Current Journal of Applied Science and Technology

32(2): 1-6, 2019 Article no.CJAST.46409
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Population Dynamics of Aphid and Pod Borer on Lentil and their Natural Enemies during *rabi* Season 2017 at Pusa, Samastipur

Deepak Ranjan Kishor[1*], Rabindra Prasad[1], Shriti Moses[1] and P. P. Singh[1]

[1]Department of Entomology, RPCAU, PUSA, Samastipur (Bihar), PIN-848125, India.

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2019/46409
Editor(s):
(1) Bishun Deo Prasad, Department of Molecular Biology and Genetic Engineering, Bihar Agricultural University, Sabour, Bhagalpur-813210, Bihar, India.
Reviewers:
(1) Murali Baskaran, ICAR-National Institute of Biotic Stress Management, India.
(2) Baba Sani Wudil, Bayero University, Kano (BUK), Nigeria.

Original Research Article

Received 02 November 2018
Accepted 04 January 2019
Published 04 January 2019

ABSTRACT

In order to determine the seasonal incidence and to explore the possibilities of management of aphid and pod borer on lentil through various tactics, a series of field experiments were conducted at Research Farm of Tirhut College of Agriculture, Dholi, Muzaffarpur, The incidence of aphid (*Aphis craccivora*), started from 4th meteorological standard week (MSW) (23.80 aphid/10 cm apical twigs). The aphid population gradually increased and reached to its peak (35.4 aphid/10cm apical twigs) on 7th MSW (22nd February) and thereafter its population gradually decreased from 8th MSW 4th week of February (31.30 aphid/10 cm apical twigs) to 12th MSW(4th week of March) (9.0 aphid/10cm apical twigs). The incidence of pod borer (*Etiella zinckenella*) was observed from 7th MSW(3rd week of February) (4.00%) and the per cent pod damage gradually increased and reached to its peak (14.30 %) on 9th MSW (1st week of march). Its infestation gradually decrease 10th MSW (12.10 %) onwards. Initially *Coccinella. septempunctata* population was very low in 4th MSW of January, 2018 (0.90/plant) and after that the population gradually increased. The maximum population of *C. septempunctata* (4.50/plant) was recorded in 8th MSW of February, 2018. Spider population was very low (1.10 spider/plant) in 4th MSW of January, 2018 and the maximum population (2.00 spider/plant)of spider was recorded in 6th SMW of February.

**Corresponding author: E-mail: dipakkishor2016@gmail.com;*
Note: This paper was presented in National Conference on Biotechnological Initiatives for Crop Improvement (BICI 2018), December 08-09, 2018, Organized by Bihar Agricultural University, Sabour, Bhagalpur - 813210 (Bihar), India. Conference organizing committee and Guest Editorial Board completed peer-review of this manuscript.

Keywords: Aphid; pod borer C. septempunctata and Spider.

1. INTRODUCTION

Lentil (*Lens culinaris* L. Medikus) is the fourth most important cool season, bushy annual pulse crop. Locally it is known as "masoor" and also known by many regional names *viz.,* adas (Arabic), masur (Hindi). The important lentil-growing countries in the world are India, Canada, Turkey, Bangladesh, Iran, China, Nepal and Syria [1]. The total cultivated area of lentil in the world is around 4.6 million ha producing 4.2 million tonnes of seeds with an average production of 1095 kg/ha [2]. In India, it is mostly grown as rainfed *Rabi* crop in an area of 1.42 million ha with annual production of 1.13 million tonnes and productivity of 797 kg/ha.It is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand, Bihar and West Bengal. The crop is generally grown on less fertile soils with low inputs. Lentil is called as poor man meat because of its rich protein 28%, carbohydrates 59%, nitrogen and fiber contents, high proportion of vitamin-A, vitamin-B, potassium and iron and low sodium and fat that regulates growth and development, low level of anti nutrients and ability to grow in water stress conditions which are the main attributes that make lentil an important crop [3]. It plays an important role in human and animal feeding and soil improvement. Lentil straw is also a valued animal feed due to low cellulose content [4] and vegetative parts can be used as green manure. Among grain legumes grown in Bihar, lentil is grown in 159.7 thousand ha with total production of 183.23 thousand tonnes and an average productivity of 1147 kg/ha (Anonymous, 2014). Harvesting of lentil may be done by the end of the spring and the beginning of summer. Farmers usually do not use nitrogen fertilizers for lentil production. This is due to the ability of lentil to fix atmospheric nitrogen. It is reported that lentil can fix 46-192 kg N per ha [5,6].

The productivity of lentil has steeply come down in changing climatic scenario due to effect of wide range of biotic and abiotic constraints. Out of these, are attacks insect pests from seedling to podding stage cause a considerable loss in yield. About three dozen insect pests have been reported to infest lentil under field and storage conditions (Hariri, 1981), out of which 21 species have been reported in India [7]. Among insect pests, aphid (*Aphis craccivora*) and pod borer (*Etiella zinckenella*) are the major insect pests and have been found to appear regularly on lentil causing severe damage. According to a survey, 30 to 40 percent pods were found to be damaged by pod borer [8]. Under favourable conditions, the pod damage may go up to 90-95% [9]. Both nymphs and adults of aphid suck the plant cell sap from almost all parts of the plant except roots resulting in less setting of flowers, stunted growth with less number of pods. Heavily aphid infested plants are stunted and produce fewer and smaller pods and seeds. Smaller plants may die due to aphid attack through cell sap sucking. Aphids can destroy about 25-50% of developing plants. Larvae of pod borer damage the pod by feeding on developing grains, inside the pods, resulting in reduction of grain yield.

2. MATERIALS AND METHODS

Field experiment was conducted at Research Farm of Tirhut College of Agriculture, Dholi, Muzaffarpur (Bihar) during *Rabi* season, 2017-18. HUL 57 was grown as test variety which was sown in a plot size 10×10 m^2 area by adopting all the recommended agronomic practices uniformly but keeping it completely free from insecticidal contamination. The crop was sown on 15th November, 2017.

The observation on pest activity was recorded by counting the no. of aphids and per cent pod damage by pod borer from randomly selected 5 plants/plot at weekly interval starting from appearance of pests to its disappearance.

The population of aphid was counted during morning hours before 7 hrs. The data thus obtained, were finally used to work out the average number of aphids per plant.

$$\text{Mean No. of aphid per plant} = \frac{\text{n1} + \text{n2} \ldots\ldots + \text{n5}}{5}$$

Where "n" denotes number of aphids per plant numbering 1 to 5.

Percent pod damage due to pod borer was calculated by using these following formulas.

$$\text{Per cent pod damage} = \frac{\text{Number of pods infected}}{\text{Total number of pods}} \times 100$$

Mean number of aphid per plant and percent pod damage due to pod borer was worked out and data was correlated with the meteorological parameters during the crop period to ascertain

the effect of abiotic factors on the population dynamics of aphid (*A. craccivora*), pod borer (*Etiella zinckenella*) and their natural enemies i.e. *Coccinella septempunctata* and spider.

The influence of abiotic factors viz. temperature °C (maximum and minimum), relative humidity (%) at 7 hrs and 14 hrs, rainfall (mm) on the fluctuating population and infestation of aphid and pod borer was also determined. For this purpose, these meteorological parameters were recorded at weekly interval. By using these data correlation and regression analysis between abiotic factors, population of aphid and pod borer and its infestation on leaf were worked out. Meteorological data were obtained from Meteorological Station, T.C.A. Dholi.

3. RESULTS AND DISCUSSION

3.1 Population Dynamics of Aphid (*Aphis craccivora*), Lady Bird Beetle (*C. septempunctata*), Spider and per cent Pod Damage due to Pod Borer on Lentil

During *Rabi* season of the year 2017-18, population dynamics of aphid and pod borer infesting lentil crop and their natural enemies like lady bird beetle and spider was observed on the crop. The population fluctuations of aphid, their natural enemies and per cent pod damage due to pod borer were correlated with meteorological parameters which are given in Table 1 and 2.

3.2 Aphid (*Aphis craccivora*)

The incidence of aphid started from 4th standard meteorological week (SMW) (23.80 aphid/plant/10 cm apical twigs). The aphid population gradually increased and reached to its peak (35.40 aphid/plant/10cm apical twigs) on 7th standard meteorological week and thereafter its population gradually decreased from 8th SMW (31.30 aphid/plant/10 cm apical twigs) to 12th standard meteorological week (09.00 aphid/plant/10 cm apical twigs). So far as the effect of weather parameters is considered, the maximum aphid population (35.40 aphid/plant/10cm apical twigs) was recorded during 7th SMW when corresponding weather parameters viz. maximum and minimum temperature (°C), relative humidity (%) at 7 and 14 hrs were 24.2, 11.0, 98.5, 83.8, respectively.

The correlation analysis of aphid population with weather parameters showed that the aphid population had significant negative correlation with minimum and maximum temperature (r = -0.613, r = -0.671) while relative humidity at 7 hrs and 14 hrs had non significant positive correlation with aphid population (r = 0.010 and r = 0.429).

3.3 Pod Borer

The infestation of pod borer started from 7th standard meteorological week. The per cent pod damage by pod borer gradually increased and reached to its peak (14.30%) in 9th standard meteorological week.Its infestation gradually decreased from 10th SMW (12.10%) and was recorded as lowest (1.30%) in 12th standard meteorological week of March, 2018. Regarding the effect of weather parameters on pod borer damage, it was found that maximum pod damage (14.30%) was recorded during 9th SMW when maximum and minimum temperature were 29.2 and 14.8°C and relative humidity at 7 and 14 hrs were 99.1 and 79.2%, respectively.

The correlation analysis of per cent pod damage by pod borer with meteorological factors showed that the per cent pod damage had positively significant correlation with minimum temperature (r = 0.582) while the maximum temperature and 7 hrs relative humidity showed non-significant positive correlation (r = 0.470, 0.164, respectively). The 14 hrs relative humidity had non-significant effect with negative correlation (r = - 0.451).

3.4 Lady Bird Beetle (*Coccinella septempunctata*)

The lady bird beetle (*C. septempunctata*) population was very low in 4th standard meteorological week of January, 2018 (0.90/plant) and thereafter the population gradually increased. The maximum population (4.50/plant) was recorded in 8th SMW of February (4.50 /plant). Its population again started decreasing from 9th SMW of March, 2018. The *C. septempunctata* population had non significant positive correlation with maximum and minimum temperature and relative humidity at 14 hrs (r = 0.007, 0.053 and 0.163, respectively) while 7 hrs relative humidity showed non significant negative correlation (r = - 0.327).

3.5 Spider

Initially the spider population was low (1.10 spider/plant) in 4th SMW of January, 2018 and

Table 1. Population dynamics of aphid, their natural enemies and per cent pod damage due to pod borer on lentil in relation to abiotic factors during *Rabi* season, 2017-18

Month	Std. metro. week	Mean no. of aphid/plant	Per cent pod damage by pod borer	Mean no. of *C. septempuctata* /plant	Mean no. of Spider /plant	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
						Max.	Min.	07 hrs	14 hrs	
Jan. 2018	4	23.80	00	0.90	1.10	19.4	7.8	100.0	93.1	00
Feb. 2018	5	26.20	00	1.80	0.90	21.4	9.2	100.0	85.8	00
Feb. 2018	6	29.40	00	1.90	2.00	25.2	9.7	97.5	73.0	00
Feb. 2018	7	35.40	4.00	4.20	1.20	24.2	11.0	98.5	83.8	00
Feb. 2018	8	31.30	9.40	4.50	1.00	27.7	11.8	97.8	82.1	00
Mar. 2018	9	25.20	14.30	2.50	1.00	29.2	14.8	99.1	79.2	00
Mar. 2018	10	17.83	12.10	1.90	0.50	31.4	13.4	100.0	17.7	00
Mar. 2018	11	11.83	4.90	1.70	0.90	31.6	15.7	99.1	72.8	00
Mar. 2018	12	09.00	1.30	1.50	0.80	34.4	14.7	97.0	65.7	00

Table 2. Correlation coefficient of population dynamics of aphid, their natural enemies and per cent pod damage by pod borer

Weather parameter	Population of aphid in 10 cm apical twigs/plant (Y_1)	Per cent pod damage by pod borer (Y_2)	Population of *C. septempuctata* /plant (Y_3)	Population of Spider /plant (Y_4)
Max.temp. (X_1)	-0.671*	0.470	0.007	-0.412
Min. temp. (X_2)	-0.613*	0.582*	0.053	-0.464
07 hrs RH (X_3)	0.010	0.164	-0.327	-0.431
14 hrsRH (X_4)	0.429	-0.451	0.163	0.444
Rainfall (X_5)	0	0	0	0

* *Significant at 5 % level of significance*

Multiple regression equation:-

$Y_1=1254.154 – 8.010(X_1) + 8.480(X_2) – 10.904(X_3) + 0.523(X_4)$

$Y_2 =224.431 – 2.573(X_1) + 4.440(X_2) -1.882(X_3) -0.233(X_4)$

$Y_3 = 161.498 – 0.906(X_1) + 1.180(X_2) – 1.463(X_3) -0.059(X_4)$

$Y_4 = 56.011 – 0.248(X_1) + 0.241(X_2) – 0.506(X_3) – 0.016(X_4)$

Coefficient of determination: 0.824, 0.565,0.394,0.727

the maximum population (2.00 spider/plant) was recorded in 6th SMW of February. The population of spider again started decreasing from 7th SMW of March, 2018. The spider population had a non significant negative correlation with maximum, minimum temperature and 7 hrs relative humidity (r = -0.412, -0.464 and -0.431, respectively) while at 14 hrs relative humidity showed no significant positive correlation (r = 0.444).

The present findings are in conformity with the results of Sharma and Yadav [10] who reported that the genotype K-333 had the lowest incidence of aphid (8.6-9.8 aphids/plant) while PL 639 proved highly susceptible variety with a mean of 33.3-40.0 aphids/plant. The aphid population gradually decreased from 7th standard week (51.0 aphid/plant/10 cm apical twig) to 10th standard week (6.3 aphid/plant/10cm apical twigs). Present results are also supported by the findings of Hossain et al. [11] who reported that the lentil crop sown in November received less aphid infestation and consequently produced higher yield than the crop sown in December. Wide inter-varietal variation was observed in suitability of plants for predators (coccinellids and spiders) which was influenced by aphid population. The predators (spider and coccinellids) population increased with increased population of aphid and decreased with a decrease in population of aphid. Present findings are also supported by the findings of Valerio et al. [12] who quantified the aphids and natural enemies at weekly interval during the crop period. Predators (coccinellids) were released in order to control aphid population. Predators activities (anthocorids, cecidomyiids, coccinellids, chrysopids, spiders and syrphids) were the most efficient in controlling aphid population.

The results from the present investigation suggested that the maximum and minimum temperature had negative but significant correlation with aphid population and relative humidity had positive but no significant correlation. Rakhshan and Ahmad [13] have also reported the appearance and population buildup of aphids and predator to be temperature/humidity dependent. The plants as well as weather parameter (temperature, relative humidity, rainfall, wind and sunshine hours) greatly influenced the aphid predator interaction. Thus, both the biotic and abiotic factors have equal role in regulating population of *A. craccivora* and *C. sexmaculata* in agro-ecosystem. Dalwadi et al. [14] worked out the correlation coefficient between weather parameters and pest population and reported that minimum temperature had high significant negative correlation with aphid population whereas relative humidity showed negative association. Prasad et al. [15] reported that aphid population had significant negative association with maximum temperature, minimum temperature, evening relative humidity and rainfall and positive association with morning relative humidity. Reddy et al. [16] carried out a study to find the correlation between population dynamics of spotted pod borer and weather parameters. The study on relationship between the *M. vitrata* larval population with preceding one week weather parameter revealed that there was a significant negative correlation with maximum temperature (-0.351) at 5 per cent level of significance whereas significant positive correlation with evening relative humidity (0.129) at 5 per cent level of significance. Gautam et al. [17] observed lowest mean population *H. armigera* (0.33 larvae/plant) during 46thand 47th SMW at the minimum temperature of 11.8° C, maximum temperature of 29°C, relative humidity 67.4 and with no rainfall whereas maximum mean population of *Helicoverpa armigera* (5.67 larvae/plant) was recorded during 8th SMW of 2017 at the minimum temperature of 11.1°C, maximum temperature of 27.9°C, relative humidity 63.9 per cent and at no rainfall.

4. CONCLUSION

The incidence of aphid (*Aphis craccivora*), started from 4th meteorological standard week (MSW) (23.80 aphid/10 cm apical twigs). The aphid population gradually increased and reached to its peak (35.4 aphid/10 cm apical twigs) on 7th MSW (22nd February) and thereafter its population gradually decreased from 8th MSW 4th week of February (31.30 aphid/10 cm apical twigs) to 12th MSW (4th week of March) (9.0 aphid/10cm apical twigs). The incidence of pod borer (*Etiella zinckenella*) was observed from 7th MSW (3rd week of February) (4.00%) and the per cent pod damage gradually increased and reached to its peak (14.30%) on 9th MSW (1st week of march). Its infestation gradually decrease 10th MSW (12.10%) onwards. Initially *Coccinella. septempunctata* population was very low in 4th MSW of January, 2018 (0.90/plant) and after that the population gradually increased. The maximum population of *C. septempunctata* (4.50/plant) was recorded in 8th MSW of February, 2018. Spider population was very low (1.10 spider/plant) in 4th MSW of January, 2018 and the maximum population (2.00

spider/plant)of spider was recorded in 6th SMW of February.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ahlawat IPS. Agronomy – *Rabi* crops, Lentil. Division of Agronomy, Indian Agricultural Research Institute, New Delhi. 2012;110 012 .
2. FAO. FAOSTAT, FAO. Statistical Database; 2010. Available:http:// www.fao.org
3. Anonymous. CGIAR Research: Areas of research; Lentil (*Lens culinaris* M). 2003; 23.
4. Erskine W, Rihawe S, Capper BS. Variation in lentil straw quality. Animal Feed Science and Technology. 1990;28: 61–69.
5. Rennie RJ, Dubetz S. Nitrogen-15-determined nitrogen fixation in field grown chickpea, lentil, fababean, and field pea. Agronomy Journal. 1986;78:654-660.
6. Rochester IJ, Peoples MB, Constable GA, Gault RR. Faba beans and other legumes add nitrogen to irrigated cotton cropping systems. Australian Journal of Experimental Agriculture. 1998;38:253-260.
7. Lal SS. Insect pests of lentil and their management. Agricultural Review. 1992; 13:225-232.
8. Sachan JN, Katti G. Integrated pest management. Proceeding of International Symposium on Pulses Research, April 2-6, IARI 2-6, IARI, New Delhi, India. 1994; 23-30.
9. Shongal VK, Ujagir R. Effect of synthetic pyrethroids, neem extracts and other insecticides for the control of pod damage by *Helicoverpa armigera* on chickpea and pod damage-yield relationship at Patancheru in Northern India. Crop Protection. 1990;9:29-32.
10. Sharma RP, Yadav RP. Response of lentil varieties to the incidence of bean aphid (*Aphis craccivora*) and its predatory coccinellids. Lens. 1993;20(1):60-62.
11. Hossain MA, Ferdous J, Salim MMR. Relative abundance and yield loss assessment of lentil aphid, *Aphis craccivora* Koch in relation to different sowing dates. Journal of Agriculture and Rural Development Gazipur. 2006;4(1/2): 101-106.
12. Valerio E, Cecilio A, Mexia A. Population dynamics of aphids (Homoptera: Aphididae) and beneficial organisms on protected strawberry crops. Boletin de Sanidad Vegetal, Plagas. 2007;33(2):153-161.
13. Rakhshan, Ahmad ME. Association of *Aphis craccivora* Koch (Hemiptera: Aphididae) infesting *Phaseolus sinensis* and *Lablab purpureus* with its predator *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae) in different seasons. Journal of Entomology and Zoology. 2017;5(4):1222-1228.
14. Dalwadi MM, Korat DM, Tank BD. Population dynamics of major insect pests of Indian bean in relation to weather parameters. Research on Crops. 2007; 8(3):672-677.
15. Prasad TV, Nandagopal V, Gedia MV. Effect of abiotic factors on the population dynamics of *Aphis craccivora* Koch in groundnut in Saurashtra region of Gujarat. Indian Journal of Entomology. 2008;70(4): 309-313.
16. Reddy SS, Reddy CN, Srinivas C, Rao AM, Reddy SN. Studies on population dynamics of spotted pod borer *Maruca vitrata* in Dolichos Bean, *Lablab purpureus* L. and their relation with abiotic factors. International Journal of Pure and Applied Bioscience. 2017;5(4):1232-1239.
17. Gautam MP, Chandra U, Yadav SK, Jaiswal R, Giri SK, Singh SN. Studies on population dynamics of gram pod borer *Helicoverpa armigera* (Hubner) on chickpea (*Cicer arietinum* L.). Journal of Entomology and Zoology Studies. 2017; 6(1):904-906.