

The Hessian Fly.

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The Hessian fly has appeared throughout the greater part of Minnesota during the summer of 1901, and considerable damage has been done to wheat, indeed as great injury as was caused by the very hot winds of July has been done by this insect.

Several appearances of the Hessian fly in Minnesota during recent years make it seem probable that this pest will require attention from our farmers from time to time as favorable weather conditions allow it to multiply in destructive numbers. Numerous reports of damage during the present summer of 1901, and the exceedingly favorable weather of last fall and spring for the development of this pest, have made it seem desirable that the wheat growers of the state should be apprised of the presence of the Hessian fly and

warned of the possibility of greater damage if preventative measures are not adopted.

The Hessian fly was reported by Dr. Lugger in 1895 and 1896. He states that it caused a loss of from 5 to 10 per cent of the entire wheat crop, the loss in some cases having been as severe as 25 per cent. The writer observed slight damages in 1897, and in 1899 enough damage was done to create general comment by farmers.

We first heard from the Hessian fly this summer at Clithrall in Otter Tail county. An inspection of the fields in that region showed the wheat crop to be badly damaged, the local miller placing the loss at 50 per cent on a conservative estimate. Inspections were also made at St. Peter, St. James, Worthington, Sibley, Ia., Pipestone, Marshall, Willmar, Wadena and Beaver Falls. The fly was found in every wheat field examined, without exception. It is probably present in all parts of Minnesota. A farmer from Todd county writes: "Out of fifty acres of wheat, if I fan the whole, I do not think I could get a bushel of marketable grain." The amount of damage done varies much with the nature of the soil and the method of farming. A loss of three or four bushels per acre was frequently found on heavy soil, while a loss of all but three or four bushels per acre was observed in several instances on light and worn soils. The amount of moisture present, however, is the most important consideration. The fly thrives best in a very moist situation. The injury is conspicuously less on strong, well-prepared land than on thin, worn soil. Wheat following corn or potatoes was less injured than wheat following wheat. It is impossible to say at the present time how much damage may be expected next year, as the insect is peculiarly susceptible to influence by weather conditions. Considerable numbers of the insects were killed by the recent hot weather. Many of the pupæ now in the stubble are dead and shrunken. There are enough healthy ones left, however, to provide for a continuation of the mischief next year if weather conditions favor the fly.

LIFE HISTORY.

The life history of this insect has been carefully worked out, both in America and in Europe, and there is a great variation in the number of annual broods present in different localities, and from year to year in the same locality. The number of broods usually found present in Minnesota is one. All published observations indicate the presence of but one spring brood in the spring-wheat countries. There are, however, at least four annual broods in the states farther south, and there seem to have been two broods in Minnesota wheat



FIG. 1.—Wheat plant showing injuries by Hessian fly: *a*, egg; *b*, larva; *c*, flax-seed, *d*, pupa; *e*, female, natural size; *f*, female; *g*, male; *h*, flax-seed between the leaves and stalk; *i*, parasite—all much enlarged except wheat plant and fig. *c*. (After Riley.)

this season before harvest, this spring having been especially favorable for the development of the fly. It is quite possible that there is a third generation in winter rye before cold weather, as the fly does breed in this cereal and also in barley, though to a much less extent than in wheat. This insect does not breed in oats or in grass.

At harvest time all of the flies are in the flax-seed stage and the insect passes the winter also in this condition. It hatches out in the spring, early in May in an average season. The time of hatching, however, is much influenced by weather conditions. It may be accelerated by warm, moist weather, or retarded by dry weather, be it hot or cold. Extremely hot weather is the most disadvantageous to the flies. After emerging in the spring the flies copulate, lay their eggs and die, all in the short period of from one to four days. The fly is very apt to lay its eggs in the same field in which it wintered over. It does not fly far. The Hessian fly in its development passes through four stages, the egg, the larva or maggot, the pupa or "flax-seed," as it is popularly called, and the adult fly.

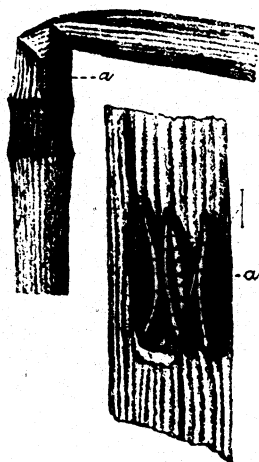


FIG. 2 —Hessian fly: at the right, three flax-seeds, (a); at the left, injured straw, flax-seeds at (a). Enlarged. (After Luggier.)

The eggs are extremely small, slender elliptical in shape, slightly reddish in color when laid and becoming darker red before hatching. The number of eggs laid by one female is very great, as many as 238 eggs having been found in a single female. The eggs hatch in from three to five days. On hatching, the little larva moves down the leaf upon which the egg was laid, and finds a field for future operations between the leaf-sheath and the stem. Here it feeds upon the plant for a

period of about twenty days. This may be at any one of the joints, though it is most frequently at the second. The location of the flax-seed in the straw is governed by the height of the grain at the time of deposition of the eggs. If the plants are just coming through the ground so that but a single leaf has appeared, the fly lays its eggs upon this first leaf, and the flax-seeds will be found at the first joint. If other leaves have appeared before the eggs are laid the flax-seeds may be found at the higher joints. Many have been found in the third and fourth joint and even within an inch of the head of grain, but the great majority are low down in the straw and so remain in the stubble when the grain is cut.

The larva now contracts and thickens and takes on the flax-seed shape which is noticeable to all, the outer larva skin furnishing the covering which protects the delicate insect within during the subsequent transformations. Extreme heat at this stage is fatal to the flies. The larva within this case now changes to the completely inactive pupa. The pupa-case is a small brown object which was long ago named by popular usage the "flax-seed." It does somewhat closely resemble a true flax-seed. This flaxseed is to be found behind the leaf-sheath just above a joint in the stem. The insect remains in this stage until its development is complete and the proper season has arrived for the hatching of the fly. When this time arrives, it is early spring in Minnesota, the insect pushes off the upper end of the flax-seed and wriggles out, a very delicate white pupa. It soon becomes reddish, however, as the fly is about to emerge. The pupa pushes its way out from behind the leaf, bursts the filmy pupa skin and emerges, a delicate little fly about one tenth of an inch long. It is much such an appearing insect as a mosquito, but is much smaller. It has dusky wings, and a red abdomen with black markings. The lifetime of this adult form is very short, from one to four days, just long enough for the mature insects to copulate and find proper

places to lay their eggs, thus to provide for a continuation of the species.

REMEDIES.

As the flies are all in the flax-seed stage at harvest time, the best method of killing the insects is by burning the stubble as soon as practicable after the grain is cut. If the grain is cut high, the stubble will burn better and fewer flax-seeds will be carried away in the straw.

Thorough plowing also must kill many of the insects, for the delicate fly cannot escape if the stubble has been well covered with earth. Plowing which does not turn the stubble well under cannot be of much service from this point of view. Where practicable, rolling or compacting the soil after plowing will imprison still more of the flies.

The writer was present at the threshing of some fly-infested wheat in order to see just where, in threshing, the flax-seeds appear which were carried from the field in the straw. A previous examination of the standing grain in the field showed many flaxseeds to be above the place where the straw would be cut by the binder. While a majority of the flax-seeds were about the roots in dead tillers and at the first and second joints of the straw, a considerable number were found at the third and even at the fourth joint of the stem. Hence many of the flaxseeds are carried from the field in the straw.

The flaxseeds were present around the thresher in greatest numbers in the screenings which fell under the machine. They were also found in the bottom of the elevator, in the bottom of the sacker and in the grain sacks. Some were blown from the screens with chaff and fell under the rear end of the machine and some were blown into the stack with the straw. There is no one place where they all appear. The flax-seeds which appear with the weed seeds and screenings under the machine are disposed of in the feeding of the screenings. They should not be left to lie where they have fallen, for the winds will scatter both the weed seeds and Hessian fly flax-

seeds. When the machine is cleaned the flax-seeds at the bottom of the sacker and elevator are usually dumped on the ground. These are few in number. The flax-seeds which fall under the machine with the chaff have a very good chance to mature. Those carried into the straw-stack must perish, except for the ones very near the surface. This number is comparatively small. The flax-seeds carried away in the sacks of grain appear at the elevator or mill in screenings. These are ground up and sold as "cockle," or go into the shorts. The grinding, of course, kills the pupæ. As a result of all this, I should say that it would pay to clean up and feed or burn all the litter about the machine when threshing is finished.

The most important remedies, however, are in the nature of preventative farm practice, the rotation of crops, the manuring of the land and the proper preparation of the soil for the grain crop. By delaying the time of sowing of the grain in winter-wheat countries till the fall brood of flies has emerged and perished it has been found possible to escape damage from the Hessian fly. In Minnesota this remedy cannot be recommended even for those parts of the state where winter wheat is raised because we have not, as yet, demonstrated the existence of a fall brood of the flies. The late spring and dry summer also make it impossible to delay the spring sowing till the flies have emerged and perished. Hence we must rely on other means.

EFFECT OF WEATHER CONDITIONS.

Extremely hot and dry weather during the summer time, while the insects are in the flax-seed stage, is destructive to them, for moisture is necessary during the transformations which take place within the pupa-case. The wet fall and summer of 1900 were favorable to the flies, as also was the very wet spring of 1901. This accounts in a measure for the appearance of the fly in destructive numbers during the summer of 1901. The intense heat of this summer of 1901 is

disadvantageous to the best interests of the Hessian fly. We must not fall into the popular error, however, of regarding a single factor of the problem as the whole proposition and trusting to the hot weather to kill all the flies. Great faith may be placed, however, in the additional heat of the burning stubble.

PARASITES.

The Hessian fly is sometimes severely attacked by insect parasites, several species occurring in this country. They are sometimes quite effective in keeping this pest in check, and the periodical appearance and disappearance of this insect is largely due to the rise and fall of the number of its enemies, the periods of greatest prosperity with the parasites following close upon the rise in numbers of the Hessian flies. This relationship terminates with the exhaustion of the supply of flies and the starvation of the parasites. Some attempts have been made to introduce especially prolific parasites from Europe. We must be thankful that these insects in the accomplishment of their own purposes accidentally assist us in our farming, but to depend upon them to the neglect of good farming methods is to depend upon an uncertainty at the expense of the crop.

RELATION TO FARM PRACTICE.

From a very early date it has been observed that some varieties of wheat are much more susceptible to injury by the Hessian fly than others, and in some states where winter wheat is grown there has been a systematic selection of varieties of wheat with reference to this point. I do not know of any such work being done in spring-wheat countries. There are, however, some details of the usual farm practice which bear directly upon this matter of susceptibility to injury by the Hessian fly.

The rotation of crops is of the greatest importance in preventing injury by the Hessian fly, in fact judicious crop rotation such as is demanded by the best agricultural practice

will prevent a very large part of the damage now done by insects to field crops. As long as large areas of country are devoted year after year to the raising of a single grain crop we must expect a periodical recurrence in devastating numbers of our worst crop insects.

Too much attention cannot be paid to the proper fitting of the soil for the money crop. The preparation of the land for wheat by growing fodder corn, millet or potatoes tends to produce a good quality of wheat straw such as will withstand an attack of the Hessian fly to much better advantage than will that grown on a poorly prepared field. The selection of good seed is also a matter which has a direct bearing upon this question of injury by the Hessian fly.

The first effect of this insect upon the crop is to induce excessive stooling, which makes the wheat look very heavy upon the ground and to discourage the growth of the grain-bearing stems, these being injured by the larvæ. Such of the stems as do mature, if infested by the larvæ of the fly, are so weakened that they fall over when the grain begins to ripen. It is the presence of these fallen straws before harvest that makes the damage conspicuous. The damage done by the fly to the grain may be divided into two portions. A part of the damage is done by the larva eating the substance of the plant, and through weakening or completely preventing the formation of the head of grain. The remainder of the loss results from the breaking over of the straw. The infested straws are frequently entirely missed by the binder or are so bent over as to be cut twice, and the head, such as it is, falls to the ground.

Any farm practice which tends to produce a stiff and strong straw also tends to render less disastrous the attack of the Hessian fly. Though the nitrogen or organic matter in the soil is an extremely important element of fertility, and though it is very easily exhausted, and the soil thereby greatly damaged, too great a proportionate amount of assimilable nitrogen tends to produce a rank and weak straw. Potash tends to produce a

strong stiff straw, and phosphoric acid is particularly necessary to the formation of the grain. Hence a good wheat soil must contain large amounts of available phosphoric acid and potash, and the proportion of assimilable nitrogen should be large, but not excessively large, as it may be on the strongest soils. The rank and weak straw produced by those unusually fertile soils containing an excessive amount of nitrogen or humus is peculiarly favorable to the lodging of the grain as well as great damage by the Hessian fly. We are also most apt to get this excessive growth of straw in the wet seasons so favorable to the development of the Hessian fly.

A common process of fitting the soil for wheat is by summer-fallowing. This process is extravagantly expensive of labor. It allows the Hessian flies and frit-flies and grasshoppers to emerge in the spring and only corrects the balance of fertility through dissipating into the atmosphere a large amount of the valuable nitrogen or humus. A much more economical, and in every way more desirable way of accomplishing this same result is through raising millet or fodder corn. Either one draws heavily upon the nitrogen frequently present in excess in the newer and heavier soils.

CONCERTED ACTION.

The farmer usually underestimates the benefit which he individually will receive from labor expended in killing the insects in his own crop. A very large part, frequently all of it, goes to him. Entirely apart from the matter of public morality, it pays to kill the insects. Many destructive insects do not spread rapidly. The Hessian fly has a strong tendency to deposit its eggs in the same field in which it was hatched, or in the immediate neighborhood. The concerted action which is essential to the best results in combating insect pests can only come from a general education of the farmers to a knowledge of the dangerous insects and to such a conception of their duty to the public as will make them active in these

matters. The farmer should make the most of the opportunities offered him by the state to learn all that is known about the insect pests of the agricultural public in order that he may act intelligently and be a force in the moulding of public opinion.

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