DISCUSSION

BIOLOGY:

Trichoplusia ni belongs to the family noctuidae of order Lepidoptera was observed for the first time to infest the cabbage crop in western Uttar Pradesh as such know published work is available on its nutritional studies and pest control.

A. Utilization of Food:

According to the liver body weight, the average of an individual caterpillar of *Trichoplusia ni* per day consumption successively increase from Ist to VIth instar. The female caterpillar consumed less food than male, which indicates the lower metabolic activity in female than the male, the consumption of food during the last two instars estimated to be 80-96 of the total consumption, on an average basis. The consumption of maximum amount of food in the last instar shows that for histogenesis, cocoon and for future development lot of food energy required in the non feeding pupal stage.

Such observations in *Trichoplusia ni* are in agreement with the Mc Ginnis and Kasting (1959), Waldbauer (1968), Kogan and Cope (1974), Mathavan and Bhaskaran (1975), Bailey and Muker ji (1977), Reddy (1983), Sharma and Tara (1988). Butter and Singh (1969), Mohite *et al.* (2004).

A successive increasing of tissue growth (TG) from Ist to Vlth instar, leading to the maximum at the last instar has been observed from the caterpillar of *Trichoplusia ni* fed over the cabbage. The studies of Kasting and Mc Ginnis (1959), Mathavan and Pandian (1974), Bailey and Singh [(1977), Vats and Kaushal (1981) and Benerjee and , Haque (1984), Mohite *et al* (2004) support to the present study. Sharma and Tara (1988), though recorded a successive increase in tissue growth from Ist to IVth instar of a noctuid but observed a greater part in the value of tissue growth in the last Vth instar. Yet Chaudhary *et al.* (2001), Deering *et al.* (2002), Ramesh and Gupta (2004), reported that the fluctuations in abiotic factors play an important role on the tissue growth. In the present investigation female caterpillar is

inferior in tissue growth over the male on live weight and energy basis having minimum tissue growth at the last instar stage, where as on dry weight basis the last instar of female supersedes the male.

On an average, the caterpillar of *Trichoplusia ni* exhibit gradual increase in food egestion from Ist to VIth instar. Such observation have been supported by several workers Kasting & Mc Ginnis (1959), Chlodney (1967), Schroeder (1972), Mathavan and Pandian (1974), Axelesson *et al.* (1975), Bailey (1983) Mohite *et al.* (2004) however, Sharma and Tara (1988) reported a sudden in egesta in the last instar larvae of a noctuid. In the present study the egestion observed higher in male than the female from IInd to VIth instar.

The rate of assimilation also show successive increase from 1st to last instar in *Trichoplusia ni.* Bailey and Mukerji (1977), Mackey (1978) and Vats and Kaushal (1981), also recorded similar observations. However Vats *et al* (1977), observed minimum assimilatory values during the last instar stage of *Pieris*

brassicae. The males of *Trichoplusia ni* have higher assimilatory values of the females on live and dry weight basis, but on the caloric basis the females have little higher assimilatory values over the males. This observation is in conformity with Singh *et al.* (1976) and Vats and Kaushal (1981).

A measure amount of assimilated food has utilized in the metabolic activities to support the growth and maintenance of the body of larva.

B. Growth Efficiencies:

The efficiency of conversion of ingested food (ECI) in *Trichoplusia ni* successively increases from Ist to IIIrd instar, while fluctuated in the IVth to VIIth· instar, with a sudden decline in the last instar in both the sexes on live, dry weight and energy basis. Sharma and Tara (1988), such observations supported by Danks H.V. 2001. Mukerji and Guppi (1970), studied low ECI values in the Vth and VIth instar stages. Kogan & Cope (1974), obtained constant values till Vth instar stage but sudden decline started in the VIth instar. Bhattacharya & Pant

(1976), mentioned the gradual increase in ECI values from Ist to last instars. However Banarji & Haque (1984), studied that the ECI values continuously increase with the age of larva except in VIth larval stage which shows considerable decrease. The decrease in the value of ECI at the last instar stage in general is due to last caterpillar's preparedness for entering into pupation, SooHoo and Fraenkel (1966). Evans (1939a,b), Mc Ginnis and Kasting (1959) have considered a gradual decline in ECI values. However, Schroeder (1971, 1973), Bailey & Singh (1977), and Mackey (1978) concluded that no set pattern could be evolved for ECI in their respective studies. In Lepidoptera, ECI may increase, decrease or show a little change with fluctuations.

The efficiency of conversion of digested food (ECD) in *Trichoplusia ni*, successively increase upto IIIrd instar and fluctuated in the later instars. Similar observations have also been reported by Mukerji & Guppy (1970), Latheef and Harcourt (1972) and Banerjee and Haque (1984). However Vats and Kaushal (1981) reported that ECD decreases from Ist to IVth instars and then show a

sudden increasing trend in Vth instar. Waldbauer (1968), has not agreed with the declining trend in EGD. Sharma & Tara (1988) mentioned a successive increase in EGO upto IVth instar, while with very high decrease in the v» instar of a noctuid. The decreasing trend of EGO in the last stage of *Trichoplusia ni* is probably due to the approach of the larva towards the pupation as reported by SooHoo and Fraenkel (1966).

For expressing the digestiveness of food material earlier workers used terms like coefficient of utilization (Evance 1939 a,b) and digestion coefficient of digestibility House (1965) but Waldbauer (1968) correcting the nomenclature expressed it as approximate digestibility (A.D.) the term which has been used in the present study. The lepidopterous larvae show a declining trend of A.D. from Ist to last instar (Waldbauer 1968; Mukerjee and Guppy 1970, Vats & Kaushal 1981 and Banerjee & Haque 1984). The present observation is know exception to this rule as different gradients for both the sexes. The Ist & IInd instar larvae feed on the soft parenchymatous tissues whose cells are easily

broken and digested, but as the larva grows it starts feeding more & fibrous part of the leaf, such as veins, which results into decline of A.D. in the successive instars. Similar views has given by Latheef and Harcourt (1972). Exceptionally, Sharma and Tara (1988) reported and increasing trend of A.D., though fluctuating, from Ist to last instar noctuid larvae. In *Trichoplusia ni* declining has also been observed from Ist to last instar.

The larva of *Trichoplusia ni* observed with almost constant growth (ate (G.R.) during its Ist three instars which fluctuates in the last three instars and decline to the minimum in its last instar on an average live weight basis. Almost similar observations are made by Sharma & Tara (1988), further, the studies on dry weight and caloric basis reveal that the caterpillar shows successive increase in G. R. upto IInd in star and later on gradual decrease leading to the minimum in the VIth instar. The minimum G.R. value in the last caterpillar is due to the process of histogenesis and histolysis which occur side by side in the larva while entering into the pupal stage. Kogan and Cope (1974) described that the G.R. with an

uniform increase of weight, is independent of the developmental stage. Scriber and Siansky (1981) also stated that G.R. may be one of the useful parameters for the preferential feeding amongst different diets.

The consumption index (CI) observed in perfect declining order from Ist to VIth instar of *Trichoplusia ni,* as also observed by Sharma & Tara (1988) in another noctuid Waldbauer (1964) mentioned that CI on live, dry weight and energy basis signifies two different biological meanings, CI at the fresh weight is probably more meaningful of behavioural response of the animal against the food, where as, the dry weight CI defines a nutritional response. The present study shows that CI dry is higher than CI live in Ist 4 instars but Vth & VIth instars show that CI dry is lower than CI live. SooHoo and 'Fraenkel (1966) found CI dry always higher than CI live. However Kogan and Cope (1974) observed, CI l live weight is greater than CI dry.

C. Food Energy Budget:

The food energy budget of caterpillars of

Trichoplusia ni show that the male larva consume and egested more of calories than the female 'where as, the female larva assimilated more of calories (50.21% of ingested biomass) than the male (40.02% of ingested biomass) throughout its larval stage. Following the consumption and egestion, tissue growth also remained higher in the male than the female. Such stored energy in the form of T.G. remained available to the next trophic level. It was also observed that the female larva of *Trichoplusia ni* spent more energy in metabolic activities than the male. Vats *et al* (1977) estimated food energy budget of a Lepidopterous larva and found assimilation to be 6 times more than the egesta. However Bailey & Singh (1977) observed more of the ingested energy commercial into egesta than the assimilatory energy in a noctuid caterpillar.

The caloric values of various developmental stages, feaces and the host plant leaves for *Trichoplusia ni* fed ovar cabbage can be arranged in the following descending orders.

Larva > pupa > adult > host plant leaves > faeces.

The more calories in the larval stage is probably due to a greater amount of fat in the larva as also reported by Schroeder (1973), Migula (1975), Bailey & Singh (1977), Mackey (1978) and Vats and Kaushal (1981).

TOXICOLOGY:

As for pest management of *Tricoplusia ni* the synthetic as well as herbal pesticide are used. It has been observed that indiscriminate and regular use of synthetic pesticides have caused immense damages to agro-ecosystem. Addition of chemical pesticides reduce or eliminate natural predators of pests and biomagnify themselves through food chains causing serious health problems in animals and human beings.

The resistance developed among the target pest population due to repeated application of pesticides in higher dosage, their rising cost and eco-friendliness laid to a public opinion against the use of chemical pesticides in crop protection.

Therefore there is need to adopt eco-friendly agro-practices for preserving environment and protecting human health by reducing the use of toxic chemical pesticides and replacing them by botanical and microbial pesticides to the extent possible (Tripathi and Tripathi, 2000).

Results of the present study on the evaluation of pesticidal properties of synthetic pesticide (endosulphan) and plant extract (*Parthenium hysterophorus*) against the insect pest (Tricoplusia ni) have been discussed. Evaluation of LC_{50} of a biocidal compound is one of the pre-requisite for the toxicological study. The LC_{50} (median lethal concentration) represents the amount of poison needed to kill 50% of animal population.

According to present investigation, for the determination of LC_50 value of endosulphan (35% EC) different concentration had been treated against the 3^{rd} instar larvae of Tricoplusia ni.

The different concentration of endosulphan (35% EC) were taken as 100, 200, 300, 400, 500, 600, 700,

800 and 1000ppm. It is evident from the Table (XIII) that LC_{50} is 434.02.

In the present investigation LC_{50} values of alcoholic and acetone leaf extracts of *Parthenium hysterophorus* in different concentration had been treated against the 3rd instar larva of Tricoplusia ni.

The different concentration of acetone and alcoholic leaf extract were taken as 200, 500, 1000, 2000 and 3000 µg/ml. It was evident that LC_{50} of acetonic and alcoholic extract were 2082.23 and 1644.15 respectively.

The insecticidal properties of *Parthenium hysterophorus* have been studied by Isman and Rodriques (1983), Nand Kumar *et al.* (1980), Rajendra and Gopalan (1979), Rajkumar and Nand Kumar (1984) and Sharma and Joshi (1977). According to their observations it clearly shows that *Parthenium hysterophorus* contains a variety of chemicals which may interfere with growth and development of insect resulting in resistance of this plant to insect attack. Also, the allomonic properties of *Parthenium hysterophorus* in

protecting this plant against insect attack has been discussed by Sharma and Joshi (1997). *Parthenium hysterophorus* contains parthenin which is a sesquiterpene lactone (Haque *et al.*, 1984; Maldonado *et al.*, 1985; Patil and Hedge, 1988). It has feeding deterrent property and also show oral toxicity to insects. *Parthenium hysterophorus* at 100ppm was found to be anti-feedant for *D. koenigi, Aedes aegypti* Linn, *T. castaneum, Periplanata Americana* and *Phthroimaea apercullella* (Zeller). In addition to this the leaf extracts of this plant also show insecticidal property for some insects (Nand Kumar *et al.*, 1980; Devi *et al.*, 1981; Raj Kumar and Nand Kumar, 1984; Bhaduri *et al.*, 1985).

On the basis of present investigation it is concluded that synthetic pesticide (endosulphan) is most toxic in comparison to acetone and alcoholic leaf extracts of *Parthenium hysterophorus*.

The growing awareness of pesticides hazards as a result of extensive and indiscriminate use of synthetic pesticides had led the scientist to search for safer and

more eco-friendly pest control agents of plant origin.

On the basis of above discussion and present investigation, it can be concluded that although the synthetic pesticide (endosulphan 35% EC) is most toxic and effective than plant extract (*Parthenium hysterophorus*) against the *Tricoplusia ni* but, it can be suggested that plant extract (*Parthenium hysterophorus*) can be used in place of the highly toxic synthetic pesticide because of its safety to beneficial insects (pollinators) and its lower cost.

The treatment of plant extracts gives higher yield and posed less hazards to natural enemies and therefore indicates their suitability for inclusion in integrated pest management.