

BIOLOGY OF *Hellula undalis* Fab. (LEPIDOPTERA: PYRALIDAE) ON CABBAGE, *Brassica oleracea* var. *capitata* L. IN THE MID-COUNTRY OF SRI LANKA

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ABSTRACT

Laboratory and field studies on insects infesting cabbage were carried out under insecticide free conditions in the mid-country of Sri Lanka. *Hellula undalis* Fab. (Lepidoptera: Pyralidae) was one of the important species of the pest complex. The average life-span of egg, larva, prepupa and pupa was 3.43, 12.14, 1.6 and 5.43 days, respectively. The pre-ovipositional period was 1.8 -4.0 (mean=3.0) days. The species had the potential to produce 10 to 22 (mean=14) generations per year. The larvae had a characteristic external morphology and behavior. So was the nature of damage they produced.

KEY WORDS: Cabbage, Damage, *Hellula undalis*, Life stages

INTRODUCTION

Cabbage (*Brassica oleracea* L. var. *capitata*), cauliflower (*B. oleracea* L. var. *botrytis*), knolkhol (*Brassica oleracea* L. var. *gongylodes*), radish (*Raphanus sativus* L.) and mustard (*Brassica juncea* L.) are the major cruciferous crops grown in the mid-country region. Cabbage cultivation is the most extensive (Anon, 1992). Pest damage is one of the most devastating problems of crucifers and cabbage borer or web worm (*Hellula undalis* Fab. Lepidoptera: Pyralidae) is an important insect pest of brassicae (Sivapragasam and Abdul Aziz, 1990). Larvae of this pest tend to cause damage throughout the entire life span of the crop and head formation is often affected (Ketipearachchi, 1992a). Farmers regularly spray hazardous insecticides irrespective of the severity of infestation and hence a systematic pest management strategy is necessary (Kodagoda, 1983; Chandrasekara *et al.* 1986). The Integrated pest management (IPM) approach may be the best alternative but this requires an extensive knowledge of the pest complex. Reference on *H. undalis* under the mid country condition is very scarce.

MATERIALS AND METHODS

This study was conducted at the Central Agricultural Research Institute (CARI) (at present Horticultural Research and Development Institute) at Peradeniya, Sri Lanka from 1985 to 1987. Staggered cultivation of cabbage (variety, KY cross) was managed under standard agronomic practices, free of insecticides in the research field. There were 1,175 planting hills at 45 cm x 55 cm spacing and a staggered crop was maintained by planting 175 seedlings randomly at biweekly intervals. Twenty-five 30, 45 and 60 day old plants were uprooted biweekly and examined microscopically for eggs, larvae and pupae of lepidopteran pests. Eggs and larvae of *H. undalis* were collected and reared in the laboratory in ventilated plastic bottles (9x9x13 cm³). Larvae were fed daily with tender cabbage leaves and emerging adults were released into culture cages (90x30x30 cm³), fed with 20% bee honey: water solution and provided with potted

young cabbage plants for oviposition. Thus continuous insect cultures were maintained in the glasshouse.

Eggs and small larvae were measured using microscopic scale disc. The life history was studied in the laboratory using eggs laid in culture cages. Eggs, larvae and pupae were reared in plastic petri dishes (diameter=9 cm.). Larvae were fed daily with fresh cabbage leaves and the frass was removed regularly. Pre ovipositional period was studied by placing individual females with several males in ventilated plastic bottles (9x9x15 cm) and feeding them with 20% bees honey: water solution. Habitat, behavior of larvae and the damage caused were studied in cages and in the field. Mean temperature and relative humidity during the period of study ranged from 22 to 28 (mean=25.8) °C and 61% to 89% (mean=84.3%) respectively.

RESULTS AND DISCUSSION

Plutella xylostella L. (Yponomeutidae), *Crociodolomia binotalis* Zel. (Pyralidae), *Spodoptera litura* Fab. (Noctuidae), *Chrysodeixis eriosoma* Doubl. (Noctuidae) and *Hellula undalis* F. (Pyralidae) were the important lepidopteran pest species identified on cabbage during the period of this study. Severity of damage was highest due to *Hellula undalis* F. Reports indicate that this is one of the most predominant and destructive species of the pest complex of cruciferous crops in the dry zone of Sri Lanka (De Silva, 1960; Ketipearachchi, 1992a and 1992b; Ketipearachchi *et al.* 1992).

Cabbage borer infestation showed seasonal fluctuation throughout the study period. During severe infestation, larval density was higher on 30 and 45 day old plants (before head formation) than on 60-day old plants. Larval population was higher at the growing point particularly on the immature and moderately mature leaves loosely covering the growing point or the developing head (Ketipearachchi *et al.* 1992).

Biology and ecology

Egg: Eggs were mostly found singly, rarely in small groups, near the lateral veins on the lower surface of immature leaves. A group contained 2-6 eggs align or compact to each other. Eggs were bead shaped, 0.42 ± 0.01 mm long and 0.31 ± 0.01 mm wide (N=30). Chorion was rigid, when fresh pale yellow to light gray and later developed a pink tinge and red patches and turned pink to pinkish brown at hatching stage. Bhalani (1984) noted that the eggs were 0.47 mm long and 0.30 mm wide and creamy white when fresh and pink before hatching. Others observed the eggs were oval, 0.44-0.50 mm in length and 0.30-0.35 mm in width light gray to creamy white when fresh and becoming pink later (Rawat *et al.* 1968, Sivapragasam and Abdul Aziz, 1990). The eggs hatched during early hours of the day. Incubation period lasted 3.6-4.6 (mean=3.4; N=30) days. Bhalani (1984) has reported the period as 2-4 days and Rawat *et al.* (1968) as 2-3 days with a viability range of 30 -100%.

Larva: Newly hatched larvae were 1.3 ± 0.03 mm long (N=30). The head of the first instar was wider than the rest of the body. Body was light grey to pale orange with a pink tinge and

BIOLOGY OF *Hellula undalis*

moderately scattered fine hairs. Body was cylindrical with five pairs of prolegs. A fine hair was found in between the longitudinal stripes in each segment. Epicranial suture was very conspicuous on the head. The head and post-occiput were black and the pro thoracic plate becoming black towards moulting. The third instar was more yellowish gray with an orange tinge on the body and with distinct pink stripes. The larva underwent five instars. The well-developed final instar was stout, 12.8 ± 0.5 mm long (N=30), yellow to light gray with a pink tinge on the body. Bhalani (1984) observed that the newly hatched larvae were about 0.9-1.04 cm long and 0.23-0.36 cm wide. It underwent four to five instars. The first instar was creamy white and the body surface moderately clothed with long fine hairs. The second instar was creamy yellow with faint pinkish brown longitudinal stripes, which became more distinct in the third instar. The first instar was creamy yellow with longitudinal stripes. Five purplish to pinkish undulating stripes appeared longitudinally along the body of the second instar larvae; one mid-dorsally, two dorso-laterally and two laterally. The pinkish stripes became more prominent in the third instar. The fourth instar was creamy yellow with a pinkish tinge and five longitudinal stripes on the back getting pinkish brown. Rawat *et al.* (1968) also reported similar results. There were brownish circular minute spiracles just below the lower dorso-lateral stripes, small setae borne on minute tubercles were found sparsely situated over the body. The head was black with prominent inverted V-shaped epicranial suture. The pro-thoracic shield was black, but turned creamy white with small dark spots in the last larval instar. Metcalf *et al.* (1962) and Singh (1984) reported that the larva possessed a black head with pinkish to grayish tinge and seven purplish brown stripes on creamy yellow body. The full grown final instar was 12-17 mm long (Rawat *et al.* 1968; Singh, 1984)

The first and the second instars mined into the mesophile closer to a vein of the leaf and then fed on mesophile leaving the epidermis which later became gray and translucent and visible as patches. The second and later instars burrowed into veins, petiole and main stem at the apex, forming large tunnels, resulting in the cessation of growth, withering of leaves and finally death of the plant. Larvae at times hide inside the silken webbings near a vein, along the petiole or stalk. This was more common especially towards moulting. Larva also folded and webbed the margins of tender leaves to hide. The entrance to larval burrowings were marked with silken webbing and yellowish brown excreta, which later turned brownish black to black in colour. Though the larval population on the crop was low, the damage caused was severe.

Bhalani (1984) reported that the larvae concealed in seedlings by folding a tender leaf and fastening the edges together with a web. During the first two instars, the larvae mined the leaves. The third instar came out of the mine and nibbled the chlorophyll of leaves. The older larvae burrowed deeper into the main stalk. Major damage was caused by destruction of small to medium sized plants. Rawat *et al.* 1968; Sachan and Srivastava, 1972, reported, badly damaged plants showed a number of larval tunnels with yellowish white excreta. Singh (1984) reported, the fungal infection that developed on the excreta and damaged tissues led to fermentation and production of foul odour.

The larval period lasted 6-17 (mean=12.1, N=30) days. Rawat *et al.* (1968) observed that this period varied from 07 - 12 days comprising 2-5 (mean=3), 1-4 (mean=2.06), 1-3 (mean=1.9), 1-4 (mean=2.1) and 1-3 (mean=2) days respectively for the five instar stages. Sivapragasam

and Abdul Aziz (1990) reported 3, 1-3, 2-5, 2-3 and 3-5 days for the five stages. Bouhelier and Hudault (1935) observed that this period ranged from 21-28 days but prolonged up to 7 weeks during colder weather.

Prepupa: Larva became sluggish and contracted during pre-pupal period. The head and legs turned darker brown to black, body became gray and the pinkish stripes disappeared. The pre-pupal period ranged from 1.3-2.0 (mean=1.6; N=18) days. Others reported 1-3 (mean=1.62) days for this period (Rawat *et al.* 1968; Sivapragasam and Abdul Aziz, 1990).

Pupa: Insect pupated in the soil or occasionally in the leaf litter or burrows of the stem. The pupa lived in a silken cocoon, obrect, 9.0 ± 0.54 mm (N=30) long, which was initially orange and later became reddish brown. Rawat *et al.* (1968) and Chitterden and Marsh (1912) observed that the pupation usually occurs in the soil within a flimsy silken cocoon. The pre-pupa was much contracted, less damp and turned opaque creamy white. The longitudinal pinkish brown lines also disappeared. The pupa was about 7-8 mm long, pale yellow but later turned light brown. The pupal period varied from 4.1-8.2 (mean=5.5, N=35) days. Others found this period varied from 5-8.5 days and that adults emerged at midnight (Rawat *et al.* 1968; Sivapragasam and Abdul Aziz, 1990).

Adult: The adult was light grey. The female was darker than the male, 11.2 ± 0.05 mm long with wingspan of 16.3 ± 0.1 mm (N=16), while the male was 8 ± 0.06 mm long with wingspan of 13 ± 0.1 mm (N=10). Forewings were brownish gray to yellowish brown with orange or dark wavy lines, distal end marginated with dark brown specks. Hindwings semihyaline, light gray to white and posterior marginated with a brown band.

Hampson (1896) described the moth as gray and brown well spread with dark reddish brown forewings, with pale dentate subbasal line. Hindwings pale with slight dark reddish brown suffusion on apical area. Hutson (1924) observed that the moth was somewhat smaller than *Crocidolomia binotalis* Zel. (Lepidoptera: Pyralidae) but both species had mottled pale and dark brown forewings and hindwings. Others reported that the adult was a grayish brown moth, 6-8 mm long and 12-16 mm with wingspan (Rawat *et al.* 1968; Sivapragasam and Abdul Aziz, 1990). The forewings are triangular and have gray markings. The moth was somewhat similar but darker and smaller in appearance than the moth of *C. binotalis*.

The pre-ovipositional period ranged from 1.8-4.0 (mean=3) days. Others reported it as 1-2 days (Rawat *et al.* 1968; Sivapragasam and Abdul Aziz, 1990). The oviposition and post-oviposition periods ranged from 1-2 (mean=1.5) and 0-1 (mean=0.7) days respectively. Sing (1984) reported that a female laid 125 -150 eggs during its lifespan. Sivapragasam and Abdul Aziz (1990) reported a female lays 175 eggs per day and peak oviposition being the second day after emergence. Eggs are laid either singly or in small groups up to 20 on both surfaces of leaves but more on lower surface and occasionally on shoots and tender stems (Rawat *et al.* 1968). Chitterden and Marsh (1912) reported that a female would lay about 300-350 eggs. Longevity of female and male moths has been reported to be 3-5 (mean=4.0) and 1-4 (mean=2.2) days respectively (Rawat *et al.* 1968). This study revealed that the lifespan of a generation ranged

BIOLOGY OF *Hellula undalis*

from 16.4 - 35.8 (mean=25.6) days. Rawat *et al.* (1968) and Singh (1984) reported this period as 15-25 (mean=18.5) days and 21-28 days respectively.

Apparently, the incidence of *H. undalis* on the staggered crop was very occasional, probably, due to the influence of natural enemies. This study revealed a high rate of larval parasitism by *Diaeratiella rapae* M'Instosh (Hymenoptera: Braconidae) on the pest (Ketiparachchi, 1992a). Parasitoids of *H. undalis* were extremely scarce during the study period. This may be due to low density and seasonality of the host population. Apparently, the rate of parasitism of *D. rapae* on *H. undalis* was lower than that on diamondback moth and *S. litura* (Ketiparachchi, 1992a). Further, De Silva (1960 and 1961) has reported a high degree of larval parasitism on *H. undalis* by *Apanteles plutellae* Kurdjumov (Hymenoptera: Braconidae) in the dry zone of Sri Lanka. Reports also discuss the influence of natural enemies on population of *H. undalis* in other locations (Rawat *et al.* 1968; Thompson, 1946). Of these, a larval parasitoid *Bracon hebetor* (Hymenoptera: Braconidae) had given up to 33.9% parasitism in India.

ACKNOWLEDGEMENTS

The author acknowledges the Deputy Director (Research) and the staff of the Division of Entomology at HORDI, Gannoruwa, for the facilities and the Natural Resources, Energy and Science Authority of Sri Lanka for the financial assistance provided.

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