

SOME OBSERVATIONS ON THE SEASONAL HISTORY OF THE EUROPEAN CORN BORER, *PYRAUSTA* *NUBILALIS* HBN., IN INDIANA

G. A. FICHT, Purdue University Agricultural Experiment Station

A knowledge of the seasonal history of the European corn borer in the infested area of Indiana is important because of its relation to control studies and practices. The dates upon which the various states in the life cycle of the insect occur in the field form the basis of the time element which is so important in formulating clean-up recommendations, in scouting and quarantine activities and control investigations. For this reason a review of the seasonal development of the insect for the past two seasons may be of value.

Pupation. Pupation data were taken on individuals which had been collected in various localities within that part of the State which became infested in 1926. These collections were made a few weeks previous to the expected time of the beginning of pupation and the borers placed in portions of corn stalks. These stalk sections were put on the soil surface amid growing grain and grass, thus providing a condition equivalent to what might be considered the normal environment of the greater portion of the spring population of this area. These data were supplemented by miscellaneous observations in natural locations.

The average time of the beginning, peak and conclusion of pupation for the 1929 and 1930 seasons was May 27, June 17 and July 1, respectively. There was no significant difference in the time of the appearance of the first pupa or maximum pupation during the two seasons, these developments occurring only one day later in 1929 than in 1930. The period during which pupae were present in the field was six days shorter in the latter season due to a hastening of the development as a result of the higher temperatures which prevailed during the greater part of the pupation period. The last observed overwintering larvae pupated on July 4 in 1929 and on June 29 in 1930.

The maximum time which individuals spent in the pupal stage was 25 days and the minimum time was 11 days. Those borers which pupated early in the period spent a longer time as pupae than those which pupated later in the season. The average length of the pupal stage over the two-year period was 16 days

Adult Emergence. Observations on the rate of emergence of moths were made under identical conditions and with the same material as the observations on pupation. The mean dates of the first appearance of moths, the time of maximum emergence and the appearance of the last moths for the two seasons were June 19, July 5 and July 13 respectively. The mean temperature during this period in 1929 was 70.10 degrees F., and in 1930, 73.28 degrees F. This difference in temperature was probably responsible for a somewhat shorter period during which moths were issuing in the latter season. Although the peak of adult emergence occurred three days earlier in 1929 than in 1930 all of the moths had issued four days earlier in 1930. The accumulation of temperature in the 1930 emergence period occurred for the most part after maximum emergence had been reached.

The precipitation during June and July of 1930 was less than one third of that of 1929, being 2.08 and 6.23 inches respectively for the two years. This was responsible for a condition which was of considerable importance as regards the spread and accumulation of the insect. The direct effect of these abnormal drought conditions together with maximum daily temperatures which on some days exceeded 100 degrees F., was a hastened emergence and a shortened life of

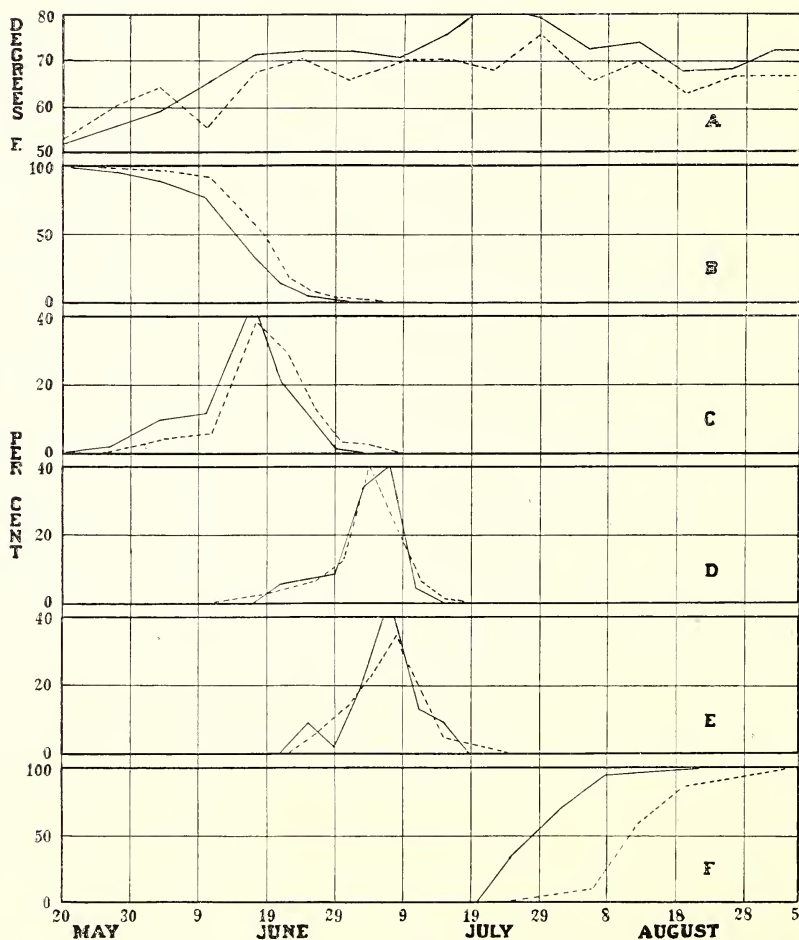


Fig. 1

Fig. 1. Graph of the comparative development of the European corn borer. Dotted line—1929, solid line—1930. A—mean temperatures, B—disappearance of overwintering larvae, C—pupation, D—adult emergence, E—oviposition, F—appearance of full-grown larvae.

the adults. This shortened life of the adult and the resulting retardation in moth activity was vividly illustrated by the much curtailed dispersion of the insect into new territory adjacent to the infested area of 1929.

A male moth was observed in the field on the date of the first appearance of pupal cases in the routine counts on June 18 and both males and females were

encountered throughout and for eight days following the period of emergence in 1929. The last observed adult was taken on July 24. This condition did not exist in 1930. Although moths were observed throughout the entire emergence period none were encountered after the date that the last pupae had emerged in the routine experiments on July 11. Individuals which were kept in a mosquito netting cage for observation died almost immediately after issuing. In no case did individuals live for as long as four days.

The sexes of the adults as determined by examinations of the pupal cases were about equal. During the two-year period, 49.25 percent of those individuals observed were females and 50.75 percent were males. Males predominated in numbers during the early part of the emergence period and females were more numerous later in the season.

Oviposition. Observations on egg deposition were made in early planted fields of corn which were chosen for these studies because of their outstanding height and vigor. A thousand plants were observed at four day intervals in these fields during each season.

The mean dates of the beginning, peak and conclusion of egg deposition during the two seasons were June 25, July 7 and July 18, respectively. The unfavorable climatic conditions existing during the oviposition period rendered the 1930 season unfavorable for the borer. This was reflected in the early part of the period by the curtailed egg laying due to low night temperatures. Between June 25 and June 29 minimum temperatures dropped as low as 49 degrees F. This condition, together with the period of high temperatures which followed when the thermometer rose above 100 degrees F., and the lack of sufficient moisture to sustain the moths, was responsible for a short oviposition period during which much fewer than the normal quota of eggs was deposited. All of the eggs observed were fertile.

Larval Development and Survival. The past season was particularly unfavorable for the establishment and survival of larvae. In a common variety of dent corn, upon which 500 eggs had been placed about the time of maximum oviposition, a total of 8.00 percent of the eggs reached the full-grown larval stage in 1930 as compared to 12.21 percent in 1929. These figures do not represent the natural rate of survival since it was shown that a lower survival figure was obtained by the use of artificial methods of infestation than where natural means of infestation were employed. A survival figure of 21.00 percent was obtained at Monroe, Mich., in 1929 when eggs which had been laid on wax paper in the laboratory were transferred to corn. The paper on which the eggs had been deposited was attached to the under side of the corn leaves by means of paper clips. The survival resulting from natural infestation under otherwise equivalent conditions was 26.02 percent. Assuming that this difference is somewhere near correct the survival figures for the Indiana area would be 14.62 percent in 1929 and 9.59 percent in 1930 on Reed's Yellow Dent corn which was the variety concerned.

In 1929 the first infested plants were observed on June 27 and contained first instar larvae. Full-grown larvae were first noted on July 30. All the borers appearing in collections made on September 3 were in the final instar and were full-fed. In 1930 the first infested plants containing newly hatched larvae were observed on June 29. Full-grown borers first appeared on July 25 and all of the borers of a collection made on August 21 were full-grown.

An important feature of the 1930 situation was the effect of the high temperatures of July on larvae. Daily temperatures as high as 104 degrees F., were recorded. A collection of larvae made following this heat period revealed that 12.00 percent of the larval population of the area had died as a result of the high temperatures. At this time, July 25, 38.00 percent of the borers were in the final instar while the remainder were principally in the fourth and fifth instars. The borers killed by the heat were without exception situated in the upper parts of the corn plants. The unfavorable conditions existing for the larvae occurring in this position was also evidenced by the presence of empty tunnels from which borers had migrated when seeking more comfortable quarters and by the presence of excessive quantities of silk which had been spun in an effort to protect themselves from the heat.

The favorable conditions for planting during the past season were responsible for a relatively uniform planting date and growth of corn which have apparently resulted in a more general and uniform distribution of borers throughout the infested regions of Indiana.

Conclusions. The average dates of the occurrence of maximum pupation, moth emergence and egg disposition for the two years under discussion were June 17, July 5 and July 7 respectively. The mean date of the first appearance of infested plants was June 28, the first full-grown larvae appeared on July 27 and all larvae were in the final instar and full-fed on August 27.

The extreme heat and drought of 1930 were responsible for the retarded spread of the borer into new territory, a smaller increase in the intensity of the infestation and a lessened accumulation of borers in the old infested area of Indiana than would have occurred during a normal season. This was brought about by a shortening of the length of life of the adults, a reduction in the number of eggs laid by individual moths, a relatively high larval mortality at the time of and following the period of hatching and establishment, and a more general and uniform distribution of borers in the infested regions.