occur in the United States. Knowing which biotypes are present in an area can help growers select wheat varieties known to be resistant to those specific biotypes (For example, studies in 2003 indicated that predominant Hessian fly biotypes in Runnels County were GB, J, L and GP. However, no recent extensive survey has been conducted to determine the biotypes present in other portions of Texas.)

Particular biotypes cannot successfully infest wheat varieties with genes for resistance to them, but over time widespread planting of one or two resistant varieties can favor biotypes that do survive on these varieties. Eventually, such virulent biotypes can become so common that formerly resistant wheat varieties suffer damage because they can no longer resist the newly abundant virulent biotype. **Thus, Hessian flies can overcome resistance in wheat just as rust fungi can develop new races to overcome rust resistance in wheat.**

Figure 11. Hessian fly pupae.

Identification in the Field

The most reliable way to identify Hessian fly infestations in seedling plants involves digging plants out from the soil and carefully pulling apart tillers, **looking for white larvae or brown pupa attached to the base of the tillers in the crown.** Leaf sheaths should be pulled back to expose larvae and pupae on stems. In the spring, larvae and pupae are found at the base of tillers in the crown but also may be present at the nodes. Again, leaf sheaths must be pulled back to expose Hessian flies feeding on stems (Fig. 11).

Management Strategies

Strategies for managing Hessian fly infestations of wheat include variety resistance; delayed planting; seed treatments; destruction of volunteer wheat; crop rotation; and beneficial insects.

Variety Resistance

Several soft and hard varieties of red winter wheat exhibit resistance or partial resistance to each of the races of Hessian fly. However, most current wheat varieties adapted to Texas possess only partial resistance to this pest (Table 1). **Resistant varieties still may be attacked by Hessian fly, but economic losses will be minimized.** In selecting a wheat variety to plant, producers also should consider other desirable characteristics such as plant disease resistance, potential yield and maturity.

Delayed Planting

Delayed planting of resistant varieties has proved effective in upper-Midwest states with "fly-free" planting dates (the date in late fall after which fly emergence will not occur). In central Oklahoma and farther north in the wheat belt, planting after the fly-free date has reduced or totally eliminated Hessian fly infestations and their resulting damage.

The deep South, however, has no fly-free dates, so delayed seeding helps to avoid only the fall's first generation(s) of this pest. Planting after adult fly activity has ceased due to cold weather has proved to be of limited value in Texas, where intermittent periods of warm fall weather allow adults to emerge, mate and lay eggs. Such environmental conditions can occur well into December, resulting in damaging larval populations. Late-planted wheat generally suffers less Hessian fly damage than does wheat planted early for grazing (Table 2), so if it is important to graze livestock in early fall, producers should plant oats or a Hessian-fly resistant wheat variety or consider an insecticide seed-treatment for fields with history of Hessian-fly damage.

Seed Treatments

Insecticide seed-treatments also control fall infestations of Hessian fly and can be effective against greenbugs in seedling wheat. However, planting resistant varieties has proven as effective as these insecticide treatments for Hessian fly control, and such planting avoids the cost of seed-treatment. Gaucho® or Cruiser® seed-treatments both are effective at controlling the first fall generation of Hessian fly in early planted wheat. The estimated cost associated with these seed-treatment insecticides ranges from $7.50 to $13.50 per 100 pounds of treated seed. (See Fig. 12 for results from previous seed-treatment trials conducted in McCulloch County.)

Destroying Volunteer Wheat

Removal of volunteer wheat can help manage many wheat pests, including Hessian fly, wheat curl mite and aphids. **Destruction of volunteer wheat will deprive Hessian fly first-generation adults of places to deposit their eggs.** Plowing under old straw to depths of 4 to 6 inches in August will reduce emergence of adult flies from buried plant residue. Burial of infested crop residue can reduce fall adult emergence significantly. However, soil erosion and moisture retention in some areas can dictate that residue burial be limited, to conform to conservation practices.

Crop Rotation

Crop rotation can reduce Hessian fly numbers within a given field; however, flies can migrate a mile or more from adjacent fields. Burning straw will kill exposed pupae and larvae in stems but will **not** kill pupae located at the soil surface or below the soil line. Burning infested straw is **not** a recommended management practice. **Baling infested straw or hay and moving it to an uninfested area also should be avoided.** When buying or selling hay or straw, look for brown pupae located behind leaf sheaths at nodes, to make sure shipped material is not infested with Hessian fly.

Beneficial Insects

Two parasitic wasps, *Homoporus destructor* and *Eupelmus allynii*, are the most common natural enemies of Hessian fly in Texas. These tiny wasps deposit their eggs in the fly's larval stage, and the developing parasite consumes the Hessian fly during its pupal stage. Studies have shown that these beneficial wasps can kill up to 60 to 80 percent of Hessian flies in some areas. However, such wasps do not survive well in low-rainfall areas common in west-central Texas. Also, these natural enemies are active only in the spring. Fall infestations of Hessian fly, often the most damaging, thus escape these parasitic wasps, and Hessian fly populations quickly can increase when two or more generations occur in the fall.

Table 1. Wheat varieties expected to be Moderately Susceptible (MS), Moderately Resistant (MR) and Resistant R to Hessian fly in north central and west central Texas. Letters in () identify specific biotypes of Hessian fly to which the variety is resistant.

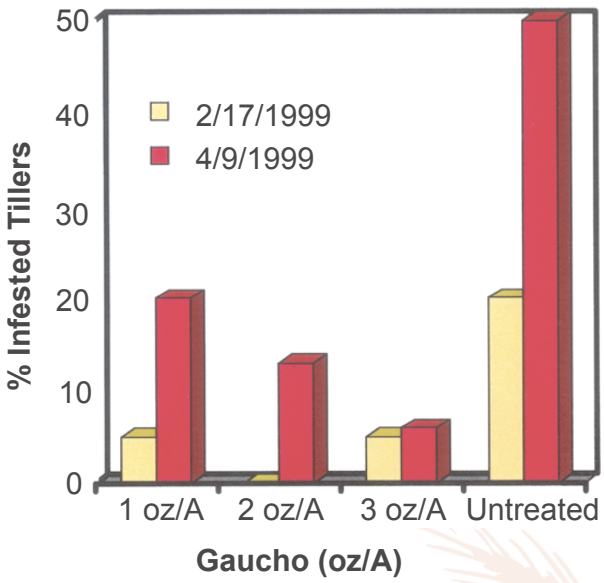
Wheat Class	Seed Source	Variety	Resistance rating (biotype)
Hard Red Winter*			
	Agri-Pro	Coronado	MR
	Agri-Pro	Pecos	MR
	Kansas State	2145	MR
	Kansas State	Stanton	MS
	Kansas State	Ike	MR
	Oklahoma State	Chisholm	MR
	Pioneer	2157	MR
	Pioneer	2158	MR
	Pioneer	2180	MS
	Texas A&M	Mit	MR
	Texas A&M	TAM 400	R
Soft Red Winter*			
	Agri-Pro	Crawford	MR
	Syngenta	Coker 9152	R (O)
	Syngenta	Coker 9184	R (C & O)
	Syngenta	Coker 9375	R (O & E)
	Syngenta	Coker 9474	R (GP, B, C, D & E)
	Syngenta	Coker 9663	MS (GP & E)
	Pioneer	25R54	R (GP, A, B, & E)
	Pioneer	25R78	R (GP, A, B, & E)

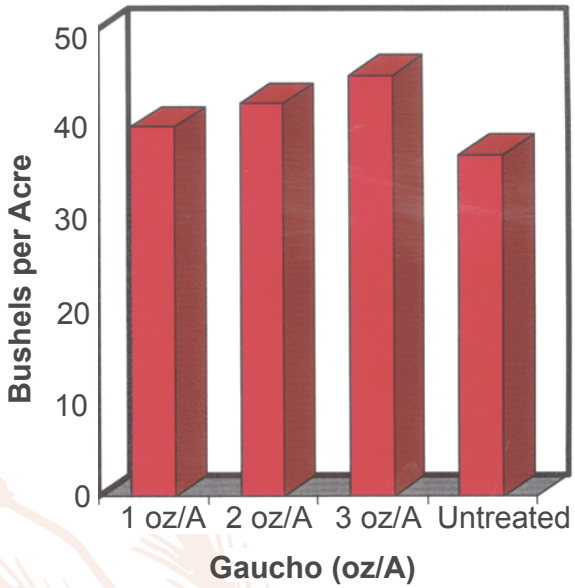
* Varieties not listed within this table are considered susceptible to the Hessian fly biotypes present in Texas.

Table 2. Effect of planting date on Hessian fly infestation in winter wheat. (data from Plains, GA)

Planting Date	% Infested Tillers		
	Dec. 5	Feb. 9	May 12
Oct. 23	42	24	65
Nov. 5	16	23	70
Nov. 20	0	20	77
Dec. 5	—	2	70

Figure 12. Effectiveness of Gaucho® seed treatments for managing Hessian fly in wheat.





Summary

In the mid-1980s, it was predicted that Hessian fly likely would not become an economic problem in areas of Texas west of Interstate 35. It was thought that the I-35 corridor might serve as a barrier zone to the Texas plains region, unless a new Hessian fly race developed that could survive and reproduce in the dry environment of west Texas wheat-producing areas. However, throughout the last 20 years, Hessian fly has progressed steadily westward. This migration may be attributed partly to planting of forage wheat in early September and partly to the presence of volunteer wheat.

If Hessian fly damage is severe in your area, planting resistant wheat varieties should be the primary management practice for controlling this pest. Other management considerations can include delayed planting, if possible; crop rotation; insecticide seed-treatments; and stubble burial.

Acknowledgments

This publication updates B-1518, by Hoelscher, Turney, and Lidell, Texas Agricultural Extension Service.

The authors want to extend their appreciation to K.S. Pike, Professor of Entomology at Irrigated Agriculture Research and Extension Center at Prosser, Washington, for the photographs and life-cycle information. Thanks are extended to Dr. Ming Chen, Research Scientist, USDA in Kansas, for collaborative efforts to identify Hessian fly biotypes in Texas.

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