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Key Mortality Factors of *Helicoverpa peltigera* (Denis and Schiffermuller) Infesting Safflower in Marathwada Region of Maharashtra, India

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ABSTRACT

The key mortality factors of *Helicoverpa peltigera* revealed that the mortality in the early instar 13.89 and 3.33 % and; 7.16 and 23.07% owing to unknown reasons and parasitisation of *C. chlorideae* during first and second generations, respectively. However, 6.24 % also died due to infection of NPV. Mortality in the late instar larvae was 17.65 and 30.00 % due to NPV during first and second generations, respectively. Mortality in the pupal stage was found to be 34.77 and 57.14 % due to unknown reasons during first and second generations, respectively. Generation survival (SG) was worked out and it was 0 and 0.21 during first and second generations, respectively.Value of trend index (I) was calculated to the tune 0.38 and 0.42 during first and second generations, respectively.

Key words: *H. peltigera, Safflower, Key mortality, C. chlorideae, Unknown reasons, NPV, Generation survival, Parasitisation, Pupal stage, Trend index, Pupal stage, Instars.*

Introduction

Safflower (*Carthamus tinctorius* L.) belongs to family Asteraceae is originated in the eastern Mediterranean area. It is an important drought tolerant oilseed crop cultivated in arid and semi arid regions of the world. Safflower is usually grown for its seeds and flower petals, which are the source of oil and pigments. A total 101 insect pests have been recorded on safflower throughout the world, however, in India 75 insect species have been reported (Patil and Halloli, 2005). In India, Safflower has been reported to be attacked by 36 species of pests (Bharaj *et al.*, 2003). However, in Maharashtra 12 insect pests are recorded on safflower (Akashe *et al.*, 2013). Out of these the safflower aphid, *Uroleucon compositae* (Theobald), capsule borer, *Helicoverpa armigera* (Hubner), leaf eating caterpillar, *Prospalta capensis* (Guenee) (= *Condica illecta* (Walker)), *Helicoverpa peltigera* (Denis and Schiffermuller) and *Spodoptera litura* (Fabricius) are considered to be major pests of the crop in India. Safflower producers have been greatly affected by *H. peltigera* damage in parallel with the increase in safflower cultivation (Ayten *et al*., 2020).

Key mortality factors may be analysed to determine the stage in the life-cycle contributes the most to the population trend when series of life-tables are available (Deevey, 1947; Harcourt, 1963, 1969 and; Atwal and Bains, 1974). The use of field life-tables has been made for studying the natural population of insect-pests. When the environmental parameters

are related to several causes of mortality, the field life-tables form a budget of the successive process that operates in a given population. Field life-table studies indicate which age interval and independent variable should be studied in detail for the effective control of the pest. It is also important to grasp the real situation of seasonal prevalence of an insect-pest for planning its successful control (Harcourt, 1966, 1969; Morris and Millar, 1954 and; Singh, 1977). The relative abundance of the native parasitoids and their impact on host populations need to be examined for effective management of pests.The information on the key mortality factors in *H. peltigera* during different age intervals and generations in safflower ecosystem of Maharashtra is rather scanty. Hence, the present study to construct the field life-tables of *H. peltigera* on safflower.

Materials and Methods

A no replicated field experiment was conducted at the research farm of Department of Agricultural Entomology, College of Agriculture, Latur, during *rabi* 2020-21. The plot size was 2.70 m x 2.60 sq. m with the variety PBNS-86 (Purna) sown at a spacing of 45 cm x 20 cm. On germination, field observations were made on the first incidence of *H. peltigera* with known numbers of larvae being collected along with the infested leaves as a start of first regular generation. The tiny larvae were reared in plastic vials individually on tender leaves till the cessation of pest population. This laboratory culture was used as a check culture for deciding the number of regular generations in the field conditions.

The sampling of early and late instar larvae was done on the basis of development in laboratory reared culture. At each observation three plots (quadrats of 2.70 m x 2.60 sq. m) were carefully examined twice in a week for number of larvae. The field collected larvae were brought to the laboratory and reared on safflower leaves to maintain the field culture. The food was changed as and when required until adult emergence. Observations were made on the larval and pupal parasitism and unknown reasons in early instars and its late instars and pupal stage as well. An interval of four to six days was provided before sampling of next generation after the mean adult emergence of previous generation. This period was considered for completion of act of oviposition by the moth of previous generation. The newly hatched first instar larvae were collected in subsequent generations. The life-table was constructed based on Morris and Miller (1954) and Harcourt (1969) as below:

X= ageinterval, egg, larva, pupa and adult; lx = number surviving at the beginning of stage noted in 'x' column; dx = number dying within the age interval stated in 'x' column; dxF = mortality factor responsible for 'dx'; 100qx = % mortality; and Sx= survival rate within the age mentioned in 'x' column. The trend index was simply 'lx' for the early instar larvae in the next generation expressed as a ratio of previous generation. It was calculated with the formula N2 / N1 were N2 is equal to the population of early instar larvae in next generation and N1 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 calculated with the formula N3/ N1- where N3 is equal to population of adult in a generation and N1 is equal to population of early instar larvae in the same generation. A separate budget was prepared to find out the key factors that influenced the population trend of pests on safflower. The method of key factors 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 or group of 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

H. peltigera completed two regular overlapping generations on safflower. The results on key mortality factors on safflower in 1st and 2nd generations during *rabi* season 2020-21 are presented in Table 1 and 2.

The mortality in early instar larvae of *H. peltigera* infesting safflower was observed to be 13.89 and 3.33 % and; 7.16 and 23.07% owing to unknown reasons and parasitisation of *C. chlorideae* during first and second generation, respectively. However, the early instar larvae to the tune of 6.24 % also died due to infection of NPV. The mortality in late instar larvae was found to be 17.65 and 30.00 % due to NPV during first and second generation, respectively. The pupal mortality was found to be 34.77 and 57.14 % due to unknown reasons during first and second generations, respectively. The trend index and gen-

eration survival was 0.38 and 0.42 and; 0 and 0.21 during first and second generations, respectively. The maximum generation mortality of *H. peltigera* during first and second generations was registered from pupal stage (k=0.1856 and k=0.3680, respectively). The total 'K' for first and second generations was K=0.6812 and K= 0.9701, respectively.

The negative trend index (0.38) revealed that the mortality factors operated during first generation were effective in suppressing the population of *H. peltigera* infesting safflower in second generation. The zero-trend index revealed that the population of *H. peltigera* infesting safflower was ceased after second generation. Thus, it can be concluded that the key mortality factors *viz*., *C. chloridae*, NPV and unknown reasons controlled the population of *H. peltigera*.

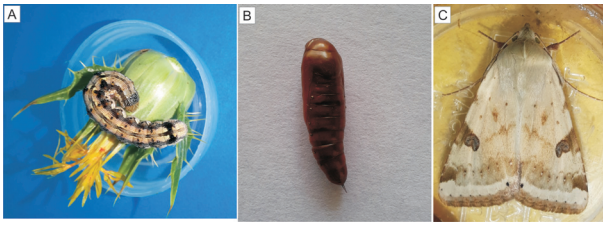

Fig. 1. Life stages of *H. peltigera* (A) Larva of *H. peltigera* (B) Pupa of *H. peltigera* (C) Adult of *H. peltigera*

Table 2. Budget of *H. peltigera* on safflower for first and second generations

Sr. No.	Age interval	'k' values of different generations of *H. peltigera*	
		1st generation	2nd generation
1	Early instar larvae	-	-
2	Late instar larvae	0.1091	0.1462
3	Pupa	0.0854	0.1549
4	Moths	0.1856	0.3680
5	Reproducing females	0.3011	0.3010
	Total 'K'	K=0.6812	K=0.9701

Table 1. Key mortality factors for first and second generations of *H. peltigera* on safflower

Age interval	Number alive/ ha at the beginning of x	Factors responsible for dx	Number dying during x	dx as % of lx	Survival rate at age X
X	lx	dxF	dx	100qx	Sx
Key mortality factors for first generation					
Early instar larvae (N1)	17094	Unknown reasons	2374	13.89	0.77
	15195	NPV	949	6.24	
	14246	*Campoletis chlorideae*	474	3.33	
Late instar larvae	13297	NPV	2374	17.65	0.82
Pupae	10923	Unknown reasons	3798	34.77	0.65
Moths	7125	Sex 50 % Females	-	-	-
Females x 2 (N3)	3562	(Reproducing females=3562)	-	-	-
Trend index (N2/N1)	6647 / 17094	-	0.38	-	-
Generation survival (N3/N1)	7125 / 17094	-	0.42	-	-
Key mortality factors for second generation					
Early instar larvae (N1)	6647	Unknown reasons	476	07.16	0.71
	6171	*Campoletis chlorideae*	1424	23.07	
Late instar larvae	4747	NPV	1424	30.00	0.70
Pupae	3323	Unknown reasons	1899	57.14	0.43
Moths	1424	Sex 50 % Females	-	-	-
Females x 2 (N3)	712	(Reproducing females=712)	-	-	-
Trend index (N2/N1)	0 / 6647	-	0	-	-
Generation survival (N3/N1)	1424 / 6647	-	0.21	-	-

Fig. 2. Parasitisation of *H. peltigera* larva due to *C. chlorideae* and infection by NPV (A) Cocoon of *C. chlorideae* (B) Cocoon and adult of *C. chlorideae* (C) NPV infected larva

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