Location of Larvae of the European Corn Borer, Pyrausta nubilalis (Hbn.), in Dent Corn[1]

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A study was made during the summer of 1956 in two corn fields located in Carroll County, Indiana, to determine the location throughout the season of both first and second generation larvae of the European corn borer in dent corn. Field I was planted May 16 and was infested mainly with first generation borers. Field II was planted June 4 and was infested with second generation larvae.

The literature on the European corn borer is voluminous but it is practically devoid of references regarding the location of the insect in the plant. A paper by Huber, Neiswander and Salter of Ohio (1) dealing with the location of the single generation corn borer larvae and one by Patch, Deay and Snelling of Indiana (2) in the location of the August generation of the two brooded corn borer larvae, were the only references to the subject.

Field I. Procedure. Field I consisted of twenty-two acres of dent corn. This field was a two year alfalfa sod, top-dressed with nine tons of barnyard manure and 400 pounds per acre of commercial 0-24-24 fertilizer. An additional one hundred pounds of 0-20-20 was placed in the row at planting time. The usual methods of plowing and preparing the seed bed were followed. Three varieties of hybrids were used: Pioneer, Steckleys, and Carghill.

On July 7, 1956 this field was sprayed with 2,4-D Amine at the rate of one pint per acre. No insecticides were used.

All studies made in this field were on first generation corn borer. The first oviposition was observed on June 10, with the peak of oviposition from June 12 to 16. The first larvae were found June 19.

Examinations and tabulations were made daily, with few exceptions, until July 23, after which the data were recorded on alternate days. Beginning September 19, examinations were made every third day until October 24, at which time the corn was husked.

Each observation consisted of ten infested plants which were uprooted and dissected completely, starting with the lowest node and leaves and working to the top of the plant. From each stalk dissected, record was made of the number and location of all egg masses, larval instars, and pupae. The height of the corn was measured from the ground level to the tip of the extended leaves and recorded. The stage of development of the plant was recorded according to the following classification: whorl, tassel, shooting, silking, milk, dent and mature.

Results. As shown in Table 1, 90 per cent of the first instar corn borers were found on the leaves, about 92 per cent of these being on

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TABLE 1. Occurrence of first generation larvae of the European corn borer by instars in different parts of the corn plant in Field I. Carroll county, Indiana, 1956.

Instar	On leaf	In midrib	Behind sheath	Inside stalk	In ear	In shank	Total	Dates found
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*No.*	
1	90.3	0	9.1	0.6	0	0	171	June 19—July 10
2	73.2	12.1	13.5	1.2	0	0	545	June 19—July 21
3	61.2	20.8	11.7	6.3	0	0	205	June 21—July 21
4	36.4	32.1	13.7	17.8	0	0	136	June 28—Aug. 12
5	12.9	15.5	13.4	55.1	2.6	0.9	192	July 6—Aug. 22

leaves six through 10. About 10 per cent of all first instar larvae were concealed behind the sheath and less than one per cent were in the stalk.

Seventy-three per cent of all second instar corn borers were found exposed on the leaves, with about 90 per cent of these being on leaves six through 11. Nearly 14 per cent were behind the sheath and 13 per cent in the midrib or in the stalk.

Sixty-one per cent of the third instar borers were exposed on the leaves, about 75 per cent of which were on leaves eight through 13. About 12 per cent were behind the sheath. Twenty-seven per cent were not exposed, being either in the midrib or in the stalk.

Thirty-six per cent of the fourth instar corn borers were found exposed on the leaves, about 61 per cent of these being on leaves nine through 13. Nearly 50 per cent were either in the midrib or in the stalk and about 14 per cent were behind the sheath. Most of the larvae other than those on the leaves, were below the ear, which usually appeared at node nine.

Thirteen per cent of the fifth instar corn borers were exposed on the leaves. They were fairly evenly distributed from leaf four through 16. About 13 per cent were behind the sheath. The midrib contained 15.5 per cent, the stalk 55 per cent most of which were below the ear, with the latter containing 3 per cent, and the shank 0.5 per cent. Thus nearly 74 per cent of the borers were concealed.

Forty-seven per cent of the pupae were found on the leaves, being distributed from leaf four through 14. About 19 per cent of the pupae were found in the stalk, 6 in the ear and 28 per cent were found behind the sheath. Eighty-one per cent of the pupae were found below the ear.

Twenty-three per cent of the empty pupal cases were found on the leaves and 12 per cent behind the sheath. The remaining 65 per cent were found in the stalk, about 78 per cent of these were below the ear.

Forty-eight observations of ten plants each (480 plants) were made from June 19 to August 22 yielding 1249 larvae, 32 pupae and 48 empty pupal cases. Of the larvae found 171 or 13.7 per cent were first instar; 545 or 43.7 per cent were second instar; 205 or 16.3 per cent were third instar; 136 or 10.9 per cent were fourth instar; and 192 or 15.4 per cent were fifth instar.

There was a sharp decrease in the number of borers present after July 10.

Summary. In Field I, 90.3 per cent of the first instar borers, 73.2 per cent of the second, 61.2 per cent of the third, 36.4 per cent of the fourth and 12.9 per cent of the fifth instar were on the leaves.

Of the first instar larvae 9.1 per cent were behind the sheaths, 13.5 per cent of the second, 11.7 per cent of the third, 13.7 per cent of the fourth, and 13.4 per cent of the fifth. Thus 99.4 per cent of the first instar, 86.7 per cent of the second, 72.9 per cent of the third, 50.1 per cent of the fourth, and 26.3 per cent of the fifth could have been reached by insecticides.

The percentage of larvae found in the midribs was as follows: First instar none, second instar 12.1 per cent, third instar 20.8 per cent, fourth instar 32.1 per cent and fifth instar 15.5 per cent.

As the borers matured a higher percentage were found inside the stalks. Over half the borers were found at or below the ear.

Six-tenths of one per cent of the first instar borers were in the stalk, 1.2 per cent of the second, 6.3 per cent of the third, 17.8 per cent of the fourth, and 55.1 per cent of the fifth.

There were no first, second, third, nor fourth instar larvae found in the ear or shank and only 3.1 per cent of the fifth instar were found in this area. Also 6.2 per cent of all pupae were found in the ear.

The first instar larvae were present from June 19 to July 10, second instar from June 19 to July 21, third instar from June 21 to July 21, fourth instar from June 28 to August 12, fifth instar from July 6 on. Pupae were found from July 13 to August 22, and pupal cases from July 29 to October 20.

There were 1249 larvae found in 480 stalks dissected over a period of 48 days in Field I. Each stalk dissected was infested with an average of 3.6 borers. Of the total borers found 171 or 14 per cent were first instar, 545 or 42 per cent were second, 205 or 17 per cent were third, 136 or 11 per cent were fourth, and 192 or 16 per cent were fifth instar. There were 32 pupae and a like number of empty pupal cases.

Field II

Procedure. Field II consisted of 11 acres of dent corn. This field was a two year alfalfa sod and received 200 pounds of commercial 4-16-16 fertilizer per acre. Howett's (600 series) and Martin brothers' (400 series) seed corn were used. Each planter box contained a different variety. Having been planted June 4 this field was infested only with second generation borers.

Four acres in this field were selected at random and 160 plants containing egg masses were staked. Each egg mass on the plant was marked and the location tabulated on the data sheet. One plant was dissected every other day from each of the above four areas and one plant at random (not within the limits of the above four). Thus a total of five plants were dissected every other day, beginning August 3 and ending October 30.

No insecticides nor herbicides were used in this field.

The first egg mass and larvae were found August 3. The tassels appeared August 9. The average ear height was on node nine.

TABLE 2. Occurrence of second generation larvae of the European corn borer by instars in different parts of the corn plant in Field II. Carroll county, Indiana, 1956.

Instar	On leaf	In midrib	Behind sheath	Inside stalk	In ear	In shank	Total	Dates found
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*No.*	
1	64.6	0	31.6	0	3.8	0	79	Aug. 3—Sept. 25
2	28.6	3.9	41.5	1.6	21.3	3.1	132	Aug. 13—Sept. 16
3	19.2	5.6	40.3	5.6	24.5	4.8	124	Aug. 13—Sept. 20
4	14.3	1.6	27.2	18.7	25.5	12.7	118	Aug. 21—Sept. 22
5	2.9	0.2	7.1	67.4	13.6	8.8	614	Aug. 23 — Oct. 30

Results. As shown in Table 2 nearly 65 per cent of the first instar corn borers were on the leaves, about 57 per cent of which were on leaf ten. About 32 per cent of all first instar larvae were hidden behind the sheath. Three per cent were found in the ear and none in the stalk. About 91 per cent of the first instar larvae were in the ear or above.

Nearly 29 per cent of all second instar corn borers were found exposed on the leaves, with about 69 per cent of these being on leaves eight through 12. About 4 per cent of all second instar borers were in the midrib, 1.6 per cent in the stalk, 21.3 per cent in the ear and 3.1 per cent in the shank. About 41 per cent of all second instar larvae were behind the sheath. About 77 per cent of the second instar, second generation larvae were in or above the ear.

About 19 per cent of the third instar borers were exposed on the leaves. Leaves eight through 13 contained about 58 per cent of the above. About 40 per cent were behind the sheath. Nearly 41 per cent of all third instar borers were concealed, 5 per cent being in the midrib, 5 per cent in the stalk, 25 per cent in the ear and 5 per cent in the shank. Of the total third instar borers about 65 per cent were at or below the ear.

Fourteen per cent of the fourth instar corn borers were on the leaves, with 64 per cent of them on leaves nine through 13. About 27 per cent were behind the sheath. Of all four instar larvae 59 were inside the corn plant. These were located as follows: midrib 1.6, stalk 18.7, ear 25.5 and shank 12.7. About 83 per cent of the fourth instar larvae were in the ear or above it.

Less than three per cent of the fifth instar corn borers were on the leaves and were evenly distributed from leaf five through 15. Only 7.1 per cent were behind the sheath. Thus 90 per cent of the fifth instar larvae were inside the plant, with 0.2 per cent being in the midrib and 67.4 per cent in the stalk (all were found between node three and 16). Thus 62.5 per cent were above the ear with 13.6 per cent actually in the ear and 8.8 per cent in the shank. Of all fifth instar larvae 60.8 per cent were found at or above the ear.

One pupae was found October 6 inside the stalk at internode six. Two empty pupal cases were found on October 18 and 24, both inside the stalk and at internode seven.

There were 1067 larvae found in 205 stalks dissected over a period of 41 days in Field II. Each stalk dissected was infested with an average

of 5.2 borers. Of the total borers found 79 or 7.4 per cent were first instar, 132 or 12.4 per cent were second, 124 or 11.6 were third, 118 or 11 per cent were fourth, and 614 or 57.6 per cent were fifth instar. One pupae was found October 6 and two empty pupal cases—one on October 16 and the other on October 24.

The number of borers present declined toward the last of September.

The variation in the number of larvae found in each instar is influenced by the period of time spent in each instar and the number of observations and the number of plants dissected during this period.

Summary. In Field II 64.6 per cent of the first instar larvae were located on the leaves, 28.6 per cent of the second, 19.2 per cent of the third, 14.3 per cent of the fourth, and 2.9 per cent of the fifth.

Thirty-two per cent of the first instar larvae were behind the leaf sheaths, 41.5 per cent of the second, 40.3 per cent of the third, 27.2 per cent of the fourth, and 7.1 per cent of the fifth. Thus over 95 per cent of the first instar were located on the leaves or behind the sheaths, 70.1 per cent of the second, 59.5 per cent of the third, 41.5 per cent of the fourth and ten per cent of the fifth.

No first instar larvae were found in the midrib. About four per cent of the second instar larvae were in the midrib, 5.6 per cent of the third, 1.6 per cent of the fourth, and 0.2 per cent of the fifth. In the stalk there were no first instar larvae, but 1.6 per cent of the second, 5.6 per cent of the third, 18.7 per cent of the fourth, and 67.4 per cent of the fifth instar larvae.

In the ear and shank there were 3.8 per cent of the first instar larvae, 24.4 per cent of the second, 29.3 per cent of the third, 38.2 per cent of the fourth, and 22.4 per cent of the fifth instar larvae.

The location of the larvae in relation to the ear was as follows: ninety per cent of the first instar larvae were in or above the ear, 76.6 per cent of the second, 64.6 per cent of the third, 83 per cent of the fourth, and 57.4 per cent of the fifth.

The first instar larvae. Of the second generation larvae found in Field II first instar larvae were present from August 3 to September 16, second instar August 13 to September 16, third August 13 to September 20, fourth instar August 21 to September 22, and fifth instar August 23 to October 30.

Literature Cited

1. HUBER, L. L., C. R. NEISWANDER, and R. M. SALTER. 1928. The European corn borer and its environment. Ohio Agric. Exp. Sta. Bull. 429: 45-50.
2. PATCH, L. H., H. O. DEAY, and R. O. SNELLING. 1944. Stalk breakage of dent corn infested with the August generation of the European corn borer. Jour. Econ. Ent. 44: 534-539.