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Key Mortality Factors of *Prospalta capensis* (Guenee) Infesting Safflower

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ABSTRACT: Life tables are a method for tracking population birth and death rates over time. They can also be used to calculate the causes and rates of population death, which has a wide range of applications in ecology, particularly in agricultural ecosystems. Field life tables were organized for defining mortality factors of *Prospalta capensis* in *rabi* 2020-21. It was detected that *P. capensis* completed two generations on safflower. The life table of field-collected life stages discovered that early and late instar larval stages were the most susceptible ones for mortality due to *Aleiodes* sp. and unknown reasons. *Apanteles* sp. also caused some mortality in larvae. The negative value of the trend index (<1) during the first generation exhibited that the mortality factors were effective in causing the decline. The generation survival rate for the first and second generations was 0.12 and 0.38, respectively.

Keywords: *Prospalta capensis*, safflower, life tables, survival rate, trend index, *Aleiodes* sp., *Apanteles* sp.

INTRODUCTION

Safflower is an important drought tolerant oilseed crop cultivated in arid and semiarid regions of the world. On safflower, 101 insect pests have been identified worldwide. Vegetable oil, animal feed, biofuel, plant-based medications, and industrial oil are the main products made from it (Biradar *et al*., 2022). While, in India, 75 insect species have been reported (Patil and Halloli 2005). According to Bharaj *et al.* (2003) safflower was attacked by 36 species of pests. However, in Maharashtra, 12 insect pests are recorded (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 major pests of safflower in Maharashtra. The per cent yield loss due to insect pests reported by various workers includes 20–25 % in Andhra Pradesh, 36 % in Madhya Pradesh, 55 % in Maharashtra, 36-46.2 % in Karnataka (Patil and Halloli 2005). However, *Prospalta capensis* reported 62.60–100 % yield losses in safflower (Sekhar and Rai 1991). When a series of life tables are available, the field life tables and key mortality factors may be examined to establish the stage in the life cycle of pests that contribute the most to the population trend (Harcourt, 1969; Atwal and Bains 1974). A life table is an essential tool for understanding how insect pest populations change throughout their life cycle and at various developmental stages (Kakde *et al*., 2014). The construction of field life tables is a useful approach to pest management strategies (Aravindarajan *et al*., 2017). This could be useful for identifying different natural enemies and developing IPM strategies (Meena and Bhamare 2022). There is very little information available on the main causes of *Prospalta capensis* mortality across generations and age ranges in the Maharashtra safflower ecosystem. Consequently, the current work is to create the *Prospalta capensis* field life tables on safflower.

MATERIAL AND METHODS

During *rabi* 2020–21, a non-replicated field experiment was conducted at the research farm of the Department of Agricultural Entomology, College of Agriculture, Latur. The size of the plot was 2.70 m × 2.60 sq. m with the variety PBNS-86 (Purna) sown at a spacing of 45 cm × 20 cm. On germination, field observations were made on the first occurrence of *Prospalta capensis*, with known numbers of larvae along with the infested leaves as the start of the first regular generation. The collected tiny larvae were reared in plastic vials individually on tender leaves till the finish of the pest population. This laboratory culture was used as a check culture for determining 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 × 2.60 sq. m) were carefully examined twice a week for a 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 needed until adult emergence. Observations were made on the larval and pupal parasitism and unknown reasons in the early instars and its late instars and pupal stage as well. An interval of four to six days was provided before sampling the next generation after the mean adult emergence of the previous generation. This period was considered for the completion of the act of oviposition by the moth of the previous generation. The newly hatched first instar larvae were collected in subsequent generations. The life table was constructed based on Morris and Miller (1954); Harcourt (1969) as below: X= age interval, egg, larva, pupa and adult; lx = number surviving at the beginning of stage noted in the '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 the previous generation. It was calculated with the formula N2 / N1, where N2 is equal to the population of early instar larvae in the next generation and N1 is equal to the population of early instar larvae in the previous generation. The generation survival was an index of population trend without the effect of fecundity and adult mortality; it was computed with the formula N3/N1, where N3 is equal to the population of adults in a generation and N1 is equal to the population of early instar larvae in the same generation. A separate budget was equipped to find out the key factors that influenced the population trend of pests on safflower. The method of key factor analysis developed by Varley and Gradwell (1965) was used to detect the density relationship of mortality factors. By this method, the killing power (K) of such a mortality factor or group of mortality factors in each age group was assessed as the difference between the logarithms of population density of the killing power of 'k's.

RESULTS AND DISCUSSION

Prospolta capensis accomplished two regular overlying generations on safflower. The results on field lifetables and key mortality factors on safflower in 1st and 2nd generation during *rabi* season 2020-21 are presented in Tables 1-2. The data from safflower revealed that the mortality in early instar larvae of *P. capensis* infesting safflower during first generation was detected to be 32.91, 1.88 and 11.54 % owing to *Aleiodes* sp., *Apanteles* sp. and unknown reasons, respectively. However, during the second generation, early instar larvae died to the tune of 7.68 and 8.32 % due to *Aleiodes* sp. and unknown reasons, respectively. The mortality in late instar larvae was found to be 54.34 and 33.32 % and; 36.35 and 28.54 % due to *Aleiodes* sp. and unknown reasons during first and second generation, respectively. The pupal mortality of 28.56 % was noticed due to unknown reasons during first generation. The trend index and generation survival was 0.16 and 0.12 and; 0 and 0.38 during the first and second generation, respectively. The maximum generation mortality of *P. capensis* during first and second generation was registered from late instar larval stage (k= 0.5166 and k= 0.3421, respectively). The total 'K' for first and second generation was 1.1984 and 0.7156, respectively. The negative trend index (0.16) revealed that the mortality factors operated during first generation were effective in suppressing the population of *P. capensis* infesting safflower in second generation. However, zero-trend index revealed that the population of *P. capensis* infesting safflower was ceased after second generation. The generation survival was 0.12 and 0.38 during the first and second generations, respectively.

The results of the present investigation are in harmony with finding of Dhurgude *et al*. (2015) evidenced that *Rogas aligharensis* (Quadri.) and unknown reasons were the major mortality factors of *C. illecta* on soybean. Kamath and Hugar (2001) revealed that the rate of parasitism in the first and second instar larvae ranged from 3.33 to 33.33 %, respectively and the third and fourth-instar larvae from 3.33 to 16.66 %, respectively. Bilapate and Chakravarthy (1999) revealed that *Aleiodes percurrens* Lyle was key parasitoids of *C. illecta* larvae infesting sunflower with mean parasitisation of 17.49, 21.29 and 23.35 % during July, August and September, respectively. Bilapate and Jadhav (1995) stated that *C. illecta* infesting sunflower was parasitised by *Aleiodes percurrens* Lyle and *Homolobus* sp. in the range of zero to 21.62 % during different months. Shelke (2019); Dhembare (2018); Shelke (2018) concluded that larvae of *C. illecta* infesting tomato, sunflower and green gram were parasitised by *Apanteles* sp. The other mortality factor operated in larvae and pupae was unknown causes. Jadhav (2004) revealed that the major mortality factor of *C. illecta* infesting sunflower was unknown reasons.

Table 1: Life table and key mortality factors for first and second generation of *P. capensis* on safflower.

Age interval	Number alive / ha at the beginning of x	Factors responsible for d_x	Number dying during x	dx as % of l_x	Survival rate at age X
X	l_x	d_xF	d_x	$100q_x$	S_x
Field life table and key mortality factors of *P. capensis* for first generation					
Early instar larvae (N_1)	37511 25166 24692	*Aleiodes* sp. *Apanteles* sp. Unknown reasons	12345 474 2849	32.91 1.88 11.54	0.58
Late instar larvae	21842 9972	*Aleiodes* sp. Unknown reasons	11870 3323	54.34 33.32	0.30
Pupae	6649	Unknown reasons	1899	28.56	0.71
Moths	4750	Sex 50 % Females	-	-	-
Females x 2 (N_3)	2375	(Reproducing females=2375)	-	-	-
Trend index (N_2/N_1)	$\frac{6172}{37511}$	-	0.16	-	-
Generation survival (N_3/N_1)	$\frac{4750}{37511}$	-	0.12	-	-
Field life table and key mortality factors of *P. capensis* for second generation					
Early instar larvae (N_1)	6172 5698	*Aleiodes* sp. Unknown reasons	474 474	7.68 8.32	0.85
Late instar larvae	5224 3325	*Aleiodes* sp. Unknown reasons	1899 949	36.35 28.54	0.45
Pupae	2376	-	-	-	1.00
Moths	2376	Sex 50 % Females	-	-	-
Females x 2 (N_3)	1188	(Reproducing females=1188)	-	-	-
Trend index (N_2/N_1)	$\frac{0}{6172}$	-	0	-	-
Generation survival (N_3/N_1)	$\frac{2376}{6172}$	-	0.38	-	-

Table 2: Budget of *P. capensis* on safflower for first and second generation.

Age interval	Number / ha	Log No./ ha	'k' values
Budget of *P. capensis* on safflower for first generation			
Early instar larvae After mortality due to *Aleiodes* sp., *Apanteles* sp. and unknown reasons	37511	4.5741	-
Late instar larvae After mortality due to *Aleiodes* sp. and unknown reasons	21842	4.3393	0.2348
Pupae After mortality due to unknown reasons	6649	3.8227	0.5166
Moths	4750	3.6767	0.1460
Reproducing females	2375	3.3757	0.3010
K=1.1984			
Budget of *P. capensis* on safflower for second generation			
Early instar larvae After mortality due to *Aleiodes* sp. and unknown reasons	6172	3.7904	-
Late instar larvae After mortality due to *Aleiodes* sp. and unknown reasons	5224	3.7180	0.0725
Pupae	2376	3.3758	0.3421
Moths	2376	3.3758	0.0000
Reproducing females	1188	3.0748	0.3010
K=0.7156			

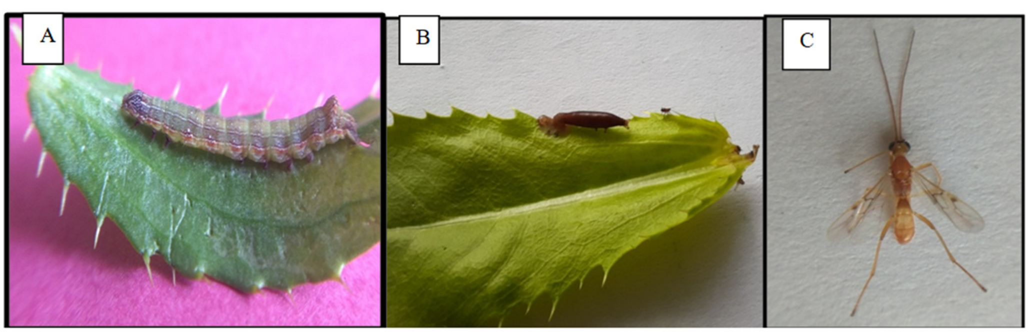

Fig. 1. Parasitisation of *P. capensis* larva by *Aleiodes* sp.(A) Parasitised larva of *P. capensis* (B) Pupa of *Aleiodes* sp. (C) Adult of *Aleiodes* sp.

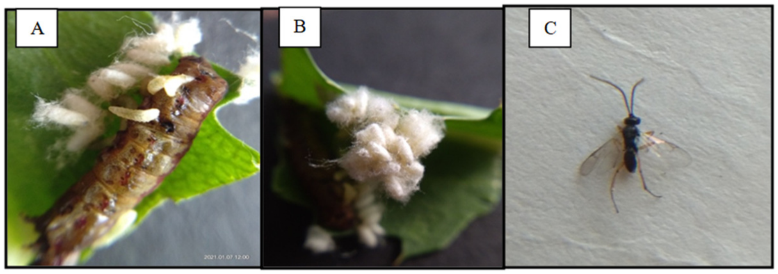

Fig. 2. Parasitisation of *P. capensis* larva by *Apanteles* sp. (A) Parasitised larva of *P. capensis* (B) Pupa of *Apanteles* sp. (C) Adult of *Apanteles* sp.

CONCLUSIONS

From the present investigation it is concluded that the key mortality factors *viz*., *Aleiodes* sp., *Apanteles* sp. and unknown reasons regulated the population of *P. capensis* infesting safflower.

FUTURE SCOPE

In this investigation life table studies estimate the intensity of pest population in safflower ecosystem so it gives the scope for need based application of pesticides and it also determines the key mortality factors and predicts the pest appearance in future.

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Conflict of Interest. None.

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