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EAR WORM INJURIES TO CORN AND RESULTING LOSSES

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After reading practically all of five hundred and twenty-five references to the corn ear worm (*Chloridea obsoleta* Fab.) in literature, it has been observed that two serious sources of loss due to the activities of this well known pest have been overlooked. A brief discussion, therefore, of the various types of injury to corn caused by this insect, with observations from last year's study may prove of some practical value.¹

It is well known that in most of the ear worm territory, the first generation of moths frequently oviposit on the unfolding leaves in the heart of the young corn plant. The larvæ upon hatching attack the tender leaves (Pl. 11, fig. 1) eating large and irregular holes in them. This injury has been variously designated in different localities as "rag worm" injury (Virginia), "shatter worm" (North Carolina), "heart worm" and "bud worm" injury (general). It would appear that there must be some injury to the vitality of the young corn plant though a few injured stalks under observation at this laboratory apparently overcame this injury and produced ears entirely comparable to stalks not thus injured and under the same growing conditions. Ear worm larvæ have several times been reported as boring into the stalk (Caudell, 1902),² but this habit is apparently unusual according to our observations.

The developing tassels are next attacked by the larvæ (Pl. 11, fig. 2). In this locality nearly grown larvæ are usually found doing this injury and in the few days' eating do considerable damage to the developing

¹ Acknowledgment is made to Mr. W. J. Phillips in charge of this laboratory for suggestions and criticism of this paper.

² Caudell, A. N. Notes on Colorado Insects. Bul. 38, N. S. Div. of Ent., U. S. Dept. of Ag., November 1902, p. 38.

staminate flowers. Were this feeding habit more frequent, a serious loss of pollen might result. A plat of two acres of field corn in which tassels were appearing July 3, 1918, was examined carefully and only ten tassels found to be thus injured. Since corn produces an excess of pollen, the loss of a few anthers is not serious.

By far the more important losses due to ear worm activity come from the attacks on the ears. It is well known that ear worm moths oviposit in the majority of cases on the fresh silks. The larvæ, upon hatching and after devouring the empty egg shells, begin at once to feed on the fresh silks. Sometimes the larvæ crawl down the silk strands well into the tip of the ear at once but not infrequently they feed more or less exposed on the silk at the tip for several instars (cf. Headlee, 1913).¹ Perhaps the most frequent type of silk injury is where the larva severs the strands some distance below the ends of the husks (Pl. 11, fig. 3). This condition is so frequent that a slight pull of the silk mass will generally indicate infested ears. If a part or all of the silk pulls out readily, ear worm work with but a few exceptions is assured. Where the silk does not yield, the husk must be opened to ascertain infestation.

Since it is through the silks or styles that the ovules are fertilized resulting in the development of the kernel, severance of the silk before fertilization will result in the absence of kernels on that part of the ear. It has been observed that the silks leading to the basal portion of the ear develop first and those to the tip, last. Dr. W. A. Taylor of the Bureau of Plant Industry, when asked for confirmation of this statement wrote (*in littera*), "the silks usually arise from a point an inch or two from the base of the ear. From this point the silking proceeds toward the tip and less rapidly towards the base. The last silks to emerge are from the tip of the ear." It appears that fertilization takes place over the greater part of the ear before ear worms reach the silks but some four or five days are necessary to fully pollinate a single ear of corn (Coulter, 1913).² Within this time ear worms enter the silk mass, sever some and thereby prevent fertilization of the tip ovules in which case a nubbin results (Pl. 11, fig. 8). Occasionally some kernels missing at the base of the ear may be explained in the same way but this is less common apparently than poorly filled out tips. The silks to the tip ovules are, in general, in the center of the silk mass. The larvæ appear to enter the ear generally through the center of the silk mass, eating as they go. If the larva merely eats in the external silk mass,

¹ Headlee, T. J. Rept. of the Entomologist. N. J. Station Rept., 1913, pp. 633-789, pls. 4, fig. 3.

² Coulter, John M. Elementary Studies in Botany. D. Appleton and Co., N. Y. 453 pp., 97 figs. (Corn, 343-351.) 1913.

as is not infrequent, fertilization may not be prevented for as Dr. Taylor further writes, "any portion that emerges beyond the husk is receptive." There are other well known sources of nubbins, but no record has been found of this one in literature. Observations here and in North Carolina indicate that it is of frequent occurrence.

The fourth source of loss is the kernels actually eaten (Pl. 11, fig. 7). This varies from a fraction of one per cent to perhaps twenty-five per cent. The number of ears damaged here and southward is frequently 100 per cent.

The larvæ living in the ears and devouring the kernels scatter excrement in the damaged areas to the extent that a repulsive and unsightly condition results (Pl. 11, fig. 4). In the case of sweet corn, many ears are rendered totally unfit for food. Sometimes the damaged portions can be cut off and the ears then used but such ears are manifestly less desirable than uninjured ones. Here is a source of loss of especial importance to growers of sweet corn. Ears of field corn, ear worm-damaged, are usually fed to stock. Haslam (1910)¹ found bacteria of the *Aerogenes* group in this excrement which is recorded as being fatal usually to horses and rabbits when injected into their veins. Such corn is less attractive than perfect ears though the public appears to be largely reconciled to corn thus damaged. The corn exhibited at the corn show at Statesville, N. C., November 23, 1918, manifestly the choice ears of the various crops represented, showed 62 per cent of the ears ear worm-damaged.

Following the ear worm activity on soft corn appear various molds (Pl. 11, fig. 6). These molds not only detract from the appearance of the corn but render the parts thus attacked undesirable for food. Haslam (1910) and others found that symptoms of blind staggers result from feeding moldy corn to horses. *Aspergillus flavus*, *Aspergillus niger*, and *Rhizopus nigricans* are mentioned in this connection. Twenty-four ear worm-damaged ears of field corn, which had been invaded by molds, were submitted to Dr. W. A. Taylor for determination of the molds and the following genera were reported: *Penicillium* (13 ears), *Fusarium* (12 ears), *Cladosporium* (10), *Acrostalagmus* (7), *Rhizopus* (3), and *Verticillium*, *Macrosporium*, *Tricothecium*, *Oospora* (1 each). Though much study remains to be done on the effect of the toxic properties of these and similar molds on domestic animals, it is known that stock, especially horses, sometimes die as a result of being fed on moldy corn.

A seventh source of loss has been entirely overlooked. A very few writers state that ear worm larvæ continue eating corn after it hardens,

¹ Haslam, Thos. P. Meningo-Encephalitis. Kans. State Ag. College Exp. Sta., Dept. of Veterinary Science, Bul. 173, pp. 235-253. 1910. Bib.

the majority, however, failing to mention this feeding habit. A few other writers state that the larvæ forsake the hardening ears for alfalfa, weeds, etc. This latter condition perhaps varies with the locality but here, only a small proportion of the larvæ leaves the hardening ears. Most of the larvæ, especially those half grown and larger, continue feeding on the hardening kernels but their feeding changes in character. In soft corn the entire kernel is devoured (Pl. 11, fig. 7) but this is rare in hard corn. The endosperm part of the kernel hardens first, the germ remaining relatively soft up to harvesting time. The larvæ, therefore, eat the lower part of the kernels, the germ part (Lintner, 1881),¹ often tunneling through a dozen or more (Pl. 11, figs. 4, 9). With the lower part of the kernel gone, the attachment to the cob is also gone so that, during the husking and subsequent handling, these kernels drop out. If the shelled corn under a pile in the field is examined, sometimes as many as one fourth of the kernels will be found to be thus injured. A few more are dislodged when the corn is poured into the wagon as will be seen by examining the shelled corn in the wagon bed. Here is a source of injury often accounting for missing kernels at the tip of the ear and resulting in a complete loss. When the larvæ eat the endosperm of hard kernels, the kernel is largely reduced to corn meal as pointed out by Claypole² (1880), also resulting in a total loss.

Finally as French³ (1882) and many others have indicated, the holes made in the husks by ear worms (Pl. 11, fig. 5) serve as entrance places for other insects which in some cases do considerable damage. In this connection the grain weevils of the south deserve especial mention. Other insects, largely *Coleoptera* and *Diptera* may be found living in the worm excrement and decaying or fermenting kernels which are of lesser economic importance.

It is a difficult matter to weigh in their proper proportions these sources of loss due to ear worm activity. In the light of these considerations there appears to be little doubt that the ear worm is one of the major corn pests at the present time.

EXPLANATION OF PLATE 11

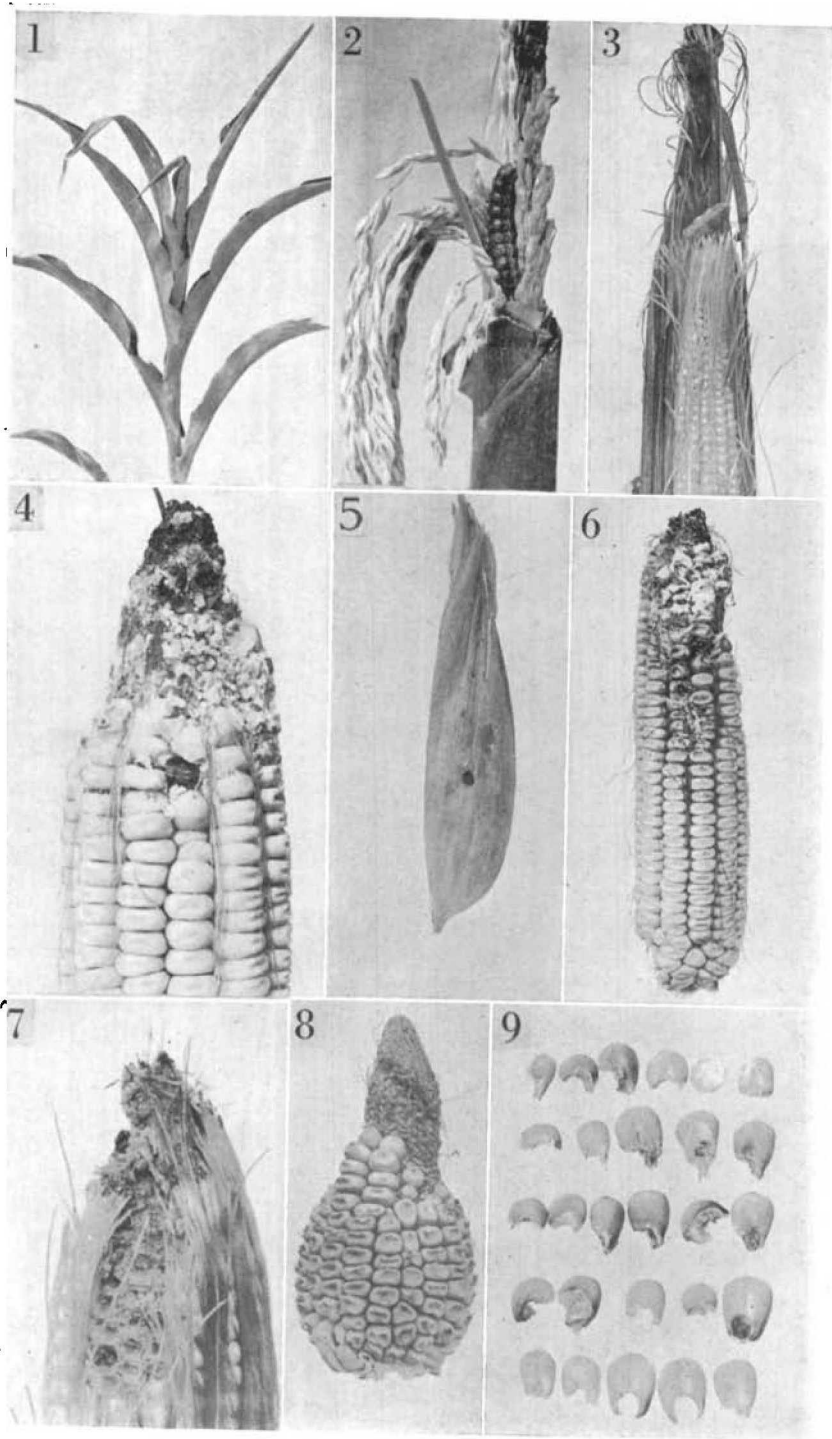
1. An example of "rag worm" injury by the ear worm showing typical damage to the heart leaves.

2. Nearly grown ear worm larva devouring the developing tassel of the stalk of field corn.

¹ Lintner, J. A. The Corn Worm, *Heliothis armigera*. *Cultivator and Country Gentlemen*, November 24, 1881. Vol. 46, p. 759.

² Claypole, E. W. *Heliothis armigera* Feeding on Hard Corn. *Amer. Ent.* 3 (n. s., vol. 1): 278. 1880.

³ French, G. H. The Corn Worm or Boll Worm. In the 11th Rept. of the Noxious and Beneficial Insects of Ill., by State Entomologist of Ill., pp. 65-104. 1882.



Ear Worm Injuries

3. Large ear worm larva in tip of ear of sweet corn. Note that many silks leading to tip ovules have been severed.

4. Ear of hardened field corn with its tip ruined by ear worm. Note larval excrement and partly visible ear worm eating the germ part of the kernels.

5. Hole in husk of field corn through which ear worm larva left the ear.

6. An ear of white field corn showing serious side and tip ear worm injury which has been invaded by molds.

7. Severe ear worm injury to tip of ear of Stowell's Evergreen sweet corn showing excrement of larva and how entire kernels are devoured when corn is soft.

8. Nubbin of white field corn apparently caused by ear worm preventing fertilization by destruction of silk. Note furrow on tip of cob where ear worm almost encircled the same, severing the silks as it went.

9. Series of hard kernels of field corn showing ear worm preference for the germ part of the kernel. All kernels shown dropped from the ear when husked or handled.

NOTES ON THE LIFE HISTORY OF THE PINE TUBE MOTH¹ (*EULIA PINATUBANA* KEARFOTT)

By ALBERT HARTZELL, Ames, Iowa

The presence of the larvæ of this insect in injurious numbers on white pine (*Pinus strobus* L.) in the vicinity of Ithaca, N. Y., offered an opportunity to study the habits of this interesting species. The work was done under the direction of Prof. Robert Matheson of Cornell University to whom the writer is deeply indebted for suggestions and criticisms. At the time the work was begun very little was known regarding the life history of the pine tube moth which, until 1905, had been confused with a European species, *Eulia politana* Haw., of widely different habits. The first reference to the pine tube moth was by Comstock² in the report of the United States Department of Agriculture for the year 1880. In 1905, Kearfott³ recognized it as a new species under the name of *Eulia pinatubana*.

THE MOTH

The adult is a small trim moth with a wing expanse of about 14 mm. The head, fore wings, and thorax are of a rust-red color. The fore wings have two lighter oblique lines crossing them; the hind wings and the dorsal side of the abdomen are silky gray.

The first moth reared by the writer emerged April 13, 1915. The moths continued to emerge under insectary conditions until April 20. From examination of the pupal cases, emergence is accomplished by the splitting of the pupal thorax along the median line, usually as far

¹ Contribution from the Entomological Laboratory of Cornell University.

² 1881. Comstock, J. H. Report of U. S. Comm. Agr., 1880, p. 264-265.

³ 1905. Kearfott, W. D. Canadian Entomologist, 37: 9-10.