J. Biol. Control, 23(1): 57-61, 2009

# Key mortality factors of *Spodoptera litura* (Fabricius) and *Trichoplusia ni* (Hübner) infesting cabbage

**D. D. PATAIT, S. S. SHETGAR, A. G. BADGUJAR, S. S. DHURGUDE and P. K. NALWANDIKAR**
Department of Agricultural Entomology, College of Agriculture,
Marathwada Agricultural University, Latur 413512, Maharashtra, India.
E-mail: ddpatait@yahoo.co.in

**ABSTRACT:** ***Spodoptera litura*** **(Fabricius) passed through one generation each during rainy and winter seasons on cabbage, while** ***Trichoplusia ni*** **(Hübner) completed two generations only during rainy season, at College of Agriculture, Latur.** ***Apanteles*** **sp., green muscardine fungus and an unidentified tachinid fly were the major mortality factors of** ***S. litura*** **and** ***T. ni*** **infesting cabbage during rainy season and** ***Campoletis chlorideae*** **during winter season. In addition to the above, unidentified parasitoids, white muscardine fungus and NPV were also identified as key mortality factors of** ***T. ni.***

**KEY WORDS**: Cabbage, key mortality factors, *Spodoptera litura*, *Trichoplusia ni*.

## INTRODUCTION

*Spodoptera litura* (Fabricius) and *Trichoplusia ni* (Hübner) are important pests of cabbage. Krishnaiah and Bhaskaran (1988) reported *S. litura* as a major pest of cabbage. Prasad (1963) recorded 70.63 per cent damage to cabbage due to *Trichoplusia ni*. A key mortality factor is useful in predicting future trends in the population of a pest (Morris, 1959). Zaz and Kushwaha (1983) recorded natural enemies like *Telonomus* sp., *Trichogramma chilonis, Microplitis* sp., and *Peribaea orbata* on *S. litura* infesting cabbage. It was observed by Chamberlin and Kok (1986) that *T. ni* infesting cabbage was parasitized by a tachinid, *Voria ruralis*. The present investigation provides information on the role of key mortality factors in the population fluctuations of *S. litura* and *T. ni* in the field, which could aid in developing biocontrol programmes for these pests.

## MATERIALS AND METHODS

A non-replicated field experiment on life tables and key mortality factors of *S. litura* and *T. ni* infesting cabbage was conducted at the farm of College of Agriculture, Latur, during rainy and winter seasons of 2006-07. The experiment comprised of 60 quadrats, each measuring 2.25 x 2.25 sq. m. The variety Golden Acre was transplanted with a spacing of 60 x 60 cm.

Four-week-old seedlings were transplanted from seed bed to main field. Frequent field visits were made in order to record the first incidence of *S. litura* and *T. ni* infesting cabbage based on observation of eggs. The observations were made twice in a week. Known numbers of eggs were collected along with the plant material. On hatching the tiny larvae were reared in small plastic boxes individually on cabbage till the cessation of pest population in the field. This laboratory culture was used as a check culture for deciding on the number of regular generations of the pests in the field conditions. The sampling of early and late instar larvae was done on the basis of development of the pests in laboratory reared culture. At each observation, five quadrats were carefully examined twice in a week for the number of larvae of target pests. The field collected larvae were brought to the laboratory and reared on cabbage. This was referred to as field culture. Fresh cabbage leaves were provided as and when required. The culture was reared till adult emergence.

Observations were made on larval and pupal parasitism and mortality due to unknown reasons during early and late instars and pupal stages. An interval of four to six days was provided before sampling eggs of the next generation after the adult emergence of the previous generation. This period was considered as completion of the pre-oviposition period by the moths of the previous generation. The life tables were constructed based on the studies by Morris and Miller (1954) and Harcourt (1969) as detailed below.

---

* Part of M.Sc. (Agri.) dissertation submitted by first author to Marathwada Agricultural University, Parbhani during 2007.

| | | |
|---|---|---|
| x | – | the age interval of egg, larva, pupa and adult |
| $l_x$ | – | the number surviving at the beginning of stage noted in the 'x' column |
| $d_x$ | – | the number dying within the age interval stated in the 'x' column |
| $d_xF$ | – | the mortality factor responsible for '$d_x$' |
| 100 $q_x$ | – | percentage mortality |
| $S_x$ | – | survival rate within the age mentioned in the 'x' column |

The '$l_x$' for eggs was derived indirectly. The viability was determined on the basis of field collected eggs and the '$d_x$' value worked out. The trend index was simply '$l_x$' for the early instar larvae in the next generation expressed as a ratio of previous generation. It was calculated by using the formula 'N2 /$N_1$' where $N_2$ is equal to the population of early instar larvae in next generation and $N_1$ is equal to the population of early instar larvae in previous generation. The generation survival was an index of population trend without the effect of fecundity and adult mortality. It was calculated by using the formula '$N_3$ /$N_1$' where $N_3$ is equal to population of adults in a generation and $N_1$ is equal to population of early instar larvae in the same generation.

A separate budget of each generation was prepared to find out the key factors that influenced the population trend in different generations of the lepidopterous pests of cabbage under investigation. The method of key factor analysis developed by Varley and Gradwell (1963, 1965) was used to detect density relationship of mortality factors. By this method, the killing power (K) of such mortality factors in each age group was estimated as the difference between the logarithms of population density of the killing power of 'k's.

## RESULTS AND DISCUSSION

***Spodoptera litura* (Fabricius)**

*Spodoptera litura* passed through only one generation each during both the seasons. During rainy season, the mortality of early and late instar larvae of *S. litura* was found to be 21.59 and 25.97 per cent due to *Apanteles* sp. and unknown reasons, respectively. However, early and late instar larvae were killed to an extent of 9.36 and 5.01 per cent, respectively, due to green muscardine fungus and an unidentified tachinid fly. Pupal mortality of 27.78 per cent was observed due to unknown factors during the same season. During winter, *Campoletis chlorideae* and unknown factors caused mortality to an extent of 16.69 and 20.04 per cent, respectively, of early instar larvae of *S. litura*. No mortality of late instar larvae and pupae was observed during winter 2006. Population growth of *S. litura* infesting cabbage ceased in succeeding generations during both the seasons (Zero trend index) (Table 1).

The generation survival was 0.37 and 0.67 during rainy and winter seasons, respectively. The K values of 0.1413 and 0.1764 indicate the highest mortality in early instar larvae during both the seasons. *Beauveria bassiana* (Rangaswamy *et al.*, 1968) and nuclear polyhydrosis virus (Battu *et al.*, 1977) were reported to be important mortality factors of S. *litura* on groundnut.

***Trichoplusia ni* (Hübner)**

Two generations of *T. ni* were observed on cabbage during rainy season 2006. However, it did not appear during winter 2006. The early and late instar larvae were found to be parasitized to the tune of 21.86 and 37.93 per cent by *Apanteles* sp. and unknown reasons, respectively, in the first generation. The early instar larvae were also killed to the extent of 1.67, 8.74 and 3.71 per cent due to *C. chlorideae,* unidentified parasitoids and white muscardine fungus, respectively, in the first generation. However, an unidentified tachinid fly and NPV caused the mortality of late instar larvae to the extent of 9.08 and 6.68 per cent. The pupal mortality was observed to be 11.53 per cent. The negative trend index (0.23) revealed that the mortality factors operating during the first generation were effective in suppressing the population of *T. ni* in the next generation (Table 2).

In the second generation, early instar larvae were parasitized by *Apanteles* sp. (6.27 per cent). However, early and late instar larvae were killed to the extent of 28.80 per cent due to unknown factors. The pupal mortality due to unknown factors was found to be 9.12 per cent. The population growth of *T. ni* ceased (zero trend index) after second generation.

The generation survival was 0.33 and zero in the first and second generations during rainy season. The maximum contribution towards generation mortality came from early instar larvae in both the generations (0.3079 and 0.0904). Joshi and Sharma (1974) also recorded the parasitization of *T. ni* infesting cauliflower to the extent of 25 per cent by *A. plutellae*. Chamberlin and Kok (1986) observed 27 and 17 per cent parasitization of *T. ni* infesting cabbage by a tachinid, *Voria ruralis*.

## REFERENCES

Battu, G. S., Dilawari, V. K. and Bindra, O. S. 1977. Investigations on microbial infections of insect pests in Punjab-II. *Indian Journal of Entomology*, **39**: 271-280.

Chamberlin, J. R. and Kok, L. T. 1986. Cabbage lepidopterous pests and their parasites in Southwestern Virginia. *Journal of Economic Entomology*, **79**: 629-632.

**Table 1. Key mortality factors of *Trichoplusia ni* on cabbage in 2006**

| Age interval | Number alive / ha at the beginning of x | Factors responsible for $d_x$ | Number dying during x | $d_x$ as % of $l_x$ | Survival rate at age x | Budget | |
|---|---|---|---|---|---|---|---|
| | | | | | | Log No./ ha | 'k' values |
| x | $l_x$ | $d_xF$ | $d_x$ | 100 $q_x$ | $S_x$ | | |
| First generation during rainy season | | | | | | | |
| Expected eggs | 7572 | Sterility | 757 | 10.00 | | 3.8792 | – |
| Viable eggs | 6815 | – | | | | 3.8335 | 0.0457 |
| Larval population | | | | | | | |
| Early instar larvae ($N_1$) | 6815 | *Apanteles* sp. | 889 | 13.04 | | 3.8335 | 0.0000 |
| | 5926 | *Campoletis chlorideae* | 99 | 1.67 | | | |
| | 5827 | Unidentified Parasitoid | 99 | 1.70 | | | |
| | 5728 | Unidentified Parasitoid | 198 | 3.46 | | | |
| | 5530 | Unidentified Parasitoid | 198 | 3.58 | | | |
| | 5332 | White Muscardine Fungus | 198 | 3.71 | | | |
| | 5134 | Unknown reasons | 1580 | 30.77 | | | |
| Late instar larvae | 3354 | *Apanteles* sp. | | 8.82 | 0.76 | 3.5256 | 0.3079 |
| | 3258 | Tachinid fly | | 9.08 | | | |
| | 2962 | NPV | | 6.68 | | | |
| | 2764 | Unknown reasons | | 7.16 | | | |
| | 2566 | Unknown reasons | | 11.53 | 0.88 | 3.3.4093 | 0.0.1163 |
| | 2270 | Sex 50 % females | | | | 3.3560 | 0.0533 |
| | 2270 | (Reproducing females = 1135) | | | | 3.0549 | 0.3011 |
| Trend index ($N_2/N_1$) | | | 0.23 | – | – | K = 0.8243 | |
| Generation survival ($N_3/N_1$) | | | 0.33 | – | – | | |
| Second generation during rainy season | | | | | | | |
| Expected eggs | 1756 | Sterility | 176 | 10.00 | | 3.2445 | – |
| Viable eggs | 1580 | – | | | | 3.1986 | 0.0459 |
| Larval population | | | | | | | |
| Early instar larvae ($N_1$) | 1580 | *Apanteles* sp. | 99 | | | 3.1986 | 0.0000 |
| | 1481 | Unknown reasons | 198 | | | | |
| Late instar larvae | 1283 | Unknown reasons | 198 | | | 3.1082 | 0.0904 |
| Pupae | 1085 | Unknown reasons | 99 | | | 3.0354 | 0.0728 |
| Moths | 986 | Sex 50% females | | | | 2.9939 | 0.0415 |
| Females x 2 ($N_3$) | 986 | (Reproducing females = 493) | | | | 2.6928 | 0.3011 |
| Trend index ($N_2/N_1$) | | | 0.00 | | | K = 0.5517 | |
| Generation survival ($N_3/N_1$) | | | 0.62 | | | | |

**Table 2. Key mortality factors of *Spodoptera litura* on cabbage in 2006-07**

| Age interval | Number alive / ha at the beginning of x | Factors responsible for $d_x$ | Number dying during x | $d_x$ as % of $l_x$ | Survival rate at age x | Budget | |
|---|---|---|---|---|---|---|---|
| | | | | | | Log No./ha | 'k' values |
| x | $l_x$ | $d_xF$ | $d_x$ | 100 $q_x$ | $S_x$ | | |
| Rainy season | | | | | | | |
| Expected eggs | Not recorded | | | | | | |
| Viable eggs | Not recorded | | | | | | |
| Larval population | | | | | | | |
| Early instar larvae ($N_1$) | 3457 | *Apanteles* sp. | 296 | 8.56 | 0.66 | 3.5387 | 0.0000 |
| | 3161 | Green Muscardine Fungus | 296 | 9.36 | | | |
| | 2865 | Unknown reasons | 593 | 20.70 | | | |
| Late instar larvae | 2272 | *Apanteles* sp. | 296 | 13.03 | 0.78 | 3.3564 | 0.1823 |
| | 1976 | Tachinid fly | 99 | 5.01 | | | |
| | 1877 | Unknown reasons | 99 | 5.27 | | | |
| Pupae | 1778 | Unknown reasons | 494 | 27.78 | 0.72 | 3.2499 | 0.1065 |
| Moths | 1284 | Sex 50% females | | | | 3.1086 | 0.1413 |
| Females x 2 ($N_3$) | 1284 | (Reproducing females = 642) | | | | 2.8075 | 0.3011 |
| Trend index ($N_2/N_1$) | | | 0.00 | – | – | K = 0.7312 | |
| Generation survival ($N_3/N_1$) | | | 0.37 | – | – | | |
| Winter season | | | | | | | |
| Expected eggs | Not recorded | | | | | | |
| Viable eggs | Not recorded | | | | | | |
| Larval population | | | | | | | |
| Early instar larvae ($N_1$) | 593 | *Campoletis chlorideae* | 99 | 16.69 | 0.67 | 2.7730 | 0.0000 |
| | 494 | Unknown reasons | 99 | 20.04 | | | |
| Late instar larvae | 395 | – | – | – | 1.00 | 2.5966 | 0.1764 |
| Pupae | 395 | – | – | – | 1.00 | 2.5966 | 0.0000 |
| Moths | 395 | Sex 50 % females | | | | 2.5966 | 0.0000 |
| Females x 2 ($N_3$) | 395 | (Reproducing females = 198) | | | | 2.2967 | 0.2999 |
| Trend index ($N_2/N_1$) | | | 0.00 | – | – | K = 0.4763 | |
| Generation survival ($N_3/N_1$) | | | 0.67 | – | – | | |

Harcourt, D. G. 1969. The development and use of life-tables in the study of natural insect populations. *Annual Review of Entomology*, **14**: 175-176.

Joshi, F. L. and Sharma, J. C. 1974. New record of braconid, *Apanteles plutellae* Kurdj. parasitising the larvae of *Plutella xylostella* L. and *Trichoplusia ni* Hub. in Rajasthan. *Indian Journal of Entomology*, **36**: 160.

Krishnaiah, P. V. and Bhaskaran, P. 1988. Efficacy of malathion and its combination with dicofol, zineb and urea in controlling major insect pests of cabbage and brinjal. *Pesticides*, **22**: 49-52.

Morris, R. F. and Miller, C. A. 1954. Development of life-tables for the spruce budworm. *Canadian Journal of Zoology*, **32**: 283-301.

Prasad, S. K. 1963. Quantitative estimation of damage to crucifers caused by cabbage worm, cabbage looper, diamondback moth and cabbage aphid. *Indian Journal of Entomology*, **25**: 242-259.

Rangaswamy, G., Ramamoorthy, K. and Oblisami, G. 1968. *Studies on microbiology and pathology of insect pests of crop plants*. Final Report on Agricultural Research Scheme financed by the PL 480 programme.

Varley, G. C. and Gradwell, G. R. 1963. The investigation of insect population changes. *Proceedings, Ceylon Association of Advancement of Science*, **18**: 142-156.

Varley, G. C. and Gradwell, G. R. 1965. Interpreting winter moth population changes. *Proceedings, International Congress of Entomology* (*London*), **12**: 377-378.

Zaz, G. M. and Kushwaha, K. S. 1983. Quantitative incidence of tobacco caterpillar, *Spodoptera litura* (F.) and related natural enemies in cole crops. *Indian Journal of Entomology*, **45**: 201-202.

**(Received: 27-06-2008; Revised: 02-08-2008; Accecpted: 27-08-2008)**