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Population Distribution and Identification of Lepidopteran Pests on Cabbage, *Brassica oleracea* Capitata L. in the Mid-Country of Sri Lanka.

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ABSTRACT. Investigations were carried out to identify major Lepidopteran pests and their distribution on cabbage, Brassica oleracea Capitata L. grown under insecticide free conditions in mid-country of Sri Lanka. The major Lepidopteran pests were Plutella xylostella L., Spodoptera litura Fab., Crocidolomia binotalis Zel., Chrysodeixis eriosoma Doubl. and Hellula undalis Fab. Of these, P. xylostella, S. litura and C. binotalis were more predominant than C. eriosoma and H. undalis. The infestations and damages of P. xylostella, S. litura, C. binotalis and H. undalis were more severe at the apex region damaging the growing point in young plants. The damage done by 1-2 mature larvae of H. undalis or S. litura to the growing point of young plants prevented the formation of heads. Two keys were developed to differentiate eggs and larvae of each species by the charactors associated with external morphology and larval behaviour.

INTRODUCTION

Insect pest damage is one of the most devastating problems of production of crucifers in the mid-country of Sri Lanka. Cabbage (*Brassica oleracea capitata* L.), radish (*Raphanus sativus* L.), knoll-khol (*Brassica oleracea gongylodes* L.), cauliflower (*Brassica* oleracea *botrytis*) and mustard (*Brassica juncea* Coss.) are the important crucifers grown in this region. Of these, cabbage is the most extensively cultivated (Anon, 1991). Lepidopteran pests (known as cabbage caterpillars) are the most important of the insect pest complex among cruciferous crops (Anon, 1982; Jasudasan and Yogaratnam, 1984 and 1985; De Silva, 1960). Cabbage suffers from damages by these pests from nursery stage up to

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harvesting and even thereafter (Ketipearachchi, 1992). Farmers mostly rely on hazardous insecticides for their control. These insecticides are applied as regular sprays irrespective of the severity of pest infestations, pre-harvesting safety intervals and adverse effects (Chandrasekara *et al.*, 1986). Apparently, the use of insecticides on cabbage is higher than in any other crucifers (personal observation). Consequences of this reliance on incides demand a sound pest control strategy for crucifers (Kodagoda, 1983; Ponnambalam, 1983). Integrated Pest Management (IPM) is the most suitable approach for pest control in crucifers. IPM approach requires an extensive knowledge on pest complex. Reference on cabbage caterpillars under mid-country conditions is scarce and this work will provide useful information necessary in developing pest management tactics.

MATERIALS AND METHODS

This study was conducted at Central Agricultural Research Institute (CARI), Peradeniya, Sri Lanka. Staggered cultivation of cabbage (variety, KY cross) was maintained in the research field following standard agronomic practices and free of insecticides for sampling. The cabbage field possessed 1175 planting points (at 45 x 55 cm spacing). Thousand seedlings were initially planted in May 1986 and that was followed by planting 175 seedlings randomly in the field at 14 days interval. Sampling was done biweekly, from 30, 45 and 60 day old plants up to January 1987. Each sample contained 25 randomly selected plants of each age group. When sampling, each plant was uprooted and placed in individual polyethylene bags. In the laboratory, each plant was divided into four successive regions, 1-4, from base to apex so that each region contained an equal number of successive leaves. The leaves were examined under the dissecting microscope (10 x 2-5) and numbers of eggs, larvae and pupae of lepidopteran pests found on upper and lower surface of leaves in each region of plant were recorded. Totally, 8 plant samples (altogether 200 plants) were taken from each age group throughout the study. The insect species found were reared in seperate culture cages (90 x 30 x 30 cm) in a glasshouse. The larvae were fed with cabbage leaves while adults were fed with 20% honey in water solution and provided young cabbage plants for oviposition. Eggs collected from culture cages were reared in petri dishes (9 cm dia.) in the laboratory up to adult stage. Larvae were fed daily and frass was removed as necessary. The morphological and behavioural characters

important for the identification of eggs and larvae were studied. Adults were identified with the reference collection of insect museum at CARI, Peradeniya. Representative specimens were sent to International Institute of Entomology, London for identification. The mean temperature and relative humidity during the period of study ranged from 22 – 28 (x = 25.82)^{0}C and 61 – 89 (x = 84.3) percent, respectively.

RESULTS AND DISCUSSION

Five species of lepidopteran pests were identified from the study. They were *Plutella xylostella* L., *Crocidolomia binotalis* Z., *Spodoptera litura* F., *Chrysodeixis eriosoma* Doubl. and *Hellula undalis* F. (Figure 1). During the periods of severe incidence these species infested plants from nursery stage to harvesting and even in storage.

Population distribution of cabbage caterpillars

Plutella xylostella was the most predominant and widespread species throughout the study. The populations of eggs, larvae and pupae of this species found on the total sampled plants of three age groups were 4320, 2900 and 294. Of the egg population, 26, 40 and 34 percents were on plants of 30, 45 and 60 days after planting (DAP), respectively. The leaves in region 2 and 3 of plants in any of the three age groups possessed 70–72% of eggs found in plants of that age. The highest density was observed on region 3 in plants of 30 DAP and on region 2 in plants of 45 and 60 DAP. Fifty percent of eggs were found on upper surface of leaves on plants of 30 as well as 45 DAP and plants of 60 DAP had 66% of its egg population on upper surface of leaves (Figure 2). Of the larval population, 22, 45 and 33 percents were on plants of 30, 45 and 60 DAP, respectively. The highest population was on regions 3 and 4 in plants of 30 and 45 DAP and regions 3 in plants of 60 DAP (Figure 2). Cabbage plants usually commence head formation by about 45 days after planting. Leaves around the forming head tightly cover the apex of plants at 60 DAP and that prevented higher larval infestation at the growing point. Investigations further indicated that larvae preferred immature to mature leaves for feeding. Thus, the growing point of cabbage plant before head formation is more prone to severe larval damages. Of the pupal population, 4, 53 and 43 percents were on plants of 30, 45 and 60 DAP, respectively. Density

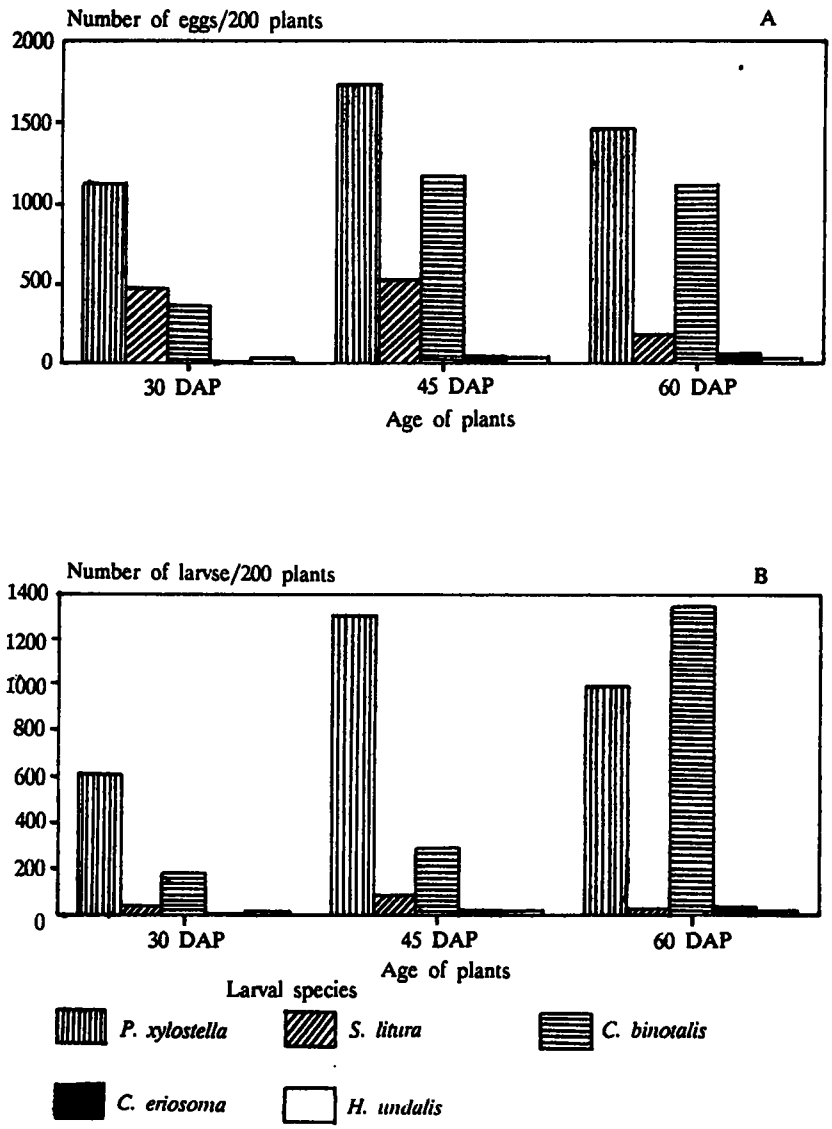

Figure 1. Densities of eggs (A) and larvae (B) of five lepidopteran pests on cabbage plants at 30, 45 and 60 day after planting (DAP).

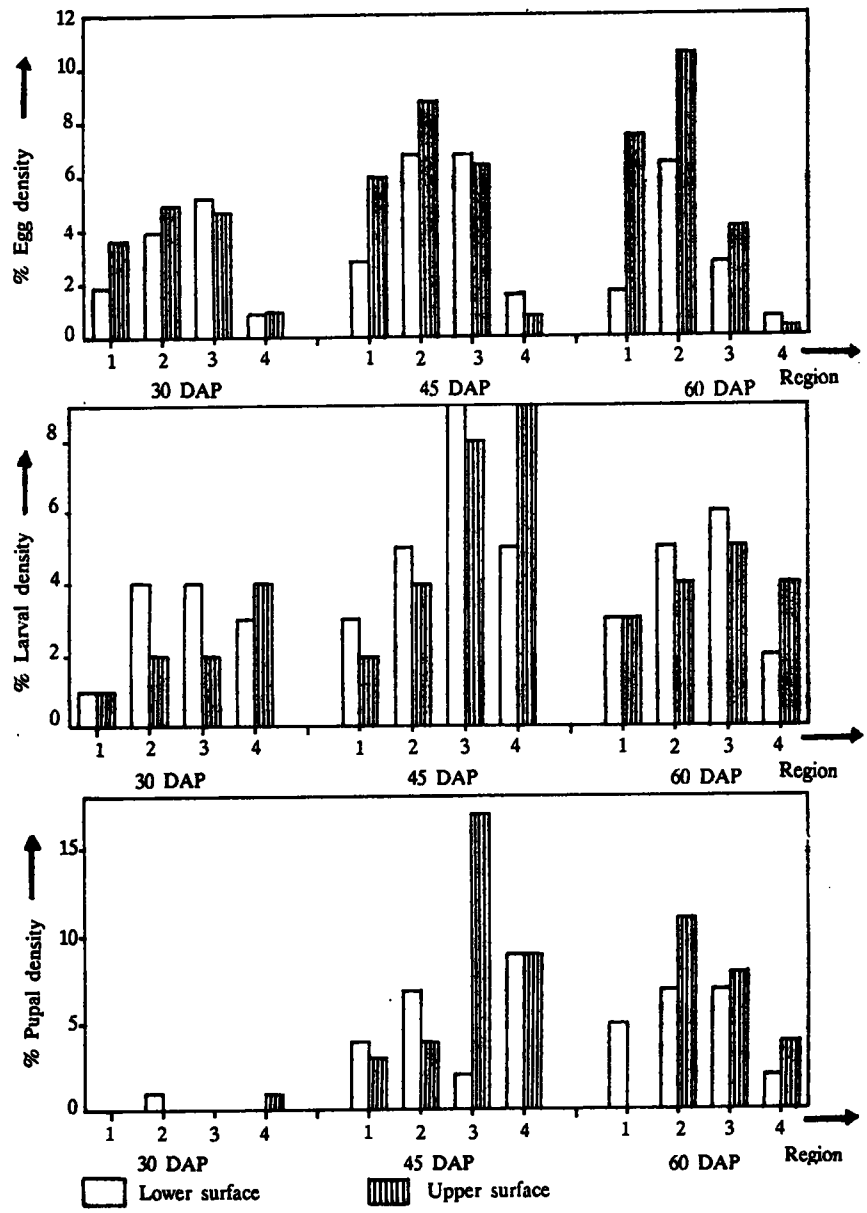

Figure 2. Percentage distribution of eggs, larvae and pupae of *P.xylostella* on lower and upper surface leaves in four consecutive regions of cabbage plants at 30,45 and 60 days after planting (DAP) (200 plants per sample).

was higher on the upper surface than on the lower surface of immature leaves (Figure 2).

Spodoptera litura was the second most predominant and widespread species. Totals of 1206 eggs and 160 larvae of this species were found on the sampled plants. Of these, 40, 44 and 16 percents of eggs were on plants of 30, 45 and 60 DAP, respectively (Figure 1). Eggs were found mostly on the lower surface of leaves. The larval distribution was 28, 54 and 18 percents respectively on plants of 30, 45 and 60 DAP (Figure 3). Investigations further indicated that the larvae infested on young plants before head formation very often destroy the growing points. *Crocidolomia binotalis* was the next predominant and widespread species. Totals of 2676 eggs and 1818 larvae of this species were found on the sampled plants. Of these, 14, 44 and 42 percents of eggs were on plants of 30, 45 and 60 DAP, respectively (Figure 1). The highest egg population was on leaves of region 2 in plants of 45 and 60 DAP. Density of eggs was also higher on the lower surface than the upper surface. Of the larval population, 10, 16 and 74 percents were on plants of 30, 45 and 60 DAP, respectively (Figure 4). The highest population was on immature leaves (region 4) in plants of 30 and 45 DAP and region 3 in plants of 60 DAP. However, larval damage destroyed the growing point of any infested plant of these ages.

Eggs of *Chrysodeixis eriosoma* were found on the lower surface of immature and moderately mature leaves. Populations of eggs and larvae were higher on plants at head forming stage (45 DAP) and thereafter (Figure 1). Larvae usually move about on moderately mature leaves.

The eggs of *Hellula undalis* was found on the lower surface of immature leaves. Higher eggs and larval population was observed on plants of 30 and 45 DAP than that on plants of 60 DAP (Figure 1).

These investigations further indicated that *Plutella xylostella, S. litura* and *C. binotalis* were the most abundant pest species. Apparently the occurrence of *C. eriosoma* and *H. undalis* was very low. It was also observed that the damage at apex region of young plants by 1–2 maturing (third and above instar) larvae of *S. litura* or *H. undalis* prevented head formation.

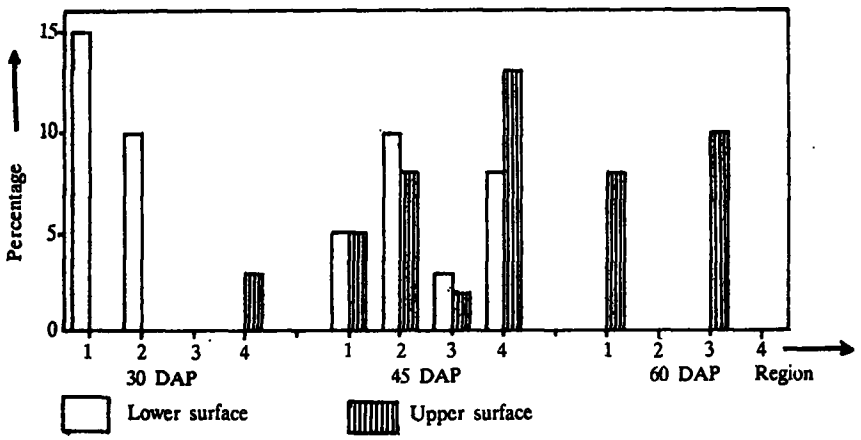

Figure 3. Percentage distribution of *S. litura* larvae on lower and upper surface of leaves in four consecutive regions of cabbage plants at 30,45 and 60 days after planting (DAP) (dats of 200 plants of each age group).

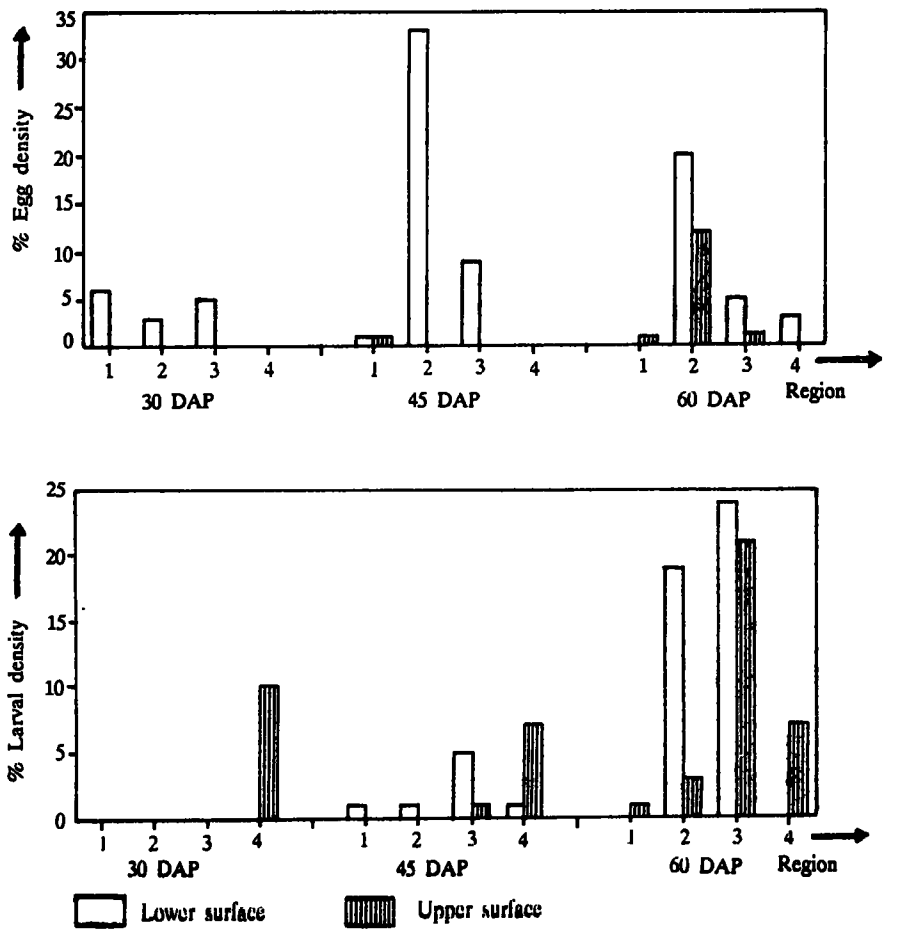

Figure 4. Percentage distribution of *C. binotalis* eggs and larvae on lower and upper surface of leaves in four consecutive regions of cabbage plants at 30, 45 and days after planting (DAP) (200 plants per sample).

Identification of cabbage caterpillars

Based on morphological and behaviourial characters of lepidopteran pest complex the following keys were devised to differentiate the species at their immature stages.

Key to the identification of eggs:

1a. Eggs are found as egg masses covered with hair scales or glued material. _____ 2

1b. Eggs are found singly or occasionally in groups of few numbers, not covered with scales or glued materials. _____ 3

2a. Egg masses covered with scales of dull orange to dull reddish brown, eggs are superimposed in the egg mass on several layers progressively in decreasing extent. Eggs are spherical with a shiny chorion, when fresh light grey to light yellow orange and turns brownish or bluish grey dorsally and paler in colour ventrally near hatching. _____ *S. litura*

2b. Eggs are found in a scale like single layered compact cluster covered by a guide substance. Eggs in the cluster are flattened oval, yellow to white when fresh, turn grayish red or reddish brown near to hatching. _____ *C. binotalis*

3a. Eggs are oval, elongated oval or bead shape. _____ 4

3b. Eggs are hemispherical or spherical. _____ 5

4a. Eggs are oval or elongated oval, about 0.37 $\pm$ 0.01 mm long yellow or white at oviposition and dull reddish brown near hatching. _____ *P. xylostella*

4b. Eggs are bead shaped and about 0.41 $\pm$ 0.01 mm long, pale yellow, yellowish white or grey when fresh, but later develop red or pinkish spots or stripes on the chorion. They are pink near to hatching. _____ *H. undalis*

5. Chorion is rigid and sculptured with vertical ribs, grey, yellowish white or white when fresh, later turns light grey or bright white near hatching. _____ *C. eriosoma*

Key to the identification of larvae:

1a. Larva with subcylindrical body and five pairs of guied prolegs in the abdomen. _____ 2

1b. Body tapers towards the anterior end and enlarges at the posterior end, possess three pairs of prolegs. Median half of the body without prolegs is humped up at rest or moving. Larva light green with faded whitish stripes on the body full grown upto about 30 ± 0.5 mm long. _____ *C. eriosoma*

2a. Larva with five longitudinal stripes on the body. _____ 3

2b. When disturbed larva shows response of wriggling and dropping down with a silken thread. First instar pale white or pale yellow with brown head which turns black closer to molting. Body surface smooth with short scattered bristle hairs, full grown upto 9.05 ± 0.18 mm long, head capsule pale yellow to pale brown, the body varies from pale yellow to green. Setae on the body are stout and black. _____ *P. xylostella*

3a. Larva is creamy yellow and stripes on the body are pink or purple. Head and prothoracic plate black and glossy. Larvae are less gregarious.

Young larva light grey to pale orange with a pinkish tinge and undulating stripes on the body, lives usually in tunnels made up by burrowing, closely fastening or folding leaves or silken webbings. When full grown the larva is stout and about 12.8 ± 0.53 mm long, yellow to light grey with pinkish tinge on the body. Live usually in burrowing of main stalk. _____ *H. undalis*

3b. Larva is yellow, green, dark brown with white, yellow or orange longitudinal lines on the body. _____ 4

4a. Young larva is green to brownish green and old larva is black brown. A pair of black spots is found dorsolaterally on the first and the eighth abdominal segments on young larvae. Larva has a stout body with well marked inverted V-shaped epicranial suture. First instar larva initially gregarious, greenish grey to olive grey. Second and above instar larva has yellow to orange longitudinal lines on the body each on middorsal, dorsolateral and ventrolateral in each side, dark brown to brownish grey longitudinal band lies laterally on the body. When full grown 36.64 $\pm$ 1.22 mm long with stout, dull brown body with some black segmental spots dorsolaterally. _____ *S. litura*

4b. Larva is pale green to yellowish green with broad grey or greenish grey lateral band on slender body. Larvae are usually gregarious and associated with silken webbings.
Head and prothoracic plate yellowish brown to dull brown. Prothoracic plate turns black closer to molting. Stripes on the body are white or yellowish white; three dorsally and each laterally on either side, the middorsal line is very narrow. Full grown upto 20.8 $\pm$ 0.4 mm long. _____ *C. binotalis*

CONCLUSIONS

The two keys developed can be used to differentiate eggs and larvae of each species by the characters associated with the external morphology and larval behaviour. These could be validated with further studies but at present used for taxonomic purposes and understanding the pest complex.

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