

## Wireworm Populations as Influenced by Soil Types<sup>1,2</sup>

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Investigations on the control of wireworms have resulted in the collection of specimens from many locations in Indiana and especially in the northern counties. While wireworms occur throughout the state and are commonly associated with poorly drained soils, information on distribution of the species in various soil types is meager. Blatchley (1) recognizes 147 species of Elateridae from the state, but provides little data on the host of the larval stage. Losses from these insects have been associated with four conditions: the species of wireworm present, soil type, soil drainage and crops grown in previous years. In this study, attention has been given to the identity of the species found in various fields as correlated to the soil type and the previous land use.

Our investigations have been confined largely to northern Indiana and more specifically, Starke county, for it is from those areas that complaints of losses have been received. Much of this area has poor soils, especially sand, interspersed with muck. Fields in Starke county are, in general, level and have poor drainage because of an impervious subsoil. The principal drainage system is the Kankakee river running along the north west side of the county and the Yellow river running from east to west through the center of the county. Muck areas are scattered throughout the county and range from a few up to 500 acres. According to a land use map prepared by the Starke County Land Use Planning Committee in the late 1930's, 42 percent of the land is low, dark sand; 31 percent bottom and valley; 12 percent high light sand; and 10 percent muck. The area along the Kankakee and the lower Yellow rivers was a part of the old Kankakee swamp and is subject to flooding. During the past six years there has been two major floods and two of lesser extent.

The common species of wireworms found in this area have a three year life cycle. In both the field and in laboratory rearings, adults changed from the pupal stage in late August or early September, and remained in the pupal cell all winter. Beetles emerged in April and May and reached the peak of activity in late May. In heavily infested areas beetles were observed crawling on the ground or in short flights a few feet in the air. Egg-laying occurred in late May and June, either in the field where the adults emerged or in nearby sod land. The eggs hatched in a few weeks and the young larvae fed on the roots of grass until fall. Winter months were apparently spent deeper

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in the soil, although some individuals have been found at 4 to 6 inch depths in November and in March. The larvae fed through three summers and caused their most serious injury in the third summer. The movement of larvae in the soil, both vertical and horizontal, is not too well known, but is influenced by temperature, moisture and food supply. During periods of high temperature in July and August it was often necessary to dig down 12 to 18 inches in muck to find specimens. In dry seasons such as the fall of 1956 it was practically impossible to find a single individual in areas known to have a high population in the spring.

Populations in infested fields were variable, but were usually concentrated in low areas and around host plants. In corn fields more than one larvae per kernel was seldom found, but as kernels and plants were destroyed, the concentration around surviving plants became more intense. A single wireworm could cause the death of plants up to 20 to 24 inches in height and as stand was reduced as many as 25 have been found around the roots of a single plant. In one seriously infested field where only a few plants survived, a trench six inches wide and six inches deep down the corn row had an average population of 12 larvae per linear foot. Potato seed pieces in the spring were often found with 10 to 12 worms each, although sprouting was seldom affected. In one instance where the larvae were attacking germinating soybean seed, a handful of loose soil from the row contained 15 to 20 seed and a like number of wireworms.

The sampling of soils to determine wireworm populations proved to be laborious and not too enlightening. Baiting with ground whole wheat, ground corn and whole kernel corn also was not too successful. One example was a field where 12 lots of whole corn were placed around the field on April 19 and dug up on the 26th. From the 12 foot-square samples from the areas around the bait stations there were no wireworms in the top three inches, a total of 4 in the 3-6 inch level, 4 in the 6-9 inch level and 4 in the 9-12 inch level.

A field in Starke county was extensively surveyed in May by taking 4 square inch samples at numerous places in the muck portion. A metal frame was shoved into the soil and the material was removed in three inch layers and carefully examined. The average number of wireworms found per square foot was 1.36 in the 0-3 inch level, 0.89 in the 3-6 inch level and 0.52 in the 6-9 inch level, or a total of 2.77 per square foot 9 inches deep. Records of stand and yield from this field are given in Table 1 and suggest an apparent correlation with the wireworm population.

During the past five years wireworms have been collected in as many locations around the state as possible. The identification of the larval stage is quite difficult, as no good key for determining them is available. Some of the larvae collected have been preserved and others reared and both types of specimens sent to M. C. Lane, who has cooperated in supplying identifications. Eight species of larvae have been collected and identified and of these *Melanotus communis* (Gyll.), the

TABLE 1. The wireworm population of a field in the spring compared with the stand and yield of corn in the fall.

Location	Wireworms				Per 100 feet of row			
	per square foot at different depths in inches				Plants		Ears	
	0-3	3-6	6-9	Total	killed	survived	harvest	weight
	No.	No.	No.	No.	No.	No.	No.	Pounds
A.	1.60	0.8	0.8	3.20	2.5	64.5	63.5	41.3
B.	1.80	0.67	0.45	2.92	5.0	68.5	58.0	30.0
C.	0.43	0.85	0.11	1.39	3.0	93.0	93.0	61.6
D.	1.62	1.26	0.72	3.60	14.0	60.5	59.5	36.0

corn wireworm, was the most abundant in numbers and in distribution. Soil types in which this and other species have been found, have shown some variation but usually have been consistent for any one species.

*Melanotus communis* (Gyll.) is a common pest of corn in the mid-west and eastern parts of the country. It was collected in 31 fields in Starke county, four in Pulaski and one each in Jasper, DeKalb and Kosciusko counties. In general the predominant soil type has been a deep, black muck, although it also occurred in black sand and even a light sand. Losses have been serious in most fields where it occurred, but often the area of infestation was small. In muck this has been the predominant species and has caused damage to both corn and potatoes. Some damage to the latter crop was caused by larval feeding on the seed pieces, although the greater loss was caused by the pitting, and rarely the tunnelling, of mature tubers in late summer. Losses have run as high as 35 percent because of the discards in the grading. Some injury was also observed to onion bulbs and to the wheat used as a windbreak for onions.

*Melanotus communis* var. *A* of Dietrich is considered by Lane as a distinct species and was found on only one farm and that in Starke county. In this instance the soil in two fields was a deep, black "itch" muck. (Soils with the "itch" characteristic were both muck and sand and contained sharp particles of silica.) The 50 acres in the fields were planted with lindane treated seed, but by June 7 the insects had destroyed 90 percent of the stand. On the following three days the fields were planted again, this time with a row treatment of aldrin mixed in with the fertilizer. Of this second planting the wireworms took about 20 percent of the stand, although the stand of 80 plants per 100 feet of row at harvest gave a satisfactory yield.

*Melanotus communis* var. *B* of Dietrich is also considered by Lane as a distinct species and was found in four fields lying along the Kankakee river, two in LaPorte and two in Starke counties. This land, a part of the old Kankakee swamp and surrounded by ditches and dikes, is lower than the level of the river. The lower areas were flooded with 8 to 12 feet of water in June, 1950; September, 1954; and May, 1956.

Our attention was called to the area in LaPorte county in June, 1951, when wireworms destroyed 170 acres of corn on one farm. Twenty acres of this were replanted with lindane treated seed and produced a good crop, as counts of ears at harvest showed an average of 81 ears per 100 feet of row on the treated as against 12 on the untreated. In 1952 the loss in the 150 acre field was about 10 percent of the stand, while in 1954 serious losses occurred on three acres only. The soil type in the area is a sandy loam which often has an impervious layer of clay under it and sometimes quicksand under that. The upper soil has a high organic content and has been called an "itch muck" by some farmers. The land has a tendency to be wet and can be farmed only by the use of extensive drainage ditches and by pumps to lower the water level.

*Melanotus blatchleyi* Leng has been found only on a farm in Marshall county where the soil is a deep black muck. This infestation was found in 1951 on land being farmed for the first time. The damage was unusual, as the wireworms killed onions and the wheat windbreak in a circular area of about two acres. Corn in the adjacent rows was four to eight inches tall at the time, but was not harmed. The entire muck area was treated with a soil insecticide and the only specimens found two years later were in an untreated fence row.

*Melanotus divarcarinus* Blatchley has been found in Tippecanoe and Decatur counties. In both instances the soil has been a light colored loam and the crop was corn.

*Melanotus fissilis* (Say) was collected on four farms in Starke county, one in White and one in Jasper. In two instances it was found associated with *M. communis*. The soil types were quite variable and included a black prairie loam, light sand, and light changing to black sand with some muck. The crop attacked was corn except in one instance it was soybeans. Here the soybeans were planted in a light sand and the germinating seeds in four spots were attacked by the wireworms. Even here the stand would have been satisfactory except that moles tunnelled under the infested seed. The farmer estimated his loss at 33 percent of his stand, but actually it was less than one percent.

*Agriotes mancus* (Say) is known as the wheat wireworms and was found in Warren county in some newly drained brown muck or peat. Damage to corn and potatoes was observed.

*Limonius dubitans* LeConte is a widely distributed species with diverse food plants. It was collected from eight fields in Starke county, two in Jasper, two in Marion and one in Ripley in southern Indiana. This species was always found in sandy types of soil, ranging from the light to black sand. In some instances parts of infested fields were mixed with muck. The food plants include corn, potatoes, onions, cabbage, and several cucurbit seeds. In Marion county this insect was largely responsible for the discontinuance of potato raising, as a high percentage of the tubers were injured. We observed in some fields the soil full of beetle emergence holes and hundreds of beetles crawling on

the soil surface or flying a few feet above the soil. In northern Indiana extensive areas of corn growing on poorly drained sand were damaged.

### Summary

Eight species of wireworms have been collected and identified from Indiana, especially from Starke and other counties in the northern third of the state. All species attacked corn and most of them potatoes. Other crops attacked included onions, cabbage, soybeans, wheat and seeds of certain cucurbit crops. The commonest species was *Melanotus communis* (Gyll.), which showed a preference for muck soils, although it occurred in both light and black sand. *Limonius dubitans* LeConte showed a preference for sandy soils and had the largest number of host plants. Other species found and the soil type in which they were living were as follows: *M. communis* var. *A.* muck; *M. communis* var. *B.* sandy loam; *M. blatchleyi* muck; *M. divarcarinus* loam; *M. fissilis* muck, loam, sand; *Agriotes mancus* peat. All species collected were associated with poorly drained areas. Sampling the wireworm population in advance of planting proved to be laborious, but did suggest an apparent correlation between the early population and subsequent damage.

### Literature Cited

1. BLATCHLEY, W. S. 1910. Coleoptera of Indiana. Ind. Dept. Geology and Nat. Resources. Bul. No. 1.