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## BIOLOGY

# Northern and Western Corn Rootworms in Minnesota

H. C. CHIANG\* and R. G. FLASKERD\*\*

**ABSTRACT**—The occurrence and population changes of the northern corn rootworm, *Diabrotica longicornis* (Say), and the western corn rootworm, *D. virgifera* LeConte, were reviewed on the basis of information assembled at the Department of Agriculture of the State of Minnesota; and the Department of Entomology, Fisheries, and Wildlife and the Extension Entomologist's Office of the University of Minnesota.

The review shows no record of the northern species in Minnesota before 1899, but it appeared between 1899 and 1915. Populations were probably very low until 1932. Sporadic infestations were reported between 1932 and 1953. Progressive increase in infestation from 1954 paralleled an increase in continuous planting of corn. The western species reached Minnesota in 1961. By 1968 it was found in practically all counties where the northern species was found. There was no displacement of the northern species by the western in Minnesota, as happened in some other localities.

The northern corn rootworm, *Diabrotica longicornis* (Say), has been in Minnesota for many years, but the western corn rootworm, *D. virgifera* LeConte, is a relatively newcomer to the state. It is acknowledged that infestations of both species have been encouraged by continuous planting of corn. The present review attempts to establish, by retrospect, the occurrence of both species and the increase of infestation as related to continuous corn planting in Minnesota.

Information was gathered from several sources: published material; and files, correspondence, and interim reports at the Division of Plant Industry, Department of Agriculture, State of Minnesota; the Department of Entomology, Fisheries, and Wildlife; and the Extension Entomologist's Office, University of Minnesota. The events are presented chronologically in several periods.

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**BEFORE 1899.** The earliest mention of corn rootworm in Minnesota publications was by Dr. Otto Lugger, the state entomologist, in his report of 1899, as follows:

"In the western and central states a third species is found, the "corn root *Diabrotica*," named as from its long feelers. Its larva is a very serious pest. As this species winters in the egg state in corn fields, a simple rotation is all that is necessary to keep it in check. It is not found in Minnesota, at least no specimens have been seen or received, while *D. 12-punctata* and *D. vittata* are very common, and the latter seems to be rapidly on the increase."

From the above, it seems fairly certain that *D. longicornis* was not present in Minnesota at that time.

**1899 TO 1931.** No further information was available until 1916, when C. W. Howard reported "The western (*sic*) corn root-worm (*Diabrotica longicornis*) has been reported in Minnesota for the first time during the past summer, appearing in several widely separated localities in the southern quarter of the state."

Further search of the literature and the files of the



State Department of Agriculture, the Department of Entomology, University of Minnesota, and the County Agricultural Agent Offices uncovered no records of this insect for the period of 1916-31.

Thus the available information suggests that *D. longicornis* appeared in Minnesota some time between 1899 and 1915, and was in very low populations up to 1931.

**1932 TO 1953.** In 1932 Dr. C. E. Mickel of the Department of Entomology instituted a system to record the insects which he identified for the county agents and the public. The records included, among other items, the scientific name, locality, and date of collection. The available records in 1932 through 1953 are given in Figure 1. Unfortunately, it is not possible to compare this distribution pattern with that of 1915, since Howard did not state exact localities.

It is to be noted that most of the records since 1932 were from the east central counties, rather than counties at the state borders or with large corn acreage. One possible explanation is that only the agents of counties near the University campus in St. Paul (Ramsey County) sent in specimens for identification.

Records at the State Department of Agriculture showed that damage on corn due to *D. longicornis* was reported in Wabasha and Dodge counties around 1944 to 1946, and in Rock, Jackson, Faribault, Murray, and Blue Earth counties in 1953. Thus, there have been sporadic noticeable infestations during this period.

**1953 TO 1954.** In 1953, the agricultural agents in the southwest and southcentral counties noted injuries in the form of root rot and lodging. Coupled with the fact that the populations of the northern rootworm were extremely high in Iowa and Nebraska, a plan was made to determine the extent of the problem in Minnesota. The program included treatment of plots with insecticide for comparison with untreated areas. Twenty five fields were located in the spring of 1954, each 10 acres or more, which had been planted to corn in 1952 and 1953 and

would again be planted to corn in 1954. The counties are shown in Figure 1.

Insecticides were applied as follows during the first two weeks of May. Two one-acre strips were sprayed across each field, and an untreated strip was left between them. In each field one strip was sprayed with aldrin and one with heptachlor, each at a rate of three-pound technical material per acre. In late May and early June, soil samples were taken to determine the populations of soil insects. Only 35 wireworms and white grubs and no corn rootworms were noted in all the plots checked. The fact that no corn rootworms were found is to be expected, since the time of sampling was too early for the larvae and the technique was not suited to extract the eggs. Yield data were taken in 19 of the 25 fields. The average bushels of shelled corn, at 14 per cent moisture, per acre were 84.6, 81.6, and 80.3 in aldrin-treated, heptachlor-treated and untreated check plots respectively. The difference between aldrin-treated and the check plots was statistically significant. Since the wireworm and the white grub populations were low, we may assume that this difference reflected the presence of at least some corn rootworm infestation in these areas.

County agents became aware in 1954 that some farmers had applied insecticide in 1953 or planned to do so in 1954. Thus we may conclude that up to that time, although neither the Institute of Agriculture of the University of Minnesota (county agents and extension specialists) nor the State Department of Agriculture (insect survey personnel) had any estimates of the populations or infestations, damage symptoms, if not actual crop losses, were severe enough to warrant treatment.

**1954 TO 1960.** Farmers and county agents became aware of the presence and damage of corn rootworm. But no records on the population levels were taken. The increasing area of soil treatment may reflect the increasing extent of rootworm infestation. Estimates by the State Department of Agriculture showed an increase from

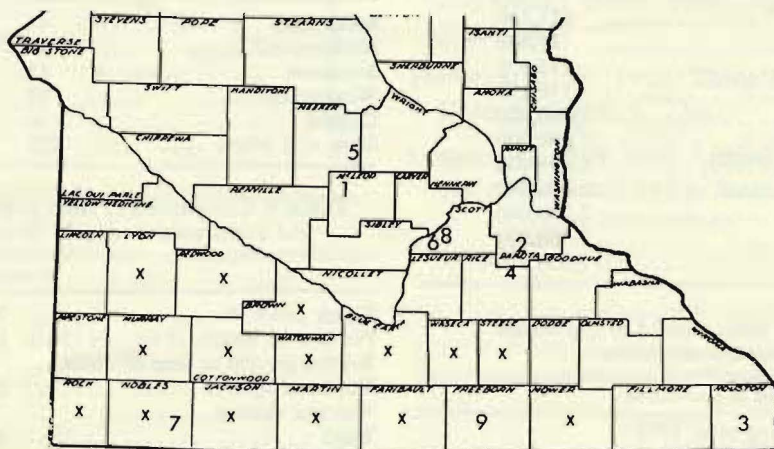


Figure 1. X=counties in Minnesota included in the soil insect survey in 1954. Localities having records of specimens of *D. longicornis* sent to the Department of Entomology, University of Minnesota, for identification between 1932 and 1953 were: 1, Hutchinson, 1932; 2, Castle Rock, 1940; 3, Caledonia, 1942; 4, Northfield, 1943; 5, Dassel, 1943; 6, Belle Plaine, 1944; 7, Worthington, 1952; 8, Jordon, 1952; 9, Albert Lea, 1953.



15,000 acres treated in 1955 to 336,150 acres in 1960 (Table 1). It is generally known that crop rotation interrupts the life cycle of the corn rootworm, and continuous cropping of corn encourages this insect. No statewide statistics were available at that time, but information on farms in Waseca County, Minn. (Chiang et al, 1961) showed that fields planted to corn after corn increased from 10% in 1955 to 20% in 1959 (Table 2). There was a continuous increase in corn rootworm infestation in Minnesota from 1954 to 1960, a period when the percentage of fields in continuous corn planting also increased.

**1961 TO 1968.** Until 1960 only the northern species was involved. In 1961 the western species first appeared in the State. It moved progressively eastward and northward and now is found practically in all counties where the northern species is found (Fig. 2).

With the combined infestation of both species, the number of acres treated for corn rootworms increased from 336,150 in 1960 to 2,000,000 in 1965 (Table 1). This increased infestation again may be related to the increase in continuous corn planting.

On the basis of information from Waseca county, fields in continuous corn were 33 per cent and 43 per cent in 1961 and 1963, respectively (Table 2). In 1967, fields sampled by State Department of Agriculture personnel for rootworm adult populations also were checked to determine if each was first-year corn or continuous corn. Table 3 summarizes the percentages of fields in continuous corn in different districts. Of 55 fields in the south-central district, in which Waseca county is situated, 69 per cent were in continuous corn. It is significant to note that for the State as a whole, 67 per cent of 230 fields were in continuous corn, very close to the 69 per cent in

TABLE 1. Estimates of number of acres of corn treated for corn rootworms in Minnesota, 1955-1967.

Year	No. acres treated
1955	15,000
1956	7,000
1957	125,500
1958	71,000
1959	244,830
1960	336,150
1961	1,000,000
1962	1,000,000
1963	1,000,000
1964	2,000,000
1965	2,000,000
1966	1,500,000
1967	1,600,000

TABLE 2. Percentage of fields planted to continuous corn in Waseca County, Minn.

Year	Percent	Sources of information
1955	10	Chiang et al. 1961
1959	20	Chiang et al. 1961
1961	33	Hill et al. 1967
1963	43	Hill et al. 1967
1967	69	State Department of Agriculture*

\* see also Table 3.

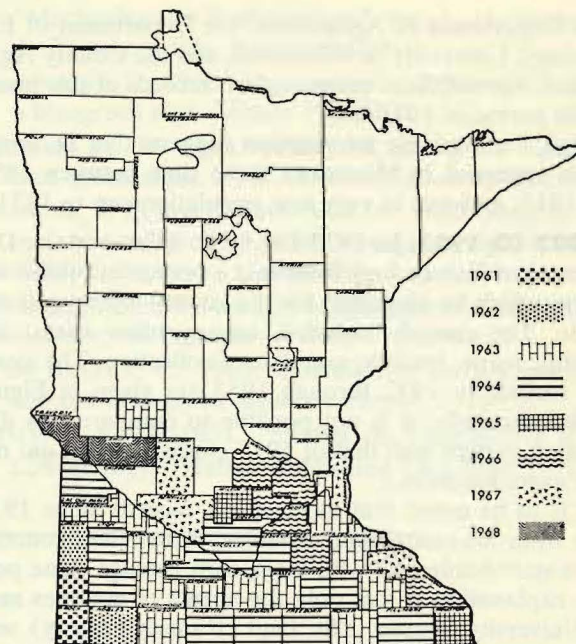


Figure 2. Years in which *D. vergifera* was first recorded, by counties in Minnesota's principal corn-growing area.

the south-central district. This relationship suggests that the general trend of continuous corn planting in the south-central district is an approximation of the state average. Thus during the 13 years 1955 to 1967, the continuous planting of corn increased approximately from 10 per cent to 69 per cent.

In 1967, the records on beetle populations were kept separately in fields in first-year corn and in fields in continuous corn. These are summarized in Table 4. Among the continuous plantings, 71 per cent of the fields had beetles, but among the first-year corn fields, only 32 per

TABLE 3. Percentage of fields planted to continuous corn in different districts in Minnesota, 1967.

District	No. fields checked	Fields in continuous corn No.	%
Southwest	45	24	55.6
Southcentral	55	38	69.1
Southeast	45	38	84.4
Westcentral	35	20	57.1
Central	40	29	72.5
State as a whole	220	149	67.0

TABLE 4. Comparison of adult populations in first-year corn and continuous corn in 46 Minnesota counties, 1967.

	1st-year corn	Continuous corn
Fields checked	71	149
Fields with beetles at time of check	16 (32%)	116 (71%)
Beetles present at time of check		
Northern species	22	2102
Western species	19	496
Total	41	2598
Fields with no beetles at time of check	55 (68%)	33 (29%)
Beetles/field		
Fields with beetles	2.5	22.4
All fields	0.6	17.4



TABLE 5. Percentage of western beetles according to counties and to the magnitude of 1968 populations.

	1964	1965	1966	1967	1968
With 5 years data					
Jackson	56	89	67	67	87
Faribault	11	24	57	48	75
Lyon	44	6	5	28	74
Lac Qui Parle	53	11	6	19	62
Nobles	72	9	65	8	56
Murray	56	81	44	5	46
Rock	51	81	62	81	42
Freeborn	5	0	14	100	40
Blue Earth	5	7	13	27	31
Watsonwan	37	67	56	5	30
Martin	48	18	19	54	27
Brown	30	2	50	26	22
Nicollet	17	2	7	7	19
Cottonwood	64	17	14	38	11
Pipestone	34	0	29	8	10
Mower	8	5	6	40	8
Yellow Medicine	40	0	1	0	7
LeSueur	0	2	20	0	6
Sibley	26	0	0	0	4
Fillmore	1	0	1	4	2
Waseca	0	12	9	17	0
Steele	2	12	33	28	0
Dodge	7	7	0	35	0
Lincoln	31	4	24	12	0
Houston	0	0	0	4	0
Redwood	35	18	9	14	0
Scott	2	0	9	20	0
With 4 or fewer years data					
Big Stone		0	0	0	47
Swift		0	0	0	14
Carver		0	0	0	4
Olmsted		0	5	36	0
Rice		0	15	24	0
Winona		0	1	19	0
Wabasha		0	0	17	0
Kandiyohi		0	0	15	0
Goodhue		0	0	9	0
Hennepin		0	17	0	0
Dakota		0	9	0	0
Wright		0	3	0	0
McLeod		2	0	0	0
Meeker		0	0	0	0
Chippewa		0	0	0	0
Renville		0	0	0	0
Washington				1	3
Pope					20
Stevens					0
Stearns					0
Sherburne					0
Isanti					0
Anoka					0

cent had beetles. The continuous corn fields had an average of 17.5 beetles/sample at the time of checking, while first-year corn fields averaged only 0.6 beetles. These data reaffirm the role of continuous corn planting in encouraging rootworm infestation.

Since the western species is highly tolerant to some insecticides, it is considered more destructive than the northern species. The western species also virtually displaced the northern species in some areas outside this state (Hill 1967). Thus eastward expansion of the western species in different counties of Minnesota is summarized in Table 5. Unlike previous reports from other areas, however, there was no consistent trend of displacement of the northern species by the western species in Minnesota.

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