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Hessian Fly In Texas Wheat

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HESSIAN FLY IN TEXAS WHEAT

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The Hessian fly, *Mayetiola destructor* (Say), is indigenous to areas in the Southern Caucasus region of Russia. The fly belongs to the family Cecidomyiidae, which also contains the sorghum midge. It was probably introduced into the United States in bedding straw used by the Hessian troops during the Revolutionary War. The Hessian fly has been reported in wheat in the United States since 1778. Within 120 years of its first discovery, the insect had spread into most of the eastern and midwestern United States and as far west as Washington state. The pest was first collected and identified from Texas in 1978.

By the summer of 1986, the following Texas counties reported Hessian fly infestations: Bosque, Bowie, Clay, Collin, Cooke, Dallas, Delta, Denton, Ellis, Falls, Fannin, Freestone, Grayson, Henderson, Hill, Hopkins, Hunt, Johnson, Kaufman, Lamar, Limestone, McLennan, Montague, Navarro, Parker, Rains, Red River, Rockwall, Somerell, Tarrant, Van Zandt, and Wise. Infestation levels vary significantly from county to county and from field to field. Texas farmers are presently producing 7 to 8 million acres of wheat. The Hessian fly caused an estimated loss of more than $5 million in wheat production in North Texas in 1984.

LIFE CYCLE

The life cycle of the Hessian fly is shown in Illustration 1. The insect overwinters (survives the cold) in the larval stage within a puparium (Figure 1) on stubble, volunteer wheat, early planted wheat and other host grasses. Puparia can also become a part of the soil surface organic debris originating from infested seedlings killed by the larvae.

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Because of their resemblance to flaxseed, the puparia are often referred to as the "flaxseed stage" of the pest. Adult Hessian flies emerge as temperatures reach a mean of 45 to 50 degrees F. Generally, the majority of this activity has been observed during mild weather and may continue well into December. Spring emergence, once initiated, extends over several weeks. This extended emergence protects the insect against population destruction in the event of sudden unfavorable weather. The occurence of multiple generations in Texas increases the possibility of crop damage and major field losses.

The adult Hessian fly (Figure 2) is similar in appearance and size to a small mosquito. The life span of an adult is generally no more than 3 days. After emergence, males quickly find receptive females. Actual mating requires only 10 to 20 seconds. Oviposition usually begins within 1 to 2 hours after mating and is completed within 1 to 2 days. Females prefer to oviposit on newly emerged young plants or leaves as opposed to older wheat plants or other host grasses.

Fecundity is variable, ranging from fewer than 40 to more than 450 eggs per female, with an average of about 200. Eggs are elongate (about .5 mm in size) and reddish when deposited. They are usually laid on the upper surface of the wheat leaf (Figure 3). Eggs require 3 to 10 days to hatch, depending on temperature. Upon hatching, red to orange larvae migrate down the grooves in the leaf behind the leaf sheath to the crown of the plant. On jointed wheat, the larvae may be found just above the node. Once the downward migration stops and the larvae begin to feed, they do not change locations. After feeding, the larval color changes from red or orange to white or nearly transparent (Figure 4).

Once full larval growth is completed (about 2 weeks), feeding ceases and the larvae form puparia. The puparia can be quite crowded on the plant if the infestation level is high (Figure 5). With favorable weather, many larvae pupate within a short time and emerge as adults between March and May. These adults initiate a second and partial third spring generation. There are always some larvae of

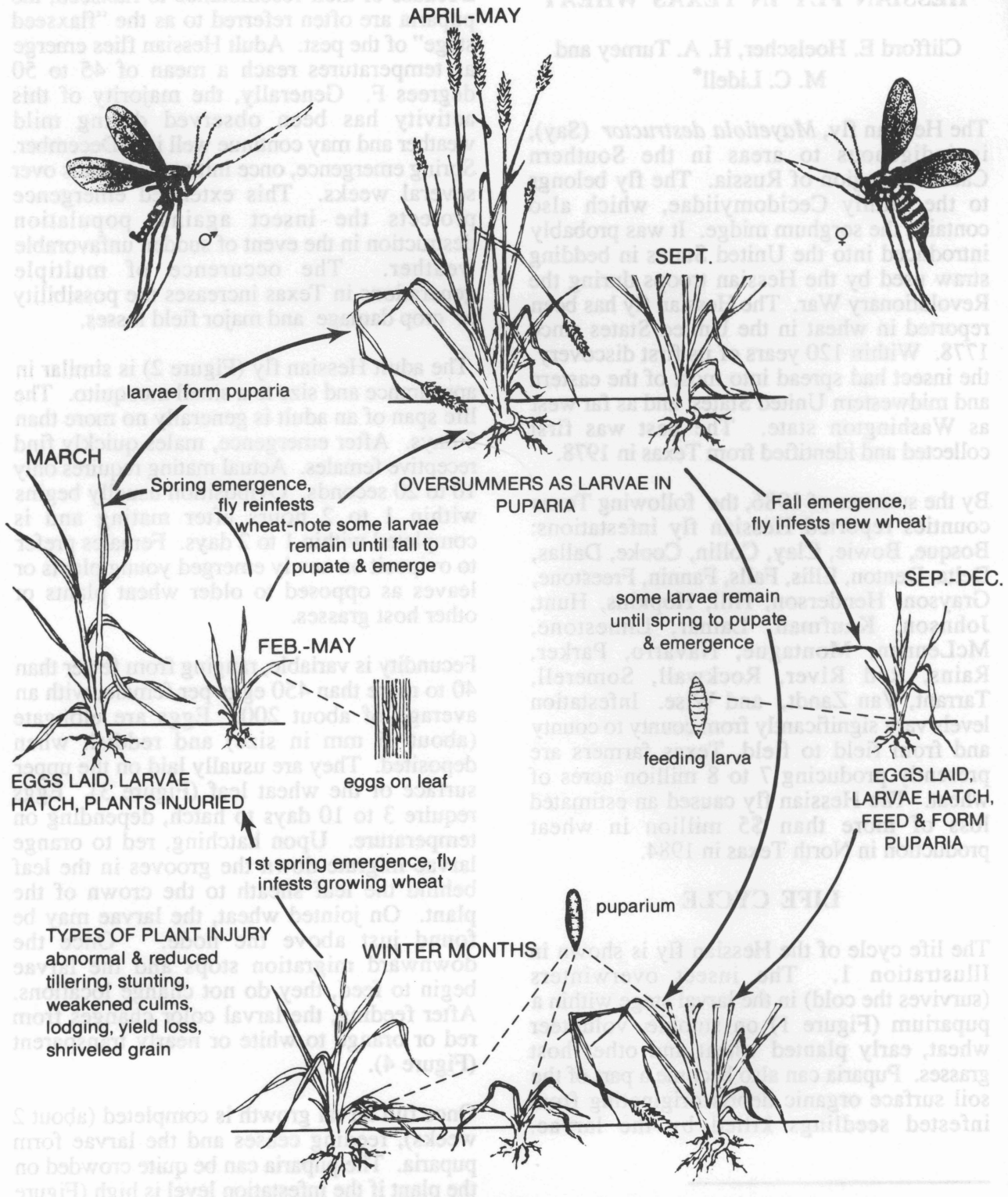

Illustration 1. Life cycle of the Hessian fly in Texas. Illustration by Pike, Packard and Burgess.

Figure 1. Puparia on seedling spring wheat

Figure 2. Adult on wheat

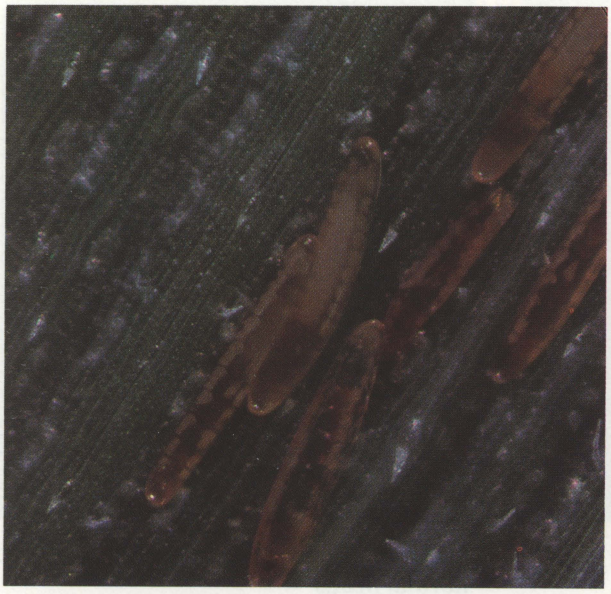

Figure 3. Eggs on wheat

Figure 4. Larvae on spring wheat

Figure 5. Puparia on jointed wheat

Figure 6. Spring wheat seedling stunted by Hessian fly

Figure 7. Stunted spring wheat seedlings (arrows point to specific stunted seedlings or tillers)

Figure 8. Four-tillered spring wheat seedling with one tiller (arrow) dwarfed

Figure 9. Closeup of dwarf tiller shown in No. 8 with puparia at base

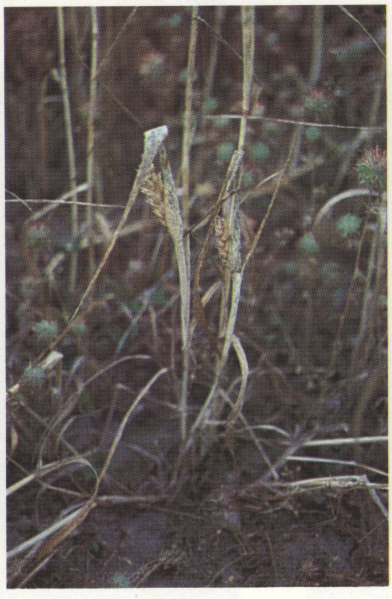

Figure 10. Stunted wheat

Figure 11. Stunted wheat heads (left) and normal heads

Figure 12. Thin wheat stand caused by fly

These photographs show various stages in the life cycle of the Hessian fly and wheat damaged by the fly. All photographs were taken in Benton County, Washington in 1980-81 except Figure 10, which was taken in San Juan County, Washington in 1978. Figures 1 through 11 were taken by K. S. Pike, Figure 12 by M. Glazer.

the first spring generation that aestivate (over-summer) or diapause (overwinter) and do not emerge from the puparia until the fall or following spring.

An increasing percentage of each subsequent spring generation aestivates (or diapauses) in the flaxseed stage to ensure summer survival. A good rain (about 1.0 inch) typically terminates aestivation. Adult flies can be expected to emerge in about 12 days. The main fall emergence normally takes place between late August and mid October. The adults from this emergence lay eggs on volunteer and early seeded wheats, or if these are unavailable, may oviposit on some of the other host grasses. Larval activity ceases about mid December with the onset of cold weather. Larvae that fail to pupate and emerge by late summer or early fall overwinter as diapausing larvae.

No single generation ever completes its development uniformly; the emergence of at least some individuals of each generation is delayed. There are usually 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 in Texas. The delayed emergence is a phenomenon that indirectly aids species dispersal; that is, larvae which remain in the flaxseed stage are protected from most environmental conditions and can survive long-distance transport. Infested bailed straw or hay may be a source of new fly infestations.

HOST PLANTS

Wheat is the preferred host but infestations have been found on barley, rye, spelt and emmer. Oats are not infested by this pest. Occasionally it has been found on wild grasses such as quackgrass, western wheatgrass, ryegrasses, little barley, goatgrass and timothy. There are likely other grass hosts in Texas.

WHEAT INJURY

Injury to wheat is caused by larval feeding on stem tissue at the crown of young plants or just above the nodes on jointed wheat. The extent of injury is generally greater in newly emerged and younger seedlings than in older established plants. Infested tillers are stunted by larval feeding and the leaves become somewhat broader and darker green (Figure 6). Although the color change and plant stunting are relatively distinctive, infested plants are still easily overlooked. For example, the young wheat plants shown in Figure 7 may appear normal at first glance, but closer observation reveals that about 50 percent of the tillers are stunted by larval feeding. The infested tillers are less than half the size of the uninfested, healthy ones. Note also that the stunted seedling near the left side of the row in Figure 7 is the same as that shown in close-up in Figure 6. Figure 8 shows a four-tillered seedling with one of its tillers dwarfed as a result of a larval infestation. Figure 9 is a close-up of the same plant showing the puparia (flaxseed) at the base of the stunted tiller.

Stunted tillers, particularly in younger plants, usually wither and die. If they survive, their growth and yield will be reduced (Figures 10 and 11). Significant grain losses can be expected when 20 percent or more of the tillers become infested. Serious infestations may lead to thin stands that yield poorly and are likely to have greater weed problems (Figure 12) than healthy stands. Figure 12 shows an irrigated wheat field that averaged 52 percent infestation and yielded approximately 15 bushels per acre. A minimum of 65 bushels was expected.

Hessian fly feeding in jointed wheat weakens the stem at the site of feeding. This may lead to significant lodging or stem breakage. Feeding also can interfere with nutrient flow to the head during kernel formation, resulting in losses of grain quantity and quality.

BIOTYPES

Sixteen strains or biotypes of the Hessian fly now occur in the United States. These biotypes look the same, but are genotypically different. They differ in their ability to infest different wheat cultivars that have specific genes for resistance. Recent studies conducted in Kansas by USDA-ARS scientists indicate that the Hessian flies collected in

Texas were predominantly Great Plains and A biotypes. These biotypes can not successfully infest wheat which has specific genes for resistance to these biotypes.

MANAGEMENT STRATEGIES

Plant breeders are working on a comprehensive testing program to determine which wheat varieties (both hard and soft) are fly resistant and adapted for production in the fly infested areas of Texas. Several soft and hard red winter wheat varieties are resistant to each of the races of Hessian fly that occur in Texas.

The wheat varieties adapted for production in north Texas which carry Hessian fly resistance are listed in Table 1. In selecting a wheat variety for planting, a producer also should consider other desirable characteristics such as plant disease resistance, potential yield and maturity.

Planting after the fly-free date (a date in late fall after which fly emergence will not occur) has been effective in reducing or totally avoiding Hessian fly infestations and damage in central Oklahoma and farther north in the wheat belt. But this practice of planting after adult 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. These environmental conditions can occur well into December and result in damaging larval populations. However, late planted wheat generally suffers less damage than wheat planted early for grazing. If grazing livestock is important in early fall, producers should plant oats or a Hessian fly-resistant wheat variety.

Destroying volunteer wheat to deprive first generation adults of a place to deposit their eggs will help reduce damage. Plowing under old straw to a depth of 4 to 6 inches in August will greatly reduce adult emergence from buried plant residue. Burial of infested crop residue can significantly reduce fall adult emergence. Problems of soil erosion and moisture retention in some areas can dictate that residue burial be limited to conform with conservation practices.

Di-Syston and Thimet are registered for controlling the Hessian fly on wheat, but do not have the residual activity to give season-long control.

Crop rotation will help, but flies can migrate a mile or more. Burning the 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 should be avoided. When buying or selling hay or straw, make sure the material shipped is not infested with Hessian fly.

Entomologists expect the Hessian fly to continue its southern movement from the presently infested area, but are optimistic that the fly will not likely become an economic problem in areas of Texas significantly west of Interstate 35. This area may serve as a barrier zone to the Texas plains region unless a new race develops that can survive and reproduce under the dry environmental conditions of the western production areas of Texas. If fly damage is severe in your community, planting resistant wheat varieties will be the primary management practice for controlling this pest. Other management considerations should include crop rotation, stubble burial and delayed planting if possible.

BENEFICIAL INSECTS

Two parasitic wasps, *Homoporus destructor* (Say) and *Eupelmus allynii* (French), are the primary biological control agents of the Hessian fly in Texas. These parasitoids deposit their eggs in the larval stage of the Hessian fly, but emerge from the pupa of the host. Parasitism of Hessian fly populations in counties north of Dallas was high in 1986, ranging from 60 to 80 percent. The incidence of parasitism was much lower in counties south of Dallas in areas newly infested by the Hessian fly (such as Hill County, where only 15 percent of the population was parasitized). These parasitic wasps are small in size and are not apparent to the producer during field observations. The economic benefit of these beneficials is currently under study at the Texas A & M University Research and Extension Center at Dallas.

Table 1. Wheat varieties with Hessian Fly resistance planted in North Central Texas.

Wheat class	Seed source	Variety
Hard red winter	Colorado St	Vona
	NAPB	Wings
	NAPB	Wrangler
	NAPB	Mustang
	Oklahoma St	Chisholm
	Kansas	Arkan[1]
	Pioneer	2157
	TAMU	Mit
	Rohm & Haas	HW1010
Soft red winter	CR Seeds	Coker 747
	Missouri	Pike
	Purdue	Abe
	Purdue	Arthur 71
	Purdue	Knox 62
	Purdue	Caldwell
	Purdue	Adder
	NAPB	Maghum
	TAMU	Bradford

[1] Arkan is a hard red winter wheat with the external kernal characteristics of a soft red winter wheat, which can cause problems in grain grading.

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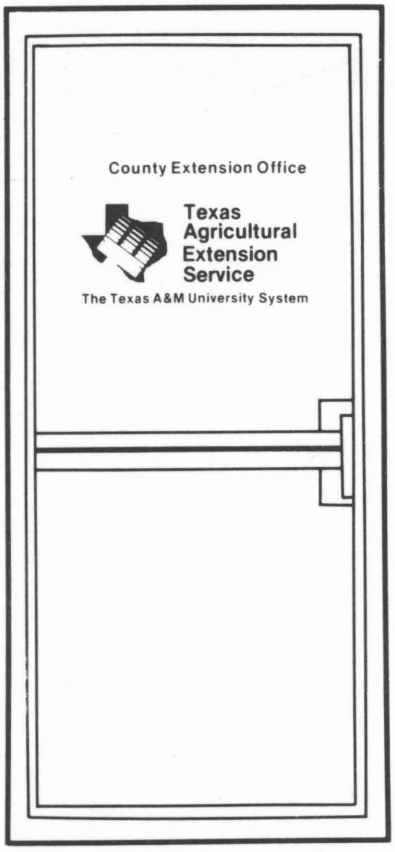

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