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Resistance of Red Clover to the Clover Leaf Weevil

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RESISTANCE OF RED CLOVER TO THE CLOVER LEAF WEEVIL[1]

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ABSTRACT

Red clover (*Trifolium pratense* L.) varieties in the third season of growth, that had been exposed to a heavy infestation of larvae of the clover leaf weevil [*Hypera punctata* (Fabricius)], differed significantly in percentage defoliation, feeding injury score, plant height, and forage production. Based on these four characters, 'Mammoth,' 'Lakeland,' 'Dollard,' and 'LaSalle' were highly resistant to larval feeding; 'Kenland,' 'Common,' and 'Pennscott' were highly susceptible. Long term second-season yield tests including six of these varieties indicated no consistent superiority of any of the varieties in the absence of weevil feeding.

***Additional index words:* *Trifolium pratense*, *Hypera punctata*, Insect preference.**

THE clover leaf weevil [*Hypera punctata* (Fabricius)] can injure clovers (*Trifolium* spp.) and alfalfa (*Medicago sativa* L.), but rarely causes the loss of an entire crop. This insect was first reported in New York in 1880 (4) and has now spread over the United States and Canada wherever clover and alfalfa are grown. Damage to the crop is caused by larval feeding and is most apparent in spring. Smooth-edged notches are eaten out of the sides of the leaves or occasionally, whole leaves are consumed. The larvae feed mainly at night and remain well-hidden during the day in trash on the surface of the ground or at the base of the plants. Generally, larval populations are greatly reduced by a fungus [*Entomophthora* (=*Empusa*) *sphaerosperma* Fresenius]. Infected larvae are yellow to gray instead of the normal green, and can be found curled on the edge of leaves because, unlike normal larvae, they do not drop to the ground during the day (2).

Breeding for insect-resistant varieties is particularly appropriate in forages because of their comparatively low per hectare value, the relatively high cost of chemical applications, and the possibility of insecticide residues. Thus, selection of red clover (*Trifolium pratense* L.) varieties, that are resistant to the clover leaf weevil, would increase the dependability and yield of this important hay and pasture crop.

A recent review of insect resistance in clovers (3) revealed no published accounts of resistance to the clover leaf weevil. One reason for the lack of such accounts may be the rarity of serious infestations of this insect. The present paper reports the results of a study on the response of 10 red clover varieties and strains to a heavy natural infestation of the clover leaf weevil that occurred in 1971.

MATERIALS AND METHODS

Ten varieties and strains of red clover were seeded in 1.5 × 7-m plots with a companion crop of oats (*Avena sativa* L.) at the Nebr. Agr. Exp. Stn. Field Lab. at Mead, Nebr. on Apr. 24,

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1969. Seven rows were hand-seeded in each plot. The test was arranged in a randomized, complete-block design with four replications. Stands of all entries were excellent. The companion crop of oats was combined on July 15, but the red clover was not harvested during the first season of growth. Second-season growth, harvested from all plots on June 8 and July 15, 1970, indicated no significant differences in yield among the 10 entries.

In late May and early June 1971, a heavy natural infestation of clover leaf weevil larvae was noted in this nursery. Striking differences in reaction to feeding by the larvae were noted among the various varieties and strains in the test. Stands of all entries in this third-year nursery remained excellent, and no injury from disease was apparent at the time of this insect infestation. These conditions presented a rare opportunity for a preliminary assessment of resistance to this insect.

Consequently, on June 11 each plot was visually scored for percentage defoliation, and an injury score also was assigned. The latter score was based on a scale of 1 to 5 (1 = no feeding damage observed; 5 = heavy feeding damage). Thus, two scores were assigned for essentially the same characteristic, the relative extent of feeding damage by the clover leaf weevil larvae. Height also was measured on June 11 immediately before a 0.9 × 6.1-m portion was harvested from the center of each plot to estimate yield. At the time of this harvest, all entries except 'Mammoth' were at 50% bloom, the normal stage for harvesting red clover yield tests. Mammoth had not yet started to flower. A sample of the harvested forage from each plot was used to determine moisture percentage. In addition, after they were dried and weighed, the samples of each entry from the four replications were composited and analyzed for N content by the Kjeldahl procedure. Stand percentage was determined for each plot by approximate measurements of missing portions of each harvested row.

RESULTS AND DISCUSSION

Performance of varieties and strains of red clover that were subjected to heavy feeding by clover leaf weevil larvae is shown in Table 1. Entries did not differ significantly in percentage stand; as already noted, all stands were excellent. Significant differences among entries were observed for percentage defoliation, injury score, plant height, and forage production. No significant differences were observed in percentage dry weight. Nitrogen percentages (one determination/entry) varied from 2.33 to 2.61.

On the basis of defoliation percentage, the entries most resistant to the clover leaf weevil were Mammoth, 'Lakeland,' 'Dollard,' and 'LaSalle,' 'Kenland,' 'Common,' and 'Pennscott' were the most susceptible. Classifications of the entries according to injury score, plant height, or yield gave generally similar rankings. The following highly significant correlation coefficients were calculated: percentage defoliation and forage yield, —0.915; percentage defoliation and injury score, 0.975; percentage defoliation and height, —0.829; injury score and forage yield, —0.946; injury score and height, —0.855; and forage yield and height, 0.912.

Unfortunately, no third-season red clover stands were available in a noninfested nursery in 1971; thus, a study of performance of directly comparable plant material in the presence and absence of weevil infestation was not possible. However as already indicated, second-season yields from this same nursery in 1970 revealed no significant differences among entries. Furthermore, it is noteworthy that in annual replicated trials at Lincoln or Mead during the years 1959 through 1970 (a period when no clover leaf weevil infestations were obvious) Lakeland, Dollard, and LaSalle showed no consistent superiority in second-season yield over 'Chesapeake,' Kenland, Common, and Pennscott. Mammoth and the two Kentucky synthetics were not included in these long-term tests.

Table 1. Performance of red clover varieties following infestation of third-season growth by clover leaf weevil larvae. Each figure is the mean of four replications.

Variety or strain	Source of seed	Stand†	Defoliation‡	Injury score§	Height	Forage production
		%			cm	kg dry matter/ha
Mammoth	F. C. 39,971	92	5.0 a*	2.0 a*	75 a*	6,306 a*
Lakeland	F. C. 39,989	97	5.0 a	2.0 a	71 ab	6,059 a
Dollard	F. C. 39,779	91	5.0 a	2.0 a	68 abc	5,762 ab
LaSalle	F. C. 39,494	89	5.0 a	2.0 a	65 bcd	5,538 ab
Ky. Syn A-3	F. C. 39,818	95	38.8 bc	4.3 bc	64 bcd	4,736 abc
Ky. Syn A-2	F. C. 39.819	90	60.0 cd	4.5 cd	58 d	4,361 bc
Chesapeake	F. C. 39,970	94	31.3 b	3.8 b	60 cd	4,142 bc
Kenland	F. C. 39,972	92	63.8 d	4.8 cd	62 cd	3,570 c
Common	Nebraska	90	57.5 cd	5.0 d	58 d	3,487 c
Pennscott	F. C. 39,991	89	51.3 bcd	4.8 cd	57 d	3,352 c
Mean		92	32.3	3.5	64	4,731

* Means followed by the same letter are not significantly different at the 5% level, by Duncan's multiple range test. † Differences between variety means were nonsignificant. ‡ Visual estimate. § Visual scale from 1 to 5 (1 = no feeding damage observed; 5 = heavy feeding damage).

A review of the parentage of the four varieties that appeared most resistant revealed that three of the four had some common ancestry (1). Dollard was developed at McDonald College, Quebec, Canada by maternal-line selection from Silesian and Orel red clovers. LaSalle is a blend variety composed of equal parts of the varieties Dollard and another Canadian variety ('Ottawa') that was developed at the Dominion Experimental farm in Ottawa. Source varieties used in the development of Lakeland include Dollard, Ottawa, and several others. Therefore Dollard, which also is highly resistant to most forms of northern anthracnose [*Kabatiella caulivora* (Kirchm.) Karak.] (1), is probably the primary source of resistance to the clover leaf weevil in LaSalle and Lakeland, although Ottawa (which was not included in our tests) may also have contributed some resistant germplasm. No information was available concerning the ancestry of the lot of Mammoth used in these studies.

The conclusion that varieties differ in resistance to feeding by clover leaf weevil larvae is based on a single year's data. Nevertheless, this conclusion is strongly supported by the significant differences observed in percentage defoliation, injury score, plant height, and forage yield of third-season stands following weevil infestation, and the lack of consistent differences in second-season yield in the absence of weevil attack. Additional observations would be highly desirable, but heavy natural infestations of this insect did not develop in our nurseries in the 3 years following 1971, nor in the 15 years preceding 1971.

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