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Influences of abiotic parameters on pheromone trap against shoot and fruit borer, *Earias vittella* Fab. On okra

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Abstract
The pheromone trap installed in crop cafeteria, Faculty of Agriculture Sciences, Bhagwant University, Ajmer during *Rabi* season (2018) in Bhendi indicated that the activity of male moths observed from 8th MSW and it was continued up to 21st MSW and showed nine peaks activity of male moths of *E. vittella* was observed from 9th MSW to 17th MSW, where the population was range from 7.00 to 10.00 male moths/trap/week and during the *Rabi* season (2019) the activity of male moths observed from 7th MSW and it was continued up to 21st MSW and showed nine peaks activity of male moths of *E. vittella* was observed from 9th MSW to 17th MSW, where the population was range from 0.33 to 23.00 male moths/trap/week.

Keywords: Okra, pheromone trap, *E. vittella*

Introduction
Okra, *Abelmoschus esculentus* L. (Moench) belong to family Malvaceae, is an economically important vegetable crop grown in tropical and subtropical conditions of the world. It is commonly known as Bhendi or lady's finger and the origin of bhendi in Africa. In, India first ranks in the world with 6,950 MT of the total production of the bhendi (Anon., 2017-18) [1]. In Rajasthan the crop occupies 3619 ha with the production of 18152 MT in the state (Anon., 2018-19) [2].

The okra crop is damaged by many insect pests right from sowing to harvest (Sharma *et al.*, 1997; Jagtab *et al.*, 2007) [13, 5]. Fruit borers, *E. vittella* Fabricius, *E. insulana* Boisduval and *H. armigera* (Hübner) in the later stage cause extensive damage to fruits and result in 69 per cent yield loss (Atwal and Singh, 1990) [3].

The pheromone traps are used to directly reduce male moths in large number. The use of sex pheromones include identification of pheromones, development of dispensers and traps, assessment of pheromone traps as a monitoring device (funnel type trap), and the use of pheromones for mating disruption (Kehat, 1993) [6]. The sex pheromone trap mechanism or bait can vary widely (Weinzier *et al.* 1991) [15].

Materials and Methods
A field trial was carried out at crop cafeteria, Faculty of Agriculture Sciences, Bhagwant University, Ajmer during *Rabi* season in the year of 2018 and 2019 by raising the variety of Arka Anamika at spacing 45x30 cm and the area of one hectare. A green colour funnel type of pheromone traps along with lure for *E. vittella* (Ervit lure) obtained from Pest Control Private Limited (PCI) office, Jaipur for the male moth evaluation in the field. The trap was installed @15/ha on the bhendi field in early morning/evening time. The height of the trap was one foot above the crop level and erivit lure were replaced in 15 days intervals (Pazhanisamy and Deshmukh, 2012) [8]. The number of male moths of *E. vittella* trapped in the pheromone traps kill before counted at weekly intervals and data on moth catches was correlated with weather parameters as per the Comez and Comez 1984.

Result and Discussion
Peak activity periods of *E. vittella* during *Rabi* season 2018
The results of *E. vittella* during *Rabi* season (2018) in bhendi indicated that the activity of male moths observed from 8th MSW and it was continued up to 21st MSW and showed nine peaks activity of male moths of *E. vittella* was observed from 9th MSW to 17th MSW, where

the population was range from 7.00 to 10.00 male moths/trap/week (Table 1). The maximum number of moths recorded was 21.00 male moths/trap/week was trapped in 14th MSW (Fig.1). The results of the present investigation are in support of Patel *et al.,* (2014) [10] carried out the number of moths of *E. vittella* trapped in the pheromone traps that were counted at weekly intervals and correlated with weather parameters. The present finding is confirmatory with Naik *et al.,* (1997) [7] the adult male moth was active from the last week of August to the first week of February, with four peaks in catches.

Peak activity periods of *E. vittella* during *Rabi* season 2019

The result of *E. vittella* during *Rabi* season (2019) in bhendi indicated that the activity of male moths observed from 7th MSW and it was continued up to 21st MSW and showed nine peaks activity of male moths of *E. vittella* was observed from 9th MSW to 17th MSW, where the population was range from 0.33 to 23.00 male moths/trap/week (Table 1). The maximum number of moths recorded was 23.00 male moths/trap/week was trapped in 14th MSW (Fig. 2). The results of the present investigation are in support of Patel *et al.,* (2014) [10] carried out the number of moths of *E. vittella* trapped in the pheromone traps were counted at weekly intervals and correlated with weather parameters. The present finding is confirmatory with Naik *et al*., (1997) [7] the adults male moths were active from the last week of August to the first week of February, with four peaks in catches.

Correlation between abiotic factors and pheromone traps catches of *E. vittella* on okra during *Rabi* 2018

The results revealed that the trap catches of *E. vittella* exhibited a non-significant positive correlation existed with minimum temperature (r=0.021) and maximum temperature (r=0.261), rainfall (r=0.00) and sunshine house (r=0.274). However, the trap catches of moth, *E. vittella* showed a non-significant negative correlation with relative humidity (r=-0.139) (Table 2). The result of the present study conforms with Pazhanisamy and Dehmukh (2012) [11]. The relative humidity has a significant negative correlation with the *E. vittella* population build-up on okra observed by Pareek *et al.,* (2001) [9]. The results of the regression model revealed that an increase of 1 ^{0}C of minimum temperature day decreased 1.50 moths per trap catches of moths respectively. The increase 1 ^{0}C of maximum temperature or one per cent relative humidity and sunshine Hours increase 1.75, 0.43, 0.25 and 0.24 moth per trap catches per week, respectively (Table 3).

Correlation between abiotic factors and pheromone traps catches of *E. vittella* on okra during *Rabi* 2019

The results of correlation studies revealed that trap catches of *E. vittella* exerted positive correlation with minimum and maximum temperature (r=0.268, 0.327), whereas negative correlation with R.H. minimum and maximum(r=-0.346, r= -0.495). The present finding is supported by Shivanna, 2012. The result of the regression model revealed that an increase of 1^{0}C of maximum temperature and one mm rainfall influence decrease trap catches of 0.75 and 2.86 moths per trap catches of moths respectively. The increase 1 ^{0}C of minimum temperature or one per cent relative humidity, rainfall and sunshine hours increase 0.96, 2,09 and 1.28 moth per trap catches per week, respectively (Table 4). These studies were in accordance with the report of Prasannakumar *et al.,* (2011) [12] in *E. vittella* on bhendi.

Table 1: Weekly observation on pheromone trap catches of *E. vittella* on Okra

Month	MSW	Trap catches of male moth *E. vittella*	
		Rabi 2018	*Rabi* 2019
		Mean of *E. vittella* trapped/trap/week	Mean of *E. vittella* trapped/trap/week
Feb	6	0.00	0.00
	7	0.00	0.33
	8	2.00	2.66
Mar	9	7.00	8.00
	10	7.66	8.66
	11	9.33	10.00
	12	13.33	15.33
April	13	18.00	19.66
	14	21.00	23.00
	15	20.00	21.66
	16	16.00	17.00
May	17	10.00	10.33
	18	6.66	7.66
	19	4.33	5.00
	20	1.66	2.00
June	21	0.66	0.66

Table 2: Simple correlation matrix of trap catches of *E. vittella* with weather parameters in Okra

	Weather parameter					
Season	Min. Temp	Max. Temp	Min. RH	Max. RH	Rainfall (mm)	Sunshine (hrs.)
2018	0.021	0.261	-0.338	-0.139	-	0.274
2019	0.268	0.327	-0.346	-0.495	0.138	0.249

Table 3: Multiple regression analysis of pheromone trap catches of *E. vittella* (Y) and weather parameters (X) in Okra during *Rabi* season (n=10) 2018

Variables	Partial regression coefficient	Standard error	't' value	R^2
Constant	-71.25	66.35	-1.07	0.458
X1= Mini. Temperature	-1.56	1.04	-1.50	
X2= Max. Temperature	2.38	1.36	1.75	
X3= Min.Relative Humidity	0.43	0.99	0.43	
X4= Max. Relative Humidity	0.11	0.44	0.25	
X5= Rainfall	-	-	-	
X6= Sunshine hours	0.57	2.34	0.24	

Table 4: Multiple regression analysis of pheromone trap catches of *E. vittella* (Y) and weather parameters (X) in Okra during *Rabi* season (n=10) 2019

Variables	Partial regression coefficient	Standard error	't' value	R^2
Constant	96.20	38.64	2.49	0.642
X1= Mini. Temperature	-1.00	1.04	-0.96	
X2= Max. Temperature	0.73	0.98	0.75	
X3= Min.Relative Humidity	-0.57	0.33	-1.72	
X4= Max. Relative Humidity	-0.79	0.38	-2.09	
X5= Rainfall	5.30	1.85	2.86*	
X6= Sunshine hours	-3.21	2.51	-1.28	

*indicates that value is significant at 5% level of significance

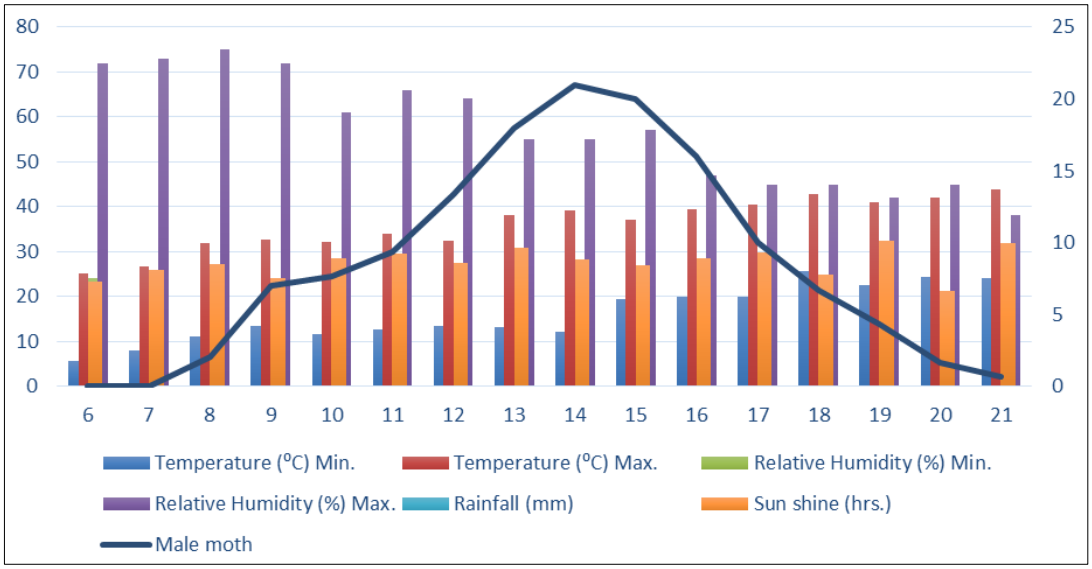

Fig 1: Weekly meteorological data recorded during experimental period (2018) at Ajmer

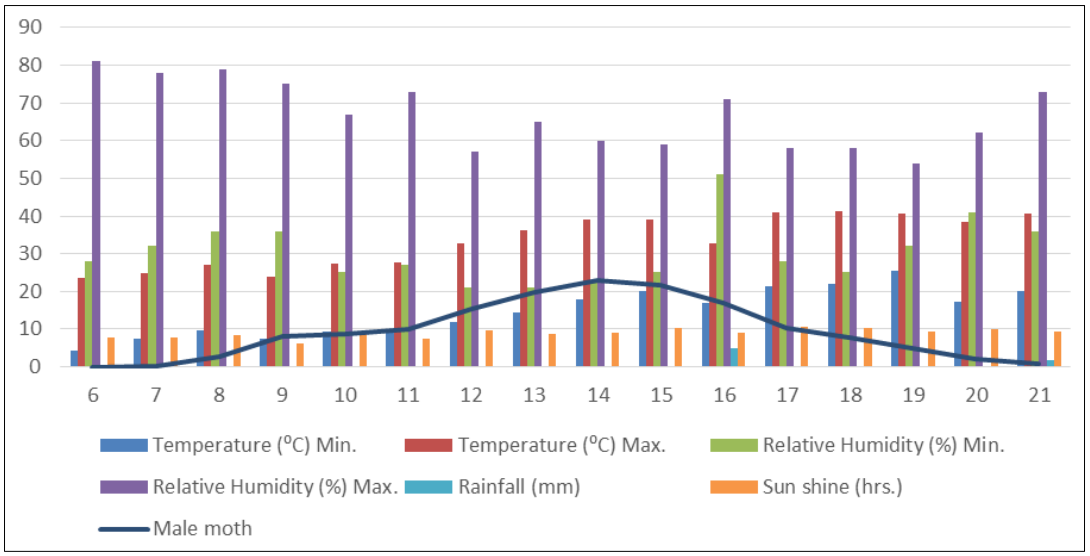

Fig 2: Weekly meteorological data recorded during experimental period (2019) at Ajmer

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