

The Effect of the Lesser Clover Leaf Weevil on the Seed Yields of Mammoth Red Clover

RAY T. EVERLY, Purdue University

The lesser clover leaf weevil, (*Hypera nigrirostris*, Fab.), is sometimes known as the clover bud worm, which is more descriptive of the nature of the injury it causes.

This insect was first found in the Eastern United States and Canada about 1875, and it is believed to have been introduced from Europe. It has spread now throughout the midwest and into the Pacific Northwest. Since 1915 it has increased very rapidly in abundance and destructiveness.

Adults of this species overwinter in the crowns of the clover plants, but are found in greater abundance in woodland areas, along fence-rows and roadsides wherever sufficient trash occurs to give protection over the winter. About the time clover begins to grow in the spring, the weevils fly from hibernation and feed for a few days on the leaves of the clover. The females lay the eggs in small slits cut in the clover stems or in the axillary and terminal buds. The eggs are usually deposited singly during the month of April. Hatching occurs in from two to three weeks and the young larvae begin feeding in the stems and buds. Feeding in the stem often causes the stem above the point of feeding to wilt and die whereas feeding in the buds, which is most common, seriously injures or destroys the developing buds. The larval period lasts from 20 to 25 days. When mature, the larvae are greenish-white, legless grubs with a dark head and a dark line across the body just back of the head. Cocoons are spun in the trash on the ground around the base of the plant, but are more commonly found on the part of the plant where the larvae have been feeding. The adults emerge from the cocoons in from five to twelve days. Emergence is generally completed about ten days before hay cutting begins. The newly-emerged adults are brown, but begin to show the greenish color after one or two days, and by the third or fourth day are a pronounced grass green. The newly-emerged adults feed on the clover for a period of two to three weeks, gradually becoming less abundant as they seek winter quarters and by mid-July most of them have left the field.

In 1952 two experiments were carried out to study the effect of the control of spittle bug nymphs on seed yield of Mammoth red clover. In addition to the spittle bug infestation, a rather heavy infestation of the lesser clover leaf weevil also developed.

The first experiment consisted of plots of clover 40 x 800 feet, which were treated on May 8 with the following insecticides and the dosages in pounds of active ingredients per acre: methoxychlor, 1.82; heptachlor, .91; dieldrin, .91; and DDT, 1.82; and an untreated plot. All materials were applied as emulsifiable concentrates by a tractor mounted weed sprayer and the treatments were replicated six times.

The second experiment consisted of plots 20 x 40 feet, with 16 treatments applied May 12 and randomized in six replicates. The following materials and dosages in active ingredients per acre were applied with a

TABLE I. Lesser clover leaf weevil populations and damage to seed yields of Mammoth red clover.
Eminence, Indiana. 1952.

	Dosage	Stems Infested	Weevils per infested stem	Weevils per 100 stems	Damage buds per 100 stems	Heads per square foot	Seed yield per acre	Seeds per head
	Lbs. ¹	Pct.	No.	No.	No.	No.	Grms.	No.
Methoxychlor	1.82	41.3	.39	16.6	81.7	91.7	204.8	12.9
Heptachlor	.91	40.0	.59	24.0	72.0	76.6	207.6	15.0
Dieldrin	.91	28.0	.26	6.0	47.3	97.6	216.5	12.5
DDT	1.82	40.7	.38	14.0	84.0	87.6	208.0	13.4
Untreated	....	54.0	.56	30.0	118.0	79.6	191.8	13.3
Average	....	40.8	.43	18.1	80.5	86.6	205.7	13.4
Least required	19:1	14.5	n.s.	15.0	38.2	n.s.	n.s.	n.s.
Significant difference	99:1	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

¹ Active ingredient in pounds per acre. Materials applied by a tractor mounted weed sprayer in 10 gallons of water per acre, applied May 8.

small plot sprayer: Heptachlor at rates of .26, .47, and 1.03; DDT at .52, .98 and 2.00; DDT and C110¹ at the rates of .53 and .18, 1.09 and .36, and 2.03 and .67; methoxychlor at .49 and .74; BHC at .58; toxaphene at 2.12; and an experimental material H at .28 and .53.

Data on the lesser clover leaf weevil were obtained from 25 stems selected at random from each plot. The numbers of stems showing infestation, the numbers of axillary and terminal buds damaged, and the numbers of larvae, pupae and adults present were recorded. In addition, the numbers of spittle bug nymphs per square foot were counted in the second experiment. Seed yields estimates were obtained by taking two samples of three square feet each in each plot in the first experiment, and one sample of three square feet in each plot in the second experiment.

The data for the first experiment are given in table I and for the second experiment in table II.

From table I the most effective material for controlling the weevil population was dieldrin, while DDT and methoxychlor were fair. The dieldrin treatment also had the highest numbers of heads per square foot and the highest seed yield.

In table II, the insecticide giving the best control was DDT at 2.0 pounds per acre. By comparison it will be noted that DDT at a slightly lower rate in the first experiment gave very similar results. The difference of four days in the treating of the two experiments probably had some effect.

Table III lists the between treatment correlation coefficients for the various data taken. In table IV are given the *b* values for the unit changes in the dependent variables for each unit change in the independent variable.

Spittle bug nymphs per square foot were not significantly correlated with either heads per square foot or yields of seed. There was no significant correlation between spittle bug populations and lesser clover leaf weevil abundance, indicating that the chemicals which controlled one species did not necessarily give control of the other.

Per cent of stems infested by the lesser clover leaf weevil were highly correlated with damaged buds per 100 stems, heads per square foot, and seed yield. For each per cent increase in infestation, the number of damaged buds per 100 stems increased 2.25; heads per square foot decreased .61; and seed yield decreased 2.61 pounds per acre.

Weevils per 100 stems are significantly correlated with per cent stems infested, damaged buds per 100 stems, heads per square foot, and seed yields. For each increase of one weevil per 100 stems the per cent of stems infested increased .82 per cent; damaged buds per 100 stems increased 1.79 buds; heads per square foot decreased .71 heads; and seed yields decreased 2.73 pounds per acre.

Weevils per infested stem were significantly correlated with damaged buds per 100 stems, heads per square foot, and seed yields. For each increase of one weevil per infested stem there was an increase of 88.82

¹ C110 had indicated a synergistic action with DDT in previous experimental work (Dow Chemical Company).

TABLE II. Lesser Clover leaf weevil populations, and damage to seed yields of Mammoth red clover. Eminence, Indiana. 1952.

	Dosage	Stems infested	Weevils per infested stem	Weevils per 100 stems	Damaged buds per 100 stems	Heads per square foot	Seed yield per acre	Seeds per head	Spittle bug nymphs per square foot
	Lbs. ¹	Pct.	No.	No.	No.	No.	Lbs.	No.	No.
Heptachlor.....	.26	58.0	.51	29.5	120.7	80.4	143.1	9.8	28.2
Heptachlor.....	.47	49.3	.72	36.5	100.0	75.7	147.9	10.9	27.3
Heptachlor.....	1.03	43.3	.52	22.6	83.3	78.9	165.4	11.6	21.0
DDT.....	.52	50.0	.42	21.8	92.0	92.5	176.2	10.7	61.3
DDT plus.....	.53								
C110.....	.18	48.0	.69	33.2	88.0	83.5	173.0	11.7	61.5
DDT.....	.98	41.3	.59	25.5	82.7	76.7	183.3	13.8	39.2
DDT plus.....	1.09								
C110.....	.36	50.7	.60	32.5	104.7	77.4	154.1	10.9	32.0
DDT.....	2.00	44.7	.39	18.5	86.7	91.7	191.1	11.9	27.7
DDT plus.....	2.03								
C110.....	.67	35.3	.59	20.5	63.3	91.6	170.6	10.3	22.5
Methoxychlor.....	.49	52.7	.55	29.8	96.7	76.4	136.9	10.0	29.2
Methoxychlor.....	.74	53.3	.55	31.3	104.8	73.1	160.6	12.1	37.3
Experimental H.....	.28	56.7	.63	37.2	105.3	78.7	143.2	10.1	48.7
Experimental H.....	.53	62.7	.68	41.3	116.0	65.9	117.7	9.8	46.5
Toxaphene.....	2.12	55.3	.75	41.8	116.0	73.8	113.2	8.4	27.0
BHC ²	.58	60.7	.62	35.8	120.0	85.7	159.0	10.1	3.2
Untreated.....	.....	56.7	.58	32.7	133.3	69.1	134.1	10.9	51.5
Average.....	.....	51.2	.59	30.7	100.8	79.4	154.3	10.8	35.2
Least required.....	19:1	12.2	n.s.	13.2	29.9	n.s.	45.0	n.s.	22.5
sig. diff.....	99:1	16.2	n.s.	17.5	39.7	n.s.	n.s.	n.s.	29.8

¹ Active ingredient per acre. Materials were applied on May 12 with a small plot sprayer in 10 gallons of water per acre.² Gamma isomer

TABLE III. Correlation coefficients for lesser clover leaf weevil infestations, populations, and seed yields of Mammoth red clover at Eminence, Indiana. 1952.

	Percent infested	Weevil per infested stem	Weevil per 100 stems	Damaged buds per 100 stems	Heads per square foot	Seed yield per acre	Spittle bug nymphs per square foot
Percent infestation.....	....	XXX	.854**	.943**	-.643**	-.774**	XXX
Weevils per infested stem.....	XXX	....	XXX	.520*	-.720**	-.705**	XXX
Weevils per 100 stems.....	.854**	XXX	....	.787**	-.781**	-.846**	XXX
Damaged buds per 100 stems..	.943**	.520*	.787**	....	-.654**	-.714**	XXX
Heads per square foot.....	-.643**	-.720**	-.781**	-.654**	....	-.700**	.138
Yield of seed per acre.....	-.774**	-.705**	-.846**	-.714**	.700**	....	.015
Spittle bug nymphs per square foot.....	XXX	XXX	XXX	XXX	.138	.015	....

* Statistically significant

** Highly statistically significant

TABLE IV. Rates of change in the dependent variable values for each unit change in the independent variable expressed as b-values.

Independent variable	Dependent variable			
	Damaged buds per 100 stems	Heads per square foot	Seed yields per acre	Stems infested
	No.	No.	Lbs.	Pct.
Percent stems infested	2.25**	— .61**	— 2.61**	....
Weevils per infested stem ¹	88.82*	— 48.79**	— 169.80**	XXXX
Weevils per 100 stems	1.79**	— .71**	— 2.73**	.82**
Damaged buds per 100 stems .....	....	— .26**	— 1.01**	XXXX
Heads per square foot	XXXX	....	— 2.49**	XXXX

* Statistically significant

** Highly statistically significant

¹The rates of losses for this dependent variable are exceptionally high due to the relatively low population. Since pupation had already started, counts made 2 to 3 weeks earlier would probably indicate a much larger population of weevils with subsequent reduction in the amount of damage per weevil.

damaged buds per 100 stems; heads per square foot decreased 48.79 heads; and seed yields decreased 169.8 pounds per acre.

The numbers of damaged buds per 100 stems were significantly correlated with heads per square foot and seed yields. For each damaged bud increase, the numbers of heads per square foot decreased .26 heads, and the seed yield decreased 1.006 pounds per acre.

Heads per square foot were significantly correlated with the yield of seed as should be expected. For each head per square foot increase, the seed yield increased 2.488 pounds per acre.

It should be kept in mind that these data are the results of only one year's study and for that reason may be modified by future studies. The value of the insecticides used might also be increased with earlier application or correct timing. But it is evident that the lesser clover leaf weevil can cause heavy losses in seed yields of Mammoth red clover.