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Influence of abiotic factors on the population fluctuation of sesame leaf webber and capsule borer, *Antigastra catalaunalis* Dup. (Crambidae: Lepidoptera)

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Abstract
A field experiment was conducted during *kharif* 2016, at College of Agriculture, V. C. Farm, Mandya to know the influence of abiotic factors on the population fluctuation of sesame leaf webber and capsule borer, *Antigastra catalaunalis.* During *summer* 2016, the population of leaf webber and capsule borer, *A. catalaunalis* exerted a negative association with morning relative humidity (r = -0.22) and sunshine hours (r = -0.64**) and the population exerted positive association with maximum temperature (r = 0.41), minimum temperature (r = 0.01) and afternoon relative humidity (r = 0.52). The combined and overall impact of all the significant abiotic factors on leaf webber and capsule borer populations were to the extent of 79.00 (R^2 = 0.79), per cent. Similarly, during *kharif* 2016, the sunshine hours showed a significant negative correlation with population of leaf webber and capsule borer. The combined and overall impact of all the significant abiotic factors on leaf webber and capsule borer, populations were to the extent of 32.00 (R^2 = 0.32), per cent.

Keywords: Leaf webber, capsule borer, *Antigastra catalaunalis*, influence, sesame

1. Introduction
Sesame (*Sesamum indicum* L.) is one of the oldest oilseed crop grown in tropical and warm temperate regions of the world (Tripathi *et al*., 2007) [1]. The origin of sesame is controversial; it is expected to be either from India or Africa. Since the presence of diverse wild species in Africa, it is considered to be the primary centre of origin.
Sesame is being an important oilseed crop cultivated in tropics and subtropical region of India and other parts of the world (Karuppaiah and Nadarajan, 2013) [2]. Globally, sesame is cultivated over more than seven million hectare with an annual production of four million tonnes and productivity of 535 kg/ha. India and China are the world's largest producers of sesame apart from India and china, Burma, Sudan, Mexico, Nigeria, Venezuela, Turkey, Uganda and Ethiopia are major sesame growing countries (Anon., 2015a) [3]. In India it is cultivated with an area of 1.75 million hectare with an annual production of 0.83 million tonnes and productivity of 474 kg/ hectare. The major sesame growing states in India includes Uttar Pradesh, Rajasthan, Madhya Pradesh, Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu and West Bengal which covers 1.56 million hectares. In Karnataka sesame is being grown in Bidar, Raichur, Koppal, Gulbarga, Bellary, Bagalkot, Gadag, Haveri and Dharwad in North Karnataka and Mysore, Mandya, Chamarajnagar, Chikmagalur and Ramanagar districts in South Karnataka accounting for area of 44,000 hectare with a production and productivity of 22,000 tonnes and 500 kg/ha (Anon., 2015b) [4].
Sesame is described as the “Queen of oilseed crops” because of its high oil content which ranges from 38-54 per cent (Sasikumar and Kumar, 2015) [5]. Nutritionally, sesame is rich in carbohydrate, proteins, calcium and phosphorous (Seegeler, 1983) [6]. The mature seeds were used in confectioneries, cookies, cakes, margarine and for bread making. Likewise, the oil is used in the manufacture of soaps, cosmetics, perfumes, insecticides as well as pharmaceutical products, and the oilcakes were used to fed livestock as a source of nutrients (Mbah and Akueshi, 2009) [7]. The sesame oil is noted for its stability due to the presence of lignins (Sesamin, Sesaminol and Sesamolinol) which substantially reduce its oxidation rate.

Similarly the medicinal impetus of sesame oil, for reducing stress, tension, in preventing nervous disorders, relieving fatigue and promoting strength and vitality (Gnanasekaran *et al.*, 2010) [8].

Inspite of its greater importance, the productivity and yields low. The decrease in yields have been attributed to several factors which includes low yielding varieties, poor agronomic practices, saline soils, poor drainage, poor planting methods, weeds, diseases and insect pests (Weiss, 1983; Ssekabembe *et al*., 2001) [9, 10]. Among the factors, insect pests take a heavy toll in yield loss (Ssekabembe *et al.,* 2001) [10]. The crop is reported to be damaged by 29 species of insect pests (Rai, 1976) [11], but due to the changed cropping pattern, the insect pest complex has escalated to about 65 species including one mite species, (*Polyphagotarsonemus latus* Blanks) (Ahuja and Bakhetia, 1993) [12].

The number of insects belonging to different orders and family have been recorded on sesame in various parts of the world and most important pests in India are leaf webber, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera), sphinx caterpillar, *Acherontia styx* Westw (Sphingidae: Lepidoptera); gall fly, *Asphondylia sesami* Felt (Cecidomyiidae: Diptera); cotton aphid, *Aphis gossypii* Glover (Aphididae: Homoptera); leaf hopper, *Orosius albicinctus* Distant (Cicadellidae: Homoptera). These pests occur in almost regular intervals on sesame at different stages of the crop and causes heavy damage. Among these insect pests, sesame leaf webber and capsule borer, *A. catalaunalis* is one of the most important and threatening pest of sesame and gained major pest status by causing 90 per cent yield losses (Ahuja and Bakhetia, 1995) [13]. Considering the importance of this pest on sesame in southern parts of Karnataka, the present investigation was planned.

2. Materials and Methods

A field experiment was laid during *kharif* 2016 under Randomized Block Design (RBD) at College of Agriculture, V. C. Farm, Mandya with 10 Treatments including an untreated control and were replicated thrice. A popular sesame multicapsule variety GT- 1 was sown with a spacing of 30×15 cm, between rows and plants, respectively. For each replication, a plot size of 3×3 mt was maintained. The observations on mean population of sesame leaf webber and capsule borer, *A. catalaunalis* were recorded at weekly intervals on 20 designated plants on leaves, flowers/ flower buds and capsule. The data on meteorological variable prevailed during the study period *viz*., maximum and minimum temperature, morning and afternoon relative humidity, sunshine hours, rainfall and number of rainy days were collected from agro-meteorological observatory unit, College of Agriculture, V. C. Farm, Mandya and weekly means were worked out.

To know the relationship between meteorological variables *viz*., maximum and minimum temperature, morning and afternoon relative humidity, sunshine hours, rainfall and number of rainy days and pest population, the weekly mean observation made on sesame leaf webber and capsule borer, *A. catalaunalis* were subjected to Pearson's rank correlation. Further, to know the influence of meteorological variables on growth and abundance of pest population, the data were subjected to "Multiple Linear Regression Analysis Techniques (Pans and Sukhatme, 1967) [14] by fitting different functions using software "SAS Syntax Reference Guide 2016, version 16.0 (SPSS 16), South Wacker Drive, Chicago, IL (SPSS, 2009).

3. Result and discussion

The results on the population dynamics of sesame leaf webber and capsule borer, *A. catalaunalis* and their relationship with meteorological variables are interpreted. The correlation matrix and regression co-efficient indicating relationship between the leaf webber and capsule borer incidence and meteorological variables were presented. The population of leaf webber and capsule borer, *A. catalaunalis* exerted a negative association with morning relative humidity (r = -0.22) and sunshine hours (r = -0.64) and the population exerted positive association with maximum temperature (r = 0.41), minimum temperature (r = 0.01) and afternoon relative humidity (r = 0.52). However the influence of afternoon relative humidity and sunshine hours were found to be significant (Table 1 and 2; Table 4). When the data was subjected to multi linear regression analysis (MLR), the results revealed that 79 per cent (R^2 = 0.79) of leaf webber and capsule borer population was influenced by sunshine hours negatively and afternoon relative humidity positively (Table 5; Table 4).

Similarly during *kharif*, the correlation matrix and regression co-efficient indicating relationship between the leaf webber and capsule borer incidence and meteorological variables revealed that, the population of leaf webber, *A. catalaunalis* exerted a negative association with sun shine hours (r = -0.56) and rainfall (r = -0.21). Likewise, the population exerted positive association with, mean maximum temperature (r = 0.23), minimum temperature (r = 0.03), morning relative humidity (r = 0.35), afternoon relative humidity (r = 0.29) and rainy days (r = 0.31). However the influence of sunshine was found to be significant (Table 1 and 3; Table 4).

When the data was subjected to multi linear regression analysis (MLR), the results revealed that 32 per cent (R^2 = 0.32) of leaf webber population was found influenced by afternoon sunshine hours negatively (Table 5; Table 4).

The results on the incidence of sesame leaf webber and capsule borer, *A. catalaunalis* and their relationship with meteorological variables are discussed. The correlation matrix and regression co-efficient indicating relationship between the incidence of *A. catalaunalis* and meteorological variables revealed a negative association with morning relative humidity (r = -0.22) and sunshine hours (r = -0.64). Similarly, the population exerted positive association with mean maximum temperature (r = 0.41), minimum temperature (r = 0.01) and afternoon relative humidity (r = 0.52). However the influence of mean afternoon relative humidity and sunshine hours were found to be significant (Figure 1).

The present findings are in conformity with Vishnupriya *et al.* (2003) [15] who reported that the evening relative humidity had a significant contribution towards increasing or decreasing the leaf webber and capsule borer population and present findings are in close agreement with reports of Kumar and Goel (1994) [16]. But, the present results are contradicted by Bharodia *et al.*, (2007) [17] who reported a significant positive association with bright sunshine hours. This variation might be due to change in locality and agronomic practices.

Similarly, during *kharif*, the correlation matrix and regression co-efficient indicating relationship between the incidence of *A. catalaunalis* and meteorological variables revealed that, the population exerted a negative association with sun shine hours (r = -0.56) and rainfall (r = -0.21). Similarly, the population exerted positive association with, maximum temperature (r = 0.23), minimum temperature (r = 0.03), morning relative humidity (r = 0.35), afternoon relative humidity (r = 0.29) and rainy days (r = 0.31). However, the influence of sunshine was found to be significant (Figure 2). When the data was subjected to multi linear regression analysis (MLR), the results revealed that 32 per cent (R^2 = 0.32) of leaf webber population was found influenced by afternoon sunshine hours negatively (Table 5; Table 4).

The result of the present investigations are in close agreement with Ahirwar *et al*., (2009) [18] who reported a non significant positive correlation with maximum and minimum temperature and relative humidity. The present findings are also in close agreement with Gangwar *et al*. (2014) [19] who reported a non significant positive relation with maximum temperature and non significant negative relation with rainfall. But these findings are contradicted with reports of Mishra *et al.* (2015) [20] who indicated a significant positive relationship between population and relative humidity. The present results are confirmed the findings of Choudhary (2015) [21] who reported a non-significant positive relationship with relative humidity and leaf webber population.

Table 1: Population dynamics of major pests and natural enemies of sesame, *summer* and *Kharif* 2016

Month	MSW	Population per plant (*A. catalaunalis*)	Month	MSW	Population per plant (*A. catalaunalis*)
January	2	0.00	August	31	0.00
	3	0.00		32	0.30
	4	0.50		33	0.60
February	5	0.80		34	1.30
	6	1.10		35	1.60
	7	1.30	September	36	2.10
	8	1.30		37	2.80
March	9	2.20		38	3.20
	10	3.80		39	4.10
	11	2.90	October	40	2.60
	12	2.10		41	2.00
	13	1.20		42	1.50
April	14	0.50		43	0.30
	15	0.00	November	44	0.00
Mean		1.26	Mean		1.60
Max		3.80	Max		4.10
Min		0.00	Min		0.00
SD±		1.13	SD±		1.27

N=14; MSW- Meteorological Standard Week

Table 2: Relationship between *A. catalaunalis* and meteorological variables, *summer* 2016

Parameters	X_1	X_2	X_3	X_4	X_5
Y- *A. catalaunalis* population	0.41	0.01	-0.22	0.52*	- 0.64**
X_1- Maximum temperature	1.00	0.59	-0.42	0.55	-0.16
X_2- Minimum temperature		1.00	0.06	0.78	0.19
X_3- Morning relative humidity			1.00	0.10	0.53
X_4- Afternoon relative humidity				1.00	-0.02
X_5- Sunshine hours					1.00

N= 14; * Significant at $P \leq 0.05$; ** Significant at $P \leq 0.01$

Table 3: Relationship between *A. catalaunalis* and meteorological variables, *kharif* 2016

Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y- *A. catalaunalis* population	0.23	0.03	0.35	0.29	-0.56*	-0.21	0.31
X_1- Maximum temperature	1.00	-0.62	-0.50	-0.52	0.19	-0.01	0.07
X_2- Minimum temperature		1.00	0.40	0.34	-0.42	0.32	0.27
X_3- Morning relative humidity			1.00	0.38	-0.40	0.24	0.92
X_4- Afternoon relative humidity				1.00	-0.78	0.28	0.31
X_5- Sunshine hours					1.00	-0.42	-0.42
X_6- Rainfall						1.00	0.88
X_7- Rainy days							1.00

N= 14; * Significant at $P \leq 0.05$

Table 4: Correlation coefficient and regression equation of *A. catalaunalis* of sesame, *summer* and *Kharif* 2016

Season	Correlation coefficient (r)				Sunshine hours (X_5)	Rainfall (mm) (X_6)	Rainy days (X_7)	R^2	Regression equation
	Temperature (°C)		Relative humidity (%)						
	Max. (X_1)	Min. (X_2)							
Summer	0.41	0.01	-0.21	0.31	- 0.64**	-	-	0.79	$Y = -3.80+0.32X_1+0.22X_2+0.16X_3+0.52X_4-0.64X_5$
Kharif	0.23	0.03	0.35	0.29	- 0.56*	-0.21	0.31	0.32	$Y = -2.57+0.35X_1-0.25X_2+0.15X_3-0.38X_4-0.56X_5-0.37X_6-0.88X_7$

* Significant at $P \leq 0.05$; ** Significant at $P \leq 0.01$

Table 5: Stepwise regression analysis showing significant variables against population of *A. catalaunalis, summer* and *Kharif* 2016

Season	Parameters	Multiple regression co - efficient	Standard error	't' value	'F' value	R^2 Value
Summer	Afternoon relative humidity	1.72	.017	3.08	12.66	0.79
	Sunshine hours	- 4.91	0.15	3.76		
Kharif	Sunshine hours	-3.06	0.13	2.37	5.65	0.32

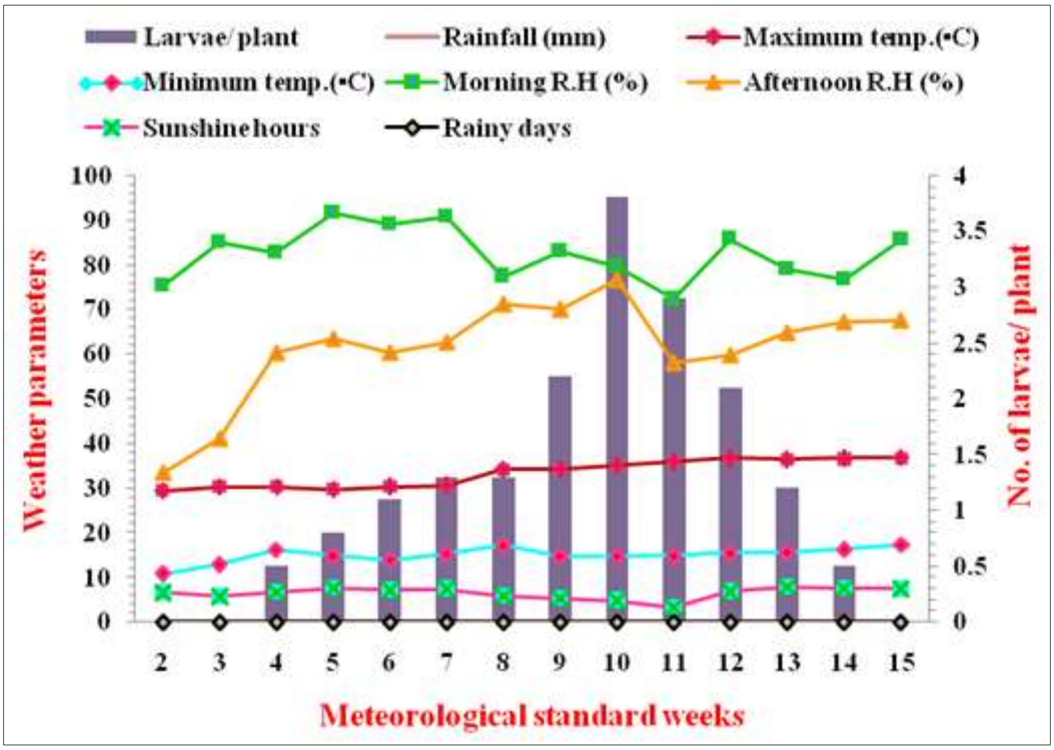

Fig 1: Influence of meteorological variables on the incidence of leaf webber and capsule borer, *A. catalaunalis, summer* 2016

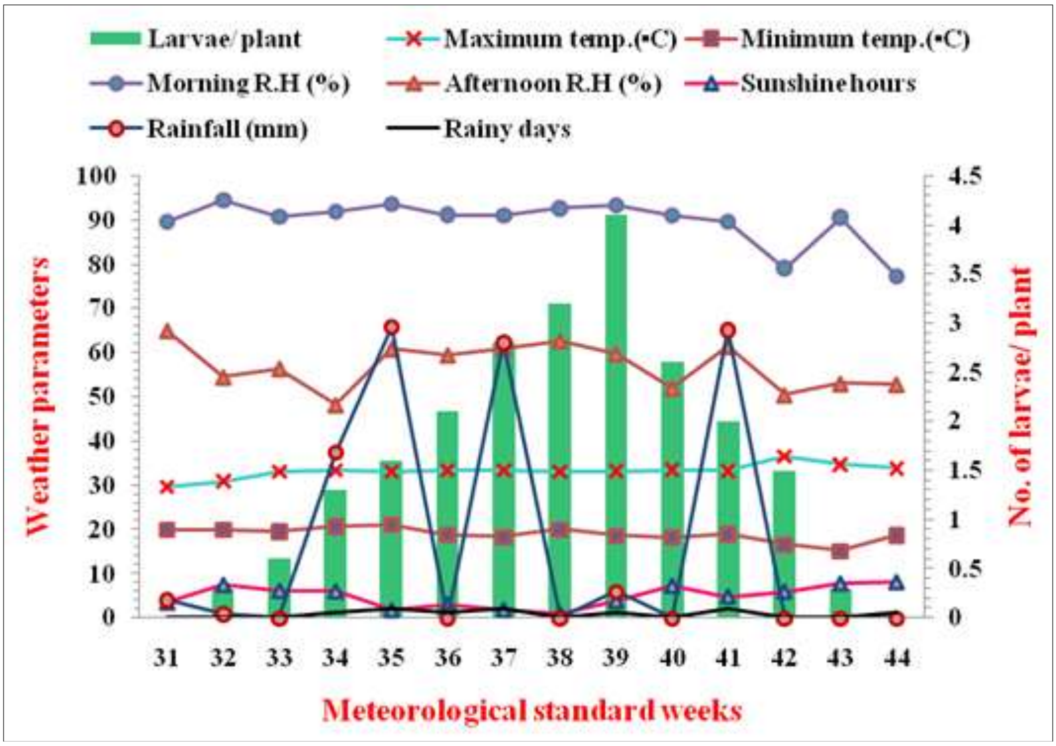

Fig 2: Influence of meteorological variables on the incidence of leaf webber and capsule borer, *A. catalaunalis*, *kharif* 2016

4. Conclusion

The correlation matrix and regression co-efficient between meteorological variables and population of sesame leaf webber and capsule borer revealed that, the sunshine hours showed a significant negative correlation with population of leaf webber and capsule borer during summer. The combined and overall impact of all the significant abiotic factors on leaf webber and capsule borer populations were to the extent of 79.00 (R^2 = 0.79), per cent. During *kharif*, the sunshine hours showed a significant negative correlation with population of leaf webber and capsule borer. The combined and overall impact of all the significant abiotic factors on leaf webber and capsule borer populations were to the extent of 32.00 (R^2 = 0.32), per cent.

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