

Kansas State Agricultural College.

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DEPARTMENT OF ENTOMOLOGY.

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CORN EAR-WORM.

BY

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IMPORTANCE.

During each of the last two years not less than 3.5 per cent of the crop of corn Kansas should have produced has gone to feed corn ear-worms.¹ During 1908 all the fields about Manhattan averaged more than 60 per cent of the ears infested and many of them showed practically 100 per cent. Extensive traveling about the state indicated injury everywhere quite serious enough to raise the average above 50 per cent. In 1909 the corn fields about Manhattan exhibited an equally severe injury, and observations made in various parts of the state indicated that the injury at that time was no less severe than that of the year before. Nine hundred and ninety injured ears selected at random showed by actual count of grains that not far from 10 per cent of the grains had been destroyed. Quaintance and Brues,² in making up their estimate of the damage done by this insect to the corn crop of the country, showed that counts made at Paris, Tex., gave an average destruction of 15 per cent of the grains. The corn ear-worm feeds so largely on the small grains at the tip of the ear that the destruction of 10 per cent of the kernels does not represent 10 per cent of the corn produced by the ear. The kernels destroyed do not average less than three-fourths the size of the others, and it would

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1. A more complete treatment of the corn ear-worm's work in Kansas will be given in a forthcoming bulletin.
 2. Bulletin No. 50, Bu. of Ent., U. S. Dept. of Agr., p. 22.

therefore be conservative to say that the insect destroys 7.5 per cent of the total amount of corn which would otherwise have been produced by infested ears. This means that our corn crops of the last two years, enormous as is their total value, have brought us about five and one-half million dollars less than they would have had the corn ear-worm damage been eliminated. Nor is this all the harm it has wrought. By piercing the husk it opens the way to the entrance of various molds and bacteria, and its excrement forms a medium on which certain species of molds and bacteria, particularly dangerous to horses, grow and develop. Feeding tests, as yet unpublished, conducted by our veterinary department, have indicated that certain species commonly found in "worm dust" will produce in horses well-marked cases of blind staggers.

In this pest, then, we have a creature that not only destroys our corn crop directly, but indirectly threatens the lives of some of our valuable domestic animals. Anything practical which will materially reduce the work of this creature is worthy of the farmer's attention. Although our study has not proceeded far enough to show how the individual farmer may, independently of his neighbors, eliminate its work from his crop, it has proceeded far enough to show how at least 40 per cent of the injury may be avoided, and experiments showing how this may be done have been thought worthy of presenting to the farmers of our state.

LIFE HISTORY AND HABITS.

Where it is Now. The corn ear-worm is now in the soil of corn fields infested with the larvae last summer. It has been there since last fall and will be there until next June. It averages about three inches below the surface of the soil. At present it is in the form of an oval light shining brown object (pupa) which is unable to move any part of the body except the tail. The larva entered the soil last fall and burrowed downward for several inches. It then excavated a tunnel from this point upward toward the surface, leaving a thin plate of surface soil untouched. It then returned to the bottom of the burrow, shed its skin and came forth as a helpless pupa.

What it will do Next Spring. In late May and in June this pupa and others like it will split open at the head end, and from each a curious looking creature will emerge. Each of these will crawl up its open burrow, burst the thin plate

of soil and crawl out upon the surface. After a few hours the wings will have expanded and the body will have so dried and hardened that the moth will be able to take flight and begin its serious business of securing food and reproducing its kind.

FIRST BROOD. In 1908 the moths began to emerge from indoor cages May 17, ceased June 22, and the majority were out by June 6. In 1909 from twenty-five pupae placed in an unheated room indoors the first moth emerged May 29, the last July 3, and the majority had emerged by June 7. From twenty-five pupae placed in soil out of doors, the first moth came June 9, the last June 26, and the majority had emerged by June 22. The females deposit their eggs upon many sorts of useful plants and upon weeds, but evidently prefer corn. They place the eggs on the young corn leaves, and the larvae, which hatch in four or five days, make their way into the tender curl and feed there. In a little over eighteen days the larvae become fully grown and enter the soil. In about thirteen days more the adult moths come out of the soil and the second brood begins its work.

SECOND BROOD. The second brood of moths begins to fly in early July, and the larvae to which its eggs give rise feed upon the corn plant during the latter part of July and the first half of August. The later members of the second brood of moths have opportunity to deposit their eggs on the corn silks. Some of the second brood larvae are therefore raised upon a diet of tender corn silk and grains. The moths of the corn ear-worm, regardless of brood, will, if the opportunity offers, lay their eggs almost exclusively upon tender corn silks.

Third Brood. By the 21st of August some of the second brood larvae have become fully grown and transformed to pupae from which the moths are ready to emerge. The third brood of moths begin to fly in the latter part of August and deposit their eggs upon tender corn silks. The larvae which hatch from these eggs consume the silks and penetrate beneath the husks of the forming ear, where they feed upon the juicy grains. Those members of the third brood which emerge after the corn silks are dried and shriveled betake themselves to weed patches and alfalfa fields and deposit their eggs upon various weeds and alfalfa. Many of the third brood larvae which during their early life were nourished upon a diet of corn are compelled to finish their growth upon a diet of weeds.

Partial Fourth Brood. By October 13 some of the larvae

produced by the earliest of the third brood moths have reached maturity, entered the soil, transformed to pupæ, which are ready to give up adult moths. These moths emerge as members of the partial fourth brood. Larvae produced by the partial brood probably never reach maturity and perish in the oncoming cold weather. Most of the third brood pupæ do not produce adults in the fall, but remain in the soil during the winter.

Summary. In Kansas the corn ear-worm experiences three full broods and one partial. The larvae of the first three feed mainly upon the corn and the latter part of the third and all of the fourth feed upon various weeds and alfalfa.

METHODS OF CONTROL.

Destruction of overwintering pupæ.

The fact that the corn ear-worm larva can and does feed on garden truck, weeds and alfalfa would lead one to suppose that it passes the winter in the soil where these grow as well as in that of infested corn fields. But the experiments of the last two years indicate that practically none of the pupæ winter in the soil of weed patches and alfalfa fields about Manhattan. Gardens are small and therefore of so little consequence in the propagation of this insect as a field-corn pest that they have not been examined. Our present data clearly indicate that the mass of pupæ, from which will come the damaging broods the following summer, winter in the soil of infested corn fields.

It has long been known that late fall or early winter plowing of infested land would, by exposing the helpless pupæ to the attacks of their enemies and to the effects of the weather, destroy a large percentage of them. Experiments at Manhattan during the winter of 1908 showed that plowing infested corn fields five or six inches deep in late fall and early winter destroyed practically 100 per cent of the overwintering pupæ.

The corn ear-worm moth is a strong flyer and readily passes from unsatisfactory fields into those more to its liking. Our observations indicate that locating the prospective corn field as great a distance as Kansas farm conditions permit from land known to be infested will not go far toward producing a clean crop. In fact, it seems that the moths will travel considerable distances in search of corn in a stage of development suitable to their needs. This is particularly true when the plants are in "silk."

The facts recorded in the three preceding paragraphs clearly indicate that late fall or early winter plowing of all the infested corn fields in a community would greatly reduce the corn ear-worm's damage the following summer, but that if only one grower thus treated his land the moths emerging from his neighbors' fields would so infest his corn that he would experience a greatly reduced benefit.

Time of Planting.

Observation of actual field conditions in the country about Manhattan during the fall of 1908 clearly showed: (1) That, other things being equal, late planted corn suffered more severely than that which was planted early; (2) that this difference was due to the fact that late planted corn was in its most attractive stage (in "silk") during the time the third and largest brood of moths was on the wing, while the early planted corn had finished "silking" by the time the mass of this brood was ready to emerge. To determine the extent to which time of planting on uninfested land would enable the individual grower working independently of his neighbors to reduce the corn ear-worm's damage he would normally suffer, we selected two and one-half acres of land which was located near fields in corn the previous year but which had itself been lying idle for one season, and divided it into six plots of equal size. In each plot three 150-foot long rows of each of the following six standard varieties of corn were planted: Leaming (115-day corn), Reid's Yellow Dent (115-day corn), Boone County White (115-day corn), McAuley (120-day corn), Kansas Sunflower (125-day corn), and Hildreth (135-day corn). Plot No. 1 was planted April 15, plot No. 2 May 1, plot No. 3 May 15, plot No. 4 June 1, plot No. 5 June 15, and plot No. 6 July 1. Plot No. 1 received a "set-back" from cold weather. Plots No. 1 and No. 2 suffered from wind and hail. Plots No. 4 and No. 5 were injured and plot No. 6 ruined by the late dry weather. Plot No. 1 produced 39.8 bushels per acre, plot No. 2 46.5 bushels, plot No. 3 49.7 bushels, plot No. 4 46.7 bushels, plot No. 5 26.1 bushels, and plot No. 6 almost nothing.

Plot No. 2, planted May 1, showed 36.2 per cent of its ears free from infestation. This was 6.1 per cent more than that shown by plot No. 1, 14.6 per cent more than plot No. 3, 30.5 per cent more than plot No. 4, 35.8 per cent more than plot No. 5, and 36.2 per cent more than plot No. 6. Furthermore,

of the ears infested plot No. 2 lost 1.2 per cent less grains per ear than plots No. 1 and No. 3, and 3.1 per cent less than plot No. 4. It is clear that in this experiment corn planted May 1 experienced about 40 per cent less damage than corn planted June 15 or later, 33 to 35 per cent less than that planted June 1, and 16 to 20 per cent less than that planted May 15.

While the variety of corn which requires the least time to mature shows the smallest amount of injury, the difference is so small as hardly to be worth considering.

Whether the individual farmer, who plants his corn upon uninfested or cleaned land (land in which the overwintering pupæ have been destroyed by late fall or early winter plowing), will obtain equal or better or worse results than those just recorded depends on the amount, of infested corn land near his crop and the extent to which his neighbors follow his example.

Recommendations.

1. Plant the crop on uninfested or cleaned land.
2. Plant the crop just as early as is possible and escape "set-back" from cold weather.
3. Plant the standard variety that yields best in your locality.

Fortunately, these are measures that make for the production of maximum yields anyway and should be adopted were there no such pest as corn ear-worm.