THE WHEAT STEM SAWFLY AS AFFECTING YIELD

By

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The wheat stem sawfly[4] is a more important factor in the reduction of yield than has been hitherto acknowledged.

The loss by this pest is usually attributed almost entirely to the weakening effect of the sawfly larvae upon the stems, which causes fallen and unrecovered heads of grain.

For 1944 this loss was estimated at 2,781,240 bushels of wheat in the northwestern counties of North Dakota where a survey conducted by Dr. F. Gray Butcher, Extension Entomologist in cooperation with the Experiment Station, showed the sawflies to be "very abundant". Had the estimate included loss sustained in other areas where sawflies were rated as "moderately abundant" and "scarce", the total loss for North Dakota alone that year would have been much greater—possibly 3½ million bushels. For years, such loss has been an annual occurrence not only in North Dakota but also in Montana and adjoining prairie provinces of Canada. The main loss is to hard spring wheat varieties. Damage to Durum wheat and other small grain crops is probably of slight consequence.

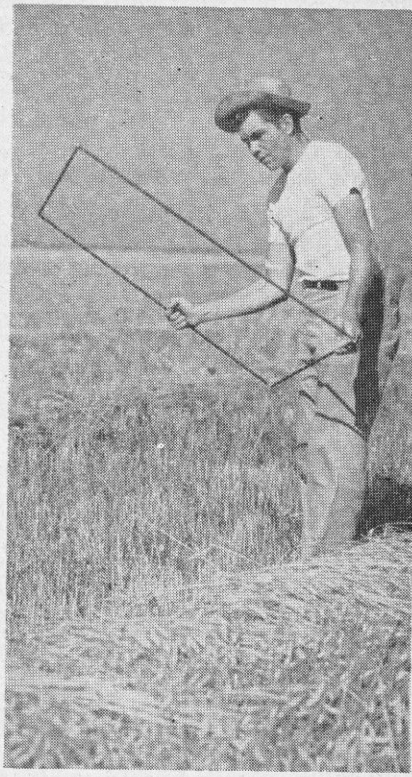

Fig. 1 Apparatus used for measuring square yard areas for sampling.

Occasionally the suggestion has been made that (1) the loss from fallen and unrecovered heads may not constitute the entire loss from sawfly, that (2) there may be loss due to the physiological effect of the sawfly larvae on the developing heads, and that (3) statements to the contrary may have been based on inadequate sampling.

On the basis of samples collected by the senior author in 1944, representing 600 heads of wheat—half of which came from sawfly infested stems and half from non-infested stems, there was no

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significant difference in yield, and it was reported "that sawfly damage causes no significant reduction in yield of the individual heads"[5]. That the close similarity in yield might have been due to a tendency of the flies to infest the more vigorous and productive stems and lower their yield to that of non-infested less vigorous stems could not be determined on the basis of the method of sampling.

During 1947 the technique was refined by tagging stems of uniform size and stage of development upon a given date in the "heading out" period. Small red tags were attached to (a) one thousand primary stems of uniformly large size and stage of development, and small yellow tags were attached to (b) five hundred secondary stems of uniformly small size and stage of development.

When the grain was ripened all tagged stems to be found were collected separately for each classification and the heads from the sawfly infested stems were separated from those of the non-infested stems, and were threshed, weighed and results tabulated. Of the 1,000 primary stems which were tagged, a total of 825 were recovered and of the 500 secondary stems which were tagged a total of 440 were recovered.

Table 1. Effect of wheat stem sawfly on yield of wheat

Type of Stems	Number of Wheat Heads	Weight in Grams		Weight in Grams per 1,000 kernels of wheat
		Threshed Sample	Per 100 heads	
Primary, Sawfly infested	507	385.2	75.97	37.506
Primary, Non-infested	318	263.5	82.86	39.601
Secondary, Sawfly infested	128	45.0	35.15	29.485
Secondary, Non-infested	312	112.8	36.12	30.178

A review of Table 1 shows two significant trends, (1) the greater proportion of the more vigorous primary stems being attacked by sawfly, and (2) the retarding effect of sawfly on yield.

Expressed on the percentage basis the sawfly infested primary stems showed a 61.5 per cent infestation, while the sawfly infested secondary stems showed an infestation of only 29.1 per cent. This indicates the greater tendency of sawflies to attack the more vigorous and heavier yielding stems.

The difference in weights per 100 heads as shown in Table 1 illustrates the depressing effect which the sawfly has on yield. For each classification the non-infested stems outyielded the sawfly infested stems. Expressed on the percentage basis, the non-infested primary stems outyielded the sawfly infested primary stems by 9.1 per cent, and the non-infested secondary stems outyielded the

[5]See Munro, J. A. "Wheat Stem Sawfly and Harvest Loss" N. Dak. Agr. Exp. Sta. Bimon. Bulletin VII No. 4—Mar.-Apr. 1945—pp 12-16.

sawfly infested secondary stems by 2.8 per cent. This difference is particularly significant in consideration of sawfly preference for the more vigorous primary stems.

Sawfly Larvae Cause Shrinkage of Kernels

Weighing of representative samples each consisting of 1,000 kernels of wheat indicated the sawfly larvae had reduced yield by causing shrinkage of the kernels. The shrinkage was most severe for the kernels from the larger, primary stems. Expressed on the percentage basis the wheat from the non-infested primary stems weighed 5.6 per cent more than the corresponding sample from the sawfly infested primary stems, while for the secondary stems there was only a 2.3 per cent difference in favor of the non-infested stems.

In addition to affecting the stems in a mechanical way which results in their breaking over with consequent loss of heads, the sawfly larvae have a physiological effect on the stems which results in lowering the yield per head. Present evidence would indicate that this loss will vary with the degree of infestation in the field, vigor of the stems, and possibly other factors. More observations on this type of sawfly damage are needed as a basis of evaluating the loss caused.

The mechanical injury which results in the stem breaking over is due to the larva cutting a v-shaped groove around the inside of the maturing stem at ground level. The larva then puts a

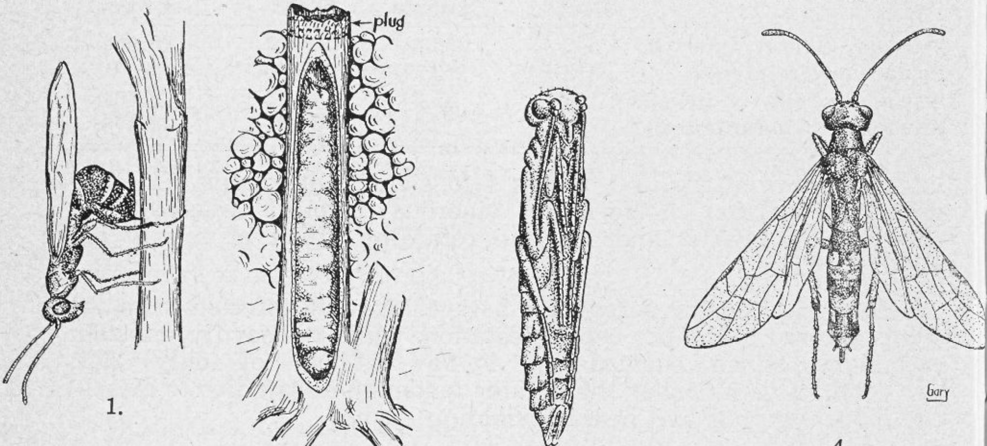

Fig. 2 The development of a wheat stem sawfly. 1. The female thrusts an egg into a wheat stem with a saw-like ovipositor at the tip of her abdomen. 2. The larva, after hatching, has fed its way downward through the joints and finally cut a narrow V shaped groove on the inside of the stem at ground level, corked the top with chewings. 3. The pupa ready to emerge in the spring. 4. The adult sawfly in June. Courtesy of "Coop Grain Quarterly."

plug of powdery material directly below the groove (See Fig. 2) and retreats below to complete its development. In the meantime the weakened stem breaks over to provide an escape for the adult insect at emergence time in late spring.

Loss due to mechanical injury by the larvae cutting the stems is influenced by the date of harvesting, weather conditions, height of stubble and possibly other factors.

That promptness in harvesting is of particular importance was indicated in a study of two fields of wheat in the Rugby vicinity. Each field was approximately 160 acres and seeded to the "Cadet" variety of wheat in the spring of 1947. Both fields had been summerfallowed the preceding year. They were cultivated, seeded and harvested with the same machinery throughout. Both fields were swath combined with the stubble left about 10 inches high. The swather, with pick-up attachment on the guards, was used in the harvesting of both fields. The only difference in the entire procedure was that one field was harvested on August 8-9 and the other during the period of September 2 to 6, according to a statement by the owners, Messrs. Kermit and Lloyd Blessum.

The fields were carefully checked for sawfly occurrence by examining 25 wheat stubs at each of 18 well distributed points of each field, and a sample representing all fallen heads of wheat on one square yard surface of ground was collected at each of these points. Observations were made and samples collected to a distance of approximately half way across each field, and results tabulated as follows:

Table 2. Sawfly damage in relation to time of harvesting

Location	Number of Replicates for each field	Harvested Aug. 8-9		Harvested Sept. 2-6	
		% Sawfly	Wheat in grams Per sq. yard	% Sawfly	Wheat in grams Per sq. yard
North Margin	5	44.0	7.88	46.0	22.09
100 yards in	5	14.4	5.03	21.6	15.86
200 yards in	5	11.2	7.25	7.2	13.35
400 yards in	3	8.0	4.84	8.0	11.34
Average		19.4%	6.25 gms.	20.7%	15.66 gms.

	Aug. 8-9	Sept. 2-6
Harvesting Period	Aug. 8-9	Sept. 2-6
Total Loss computed in bushels per acre	1.11 bu.	2.78 bu.
Normal loss in fields where no sawfly occurred*	.27 "	.55 "
Loss in bushels per acre due to sawfly	.84 "	2.23 "

*The figures on normal loss are based on data from fields where there was no sawfly occurrence but where other conditions fairly represented those of the Rugby fields.

Table 2 illustrates the loss due to sawfly in relation to time of harvesting. While there is slight variation in the sawfly occurrence of the two fields, this is probably not sufficient to be of significance. The amount of grain loss resulting from sawfly activity is influenced to a large extent by the amount of windy or stormy weather occurring after the grain is ripe and ready to harvest. Hence, the most practicable way of preventing such loss

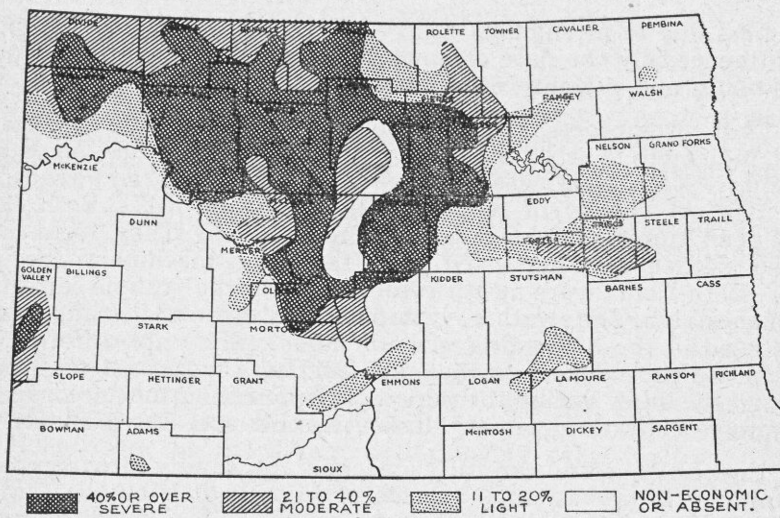

Fig. 3. The wheat stem sawfly infestation in 1947 in North Dakota. This information was obtained through the examination of margins of wheat fields by the USDA Bureau of Entomology in cooperation with the NDAC Experiment Station and Extension Division. The wheat stem sawfly was not recorded from the following counties: Cavalier, Dickey, Grant, Richland, Sargent and Sioux.

Table 3. Percentage of wheat stem sawfly infested stems.

1946 Variety	% Sawfly Infestation	1947 Variety	% Sawfly Infestation
Hard spring wheat		**Hard spring wheat**	
Renown	84	Redman	100
Mida	82	Regent	96
Regent	72	N. N. 1556	94
Thatcher	28	Pilot 13	94
Rescue	6	Thatcher	94
		New Thatch	92
Durum		Cadet	90
Mindum	6	Ceres	90
		N. N. 1756	88
		Henry	88
		Vesta	86
		Mida	86
		Rival	76
		Rescue	52
		Durum	
		Stewart	22
Barley		L. D. 153	20
Spartan	44	Mindum	10
Kindred	2	Kubanka	10
Tregal	Trace	Carleton	6

is to harvest the field as soon as possible after the grain is ripened. The use of the swather with pick-up attachments, and cutting the stubble low, aids in retrieving heads of wheat which might otherwise be lost.

Stems of small grains were examined in 1946 and 1947 on the North Central Experiment Station plots at Minot. Fifty stems were collected at random in the three-foot end margin of each plot. The percentage of infestations are listed in Table 3.

CLINTON AND OTHER NEW OATS VARIETIES

By
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Farmers intending to purchase seed of Clinton, or other new rust resistant varieties of oats now offered, will want to consider the facts set forth below, based on results and observations made during the last 4 years that Clinton has been under test in North Dakota.

Clinton probably will not outyield other good varieties now grown unless disease seriously injures the other varieties. In the absence of serious disease conditions several other varieties may outyield Clinton.

Clinton, however, has certain advantages, other than capacity for high yield, which justifies its introduction and use, especially in the southeastern and eastern counties of the State where serious disease conditions are more likely to occur than elsewhere in the State, and where early oats have preference. Clinton is early, has very strong straw, grows taller than several other early varieties, does not shatter readily and has a high weight per bushel.

Clinton is resistant to more races of stem rust than Vicland, Tama, Marion, Rainbow or Ajax; has good resistance to most races of crown rust (susceptible to race 45) and is resistant to *Helminthosporium* blight, a disease which can injure Vicland, Tama and other selections from the Victoria-Richland cross. This blight was observed in some North Dakota fields of Vicland in 1947, which suggests a possible more serious increase in this disease, especially in the southeastern sections of the State where soil moisture conditions are most favorable, and Vicland and Tama are most extensively grown. Varieties Marion, Rainbow, Ajax are also resistant to *Helminthosporium* blight and yield high, but in a year of serious crown rust could be injured.

Other new varieties like Benton, Bonda and Mindo compare favorably with Clinton in resistance to the rusts, also to *Helminthosporium blight.* All class as early ripening, have relatively thin hulls and high test weight. Benton grows taller than Clinton, thus might be suited better to the lighter soils, in areas where