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CANNIBALISTIC BEHAVIOUR OF HELIOTHIS ARMIGERA (HUBN.)

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SUMMARY

Trials conducted with larvae of *Heliothis armigera* (Hubn.) showed that cannibalism is a major regulatory factor at high density populations and of less importance at lower densities. Larvae while feeding attack one another and completely devour the maimed individuals with only the head capsules remaining. With varying numbers of up to 50 larvae per container usually only three larvae reached the pupal stage. Populations larger than three individuals were reduced after 7 days in instances of a small excess and progressively sooner as the density increased.

I. INTRODUCTION

The corn ear worm (*Heliothis armigera* (Hubn.)) is a major pest of several important economic crops in Queensland. Any factors acting as natural checks on population increases of this pest could be of value in an integrated control programme. Field observations in maize, sorghum and sunflower crops on the Darling Downs of south-eastern Queensland have shown that from large numbers of eggs of *Heliothis* species laid on these crops, only a small percentage of the larvae develop to the final instars and under such circumstances the number and size of the larvae vary inversely to one another. Sloan (1940) reported similar results at Biloela, in central Queensland, and indicated that this condition was more noticeable on maize than on sorghum or cotton because of the greater likelihood of larvae making contact with each other. Even though parasites and predators may play a major role in the natural control of *Heliothis*, it appears that larval cannibalism can also be an important controlling influence on populations during the early instars.

Barber (1936) ascertained the cannibalistic habits of *Heliothis obsoleta* Fab. in America by studying populations in small maize cobs in the laboratory and by examining the relationship between cannibalism and cob structure. He reported population decline after 2 days with high densities and after 5 days at low densities. According to recent nomenclature the species studied by Barber is *Heliothis zea* (Boddie) (J. D. Hoffman, personal communication). More recently, conflicting reports have been published on the extent of cannibalism. Kinzer and Henderson (1968), while studying grain damage in sorghum by

introducing populations of *Heliothis zea* (Boddie), noted that cannibalism was not a significant problem and recorded that up to 13 larvae per sorghum head may complete development. A popular belief is that cannibalism is not an important population control factor until the third instar.

To obtain local data on cannibalism in *H. armigera* and to determine the relationships between time and population size, two experiments were undertaken in the laboratory at the Toowomba field station during July and September 1970.

II. MATERIALS AND METHOD

In each of the trials newly hatched larvae were selected from a laboratory culture of *H. armigera* and transferred by camel hair brush to approximately 40 g of an artificial diet in plastic containers 9 cm in diameter and 4 cm high. The artificial diet is made up as follows:

Ingredients A

Soaked navy beans (dry beans soaked in water overnight)	234 g
Methyl para hydroxy benzoate	2·2 g
Yeast	35 g
Ascorbic acid	3·5 g
Sorbic acid	1·1 g
Water	350 ml
Formaldehyde (10%)	8·8 ml

Ingredients B

Agar	14 g
Water	350 ml

The ingredients are blended thoroughly in an electric blender. The agar is first dissolved in boiling water and allowed to cool to about 70°C, when ingredients A and B are mixed together. The medium should be dispensed immediately into clean vials and kept under cool conditions.

The several population levels were replicated four times and the cultures were held under dark conditions in an incubator at 26·6 ± 0·6°C. Daily records were made of the number and instar of live larvae in order to determine the stage at which cannibalism occurred. In Trial 1 the results were recorded only from 7 days after commencement. In Trial 1 initial populations of 1, 2, 4, 8 and 16 larvae were used per container and in Trial 2 of 1, 3, 6, 12, 25 and 50 larvae were used.

The food medium was freshly prepared and only healthy first instar larvae were selected. Attempts to confirm the records by head capsule measurements of the dead larvae were unsuccessful because most of the remains of the moulted skins were lost in the excreta.

III. RESULTS

Results from Trial 1 are presented in Figure 1 and from Trial 2 in Tables 1 and 2 and Figure 2. Table 1 indicates the larval ages over which cannibalism is a most effective population regulatory factor, with data expressed as larvae consumed per 24 hr over the age intervals 0-1 day, 1-8 days, 8-16 days. The times taken for a population to be reduced to various percentages of its original size are set out in Table 2.

TABLE 1

MEAN NUMBER OF LARVAL DEATHS PER DAY, TRIAL 2

Population Level (No. per container)	Age (days)		
	0–1	1–8	8–16
50	16·60	4·11	0·49
25	4·80	2·26	0·19
12	0·80	0·60	0·33
6	0·20	0·28	0·05
3	0·00	0·05	0·06
1	0·00	0·00	0·00

TABLE 2

MEAN DAYS FOR POPULATION REDUCTION, TRIAL 2

Population at Commencement	Mortality (%)			
	20	40	50	75
50	0·6	1·0	3·3	6·2
25	1·3	3·4	4·3	7·4
12	3·1	8·1	13·0	..
6	6·2	8·5	17·0	..
3	..	..	..	..
1	..	..	..	..

IV. DISCUSSION

The results in Trial 2 show that first instar larvae of *H. armigera* are capable of devouring first instar larvae. Comparisons of the rates of population decline over the first 24 hr, for the various original population densities indicate that cannibalism is directly related to population (Table 1). This relationship holds over all age intervals (Table 1), although it is more pronounced during the first instar. In addition, at low population densities numbers are not reduced until after 7 days, whereas at higher densities cannibalism occurs within 24 hr (Table 2). These results are parallel with those of Barber (1936), who showed that of 82% of larvae reaching second instar only 2% reached final instar at high densities. At lower densities 100% survived to second instar and 24% reached final instar. Other published data (Bot 1966) showing that cannibalism occurs only during the later stages of development may have been based on results from low density populations, in which case survival pressures during early instars were absent.

Observations on first instar larvae under high densities and without food showed that cannibalism is quite marked during these early stages, with the sluggish larvae being devoured first.

The population reductions shown in Table 1 for the time interval 0-1 day are greater than those given by Barber (1936) and suggest that a species difference may be involved.

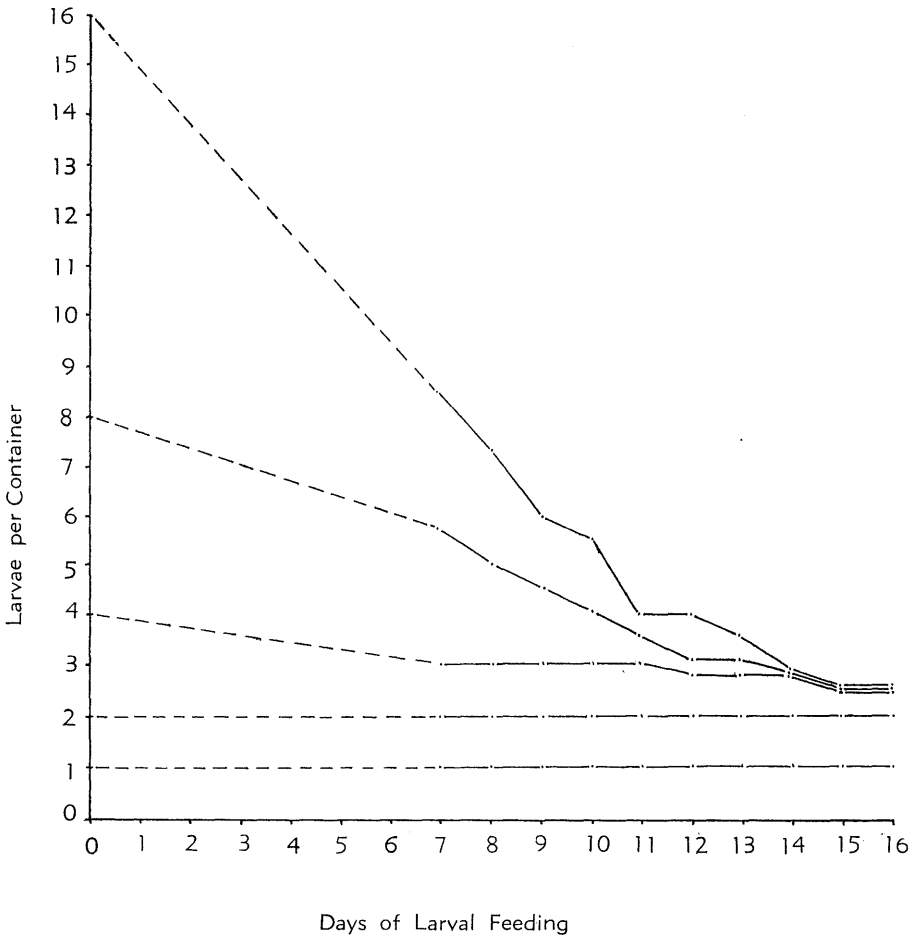

Fig. 1.—Decrease in population of larvae confined to boxes during feeding period—Trial 1.

Figure 2 indicates that cannibalism is a major controlling influence only over the first 8 days, as most populations have been sufficiently reduced in this time to allow completion of development on the remaining medium. A slight inconsistency is shown at the population level of 12 larvae per container where the decline is gradual throughout larval life.

The uniformity with which all treatments were reduced to a similar size suggests that population size is governed by the quantity of food and the foraging area available, and the degree to which a population exceeds a suitable size determines the rate of decline. This behaviour is characteristic of all instars but the intensity of cannibalism depends upon the size and number of larvae and the degree of crowding to which they are subjected.

Larval development time was not affected by the population size since the larvae in all treatments took 15·5 days to pupation on the medium supplied.

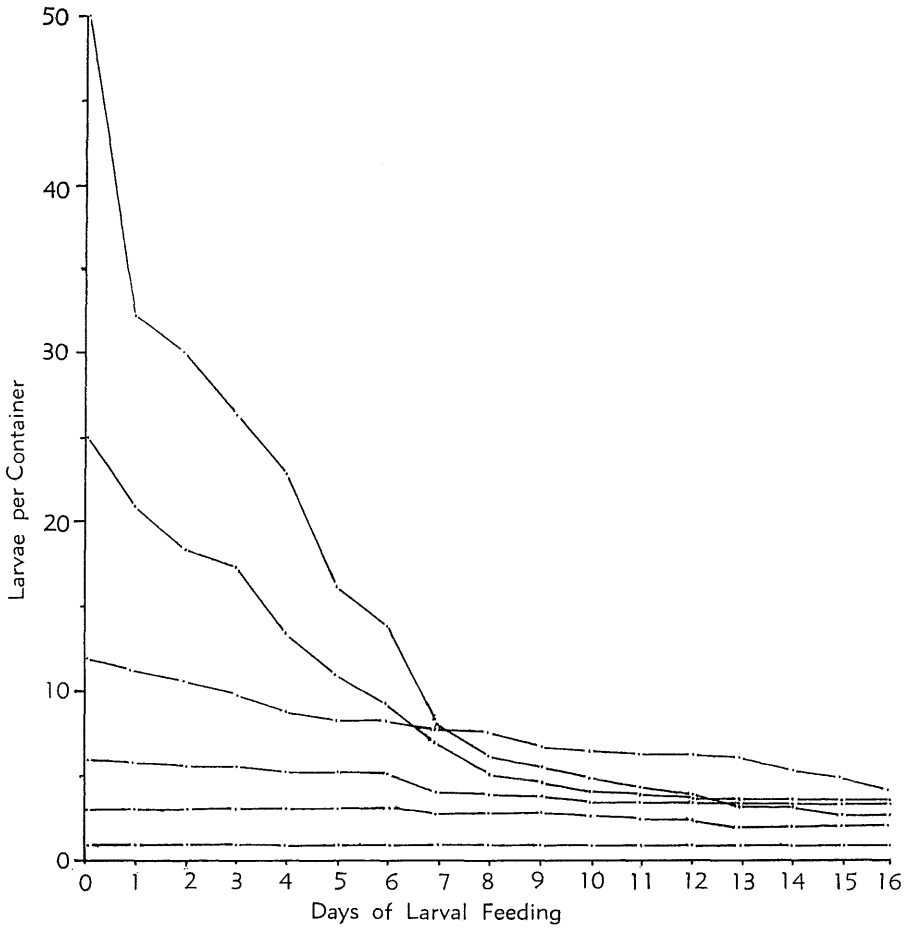

Fig. 2.—Decrease in population of larvae confined to boxes during feeding period—Trial 2.

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