การศึกษาเรื่องการกำจัดหนอนเจาะลำต้นข้าวโพด

Some Studies on the Control of Corn Borer in Thailand[1]

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The corn borer, *Pyrausta salentialis* Snell, is one of the most damaging pests in areas where corn has been grown for several years in Thailand. It is also a well known pest of corn in China, Malaya and the Philippines. The borer is a particularly difficult insect to control, mainly because of the protection afforded by stem of the host-plant to the injurious stages. In fields where the pest is well established and abundant such as in many districts of Rayong, Cholburi, Kanchanaburi, Saraburi and Nakorn-Sawan provinces, more than 90% of corn may be damaged. Heavy infestations of the borer in these areas have indicated the need for more information on the biology, habits, and a regular program for effective control measures of this pest.

During the 1959-1964 seasons, a research program on the control of this insect was conducted in Bangkhen district where populations of the corn borer have been found high enough to justify the experiments. This report covers some result of studies designed to determine the effective date to begin spraying insecticides, the efficacy of insecticides and the role of the egg parasite, *Trichogramma australicum* G., in the control of this pest.

It should be mentioned that although natural infestations of the corn borrer can occur on other hosts, particulary on many species of wild herbaceous hosts, the corn plant appears to be more preferable and probably plays a vital role in the bionomics of this insect in many corn growing areas. The sudden appearance of a vast number of this insect, so commonly observed at the beginning of a growing season, led to an assumption of adult moths migration from alternate host-plants. It is therefore important to find the distributions of the amount of infestations and the number or egg masses in relation to the growth stage of corn and use these findings as a tool in establishing a control program.

TYPE OF INJURY

The first instar larvae, after hatching, begin feeding on the spirally rolled leaves of corn. As the leaves expand in their growth, the feeding points appear as pin holes and frass

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beneath the leaf blads. These holes increase in size as the larvae grow. It is the first indication of the borer attack which can be easily seen in the field. Much damage to corn is however characterised by a good deal of breaking-over of stems caused by larvae tunnels and by the boring into young cobs of the later laval stages. It a heavy attack such as a corn field in Rayong which was almost a total loss, as many as 1700 berers per 100 plants were found. Serious damage usually occur when the stalks are heavily infested during tassel stage. In this case, most of the stalks collapse and die before producing ears. Corn stalks with the tassels broken or bending over are also common in the field when they were invaded by larvae that begin developing at the time the tassel emerges.

LIFE HISTORY AND HABITS OF CORN BORER

Field corn in each growing season are usually attacked by two generations of borers. Eggs are laid in imbricated rows which average 21 eggs per mass on the under surface of the leaf-blade near the midrib. There is also occasional egg laying on the upper surface of the leaf. The eggs ordinarily hatch in 3-4 days (Table 1) and the first instar larvae of the first generation begin their feedings on young leaves. The first instars of of the second generation feed primarily on tassels and sometimes beneath the husks or between the ear and stalk. At the third instar, the larvae begin to tunnel into the stalk. Through the midribs and the sheaths of leaves. They continue to feed in corn stalks until they are full-grown. The larvae molt 4 times and the larval stage lasts 15-21 days. Pupation takes place in the larval burrow just close to the exist hole and the pupal stage lasts 4-7 days. The female moth deposits their eggs 2-3 days after emerged and each female can lay 44 to 70 eggs. The life span of the adult moth in captivity extends from 3 to 5 days. The total development period requires some 24-30 days.

DAMAGE DISTRIBUTION IN VARIOUS STAGES

Distribution of the percentages of borer damages in various stages of corn

The study was carried out in 1961 in field plots, each of which was 6×35 meters. The plots were replicated four times. Corn was planted in June which is a favorable time of common practice in this district. The distances between rows was one meter and between hills was 50 centimeters. There were 3 plants per hill to make a total of 864 plants per plot. Infested stems of corn were cut at base just above ground level and count was made at seven-day intervals. The data on the average percentages of stem or tassel stalk infestations were plotted against corn ages in Fig. 1 to show typical distribution of the level of infestation at various stages of corn.

The result of this experiment showed that invasion of the corn stalk did not occur until the plants were over one month old. The stem invasion increased markedly in corn following late whorl stage of development and reached its high peak on corn approaching or in

Table 1

Life cycle of the corn borer (*P. salentialis* Snell)

No.	Length of time in each stage (days)								Total (days)
	Egg	1st molt	2nd molt	3rd molt	4th molt	Larva	Pupa	Adult	
1	3	3	2	4	4	16	6	4	29
2	3	4	3	3	4	19	5	5	32
3	3	4	3	4	4	19	5	4	31
4	4	3	4	4	4	18	6	4	32
5	3	4	3	5	4	20	6	3	32
6	4	3	3	5	4	17	6	4	31
7	4	3	2	3	3	16	6	4	30
8	4	3	3	3	4	17	6	5	32
9	4	3	3	3	4	17	5	5	31
10	3	4	2	3	4	15	6	5	29
11	4	4	3	4	4	21	5	3	33
12	4	3	3	3	4	16	5	5	30
13	4	3	3	4	4	17	5	4	30
14	4	3	3	3	4	17	6	3	30
15	3	3	3	3	4	15	6	3	24
16	3	4	3	3	3	15	6	4	28
17	4	3	3	4	4	16	7	5	30
18	4	3	3	3	4	15	5	3	28
19	4	3	4	3	4	18	4	5	31
20	4	3	3	4	4	18	5	4	31
21	4	3	3	3	4	16	5	5	30
22	3	4	3	4	4	18	5	5	31
range	3–4	3–4	2–4	3–5	3–4	15–20	4–7	3–5	27–33
average	3.67	3.31	2.99	3.54	3.91	17.09	5.32	4.18	30.36

the mid-tassel stage of growth. After that the number of stem infestation decreased rapidly and consistently in various stages of corn. There is however a notable interruption at the late silk stage. This interruption may be contributed by the infestation of the successive generation of the borer which coincides with the egg mass count in the later experiment.

Egg masses distribution in various stages

In this experiment, conducted in 1962, the number of egg masses on corn were counted at seven-day intervals. Single corn stems were cut just above ground level and count was made of the egg masses. Samples were replicated four times in randomized plots of equal size to that of the above experiment and 25 corn stems were

examined in each replicate to give 100 stems per sample. The trend indicating the fluctuation of corn borer population as determined by total numbers of egg masses is shown in Fig. 2.

The result of this experiment indicated that the corn borer did not lay its egg on plants until the plants were over three weeks old. There were at least two generations of the borer developing in each growing season. Most of the eggs of the first generation were deposited on corn plants approaching or between the late whorl stage and the mid-tassel stage. The second generation deposited most of their eggs on corn in or following mid-silk stage of development. On account of the development of egg stage to the third larval instar, which will last for 8-17 days, the stem invasion of the borer should take place most on corn plants reaching or in the mid-tassel stage. This conjecture therefore coincides with the experimental result described above.

ESTABLISHING DATE FOR INSECTICIDE APPLICATION

The success of the corn borer control by insecticide depends much on the exposure of the first to third instars to chemicals. Once the larvae invade into stalk of corn which occur in later instars, they gain a good protection from stem and cannot be killed easily by insecticides. It has been pointed out in the earlier section of this report that the female moths did not lay their eggs until the plants has attained their certain age above three weeks old. It has also been established that oviposition reached its high peak when the plants were between the late whorl stage and the mid-tassel stage of development. Larvae which emerged from eggs in these periods of oviposition caused a high level of stem infestation in the developed corn at mid-tassel stage.

Since the eggs of the second generation are much subjected to high infestation of parasites (to be dicsussed later) and the damage done by borer larvae of this generation when the corn has already reached maturity, is considerably mild and may be negligible. The spray program which leaves the residues of insecticides covering the crops at the vital period of larval infestation, i. e. the corn of one month to two months old or at abount the late tassel stage of growth, should be favorable for the control of this pest. Therefore it is recommended that at least three applications of insecticides which have rather long residual effects should be used at 10-day intervals beginning at the time when the plants were 30 to 40 days old.

EXPERIMENTS ON CORN BORER CONTROL BY INSECTICIDES

Several experiments on the use of insecticides in the control of this pest were conducted at Bangkhen Experiment Station in 1961. One of these experiments was set up according to the proposed spray program of control described above. In this experiment, sprays tested against larvae of this insect were made

using DDT as a standard insecticide in comparison with endrin, dieldrin, TDE, parathion, toxaphene, and chlordane. Treatments of 0.1 % DDT, 0.05 % endrin, 0.05 % dieldrin, 0.1 % TDE, 0.05 % parathion, 0.1 % toxaphene and 0.03 % chlordane were applied at the rates of 1.5, 0.25, 0.5, 1.5, 0.5, 1.5 and 0.5 pounds of active ingredient per acre respectively. Three applications were made at 10-day intervals beginning on the date when the plants were 37 days old. The treatments reduced the mean percentages of stem damaged by the borer from 75 % to 37.69, 15.18, 33.61, 35.66, 48.61, 49.21, 68.44 respectively (Table 2). There was highly significant difference among these treatments; all insecticides, except chlordane, gave significant control for the damage of this borer on corn stems. Endrin was found to be superior to the rest of insecticides used in this experiment.

ROLE OF *TRICHOGRAMMA AUSTRALICUM* GIRAULT IN THE CORN BORER CONTROL

The egg parasite, *Trichogramma australicum* Girault, plays an important role in the control of corn borer in Bangkhen destrict. Since it was first discovered in 1959, there has been some evidence that the infestation of corn by the corn borer has decreased markedly. In 1960 the percentage of infestation of the borer in corn stem in untreated plot has been 84.3 % and this has been reduced to 75.00, 8.30, 11.83, and 2.5 % in the same plot and the same period of growing season in 1961 to 1964 respectively. The effectiveness of this parasite can be illustrated by the trends (Fig. 3) indicating the numbers of parasitized and non-parasitized egg masses which were counted from experimental plots in 1962. It shows that during the first week of egg laying by the borer, the number of parasites developing on a moderate corn borer population was very small, only 14,28 % of the egg masses being parasitized. Hewever, the population of this parasite increased rapidly and in the following week, when the oviposition of the corn borer was at the peak of the season, 84.09 % of the total 44 egg masses per 100 plants were parasitized. After that *T. australicum* G. had essentially eliminated the borers as pests when 89–100 % of their eggs were infested by this parasite.

Table 2

Percentage infestation of corn stems after insecticide treatments, Bangkhen, 1961

Insecticide	Rate of Application pound/acre	Percentage Infestation				Mean
		Rep. 1	Rep. 2	Rep. 3	Rep. 4	
Endrin	0.25	13.56	5.82	20.34	21.00	15.18
Dieldrin	0.5	20.43	28.14	40.68	45.18	33.61
TDE	1.5	20.43	33.00	44.04	45.18	35.66
DDT	1.5	34.14	37.47	36.39	42.75	37.69
Parathion	0.5	47.43	51.60	47.40	48.00	48.61
Toxaphene	1.5	54.57	51.57	45.51	45.18	49.21
Chlordane	0.5	54.57	69.18	70.00	80.00	68.44
Check	–	60.00	72.20	80.80	87.00	78.00

F ratio, treatments = 32.95

L.S.D. 5 % = 9.96

สรุป

หนอนเจาะลำต้นข้าวโพดชนิด *Pyrausta salentialis* Snell. เป็นศัตรูสำคัญที่สุดชนิดหนึ่งในไร่ที่มีการปลูกข้าวโพดซ้ำซากกันมานานปี เช่นในตำบลและอำเภอต่าง ๆ ของจังหวัด ระยอง ชลบุรี กาญจนบุรี สระบุรี และนครสวรรค์ ในไร่บางแห่งปรากฏว่าได้มีแมลงชนิดนี้ลงทำลายให้ข้าวโพดศูนย์เสียไปสูงกว่า 90 % ได้มีการศึกษาเพื่อมีการปราบแมลงชนิดนี้ ตั้งแต่ปี พ.ศ. 2502 มาจนถึงปี 2507 สำหรับรายงานครั้งนี้เป็นแต่เพียงผลการศึกษาเกี่ยวกับชีวประวัติของแมลงชนิดนี้ การหาระยะเวลาเริ่มต้นที่เหมาะแก่การฉีดยาฆ่าแมลงให้ได้ผล ประสิทธิภาพของยาฆ่าแมลงบางชนิดที่มีต่อหนอนเจาะลำต้นข้าวโพด และบทบาทของแตนเบียนไข่ *Trichogramma australicum* Girault ในการปราบแมลงชนิดนี้

ในการศึกษาครั้งนี้สรุปผลได้ว่าวงจรชีวิตนับตั้งแต่เป็นไข่จนถึงตัวเต็มวัยของหนอนเจาะลำต้นข้าวโพดกินเวลา24—30วัน โดยอยู่ในระยะไข่ 3–4 วัน ตัวหนอน 15–21 วัน ดักแด้ 2–3 วัน หลังจากออกเป็นตัว

และสามารถวางไข่ได้ 44–70 ฟองต่อตัว ในฤดูปลูกข้าวโพดฤดูกาลหนึ่ง ๆ นั้นจะมีแมลงชนิดนี้เข้าทำลายได้สองชั่วอายุขัย ปริมาณสูงสุดของพวกที่เจริญในชั่วแรกจะตกอยู่ในระยะที่ข้าวโพดอยู่ระหว่าง tassel stage และปริมาณสูงสุดของพวกที่เจริญในชั่วที่ข้าวโพดอยู่ในระยะ silk stage.

จากผลของการทดลองหาระยะเริ่มต้นของการฉีดยานั้นปรากฏว่าในระยะเริ่มต้นของการฉีดยาที่เหมาะอยู่ในเวลาที่ข้าวโพดมีอายุ 30–40 วัน และควรจะใช้ยาที่มีฤทธิ์ตกค้างนานทำการฉีด 3–4 ครั้ง แต่ละครั้งห่างกัน 10 วัน เท่าที่ทดลองในครั้งนี้ปรากฏผลว่ายาฆ่าแมลงเอ็นดริน (endrin) ที่ฉีดในอัตรา 0.25 ปอนด์ต่อเอเคอร์ ให้ผลดีกว่ายาฆ่าแมลง ดีดีที (DDT) พาราไธออน (parathion) และคลอเดน (chlordane) ที่ฉีดในอัตรา 0.5 ปอนด์ต่อเอเคอร์ นอกจากนี้ยังปรากฏว่าดีกว่า ยาดีดีที (DDT) ทีดีอี (TDE) และท็อกซาฟีน (Toxaphene) ที่ฉีดในอัตรา 1.5 ปอนด์ต่อเอเคอร์ สำหรับแตนเบียนไข่ *Trichogramma australicum* G. นั้นมีบทบาทสำคัญช่วยปราบหนอนเจาะลำต้นข้าวโพดให้หมดไปได้มาก ทำให้หนอนเจาะลำต้นมีปริมาณลดลงทุกทีนับจากปี พ.ศ. 2503 เป็นต้นมา ซึ่งในปีนั้นได้มีต้นข้าวโพดถูกเจาะ 84.3 % และลดลงไปเป็น 75.00, 8.30, 11.83 และ 2.5 % ในที่แห่งเดียวกันในปี 2504–2507 ตามลำดับ

FIGURE 1

DISTRIBUTION OF THE PERCENTAGE INFESTATIONS OF THE CORN BORER IN CORN STEMS BANGKHEN 1961

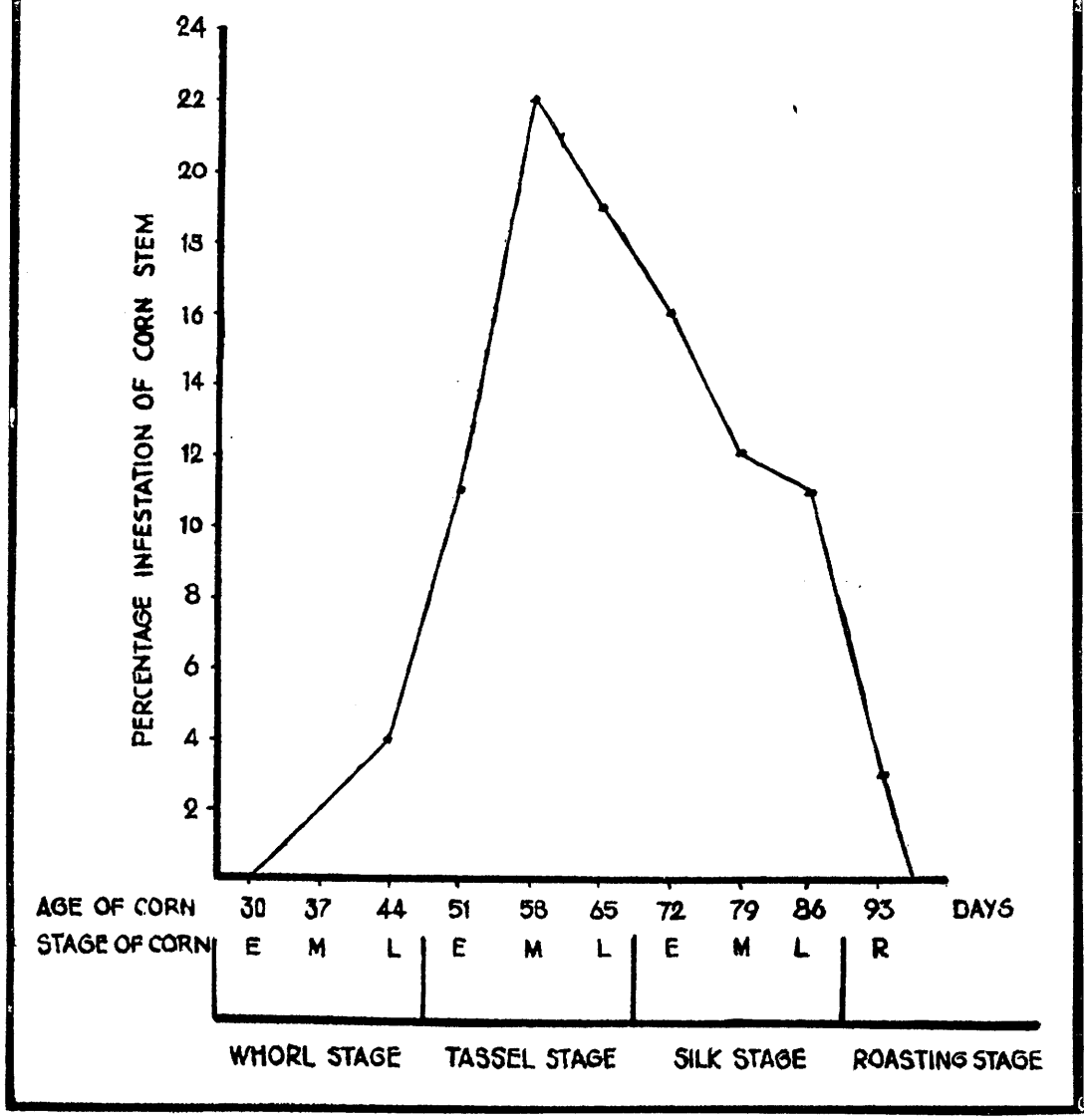

FIGURE 2
DISTRIBUTION OF THE NUMBERS OF CORN BORER EGG MASSES IN VARIOUS AGES OF CORN

BANGKHEN 1962

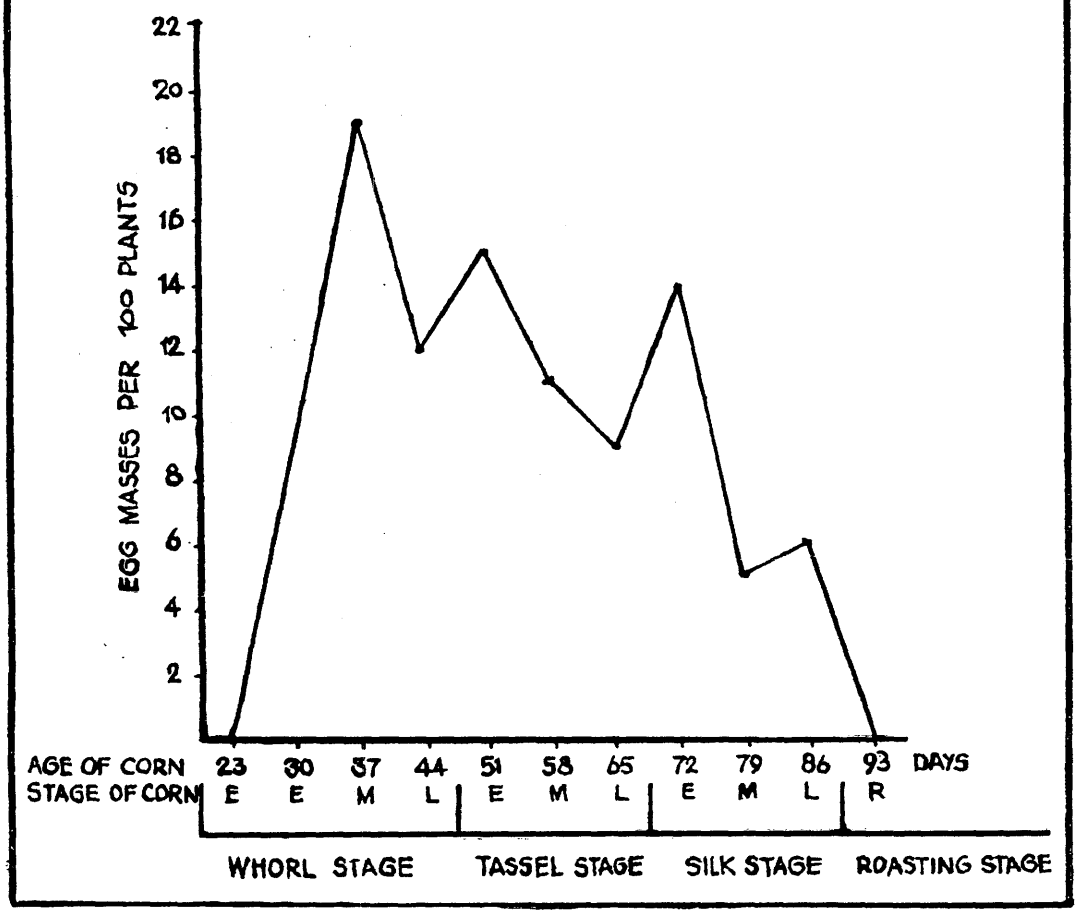

FIGURE 3

DEGREE OF PARASITISM OF TRICHOGRAMMA AUSTRALICUM G. AND THE NUMBER OF EGG MASSES OF THE CORN BORER IN JULY TO SEPTEMBER, 1962