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Population dynamics of insect pests of Indian bean in relation to abiotic factors in South Gujarat

SG Parmar and LV Ghetiya

Abstract
Studies on the effect of abiotic factors on population fluctuation of sucking pests infesting Indian beans was carried out at the Agriculture Experimental Station, Navsari Agricultural University, Paria, Dist.-Valsad (Gujarat) during Rabi 2018-19. Results revealed that an infestation of aphids, jassid and whiteflies were found at all crop growth stages. The peak activity of aphids was seen from the 1st to 5th standard week (1st to 5th week of January). Thereafter, the population of aphids decreased but remained active throughout the crop period. The higher activity of jassid was seen from the 1st to 3rd standard week (1st to 3rd week of January). The peak activity of whitefly was seen from the 4th to 5th standard week (4th to 5th week of January). The correlation study indicated that the maximum temperature (r = -0.554), minimum temperature (r = -0.870) and evening relative humidity (r = -0.599) had a significant negative correlation with the aphid population. In the case of jassid, the minimum temperature (r = -0.852) and evening relative humidity (r = -0.569) had significant negative. The minimum temperature (r = -0.823) had a highly significant negative correlation with the whitefly population.

Keywords: Population dynamics, abiotic factors, aphid, jassid, whitefly, Indian bean

1. Introduction
Indian beans [*Lablab purpureus* (L.) Sweet] belong to the family Leguminosae and sub-family Fabaceae. It is one of the most ancient pulse crops among cultivated pulses. It is native to India and is commonly grown in almost all states *viz*., Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Gujarat, etc. Besides India, it is also grown throughout the tropical regions of Asia, Africa and America. It is a multipurpose crop grown for pulse, vegetables and forage. The crop is attacked by several insect pests during its lifespan. The major constraints affecting yield in Indian beans are insect pests either act as a vector of diseases or cause injury to the different parts right from the seedling to the maturity stage of the crop. Among the pod-sucking insects, aphids (*Aphis craccivora* Koch) and legume spotted pod borer (*Maruca vitrata* Geyer) are causing economic yield loss (Adipala *et al*., 1999) [1]. Govindan (1974) [11] recorded as many as 55 species of insects and mite feeding on the crop from the seedling stage to the harvest of the crop in Karnataka. In Gujarat, the Indian bean crop is mainly attacked by the black aphid, *A. craccivora* Koch, leafhopper, *Empoasca kerri* Pruthi, thrips, *Megaleurothrips distalis* Karny and pod borer, *Helicoverpa armigera* (Hubner) Hardwick. These major and minor pests attack on tender leaves, growing shoots, flowers, flower stalks, buds, tender or mature pods in field and their damage continues in storage (Butani and Jotwani, 1984) [3]. On an average 2.5 to 3.0 million tonnes of pulses are lost annually due to ravages of pest complex (Upadhyay and Mukerji, 1998) [16].
Among various insect pests, *A. craccivora*, *E. kerri*, and *Bemisia tabaci* Gennadius are potential sucking pests causing considerable damage to Indian beans by attacking various plant parts *viz.*, buds, flowers, fruits and leaves of Indian beans. Among them, *A. craccivora* causes a 25 to 80 per cent reduction in yield by sucking the sap from the ventral surface of tender leaves, growing shoots, flower stalks and pods. The high incidence of insect pests in Indian beans is considered the primary biotic constraint to Indian beans in achieving potential productivity and yield instability over the years in South Gujarat. The different pests show vital fluctuations in Indian beans under natural environmental situations. The information on the influences of abiotic factors on the population dynamics of insect pests of Indian beans is very scanty in South Gujarat situations. Therefore, it is necessary to evaluate the effect of abiotic factors on the fluctuation of the pest population in Indian beans. The information provides a base for sound eco-based management strategies. Considering the above facts, the present investigations on the population dynamics of sucking insect pests of Indian beans were

carried out.

2. Materials and Methods

To study the effect of abiotic factors on population fluctuation of various pests infesting the Indian beans variety *Katargam Papdi* (Local) was raised in a 400 m^2 plot at the Agriculture Experimental Station, Navsari Agricultural University, Paria, Dist.-Valsad (Gujarat) during the r*abi* season of 2018-19. The plot was kept free from the application of insecticide to allow pests to multiply throughout the season. To record the incidence of the insect pests at the weekly interval starting from 10 days of sowing until harvesting of the crop from five quadrates measuring 2.0 x 2.0 m. From each quadrate, 10 plants were randomly selected and tagged for this purpose. The aphid (*A. craccivora*) population was recorded from each tagged plant as per the following rating score of aphids and the mean number of aphid indices was worked out.

Aphid index

Rating score	Population description
0	No aphid population.
1	The scattered population of aphids on plants and no formation of the colony.
2	Few small colonies of aphid on the plant but no visual damage.
3	Big colony of aphids on the plant, aphids can be counted in the colony and the effect of aphids on the plant can be seen.
4	Big colony of aphids on the plant, aphids cannot be counted and the plant withered due to infestation.

For recording the population of jassids and whitefly, three leaves each from the top, middle and bottom portion of each tagged plant were observed and the mean number of jassids and whitefly per leaf was computed. The population fluctuation of each pest was correlated with meteorological parameters *viz*., minimum temperature (MinT), maximum temperature (MaxT), morning relative humidity (RH_1), evening relative humidity (RH_2), bright sunshine hours (BSS), wind speed (WS) and evaporation (EP), using the standard statistical procedure as suggested by Steel and Torrie (1980).

3. Result and Discussion

Results revealed that the infestation of aphids, jassid and whiteflies were found at all the crop growth stages during 2018-19 (Table 1). The population of aphids started from the 48th standard week (4th week of November) with a 0.3 aphid index. Further, the population of aphids increased continuously up to the 4th standard week (4th week of January) and reached a peak level of 2.86 aphid index, coinciding with the peak stage of flowering and pod formation in the last week of January. The peak activity of aphids was seen from the 1st to 5th standard week (1st to 5th week of January) (Table 1). Thereafter, the population of aphids decreased but remained active throughout the crop period. The minimum aphid population was recorded during the 48th standard week coinciding with the 4th week of November.

The activity of jassid started from the 47th standard week (3rd week of November) with 0.56 jassid per leaf, which was the lowest population during the season. Further, the population of jassid increased continuously up to the 3rd standard week (3rd week of January) and reached a peak level of 5.18 / leaf, coinciding with the peak stage of flowering and pod formation in the last week of January. The higher activity of jassid was seen from the 1st to 3rd standard week (1st to 3rd week of January). Thereafter, the population of jassid decreased but remained active throughout the crop period (Table 1).

The activity of whitefly on the Indian beans crop started from the 47th standard week (3rd week of November) with 0.78 whitefly/leaf. Further, the population of whitefly was increased continuously up to the 5th standard week (last week of January) and reached a peak level of 3.78 whiteflies/leaf, coinciding with the peak stage of flowering and pod formation in the first week of February. The peak activity of whitefly was seen from the 4th to 5th standard week (4th to 5th week of January). Thereafter, the population of whitefly decreased but remained active throughout the crop period. The minimum whitefly population (0.38 / leaf) was recorded during the 8th standard week coinciding with the 3rd week of February (Table 1).

The correlation study indicated that the maximum temperature (r = -0.554) and evening relative humidity (r = -0.599) had a significant negative correlation with the aphid population, whereas the minimum temperature (r = -0.870) showed a highly significant negative correlation with the aphid population. Morning relative humidity (r = 0.135) sunshine hours (r= 0.047), and wind speed (r= 0.352) had a non-significant positive correlation with the aphid population (Table 2). In case of jassid, the minimum temperature (r = -0.852) had a highly significant negative correlation and evening relative humidity (r = -0.569) showed a significant negative correlation. Morning relative humidity (r = 0.197), BSS (r= 0.049), and wind speed (r= 0.226) had a non-significant positive correlation with jassid. Whereas, the maximum temperature (r = -0.419) showed a non-significant negative correlation with jassid population. The minimum temperature (r = -0.823) had a highly significant negative correlation with the whitefly population. The maximum temperature (r = -0.201), evening relative humidity (r = -458) and sunshine (r= -0.238) had a non-significant negative correlation with the whitefly population. Whereas, morning relative humidity (r = 0.326) and wind speed (r= 0.334) had a non-significant positive correlation with the whitefly population (Table 2).

Table 1: Population fluctuation of insect pests on Indian beans during *rabi* 2018-19

Month & Week	Std. Week	Aphid index	Jassid (No./leaf)	Whitefly (No./leaf)
November III	47	0.0	0.56	0.78
IV	48	0.3	0.64	1.04
December I	49	0.88	0.88	0.6
II	50	1.3	1.3	0.7
III	51	1.52	2.6	1.16
IV	52	1.92	3.14	1.88
January I	1	2.14	4.5	2.52
II	2	2.46	4.66	2.24
III	3	2.62	5.18	2.78
IV	4	2.86	3.56	3.54
V	5	2.46	3.28	3.78
February I	6	2.1	3.04	1.76
II	7	1.72	2.18	0.72
III	8	0.92	1.14	0.38

Table 2: Correlation coefficients between weather parameters and major insect pests of India bean during 2018-19

Weather parameters	Aphid	Jassid	Whitefly	*H. armigera*
MaxT (°C)	-0.554*	-0.419	-0.201	-0.464
MinT (°C)	-0.870**	-0.852**	-0.823**	-0.840**
RH_1 (%)	0.135	0.197	0.326	0.141
RH_2 (%)	-0.599*	-0.569*	-0.458	-0.655*
BSS (hr)	0.047	0.049	-0.238	0.178
WS (km/hr)	0.352	0.226	0.334	0.210

* Significant at 5% level ** Significant at 1%

The results of the present findings are in agreement with Dalwadi (2005) [5] who recorded the commencement of aphid activity from the fourth week of November with peak activity during the last week of January. He also recorded a negative correlation between *A. craccivora* in Indian beans and minimum and maximum temperature. Dalwadi *et al*. (2007) [6], Godwal (2010) [10], Yadav *et al.* (2015) [17], as well as Devashrayee and Patel (2022) [7], also showed a negative correlation of *A. craccivora* with minimum temperature, which is in line with the present findings. In contrast to the present findings, Neupane and Subedi (2019) [14] showed a positive correlation between the aphid population in lentils and the minimum temperature as well as the maximum temperature at Chitwan, Nepal. This might be due to changes in a location or host crop.

The observations made in this report are following the findings of Dalwadi (2005) [6] who opined that the population of jassid was very low during the early phase of the Indian beans crop. Then there was a slight increase in the jassid incidence and remained more or less at the same level up to the end of January. Chaudhari *et al.* (2016) [4] also reported higher activity of hoppers in Indian beans from mid-January to mid-February at Anand, Gujarat. The significant negative correlation between jassid populations and maximum and minimum temperature was also recorded by Singh *et al*. (2019) [15] at Jobner (Rajasthan) in Green Gram [*Vignaradiata* (L.) Wilczek] as well as Devashrayee and Patel (2022) [8] at Bharuch, Gujarat in Indian beans. The present work is contradictory with the results of Mohapatra *et al*. (2018) [13] at Faizabad, Uttar Pradesh showed a non-significant positive relationship between maximum temperature and minimum temperature with the jassids population in black gram, *Vigna mungo* (Linn.). Gehlot and Prajapat (2020) [9] at Jodhpur, Rajasthan and Bali *et al*. (2022) [2] at Chatha, Jammu and Kashmir also showed a positive correlation between temperature and the jassid population in mungbean (*Vigna radiata*) and cluster bean [*Cyamopsis tetragonoloba* (L.) Taub], respectively. This might be due to changes in a location, host crop or season.

These results are in close agreement with Gangurde *et al.* (2014) [8] reported the commencement of whitefly in Indian beans from the second week of October and attained a peak in the fourth week of January at Navsari, Gujarat with a significant negative correlation with temperature. Chaudhari *et al.* (2016) [5] also reported a relatively greater number of *B. tabaci* in Indian beansin January-February of the year 2012. Yadav and Singh (2013) [17] also reported a significant negative correlation between the whitefly population in mungbean and the maximum temperature in Varanasi, Uttar Pradesh, India. Singh *et al*. (2019) [15] reported a significant negative correlation between the whitefly population in green gram [*Vigna radiata* (L.) Wilczek] and the minimum temperature at Jobner, Rajasthan. Equally, the maximum and minimum temperature showed a significant negative influence on the incidence of whiteflies in Indian beans at Bharuch, Gujarat, India (Devashrayee and Patel, 2022) [8]. Khaliq *et al*. (2022) [12] showed a highly significant negative correlation with the incidence of whitefly *Bemisia tabaci* (Gennadius) on mungbean at Chatha, Jammu.

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