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Cabbage Webworm on Crucifers in Malaysia

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Abstract

The cabbage webworm, *Hellula undalis* (F.) is a major pest of cruciferous vegetables in the lowlands of Malaysia. The common host plants include cabbage, radish, cauliflower, Chinese kale, Chinese mustard and the *Cleome* weed spp. Damage by cabbage webworm is particularly serious on cabbage because damage on the shoot by a single larva can cause either death of the plant or production of unmarketable multiple heads. The critical period of damage is usually from transplantation to the heading stage of cabbage. Generally, higher populations of CWW on cabbage coincided with the drier periods of the year, and low populations during the wetter ones. Within a single season, peak population generally occurred around 40 days after transplanting. Under laboratory conditions, the total developmental period from egg eclosion to adult emergence was about 26 days. Incubation period was about 3 days and the larval period about 14 days. There were usually five instars. The pupal period lasted 8.5 days. Adult longevity was about 7 days for both sexes and the shape of the survivorship curve was a Slobodkin's Type 1. The mean number of eggs laid per female was 175 and the mean egg per day per female was 27. Cabbage webworm was effectively controlled by shoot-tip treatment using *Bacillus thuringiensis* applied once a week until head formation. So far, two species of parasitoids have been recorded but their incidence was low.

Introduction

Many insect pests attack cruciferous vegetables in Malaysia (Yunus and Ho 1980). Among those of growing concern is the cabbage webworm (CWW), *Hellula undalis* (F.) (Lepidoptera:Pyralidae). CWW was first recorded in Malaysia in 1922 (Ooi 1979), but little research was done on this pest until the early 1980s. However, with the introduction of the heat-tolerant hybrid lowland cabbage varieties in 1973, CWW emerged as a major pest that warranted serious attention (Lim et al. 1990). Currently, CWW is an important pest on crucifers in almost all lowland areas in Malaysia, including Sarawak and Sabah. Ooi (1979) reported its occurrence as a minor pest in the Cameron Highlands (altitude 1525 m) where the temperatures are relatively cooler. However, there has been no confirmation on this in subsequent studies. Sachan and Gangawar (1980) suggested that a decrease in importance of CWW in India was related to the increase in altitude at which crucifers are increasingly being grown.

Ooi (1979) suggested that CWW could probably have been introduced into Malaysia through commercial activities because it lacked a good complement of natural enemies and crucifers are its natural hosts. This was the case for the diamondback moth (Tan and Lim 1985). Our observations on harvested cabbage heads, where we found live CWW larvae even into the 18th folded cabbage leaf, tended to lend some support to this suggestion.

Nature of Damage and Host Plants

The importance of CWW on crucifers, particularly cabbage, is underlined by the fact that a single larva, by virtue of its boring in the shoot, could either cause death to the young plant or the formation of unmarketable multiple heads on relatively older plants. This means that it is not possible to advocate specific chemical control measures for CWW, and that the control should be, by and large, preventive. In the field, a low population of larvae could cause significant losses, and in untreated cabbage, losses could go as high as 99%. Although the larva is present throughout the crop, it is severe only during the period between transplanting and the heading stage of cabbage.

In Malaysia, besides cabbage (*Brassica oleracea* var. *capitata*), CWW infests other crucifers such as cauliflower (*B. oleracea* var. *botrytis*), radish (*Raphanus sativus*), Chinese kale (*B. alboglabra*) and Chinese mustard (*B. juncea*) (Yunus and Ho 1980). Noncruciferous weeds such as *Cleome* spp. and *Hygrofolia salicifolia* were also found to be natural hosts for this insect. Our studies in the glasshouse showed that CWW prefers Chinese mustard over cabbage and radish. In terms of oviposition, the caged moth laid more readily on Chinese mustard and radish compared to cabbage.

Biology and Ecology

The egg of CWW is oval, about 0.44 mm in length and 0.32 mm in diameter. It is white when freshly laid but later turns slightly pinkish and then brownish-red just before hatching. Eggs are laid either singly or in rows of 2 or 3. The developmental durations of the various stages of CWW on cabbage are summarized in Table 1. The egg incubation period was about 3 days and mean egg viability was 60%. There were generally five instars on cabbage. The first instar, which usually mined the leaf, lasted about 3 days. The second instar ranged from 1 to 3 days, third instar from 2 to 5 days, fourth instar from 2 to 3 days and fifth instar from 3 to 5 days. There was a short prepupal period of about 1 day. Pupation normally occurred in the soil within a pupal case or in leaf debris. In the laboratory, pupation occurred at the sides of the breeding cage or the sides of the glassware where it is bred. The mean pupal period was 8.5 days. The total developmental period was about 26 days when bred on cabbage. The sex ratio of adults that emerged from field-collected larvae bred in the laboratory was 0.57.

The adult is a grey moth measuring 6-7 mm in length with a wing span of 14-15 mm. The forewing has wavy markings with a distinct kidney-shaped spot at about one-third the length from the apex. In the newly emerged female, these markings were relatively darker than the male. Further, in the female, the terminal segment of the abdomen is long and pointed whereas in the male it is relatively blunt. Adult longevity was about 7 days for both sexes and the shape of the survivorship curve was a Slobodkin's Type 1 (Fig. 1). In most adults, oviposition generally

Table 1. Development of CWW on cabbage under laboratory conditions (28 ± 2°C, 70-90% RH).

Stage	Days (mean ± SD)
Egg	2.89 + 0.41
Larva	
Instar 1	3.00 + 0.00
Instar 2	2.20 + 0.75
Instar 3	3.20 + 0.98
Instar 4	2.00 + 0.63
Instar 5	4.00 + 0.89
Pupa (+ prepupa)	8.50 + 0.58
Total developmental period (egg to adult emergence)	26.00 + 1.15

commenced within 24 hours and might last from 3 to 10 days. The mean number of eggs laid per female was 175 and the mean eggs per day per female was 27. The peak oviposition time was on the second day after emergence (Fig. 1).

Field studies on cabbage cultivated continuously did not reveal any obvious yearly trends. However, peak populations generally coincided with the drier periods of the year, i.e from February to April and June to July whereas the population was low during the wetter periods from September to December. In the field, on a single cabbage crop, the peak population of CWW normally occurred around 40 days after transplanting. The distribution of the larvae per plant is shown in Fig. 2. The mean larval population was normally one per plant with a maximum of nine. Aziz noted that before heading, most of the larvae (88.5%) were found on the peripheral leaves whilst 11.5% were found on the shoot region of cabbage.

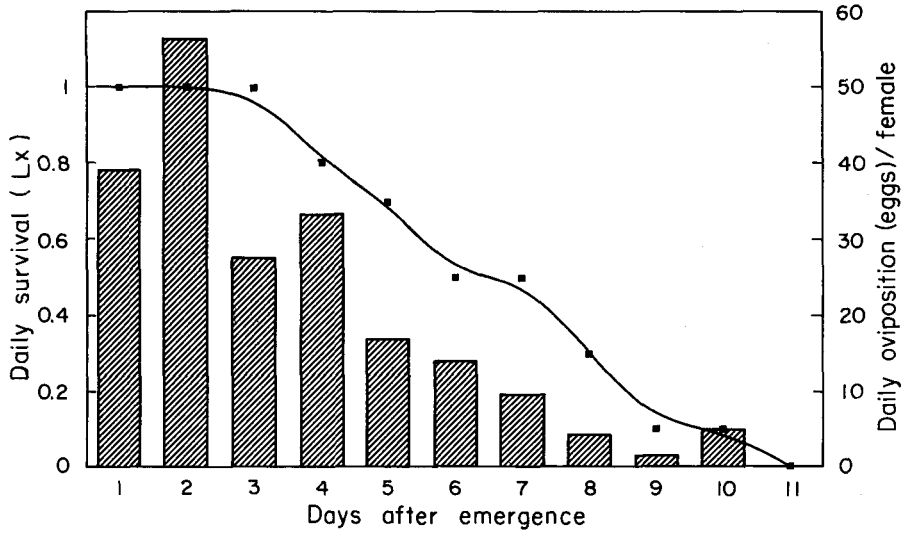

Fig. 1. Survival and oviposition pattern for CWW under laboratory conditions (28 ± 1 °C; 70-90% RH).

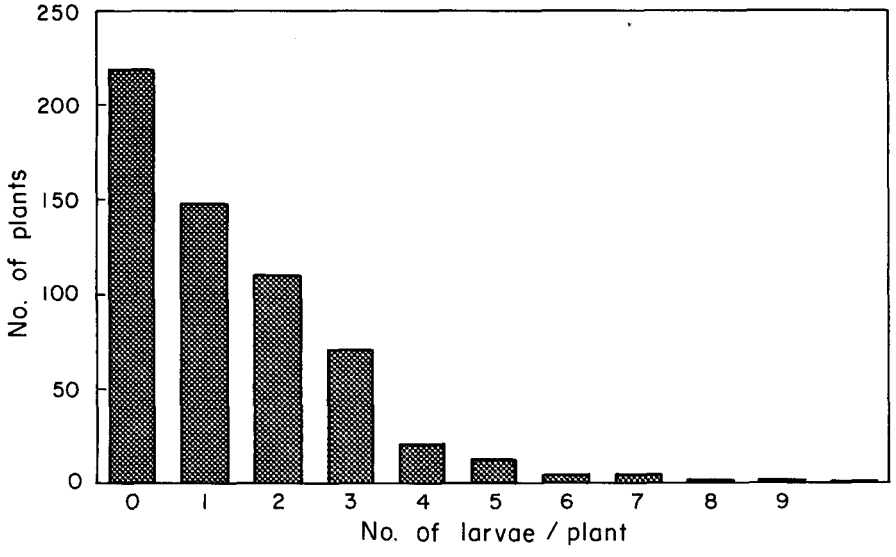

Fig. 2. Distribution of CWW larvae on cabbages.

Control Measures

Insecticides

This is currently the only effective method of control for CWW in the field. Ng (1980) evaluated eight insecticides against CWW on cauliflower and found that sprays of trichlorfon 95 (0.02% ai) and sulprofos (0.10% ai) gave 100% control at 1 and 6 days after initial spraying. There was no significant difference between the different rates tested. Following this MARDI (1981) reported that *Bacillus thuringiensis* Berliner, *B. thuringiensis* + granulosis virus and decamethrin-treated cabbage plots had significantly lower populations and higher marketable heads than in the untreated check plots. However, in the same trial, the virus and dimethoate-treated plots had relatively high populations of CWW (Table 2) vis-a-vis the control plot. In a later trial (MARDI 1986), nine insecticides were evaluated. It was found that CWW can be effectively controlled by shoot treatment carried out at the early stage of plant growth (1-1.5 months after transplanting). The effective insecticides were permethrin, abamectin, teflubenzuron, chlorfluazuron, triflumuron, phenthoate, exthofenprox and l-cyhalothrin. Further screening was done in 1987 using eight insecticides (MARDI 1987), which included abamectin, profenofos, cypermethrin, triazophos, etrimfos, benzoylurea and permethrin. Abamectin was more effective than the other insecticides. In abamectin-treated plots only 2% of the plants were damaged compared to 42.2% and 65.0% in the two control plots. Permethrin which was effective in 1987, however, registered the highest percent damage (15.7%) and the lowest yield (18.6 kg/plot) amongst the insecticide-treated plots (Table 3). Besides permethrin, the use of the other insecticides

Table 2. Efficacy of insecticides and two microbials against CWW in cabbage plots at Jalan Kebun, Selangor, Malaysia.

Treatment	No. insects[a]	No. heads per plot (mean)	% marketable heads
Granulosis virus (GV)	256 c	7.8 b	0.0 b
B. thuringiensis (Bt)	65 d	15.3 a	51.3 a
GV + Bt	71 d	14.5 ab	62.5 a
Deltametrin	84 d	16.8 a	65.0 a
Dimethoate	419 a	8.0 b	0.0 b
Untreated control	330 b	10.3 ab	6.3 b

[a]Population mean for all sampling dates. Numbers followed by the same letter, for a given column, are not significantly different according to DMRT (P = 0.05). Source: MARDI 1981.

Table 3: Evaluation of insecticides for the control of CWW on lowland cabbage based on shoot-tip treatment.

Treatments	No. Larvae per 10 plants (mean)	% damaged plant/plot	Weight of marketable heads (kg/plot)
Abamectin	0.01 c	2.0 c	28.2 a
Profenofos	0.01 c	8.4 c	22.0 b
Cypermethrin	0.02 c	11.0 c	21.6 b
Triazophos	0.02 c	12.5 c	21.5 b
Etrimfos	0.03 c	12.7 c	20.5 b
Benzoylurea	0.03 c	15.0 c	20.1 b
Permethrin	0.03 c	15.7 c	18.6 b
Control A	0.15 b	42.2 b	12.1 c
Control B	0.27 a	65.0 a	5.1 d

Source: MARDI 1987.

such as triazophos, profenofos, fenthion, methamidophos, the IGRs and cypermethrin currently seemed to be fraught with difficulties as they do not provide adequate control of CWW. This suggested that there could be resistance development by this insect to these insecticides. However, this is yet to be confirmed in the laboratory. Fortunately, *B. thuringiensis* is still very effective against this pest. In a recent trial (MARDI 1989), it was found that Thuricide (*B. thuringiensis*, 16,000 IU/mg) and Florbac (*B. thuringiensis*, 8500 IU/mg) shoot-tip treatment gave very good control against CWW. Insecticide application is done weekly starting from 3 to 5 days after transplanting to at least the first 4 weeks until heading. In severe cases, twice weekly applications are done.

Biological control

In Malaysia, there is little information on the natural enemies of this pest. Tan (pers. comm.) recorded an ichneumonid *Trathala flavoorbitalis* as a larval/pupal parasitoid. In field trials, we found a braconid *Bassus* sp. (indet.) emerging from the larva. However, its incidence in the field based on percentage parasitism is low (less than 15%). Lim (1982) reported that *Cotesia plutellae* parasitized CWW under laboratory conditions and attained successful pupation. However, no adult emergence was noted. In the laboratory, we observed a protozoan disease affecting the larval population, especially when the larval food substrate (cabbage leaves) was too moist. Unfortunately, not much is known about this disease.

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