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Effect of Host Condition on the Clover Root Borer

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Abstract
Oviposition by the clover root borer, *Hylastinus obscurus* (Marsham), is completed earlier in weakened than in vigorous plants, but development is more rapid in vigorous or lightly infested roots. High populations occurring early in the season result in plant mortality with subsequently slowed borer development.

Schmitt (1844) and Riley (1879) believed that the clover root borer, *Hylastinus obscurus* (Marsham), preferred weakened plants for oviposition. Rockwood (1926) thought development was more rapid in weakened plants. Field observations made in Ohio in 1954 and 1955 showed that weakened plants had more and further-developed borers. However, reasons for these phenomena appear different from previously ascribed reasons.

During 1954 and 1955 separate samples of 30 roots each were taken of living and dead plants within the same field. In most cases root borer populations were considerably higher in the dead than in the living plants, and borers were more advanced. However, from these observations alone it was impossible to conclude whether development was more rapid because of the weakened plant condition or if plants died because of early, heavy borer infestations. If plants die because of early, heavy infestations, one would expect the more heavily infested plants to contain borers more advanced in their development. To check this theory, samples taken in 1954 were also divided into three categories; roots with 1 to 5, with 6 to 10, and with 11 or more borers. Roots taken in 1955 samples were separated into two categories, those containing one to four borers and those harboring five or more. Because of the great number of samples involved, only those taken during the periods in which significant differences occurred are summarized in Table 1. Samples taken after August 20 in no case showed differences in stages of borers present, but this

condition was likely caused by the fact that most borers became adult at this time, and their age could not be reliably determined.

Table 1. Root borer populations and development

Date	Comparison	Stage of Development[a]				Total Borers	t	χ^2
		Egg	Larva	Pupa	Adult			
				1954—Live vs. dead plants				
July 26	Live		86	10	4	164	2.20*	20.5**
	Dead		66	22	12	245		
Aug. 2	Live		68	17	15	119	2.45*	27.7**
	Dead		38	27	35	200		
Aug. 9	Live		75	16	9	75	3.48*	57.1**
	Dead		27	16	57	177		
				1954—Living plants				
June 28	1–5	3	97			35		7.3*
	6–10	13	87			92		
	11+	0	100			34		
July 12	1–5	5				21		6.3*
	6–10	3				117		
	11+	10				157		
July 26	1–5	3				29		14.2**
	6–10	1				74		
	11+	2				64		
				1954—Dead plants				
July 26	1–5		79	13	8	24		5.2
	6–10		60	25	15	106		
	11+		69	22	9	115		
Aug. 2	1–5		43	30	27	54		8.3*
	6–10		25	25	50	59		
	11+		43	27	30	86		
Aug. 9	1–5		44	16	40	45		13.9**
	6–10		14	18	68	71		
	11+		30	13	57	61		
				1954—Old vs. new field				
May 31	Old	20	80			51		22.1**
	New	65	35			52		
June 7	Old	16	82	2[b]		51		8.1**
	New	41	59	0		54		
June 20	Old	0	100			101		22.0**
	New	19	81			108		
June 28	Old	0	96	4		50		7.9**
	New	14	86	0		120		

			1955—Early vs. normal cutting					
July 5	Early	6	90	4		138	2.94**	20.0**
	Normal	27	73	0		71		
July 12	Early	3	83	13	1	179	1.29	10.3**
	Normal	8	88	4	0	113		
July 19	Early	5	70	16	9	148	1.83	15.5**
	Normal	8	84	8	0	112		
July 26	Early	3	71	14	12	152	1.24	14.9**
	Normal	9	81	7	3	112		
Aug. 2	Early	1	58	27	14	85	0.46	19.3**
	Normal	8	75	14	3	118		
			1955—Normal cutting					
June 20	1–4	36	64			39		10.5**
	5+	10	90			69		
July 5	1–4	50	50			32		15.9**
	5+	8	92			39		
Aug. 9	1–4	0	50	36	14	36		11.1**
	5+	3	72	13	12	143		
Aug. 16	1–4	3	49	23	25	39		9.7**
	5+	0	75	16	9	131		
			1955—Early cutting					
July 5	1–4	21	68	11		28		17.6**
	5+	2	96	2		120		
July 12	1–4	4	81	15		26		0.6
	5+	3	84	13		152		
July 19	1–4	3	59	16	22	32		9.0*
	5+	6	73	16	5	116		

a. Percent of total borers.

b. Probably from overwintering larvae.

* Significant at 5% level; ** at l%.

Chi-square was used to compare borer development under different plant conditions. Chi-square values were calculated from the actual number of borers in each stage—egg, larva, pupa, or adult—but these data are expressed as percentages in Table 1 for ease of interpretation. No attempt was made to separate larvae by instar. If less than four borers were present in any stage, these were lumped with the next stage for analysis. To compare total number of borers present, individual root counts were transformed by the inverse hyperbolic sine (Pruess & Weaver 1959), and the *t* test was used to test for differences in transformed totals.

1954 Samples

In the field sampled in 1954, dead plants on all dates contained more and farther advanced borers than living plants, as shown in Table 1. In living plants, differences in stage of development were significant on three dates. These samples were all taken early in the season. Borers in the heavily infested roots were generally more advanced, presumably because they had an earlier start. However, turning to samples of dead roots, we find that in general those plants having 6 to 10 borers had the most advanced borers and those with 1 to 5 the most delayed. The very heavily infested plants (11 or more borers), though presumably infested earlier than those with less infestation, probably had development somewhat delayed, owing to competition, while the lightly infested plants were the last ones infested and therefore had younger borers. Further evidence for such a situation will be seen in the 1955 samples.

1955 Samples

A few plants in the field sampled in 1954 lived over into 1955. Oviposition began about a week sooner in these roots than those in a nearby new field. These old plants were severely weakened and most of them had died by June 1. However, when sampling was concluded on June 28 larvae were almost 2 weeks farther advanced than in the new field, as evidenced by size of larvae and appearance of first pupae. The author (Pruess 1957) previously concluded that development was more rapid because of the weakened condition of the plants. However, reexamination of the data showed that all oviposition in the old field had ceased by June 20 while many eggs were still being laid in the new field at this time. This continued increase in population would, of course, keep the average age of borers younger.

Part of the new field sampled in 1955 was clipped on May 11, just after spring migration ended. Repeated clipping so weakened this area of the field that most plants were dead by the middle of June. Differences in total numbers of borers in the two parts of this field were significant only in the first sample taken on July 5. Numbers tended to equalize as the season advanced. It seems that this difference was due largely to the earlier completion of oviposition and hatching of larvae in the weakened plants. Although the number of adult root borers was almost identical in the two areas, those ovipositing in vigorous plants were laying more eggs in July, while the higher populations in the weakened plants at this time indicated that many eggs were laid sooner in this part of the field. The low population observed on August 2 in the weakened plants was probably not representative. At this time heavily infested plants in the early cut portion were so badly decayed that many borers were undoubtedly missed despite attempts to choose plants at random, regardless of condition. Even more outstanding than the difference in population was the stage of development of borers in the two parts of the field. Chi-square tests showed that borers were much more advanced in the early-cut portion. However, this again may be attributed largely to the fact that oviposition was completed sooner with subsequent earlier hatching and maturation of larvae in this section of the field.

In the weakened early-cut portion of the field it was found that on July 5 the heavily infested plants had the farthest advanced borers, no difference on July 12, and that by July

19 the trend had already reversed. After this period, however, no difference was evident, probably because all plants, regardless of root borer infestations, had become badly decayed and furnished a poor substrate for borer development.

In the normally cut portion of the field it was noted that those plants having the most borers also contained the more advanced borers early in the season, but that later the reverse was again true. As one would scarcely expect host condition to greatly affect the time required for hatching of eggs, we can conclude only that the reason for a higher percentage of pupae and adults in the heavily infested roots was that these eggs were laid sooner. It also appears that borer growth was slower in the heavily infested roots, as judged by the delayed development in these roots in the samples taken August 9 and 16.

It must be realized that the conclusions drawn here were based on random samples taken under uncontrolled field conditions. Further laboratory and field studies would be desirable. However, the type of tests used leaves no doubt that real differences did exist and the conclusions set forth herein seem to explain these differences satisfactorily.

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