Rating Sugarbeets for Damage by the Sugarbeet Root Maggot

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Introduction

Yun (1)[2] found a damage rating scale to be the most useful criterion in evaluating insecticides applied to field test plots for control of the sugarbeet root maggot, *Tetanops myopaeformis* (Röder) (Diptera, Otitidae); others (which he judged to be less useful) were loss of plant stand, maggot counts, and yield. But he did not present data in support of his statements. At this laboratory, maggot counts have been used almost exclusively since 1962 to determine the direct effect of chemicals on sugarbeet root maggots. However, in some tests the data also included percentage of beets infested, percentage of beets scarred (feeding damage), and damage rating. We present here an assessment of these indices based on records at this laboratory for the period 1962-1972.

Procedure

Plots ranged from 2 to 12 rows wide and were either 50-60 feet long or were strips the length of the field. Insecticides were applied at planting or to young plants. Treatments were randomized in from 4 to 34 replicates. Counts and ratings were made on 1, 5, or 10 beets dug from near the center of each plot.

Percentage infestation was the percentage of beets with maggots in the soil sample, whether or not the beet root showed evidence of feeding. Percentage scarred beets was determined independent of the presence or absence of maggots. The damage rating scale used in 1963 was 0-10 with 0 = no feeding and 10 = very severe scarification. No description of intermediate values was given. The damage rating scale used in 1971 was 0-5 as follows:

0: no scars
1: 1-4 small scars of pin-head size
2: 5-10 small scars, or up to 3 larger scars
3: more than 3 large scars
4: ½-¾ of root area blackened by scars
5: more than ¾ of root area blackened, an obviously heavily damaged beet.

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[2]Numbers in parentheses refer to literature cited.

In all cases, mean maggot counts plotted against related measurements showed a curvilinear relationship. An essentially straight line relationship was obtained by transforming maggot counts to their square root. Correlations were calculated by using treatment means.

The results are presented in Table 1. All correlations were significant at the 95% level of confidence.

Discussion and Conclusions

The first attempt (in our records) to assign damage ratings was made in 1962 when descriptive terms only were noted during larval sampling. We arbitrarily assigned the number 1 to the term "none to slight" and the number 5 to the term "severe," scaled intermediate descriptions by their average maggot counts on a linear scale, and then correlated the assigned numerical ratings with maggots per beet. The correlations (r values) for two tests were 0.8200 and 0.8955. However, in each of these tests, only 8 beets were examined per treatment for 51 treatments. Thus the exercise served only to demonstrate that a damage rating scale could be devised that would reflect maggot populations.

In 1963 a numerical rating scale of 0-10 was used, the number of beets per treatment was 20-30, and the correlation (r value) with maggots per beet was 0.8981. In 1971, a numerical rating scale of 0-5 was used, the number of beets per treatment was 40, and the degree of correlation increased to 0.9736. The 0-5 scale was quite satisfactory because 95% of the variations in ratings were accounted for by variations in maggot counts.

Correlations between percentage of beets infested or percentage of beets scarred and numbers of maggots per beet were also high and ranged from 0.9446 to 0.9789. However, percentage infested requires sifting soil, while percentage scarred requires only an examination of the beet.

An additional correlation (not shown in Table 1) between percentage infested and damage rating scale (1971 data) gave an r value of 0.9517. In addition, analyses of variance of the 1971 data and separation of means by Student's t test gave a finer separation of means when based on the damage rating than when based on the number of maggots per beet (Table 2). This substantiates Yun's (1) statement that a damage rating scale can be very useful. Yun's scale ranged from 1 = no scars to 5 = severe (more than ⅓ of root tip cut off, beet dead or nearly dead).

On the basis of these data, any of the measurements could be used with confidence to evaluate the efficacy of insecticide treatments. However, in heavily infested areas, even in treated plots where good or excellent control has been obtained, beets may still be 100% infested or scarred. Then only the number of maggots or the degree of damage

Table 1. — Correlations between number of sugarbeet root maggots per beet and related measurements of damage, 1962-1972. Twin Falls, Idaho.

Related Measurement	Years 19-	No. Tests & Reps.	No. Treatments	No. Beets per Treat. $\bar{x}$	$\bar{Y}$ (actual) No. Maggots/Beet $\bar{\bar{y}}$	Range	$\bar{X}$ Related Measure $\bar{\bar{x}}$	Range	r	Regression Formula $\sqrt{\bar{Y}} = a + bX$ a	b
% Infested	65,66,67	3, 24-34	35	240-340	5.19	0.03 - 12.6	66.1	26 - 91	.9789	−1.1138	.0476
	71	3, 4	20	40	1.34	0 - 4.2	32.2	0 - 77.5	.9522	.1608	.0242
%Scarred	71,72	8, 5 & 6	58	50- 60	1.43	0 - 6.3	39.4	0 - 100	.9446	.0835	.0232
Verbal Rating	62	1, 8	51	8		0.1 - 16.2		1 - 5	.8200		
		1, 8	51	8		0.8 - 30.4		1 - 5	.8955		
Numerical Rating 0-10	63	2, 4- 6	66	20- 30	3.88	0.5 - 8.7	1.98	0.8 - 3.4	.8981	.0884	.9023
Numerical Rating 0-5	71	3, 4	20	40	1.34	0 - 4.2	0.69	0.1 - 1.9	.9736	.1016	1.2154

Table 2. — Treatment means for three measurements of sugarbeet root maggot infestation. Data for three insecticide tests in 1971 combined. Means followed by the same letter in vertical columns do not differ significantly at the 5% level.

No. Maggots/ Beet (+0.01)	% of Beets Infested (+0.1)	Damage Rating 0-5
0.01a	0.1a	0.13a
.01a	.1a	.13a
.01a	.1a	.10a
.01a	.1a	.10a
.04ab	2.6a	.10a
.09ab	7.6a	.10a
.31ab	5.1a	.35ab
.31ab	20.1ab	.18a
.64ab	32.6 bc	.53abc
.81ab	37.6 bcd	.80 bcd
.91ab	32.6 bc	.73 bcd
1.04ab	35.1 bc	.68 bc
1.24ab	57.6 def	.83 cd
1.26ab	32.6 bc	.85 cde
1.91 bc	52.6 cde	.90 cde
3.19 cd	47.6 cd	1.18 def
3.46 cd	72.6 ef	1.40 f
3.61 cd	52.6 cde	1.30 ef
3.74 d	77.6 f	1.53 fg
4.21 d	77.6 f	1.90 g

are useful as criteria. The method of choice therefore appears to be the damage rating since it requires the least amount of time and effort. We estimate that the use of damage ratings saves at least 90% of the time that would otherwise be spent in sifting soil for maggots. The damage rating scale was used satisfactorily in our 1975 tests.

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Literature Cited

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