WHEAT STEM SAWFLY[1]

by
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Investigations in 1948 were largely a continuation of work previously begun on: 1. Evaluation of insecticides in sawfly control; 2. Fall tillage as a factor in control; 3. Effect of larval feeding on yield; 4. Sawfly occurrence in wheat varieties; 5. Delayed seeding to avoid sawfly damage; and 6. Observations on biology and natural control of the wheat stem sawfly.

Wheat stem sawfly occurred over much the same area in North Dakota in 1948 as in preceding years, the heaviest incidence being in the northwestern one-third of the state. Much of the crop however was harvested before high winds, occurring about August 20, caused infested stems to fall.

1. Tests of Insecticides in Sawfly Control

The purpose of this experiment was to determine further the possible role of insecticides, which, if effective, would not be prohibitive in cost, in the control of the wheat stem sawfly. Five insecticidal dusts were applied to plots on each of five fields of hard spring wheat located near Minot, North Dakota. An additional formulation containing 5 per cent DDD was applied in one of the

Figure 1.—The insecticides were applied with a power duster mounted on a two-wheeled trailer. Photo by K. S. Engel.

[1]Progress report on Bankhead-Jones Offset Project No. 77 "An evaluation of DDT and other residual insecticides in the control of wheat stem sawfly"
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fields. The plots were 1/10 acre size (136 feet x 32 feet) and extended an equal distance (16 feet) into the edge of the field and the grassy border. The plots were replicated three times in all but one of the fields where they were replicated twice. The applications were made at the rate of 20 lbs. per acre, with a power duster mounted on a two-wheeled trailer, and only when the air was fairly calm. The results which were determined on the basis of an examination of 50 stems taken at random from the center of each plot at four feet in from the edge of the field are summarized in Table 1.

Table 1.—The Effect of Insecticides on Sawfly

Farm and Date of Application	No. of Replicates	Percent sawfly with different insecticides						
		Chlordane 5%	DDT 5%	Toxaphene 10%	Parathion 2%	BHC 3%	DDD 5%	Check: No Insecticide
Reinart's farm June 13	3	47.3	46.6	51.3	64.0	76.0	.....	50.0
Stenjehm farm June 13	3	93.3	87.3	88.7	85.3	93.3	.....	98.0
Tripp farm June 21	3	21.3	12.7	29.3	23.3	18.7	.....	18.0
Linertz farm June 22	3	80.7	80.0	82.7	79.3	80.0	.....	83.3
Linertz farm June 22	2	81.0	75.0	76.0	75.0	87.0	84.0	90.0
Average per cent Infestation	.....	65	60	66	65	71	.....	68

On the basis of the above results none of the chemicals produced satisfactory control. This is the second year's testing of several of these insecticides to determine their role in the control of wheat stem sawfly and the 1948 results are no more encouraging than of the previous year.

Source and concentrations of Insecticides used:

5% Chlordane, Velsicol Corporation, Chicago, Illinois.
5% DDT, Agricultural Supply Company, Grand Forks, North Dakota.
10% Toxaphene, Occident Elevator Company, Billings, Montana
2% Parathion, American Cyanamid Company, New York City, N. Y.
3% Gamma, Benzene hexachloride, BHC, Pa. Salt Mfg. Co., Wyndmoor, Pa.
5% DDD, Rohm & Haas Company, Philadelphia, Pa.

2. Fall Tillage as a Factor in Control

This experiment was designed to test the value of several types of fall tillage in the destruction of sawfly larvae while they were in the stubble. The tillage was applied both early and late and consisted of mold-board plowing of about 4½" depth; duckfooting of about 2½" depth; double disking of about 2" depth; and one-way disking of about 2½" depth. A strip of untilled stubble remained undisturbed between each tilled strip to serve as a check. The mold-board plowing was regarded as "deep" tillage and other cul-

tivation as "shallow" tillage. A field of wheat stubble on the Stanley Saugstad farm located about 5 miles east of Minot was selected for the test. This field had shown a sawfly infestation of about 80 per cent prior to harvesting.

The early tillage treatments were applied August 23 and the late tillage on October 2. On the latter date, an examination of stubble samples picked at random from the one-way disking treatment of August 23 indicated the degree of control to be largely contingent on exposure of the roots to weathering agencies. Roots which had been exposed to the sun and weather showed then a ratio of one living larva to four dead larvae, while in roots which had remained buried, there was one living larva to one dead larva.

The results would stress the importance of early fall tillage which leaves the stubble and roots on the surface as a "trashy layer". Such procedure not only causes a high mortality of the larvae but is in harmony with good soil conservation practice, as it protects the soil against blowing. An examination of the plots will be made in the spring of 1949 to evaluate the relative effectiveness of the different treatments.

3.—Effect of Sawfly Larvae on Yield

This investigation was continued in line with procedure developed by Munro et al (1947)*. The stems were tagged on July 7 and 8 into two categories which were distinguished by the color of the tags used. The categories consisted of (1) primary or uniformly large and vigorous stems and (2) secondary or small, undersized stems. The work was done on the Mida variety of wheat located on the North Central Experiment Station farm 3 miles south of Minot, the Otis K. Schlak farm 12 miles southwest of Minot, and the Earl Martin farm 7 miles east of Minot. On August 19 and 20 the tagged stems were collected and the results tabulated in Table 2.

Table 2.—Effect of Wheat Stem Sawfly on Yield and Shrinkage

Type of stems	No. of wheat heads	Wt. in grams threshed sample	Wt. per head (gram)	Wt. in grams per 1000 kernels of wheat
Primary, sawfly infested	1427	962.74	.67	34.12
Primary, non-infested	28	22.71	.81	35.92
Secondary, sawfly infested	853	426.67	.50	31.25
Secondary, non-infested	159	75.65	.48	35.38

Expressed on the percentage basis 98.1 per cent of the primary stems in the plots were infested with sawfly in 1948 as compared with 61.5 per cent in 1947, and for the secondary stems 84.3 per cent were infested in 1948 as compared with 29.1 per cent in 1947. That is, in both years the sawflies showed a decided preference for the more vigorous and high yielding stems.

*Munro, J. A., R. L. Post and Royce B. Knapp, 1947. The Wheat Stem Sawfly As Affecting Yield. N. D. Agr. Expt. Sta. Bim. Bul. 10 (2):46-51.

That the wheat stem sawfly has a depressing effect on the weight of the heads is indicated by the results obtained over the past two years. In 1947, sawfly activity resulted in an 8.3 per cent decrease in weight of wheat for the primary infested stems and in 1948 a decrease of 16.8 per cent. For the secondary stems the results were contradictory in that sawfly activity, while causing a 2.7 per cent decrease in weight of wheat per head in 1947, represented a 4.8 per cent increase in 1948. The probable explanation of this being that the secondary stems varied considerably in size, and with the high infestation (84.3%) only the poorest stems remained free of sawfly larvae.

Additional confirmation to the depressing effect of sawfly on production was had from the weighing of the kernels. In 1947 the lowered weight or shrinkage of kernels resulting from sawfly activity in the primary stems was 5.3 per cent and from the secondary stems was 2.3 per cent. For 1948 the shrinkage in kernel weight was 5 per cent for the primary stems and 11.7 per cent for the secondary stems.

Such shrinkage therefore should be taken into account along with the loss of "fallen" heads, due to the breaking over of the infested stems. when estimating the loss of wheat caused by sawfly. Based on the "fallen" and unrecovered heads due to sawfly damage an estimated loss of 3 to 5 million bushels of wheat has occurred annually in North Dakota over the past eight years. The loss due to shrinkage and other factors would probably represent an additional loss of 9 per cent or more to the wheat from the infested stems. Further experiments and field observations are needed to clarify this point.

A survey of sawfly infestation in North Dakota was conducted by the Bureau of Entomology and Plant Quarantine, USDA, in cooperation with the N. D. Agricultural Experiment Station. The survey information is based on sampling ten well distributed fields selected from each county. The percentage of infested wheat stems is shown in Figure 2. Although this map shows the major sawfly areas in North Dakota some individual fields would show higher percentage of infestation than recorded on the map.

4.—Sawfly Occurrence in Wheat Varieties

This investigation, begun in 1946, included the examination of 50 stems of wheat, picked at random each year, from varietal plots on the North Central Experiment Station farm near Minot. The samples were taken prior to harvesting from about 3 feet in from one end margin of each varietal plot. Results compiled over the past 3 years are shown in Table 3.

On the basis of the following tabulation Rescue wheat was the least infested of the hard spring wheats and Carleton the least infested of the durum. LD 303 and LD 271 which showed the highest percentage of infestation for durum wheats are new early-maturing varieties.

Table 3.—Percentage Sawfly Occurrence in Wheat Varieties

VARIETIES	1946	1947	1948
Hard Spring Wheat			
Renown	84	.....	.....
Mida	82	86	92
Regent	72	96	98
Thatcher	28	94	92
Rescue	6	52	30
Redman	....	100	84
Pilot 13	....	94	84
Cadet	....	90	84
Ceres	....	90	98
NN 1756	....	88	84
Henry	....	88	78
Rival	....	76	92
Vesta	....	86	....
NN 1556	....	94	....
1831	....	.....	66
Apex	....	.....	96
Minn. 277	....	.....	96
NN 1924	....	.....	90
Durum			
Mindum	6	10	36
Stewart	....	22	4
Carleton	....	6	2
Kubanka	....	10	....
LD 153	....	20	....
Vernum	....	.....	24
LD 303	....	.....	68
LD 271	....	.....	74

5. Delayed Seeding Avoids Sawfly Damage

That delayed seeding of wheat is effective in preventing sawfly damage was indicated from wheat varieties sown on May 12 and June 2 at the Minot station.

Fifty stems were collected from the same location of each plot and examined for sawfly larvae, and results tabulated as follows:

Table 4.—Percentage sawfly occurrence in seedling trials.

Variety	Date of Seedings	
	May 12	June 2
Durum wheat		
LD 271	74	0
LD 303	68	0
Hard Spring wheat		
Cadet	84	0
Rival	92	0
Mida	92	0

The above results indicate that delayed seeding of wheat may have worthwhile possibilities as a method of avoiding sawfly damage especially if the delay in seeding does not result in lowering yield above that of sawfly damage in early seeded wheat. A larger

number of varieties and greater variation in seeding dates is planned for the experiments to be continued on this phase of the investigation in 1949. In addition, yield data will be recorded.

6. Observations on Biology and Natural Control

A review of sawfly occurrence throughout the years has shown the populations of this species to fluctuate widely. Natural control agencies, including naturally occurring parasites, may be largely responsible for these shifts of intensity and changes in populations.

Sawfly infested stubble collected from a large area of the state during the late summer of 1947 showed natural control to be at a low ebb. Indications then pointed to not over 5 per cent mortality of the maturing larvae from natural causes of which about 2½ per cent mortality was attributed to parasitism.

Observations indicated that parasitism became an increasingly important factor in 1948. This was emphasized in the study of a wheat field in the Minot area. In the latter part of July, 1948 this field showed about 80 per cent sawfly occurrence in the stems but by October only 30 per cent of the stubble contained living larvae. This marked decrease in living larvae from 80 per cent in July to 30 per cent in October appeared to be due in a large part to parasitism by the parasite *Microbracon cephi* Gahan. One other species of parasite was occasionally observed which although not at a stage where definite determination was possible, was probably *Pleuroptropis utahensis* Crawford.

Sawfly Development

Sawfly development was slightly later than usual for this area in 1948. By the first week in June most of the insects were well

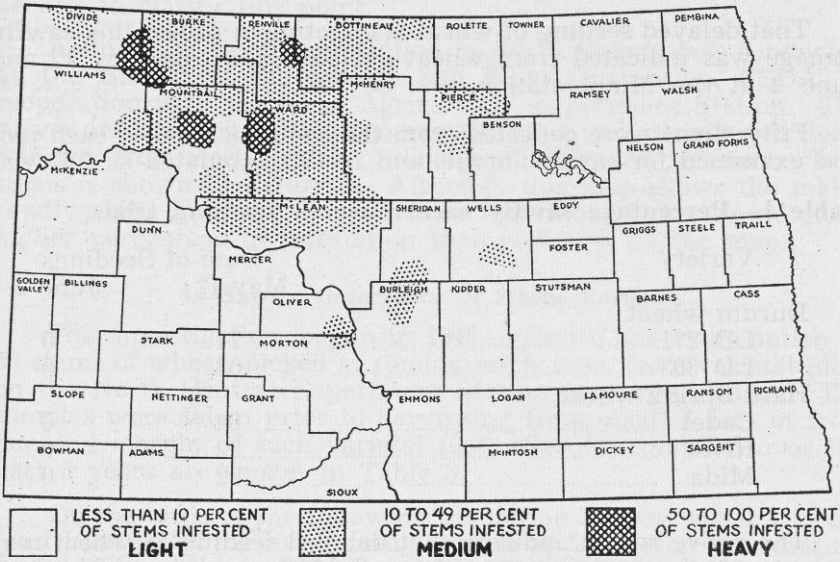

Fig. 2.—Wheat stem sawfly infestation in North Dakota—1948
(Map prepared by E. G. Davis, U. S. Bur. of Ent. and Plant Quarantine)

advanced pupae and only an occasional adult was observed. By June 20 it was observed that egg laying in the Minot area was well started, with one egg per stem as a rule with a maximum of 28 found in one of the stems. There were more eggs at the edge of the field than in the center but the difference was slight. Eggs were not found until the stems showed two nodes with about 1½" of space between the nodes.

Subsequent examinations showed egg laying to be fairly well completed by the end of June. On July 2 an examination of a field in the Minot area showed that a large proportion of the eggs were hatched and the young larvae were feeding in the stems. Some field margins at this time showed 100% of the stems infested.

Conclusions

1. **The application of insecticides as yet developed, are impractical in control of the wheat stem sawfly.**
2. **The early application of shallow tillage which exposes the stubble as well as the roots to weathering is highly effective in destroying the sawfly larvae.**
3. **Sawflies not only show a decided preference for the more vigorous and high yielding stems but also reduce their yield slightly over 9 per cent due to shrinkage of the developing kernels. This shrinkage is a type of loss which is usually disregarded because it is not as spectacular as the commonly recognized loss resulting from the breaking over of the infested stems.**
4. **Wheat may be protected against sawfly by delayed seeding but to what extent this "advantage" might be offset by the decreased yield from late seeding should be determined.**
5. **The parasite, Microbracon cephi may be largely responsible for the shifts of intensity and changes in sawfly populations.**
6. **Early harvesting, before storms cause the infested stems to break over, is at present the most practical means of avoiding loss from fallen heads.**
7. **Rescue is the only commercial H.R.S. wheat with much resistance to sawfly. The durums now being generally grown were also very resistant.**

Acknowledgements

Sincere appreciation is expressed to Mr. E. G. Davis, in charge, and Mr. Royce B. Knapp and Kenneth M. Dahl, Bureau of Entomology and Plant Quarantine, Minot, for furnishing transportation and assistance at times in the work; to Mr. G. N. Geiszler, superintendent of the North Central Experiment Station for making varietal plots of wheat available for determining sawfly occurrence and for assistance in tillage practices in sawfly control; to Messrs. Chris Linertz, Earl Martin, Don Reinart, Stanley Saugstad, Martin Stenjehm, and Robert Tripp for making fields available for experimental purposes; and to Messrs. Saugstad and Martin who also loaned machinery required in conducting the tillage experiments.