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Seasonal incidence of sesame leaf and capsule borer, *Antigastra catalaunalis* (Dup.) in relation to abiotic factors

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Abstract
Investigations on "Seasonal incidence of sesame leaf and capsule borer, *Antigastra catalaunalis* (Dup.) in relation to environmental factors.**"** were conducted at Agronomy farm and Department of Entomology, S.K.N. College of Agriculture, Jobner during *Kharif*, 2015 and 2016. *Antigastra catalaunalis* were recorded as major insect pests of sesame during both the years of study. The infestation of *A. catalaunalis* commenced in the third week of August and reached its peak in the last week of August during 2015 and 2016, respectively. The correlation studies indicated that the *A. catalaunalis* population had significant negative correlation (r= -0.78) and (r= -0.68) with maximum temperature during both the years, while with minimum temperature and relative humidity had positive significant correlation (r= 0.88, r=0.87, respectively) and rainfall had non significant correlation during *Kharif* 2015. The *A. catalaunalis* population had non significant correlation with minimum temperature, relative humidity and rainfall respectively) during *Kharif* 2016.

Keywords: sesame, *Antigastra catalaunalis* (Dup.), seasonal incidence, correlation, abiotic factors

1. Introduction
Sesame, *Sesamum indicum* (Linn.) (family: Pedaliaceae) is the oldest oilseed crop of world cultivated throughout the India. East Africa and India are considered to be the native home of sesame (Bedigian, 1985 and Nayar and Mehra, 1970) [7, 16]. Its seeds contain 52- 57 per cent oil and 25 per cent protein (Smith *et al.*, 2000) [20]. The important sesame growing countries are India, china, sudan, Burma and Mexico. In India, the cultivation is mainly confined to Uttar Pradesh, Rajasthan, Madhya Pradesh, Andhra Pradesh, Odisha, Gujarat, Tamil Nadu and Karnataka. In India, production of sesame was estimated to be 8.11 lakh tonnes during 2014-15 (Anonymous, 2015a) [5]. The total area under cultivation of sesame in Rajasthan was about 3.30 lakh hectares with annual production to the tune of 9.49 thousand tonnes and average productivity of 288 kg (Anonymous, 2015b) [6]. Its cultivation gained impetus because of high quality edible oil, rich source of carbohydrate, protein, calcium and phosphorus (Seegeler, 1983) [17] and, therefore, considered to be the 'queen of oil seeds'. The pests attack tolls a heavy loss (25- 90%) in seed yield (Ahuja and Kalyan, 2002) [4]. Among 67 insect pests damaging sesame crop, the leaf insect pests, *viz.*, leaf and capsule borer, *Antigastra catalaunalis* (Dup.); jassid, *Orosius albicinctus* Distant; whitefly, *Bemisia tabaci* (Genn.) and mirid bug, *Nesidiocoris tenuis* (Reuter) are considered to be key pests (Ahirwar *et al.*, 2009) [1]. The *A. catalaunalis* is an important pest because this attacks the crop in all the growth stages after about two weeks of emergence (Suliman *et al.*, 2004) [22]. The attack is more severe during dry seasons and after initiation of flowering. It feeds on tender foliage by webbing the top leaves, bores into the pods and shoots (Narayanan and Nadarajan, 2005) [15]. This insect pest causes 10-70 per cent infestation of leaves, 34-62 per cent of flower buds/ flowers and 10-44 per cent infestation of pods resulting in upto 72 per cent loss in yield (Ahirwar *et al.*, 2010) [2]. The production and productivity of sesame is greatly affected by biotic and abiotic factors. Among them, insect pests are one of the important limiting factors affecting the production of sesame both in terms of quality and quantity (Egonyu *et al.*, 2005 and Ahirwar *et al.*, 2010) [11, 2]. In order to prevent the infestation of the insect pests and to produce a quality crop, it is essential to manage the pest population at appropriate time with suitable measures. Due to variation in the agro climatic conditions of different regions insects show varying trends in their incidence, nature and extent of damage to the crop.

Suitable understanding of the population dynamics of major insect pests is important due to variation in the weather condition and changing pest status. The study would give an idea about their peak period of pests activity which may be helpful in developing pest management strategy against them. For effective pest management, study on the influence of the various factors responsible for population fluctuation on a particular crop might assist in prediction of its occurrence in a given area (Subharani and Singh, 2007) [21]. Thus the knowledge of the influence of weather parameters on the incidence of insect pests on sesame will help to develop a forecasting system to implement timely plant protection measures.

2. Materials and Methods

To study the seasonal incidence of sesame leaf and capsule borer, *A. catalaunalis* on sesame, variety RT-125 was sown on 12th July in both the years, 2015 and 2016 in five plots of size 2.5 x 1.5 m^2 keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively.

2.1 Method of observations

For recording the infestation, the crop was left for having the natural infestation. The observations on borer population were recorded on the five randomly selected and tagged plants in each plot at weekly interval from appearance of the pest till harvesting of the crop. The weekly mean data of atmospheric temperature (maximum and minimum), relative humidity and rainfall were obtained from the Meteorological Observatory, Department of Agronomy, S.K.N. College of Agriculture, Jobner.

2.2 Interpretation of data

to interpret the results of seasonal incidence of leaf and capsule borer, *A. catalaunalis* on sesame crop, simple correlation was computed between pest population and abiotic factors of environment, *i.e.,* the minimum and maximum temperature, relative humidity and rainfall. The following formula was used for calculating correlation coefficient (Gupta, 1996) [12].

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N \sum x^2 - (\sum x)^2 \cdot N \sum y^2 - (\sum y)^2}}$$

Where,
r = Simple correlation coefficient
x = Independent variable, *i.e.* abiotic component
y = Number of observations
N = Dependent variable, *i.e.* insect pest

3. Results

During this field experimentation, the sesame leaf and capsule borer, *A.catalaunalis* was recorded quantitatively at different stages of plant growth with a view to provide sound base of pest management in relation to key abiotic factors, *viz.*, maximum and minimum temperature, relative humidity and rainfall under the prevailing agro-climatic conditions. The infestation of leaf and capsule borer commenced in the second week of August (33 SMW) and persisted throughout the crop season, *i.e.* upto third week of October, 2015 and 2016. Initially, the population of leaf and capsule borer was 6.69 and 6.54 per five plants during *kharif*, 2015 and 2016, respectively (Table-1, 2). The population of this pest gradually increased (34 SMW) and reached to its peak in the last week of September (6.96 and 7.01/ five plants during *Kharif*, 2015 and 2016, respectively). The population of leaf and capsule borer ranged from 4.00- 6.90 per five plants during *Kharif*, 2015 and 3.00- 6.98 per five plants in 2016. After reaching the peak, the pest population started to decline and reached to low level in the third week of September. At this time, the crop was in the maturity stage during both the years.

The leaf and capsule damage done by *A. catalaunalis* was commenced in the second week of August in both the years of study. Maximum leaf damage by *A. catalaunalis* was recorded in the last week of August, *i.e.* 27th August, 2015 (17.77%), and 26 August, 2016 (17.96%). Maximum capsule damage by leaf and capsule borer incidence was recorded in the last week of September (13.90 and 10.10% in *Kharif*, 2015 and 2016, respectively).

3.1 Effect of environmental factors on population of *A. catalaunalis*

The appearance of leaf and capsule borer population on sesame crop started at 32.4 ^{0}C maximum, 24.4 ^{0}C minimum temperatures, 79 per cent mean relative humidity and 12.0 mm rainfall during 2015 and at 31.9 ^{0}C maximum temperature, 24.2 ^{0}C minimum temperature, 81 per cent relative humidity and 3.8 mm rainfall during 2016. The maximum leaf and capsule borer population (6.96/ five plants) was recorded at 35.6 ^{0}C and 23.4 ^{0}C maximum and minimum temperature and 63 per cent mean relative humidity in the first year, *i.e. Kharif*, 2015. In the second year (*Kharif*, 2016), its population was recorded maximum (7.01/ five plants) at 32.70 ^{0}C maximum temperature, 24.70 ^{0}C minimum temperature and 79.00 per cent mean relative humidity. The maximum temperature had negative significant correlation (r= -0.76), minimum temperature had significant positive correlation (r=0.88), mean relative humidity had significant positive correlation (r= 0.87) and rainfall had non-significant correlation with leaf and capsule borer population, *A. catalaunalis* during *Kharif* 2015. The maximum temperature had negative significant correlation (r= -0.68), and minimum temperature, relative humidity and rainfall had non significant correlation with the population of leaf and capsule borer during *Kharif*, 2016.

4. Discussion

A meagre work is done on this aspect in Rajasthan conditions. The work conducted by different workers include Ahuja (1989) [3], Singh *et al.* (1992) [18], Sinha and Prasad (1992) [19], Kumar and Goel (1994) [14], Biswas (2005) [8], Egonyu *et al.* (2005) [11], Thakur and Ghorpade (2006) [23], Ahirwar *et al.* (2009) [1], Kumar *et al.* (2010) [13] and Choudhary *et al.* (2015) [10].

The maximum temperature had negative significant correlation (r= -0.76), minimum temperature had significant positive correlation (r=0.88), mean relative humidity had significant positive correlation (r= 0.87) and rainfall had non-significant correlation with leaf and capsule borer population, *A. catalaunalis* during *Kharif* 2015. The maximum temperature had negative significant correlation (r= -0.68), and minimum temperature, relative humidity and rainfall had non significant correlation with the population of leaf and capsule borer during *Kharif*, 2016. These findings corroborate with the findings of Choudhary *et al.* (1986) [9] who observed that maximum daily temperature had a significant negative

effect on population build-up of *A. catalaunalis*. a slight variation in the time of peak population of *A. catalaunalis* was observed with the finding of Singh *et al.* (1992) [18] and Sinha and Prasad (1992) [19] who observed the peak population of *A. catalaunalis* in the first and second week of September, this might be due to the variation in abitoic factors of environment. In the present study, the incidence of *A. catalaunalis*, was recorded throughout the crop season which got support from the findings of Choudhary *et al.* (1986) [9] and Kumar and Goel (1994) [14].

Table 1: Seasonal incidence of leaf and capsule borer, *Antigastra catalaunalis* (Dup.) on seasame, *Sesamum indicum* in relation to environmental factors (*Kharif*, 2015)

S. No.	Standard Meteorological weeks (SMW)	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Total rainfall (mm)	Caterpillar population of leaf and capsule borer/ 5 plants	Leaf damage (%)	Flower and capsule damage (%)	Total damage (%)
			Maximum	Minimum						
1.	33	13.08.2015	32.4	24.4	79	12.0	6.69	10.66	0.00	14.09
2.	34	20.08.2015	32.9	24.3	69	00.0	6.90	12.36	0.00	18.01
3.	35	27.08.2015	35.6	23.4	63	00.0	6.96	17.77	0.00	13.92
4.	36	03.09.2015	36.1	21.7	60	00.0	5.70	9.00	0.00	11.14
5.	37	10.09.2015	37.9	21.9	54	00.0	5.25	3.00	5.67	9.67
6.	38	17.09.2015	35.7	24.3	67	10.0	5.90	2.66	7.34	12.98
7.	39	24.09.2015	34.6	19.8	53	00.0	6.01	2.10	13.90	16.00
8.	40	01.10.2015	37.2	17.2	41	00.0	4.30	1.12	7.00	8.12
9.	41	08.10.2015	36.8	16.3	43	00.0	4.00	1.00	6.35	7.35
Maximum temperature (r)							-0.757*	-	-	-0.821*
Minimum temperature (r)							0.884*	-	-	0.704*
Mean relative humidity (r)							0.865*	-	-	0.703*
Rainfall (r)							NS	-	-	NS

Table 2: Seasonal incidence of leaf and capsule borer, *Antigastra catalaunalis* on sesame, *Sesamum indicum* in relation to environmental factors (*Kharif*, 2016)

S. No.	Standard Meteorological weeks (SMW)	Date of observation	Temperature (^{0}C)		Average relative humidity (%)	Total rainfall (mm)	Caterpillar population of leaf and capsule borer/ 5 plants	Leaf damage (%)	Flower and capsule damage (%)	Total damage (%)
			Maximum	Minimum						
1.	33	12.08.2016	31.9	24.2	81	03.8	6.54	11.01	0.00	11.01
2.	34	19.08.2016	30.5	24.4	83	17.4	6.98	14.84	0.00	14.84
3.	35	26.08.2016	32.7	24.4	79	16.6	7.01	17.96	0.00	17.96
4.	36	02.09.2016	32.3	22.5	65	00.0	6.92	13.65	0.00	13.65
5.	37	09.09.2016	34.9	22.4	59	00.0	5.80	4.23	6.00	10.23
6.	38	16.09.2016	37.9	23.3	56	00.0	5.10	3.40	5.08	8.48
7.	39	23.09.2016	37.1	22.7	59	00.0	4.00	3.00	10.10	13.10
8.	40	30.09.2016	34.3	23.6	72	13.2	3.50	2.47	8.20	10.67
9.	41	07.10.2015	35.2	20.5	61	00.0	3.00	2.00	5.52	7.52
Maximum temperature (r)							-0.68*	-	-	-0.67*
Minimum temperature (r)							NS	-	-	NS
Mean relative humidity (r)							NS	-	-	NS
Rainfall (r)							NS	-	-	NS

5. Conclusion

It was concluded that the infestation of *A. catalaunalis* reached to its peak in the last week of August during 2015 and 2016, respectively. The correlation studies indicated that the *A. catalaunalis* population had significant negative correlation (r= -0.78) and (r= -0.68) with maximum temperature during both the years, while with minimum temperature and relative humidity had positive significant correlation (r= 0.88, r=0.87, respectively).

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