SEASONAL INCIDENCE OF MAJOR INSECT PESTS IN MUNGBEAN, *Vigna radiata* (L. Wilczek)

ABSTRACT

The current studies on seasonal incidence of major insect pestswere carried out at Students' Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (UP), India during *Kharif* 2022 and 2023. The current study revealed that whitefly,*B. tabaci*was commenced from the second fortnight of July and touched the peak at 32th (9.8 whitefly per cage) and 35th SMW (9.4 whitefly per cage) in both the year, respectively. The populations of *B. tabaci*had a significant negative correlation with rainfall (r= -0.699) in *Kharif* 2022. The jassidhad the highest population in 34th SMW (4.6 jassid/cage) in *Kharif* 2022, while in second year, maximum jassid population of 5.1 jassid/cage was recorded during 33rd SMW. Wind speed had a significant and negative effect (r=-0.804) on the population of jassid during *Kharif* 2023. Seasonal abundance of thrips showed that, in first year, the thrips activity reached maximum at 33rd SMW (1.2 trips/5 flower buds). In next season, peak population of 1.4 thrips per 5 flower buds was in 32nd SMW. The correlation study during both the seasonrevealed that the sunshine hours (r= -0.683) showed significant and negative effect on thrips populationin 2023. Peak pod borer damage was observed in 36th SMW (5.3%) and 35th SMW (6.7%) during 2022 and 2023, respectively. Correlation between pod borer damage and weather parameters showed that wind speed had negative and significant (r= -0.707) effect on borer damage in first year.

Keywords: Seasonal Incidence, *Kharif* mungbean, white fly, jassid, thrips, pod borer

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) is a very important pulse crop in India after gram and pigeon pea (Ved *et al.*, 2008).Due to the presence of protein, minerals and vitamins in mungbean, it is used to make dry and green fresh legume vegetables (Das *et al.*, 2014). In India, the productivity of this legume mungbean is 629 kg per hectare and we consume it extensively for making papad, biscuits, bread, soup and consuming fresh sprouts by swelling them in water (Sehrawat *et al.*, 2013). Mungbean seeds are rich in (amounts in 100 g) minerals like calcium (132 mg), iron (6.74 mg), magnesium (189 mg), phosphorus (367 mg) and potassium (1246 mg) and vitamins like ascorbic acid (4.8 mg), thiamine (0.621 mg), riboflavin (0.233 mg), niacin (2.251 mg), pantothenic acid (1.910 mg) and vitamin A (114 IU) (Haytowitz and Matthews, 1986). More than 80 per cent of mungbean production comes from 10 states of India. These are Rajasthan, Madhya Pradesh, Maharashtra, Bihar, Karnataka, Tamil Nadu, Gujarat,Andhra Pradesh, Odisha and Telangana.There can be many reasons for the low production of this mungbean crop in India in which one of the most important reasons for the deficiency are insects and from sowing to the storage of mungbean,many types of insects cause harm to it, and 64 types of species of such insects are found in India (Lal, 2008). The insect pests noted on mungbean involve whitefly (*Bemisiatabaci*, Genn.), jassid (*Empoascakerri*, Pruthi), thrips (*Caliothrips indicus*, Bagnall), pod borers (*Helicoverpaarmigera*, Hubner and *Maruca testulalis*, Geyer),green bug (*Nezaraviridula*, Linn.),semilooper (*Plusiaorichalcea*, Fab.), stem fly (*Ophiomyia phaseoli*, Tryon.), tortricid moth (*Cydiaptychora*, Meyr), galerucid beetle (*Madurasiaobscurella*, Jacoby) and cutworm (*Agrotisipsilon*, Hufn) (Nitharwal *et al.*, 2013).Keeping in view, all the facts the present research was conducted on the seasonal incidence of the major insect pests of mungbean and their correlation with abiotic factors *viz*. minimum temperature (°C), maximum temperature (°C), Average Relative Humidity (%), rainfall (mm), sunshine (hrs), and wind speed (km/hr).

MATERIALS AND METHODS

The experiment for present investigation was conducted under field conditions at Students' Instructional Farm of Acharya Narendra DevaUniversity of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India during *Kharif*, 2022 and 2023 on mungbean variety SML-668. Theexperimentalsitefallundersub-tropicalclimaticzoneofIndo-Gangetic plains and situated at 26.47^0 N latitude and 82.12^0 E longitudes ataltitude of 113 meters from mean sea level. The climate of area is subtropical and semi-arid with an average annual rainfall is about 1070 mm. The major part of rain received from last weeks of June to mid September. The minimum and maximum average temperature of the area range from 7.9-27.7 and 18.6- 38.0 degree, respectively. A bulk plot of 100 m^2 was sown with 30 cm row to row and 10 cm plant to plant spacing by following recommended agronomic practices and fertilizer application to study the population build up of the major insect pests associated with mungbean. The pests' population was recorded in this unprotected plot at 7 days interval fromthe 20 days after sowing and continued up to maturity. Whitefly and Jassid population was recorded with the help of rectangularcageof 45 cm long, 30 cm wide and 90 cm high on randomly selected 5 places. Thripspopulationwas recordedon5randomlyselectedplantsstartingwith50%floweringintermsofnumber/5 flower buds. At harvest 5 plants was selected randomly and the number of healthy and damaged pods counted to work out the per cent pod damaged by the pest. The meteorological data of the corresponding weeks was also recorded from Department of Agrometeorology of the University. The insect population was correlated with the meteorological data using a suitable method of analysis.

RESULTS AND DISCUSSION

The observations were made at regular intervals to monitor the appearance of major insect pests in *Kharif* 2022 and 2023. Data were collected on the severity of the insect pest complex, which includes whitefly (*B. tabaci*), Jassids (*E. kerri*), Thrips (*C. indicus*) and per cent pod borers damage. These data were evaluated in conjunction with the current environmental conditions. The results demonstrated the insect pests were active during different phases of crop growth.

Incidence of whitefly

The data presented in Table 1a revealed thatduring *Kharif* 2022, the whitefly population started in 29th Standard Meteorological Week (SMW) (1.7 whitefly/cage) and continued up to the 37th SMW (1.3 whitefly/cage) with two major peak during 32nd SMW (6th to 12th August) (9.8 whitefly/cage) and 35th SMW (27th August to 02nd September) (8.5 whitefly/cage). The overall population of the whitefly ranged from 1.3 to 9.8 whitefly per cage. The maximum population of 9.8 whitefly per cage were recorded during the 32nd SMW when the minimum and maximum temperature was 26.2°C and 33.6°C, whereas, the relative humidity,rainfall, sunshine and wind speed were 81.5 per cent, 8.00 mm, 7.5 hrs and 6.6 km per hrs,respectively. The minimum population of white fly (1.3 per cage) was noted in 37th SMW (Fig. 1). Correlation studies revealed that the population of white fly showed a significant negative correlation (r= -0.699) with rain fall. Further, the white fly population showed a non-significant positive correlation with minimum and maximum temperature and sunshine hours (r= 0.137, 0.227 and 0.413, respectively) while they showed a non-significant negative correlation with relative humidity and wind speed (r= -0.038 and -0.342) (Table 1b).

During *Kharif* 2023, the incidence of whitefly was recorded first time during 29th SMW (2.9 whitefly per cage) and continued up to 37th SMW. Whitefly population ranged from 2.9 to 9.4 individuals per cage. Maximum count of whitefly was recorded in 35th SMW (27th August to 02nd September) (9.4 whitefly/cage) at the minimum and maximum temperature of 25.5°C and 34.7°C, respectively with two major population peaks at 31st SMW (8.3 whitefly/cage) and 33rd SMW (7.2 whitefly/cage)(Table 2a & Fig. 2). Correlation studies revealed that none of the weather parameters showed any significant correlation with the white flypopulation. Further, the white flypopulation showed a non-significant positive correlation with maximum temperature (r= 0.096) and relative humidity (r= 0.086), respectively while they showed a non-significant negative correlation with rainfall, sun shine hours and wind speed (r= -0.179, -0.060 and -0.293, respectively) (Table 2b).

Thesefindings are in partially agreement withthe findings of Mohapatra *et al.* (2018) who reported the first appearance of whitefly population 1.80/plant /cage in the 35^{th} standard week. The population followed gradually increased and attain a peak population of 18.50/cage/plant during 39^{th} standard week at 35.57-22.35^{0}C temperature and R.H 72.00%.Similar findings were also reported by Patel *et al.*(2021)who found that appearance of adult whitefly on green gram was first time during 31^{st} SMW (i.e. 30^{th} July to 05^{th} August). The whitefly population was ranged from 4.20-14.10 whiteflies /cage/plant during the cropping season. Present findings are also supported by Chauhan *et el.,* (2022) who found that rainfall was to be the major factor affecting the population of whitefly adult as significant and negative correlation was reported between the two (r = -0.682*).

Incidence of Jassid

The incidence of jassid was recorded during *Kharif* 2022 revealed thatjassidappeared in the crop on 30^{th}SMW (1.2jassid/cage) and infestation continued till 37^{th} SMW. The peak population (4.6 jassid/cage) was recorded on 34^{th} SMW. The overall population of thejassid ranged from 1.2 to 4.6jassid/cage (Table 1a, Fig. 1). Correlation studies revealed that none of the weather parameters showed any significant correlation with the jassidpopulation. Jassidpopulation showed a non-significant positive correlation with average relative humidity (r= 0.273) and sunshine hours(r= 0.518) while they showed a non-significant negative correlation with minimum and maximum temperature, rainfall and wind speed (r= -0.387, -0.327, -0.061 and -0.315, respectively) (Table 1b).

During *Kharif* 2023, the incidence of jassid was observed first time during 31^{th} SMW (1.9 jassid/cage). The peak population was recorded in 33^{th} SMW (5.1jassid/cage) (Table 2a, Fig. 2). During 33^{th} SMW, the minimum temperature and maximum temperature was 26.3°C &33.6°C, respectively whereas, the relative humidity was 82.0%, rainfall 16.2 mm, sunshine 3.0 hrs and wind speed 2.9 km per hrs. The minimum population of 1.7jassid per cage was noted in 37^{th} SMW. Incidence data was correlated with weather parameters reflected that jassid population had significant negative correlation with wind speed (r=-0.804) while minimum and maximum temperature and sun shine hours showed non significant negative effect. However, average relative humidity (r=-0.804) and rainfall(r=-0.804) showed positive and non significant effect on the population of jassid (Table 2b).

Present results endorse the findings of Patel *et al.*,(2021) who recorded that first appearance of jassids on mungbean was during 31^{st} SMW (i.e. 30^{th} July to 05^{th} August). The population of jassids was ranged from 1.20-6.30 jassids/cage/plant. Singh *et al.*, (2019)also revealed that jassid and whitefly population recorded in the first week of August (32nd SMW) which reached its peak in first week of September, i.e. 36th SMW (12.90 jassid and 14.20 whitefly/three leaves).According to Sapekar*et al.*(2020),jassid was noticed from 32nd MW up to the harvesting 41st MW and recorded the highest population (4.6 jassid/three leaves) during the 39th SMW.Kapil *et al.*, (2022) revealed that the correlation matrix indicated a significant negative correlation of jassid and aphid with minimum temperature while jassid and aphid population recorded non-significant negative correlation with sunshine hours and rainfall. Kumar *et al.,* (2023)also found thatjassid showed positive correlation with temperature but negative correlation was found with relative humidity and rainfall.

Table 1a: Seasonal incidence of major insect pests on mungbean in relation to weather parameters during *Kharif* 2022

SMW	Date	Incidence of Major Insect Pests				Weather Parameters					
		White fly/cage	Jassid/ cage	Thrips/ 5 flower buds	% Pod borer damage	Temperature (^{0}C)		Average RH (%)	Rainfall (mm)	Sunshine (hrs.)	Wind Speed (km/hr.)
						Min.	Max.				
29	16-22 July	1.7	0.0	0.0	0.0	27.0	35.1	71.8	30.8	5.5	6.9
30	23-29 July	2.0	1.2	0.0	0.0	25.1	32.4	83.6	83.6	1.4	6.3
31	30 July-05 Aug.	3.6	1.3	0.0	0.0	25.7	32.8	83.0	21.2	2.5	4.2
32	06-12 Aug.	9.8	2.7	0.6	0.0	26.2	33.6	81.5	8.0	7.5	6.6
33	13-19 Aug.	7.2	3.8	1.2	0.0	25.4	32.5	84.4	31.8	5.7	7.2
34	20-26 Aug.	4.4	4.6	0.9	1.3	25.5	32.2	83.0	65.2	7.6	4.6
35	27 Aug.-02 Sept.	8.5	3.4	0.6	3.7	25.5	33.7	78.4	18.4	4.0	2.2
36	03-09 Sept.	5.7	2.9	0.0	5.3	24.7	34.8	70.1	11.4	7.9	3.0
37	10-16 Sept.	1.3	2.2	0.0	1.9	24.4	31.5	85.4	98.6	5.0	7.5

SMW= Standard Meteorological Week

Table 1b: Relationship between major insect pests of mungbean with weather parameter during *Kharif* 2022

Insect Pests	Weather Parameters					
	Temperature(°C)		Relative Humidity (%)	Rainfall (mm)	Sunshine (hrs.)	Wind Speed (km/hr.)
	Min.	Max.				
White fly, *Bemisiatabaci*	0.137 NS	0.227 NS	-0.038 NS	-0.699*	0.413 NS	-0.342 NS
Jassid, *Empoascakerri*	-0.387 NS	-0.327 NS	0.273 NS	-0.061 NS	0.518 NS	-0.315 NS
Thrips, *Megaleurothripsusitatus*	0.103 NS	-0.248 NS	0.357 NS	-0.182 NS	0.386 NS	0.038 NS
Pod borer damage (%)	-0.523 NS	0.320 NS	-0.525 NS	-0.192 NS	0.341 NS	-0.707*

NS-Non significant   *Significant at 5%

Table 2a: Seasonal incidence of major insect pests on mungbean in relation to weather parameters during *Kharif* 2023

SMW	Date	Incidence of Major Insect Pests				Weather Parameters					
		White fly/cage	Jassid/ cage	Thrips/ 5 flower buds	% Pod borer damage	Temperature (^{0}C)		Average RH (%)	Rainfall (mm)	Sunshine (hrs.)	Wind Speed (km/hr.)
						Min.	Max.				
29	16-22 July	2.9	0.0	0.0	0.0	27.6	34.8	76.7	0.0	6.6	5.3
30	23-29 July	3.0	0.0	0.0	0.0	26.9	35.6	76.5	8.0	7.5	5.6
31	30 July-05 Aug.	8.3	1.9	0.7	0.0	21.1	36.0	81.6	48.0	3.7	4.2
32	06-12 Aug.	5.4	2.4	1.4	0.0	26.2	32.3	82.6	78.6	0.9	4.4
33	13-19 Aug.	7.2	5.1	1.1	0.0	26.3	33.6	82.0	16.2	3.0	2.9
34	20-26 Aug.	5.4	3.7	1.2	4.3	25.2	32.7	82.9	101.4	2.7	4.6
35	27 Aug.-02 Sept.	9.4	2.3	0.6	6.7	25.5	34.7	75.7	6.4	7.7	4.8
36	03-09 Sept.	4.3	3.9	0.0	6.1	24.9	33.3	78.7	48.0	5.6	3.8
37	10-16 Sept.	3.3	1.7	0.0	2.9	25.1	34.2	82.1	114.4	3.0	3.7

SMW= Standard Meteorological Week

Table 2b: Relationship between major insect pests of mungbean with weather parameter during *Kharif* 2023

Insect Pests	Weather Parameters					
	Temperature(°C)		Relative Humidity (%)	Rainfall (mm)	Sunshine (hrs.)	Wind Speed (km/hr.)
	Min.	Max.				
White fly, *Bemisiatabaci*	-0.522 NS	0.096 NS	0.086 NS	-0.179 NS	-0.060 NS	-0.293 NS
Jassid, *Empoascakerri*	-0.201 NS	-0.618 NS	0.536 NS	0.257 NS	-0.481 NS	-0.804*
Thrips, *Megaleurothripsusitatus*	-0.139 NS	-0.551 NS	0.625 NS	0.266 NS	-0.683*	-0.296 NS
Pod borer damage (%)	-0.108 NS	-0.252 NS	-0.232 NS	0.172 NS	0.286 NS	-0.078 NS

NS-Non significant   *Significant at 5%

Figure 1: Seasonal incidence of major insect pests on mungbean in relation to weather parameters during *Kharif*,2022

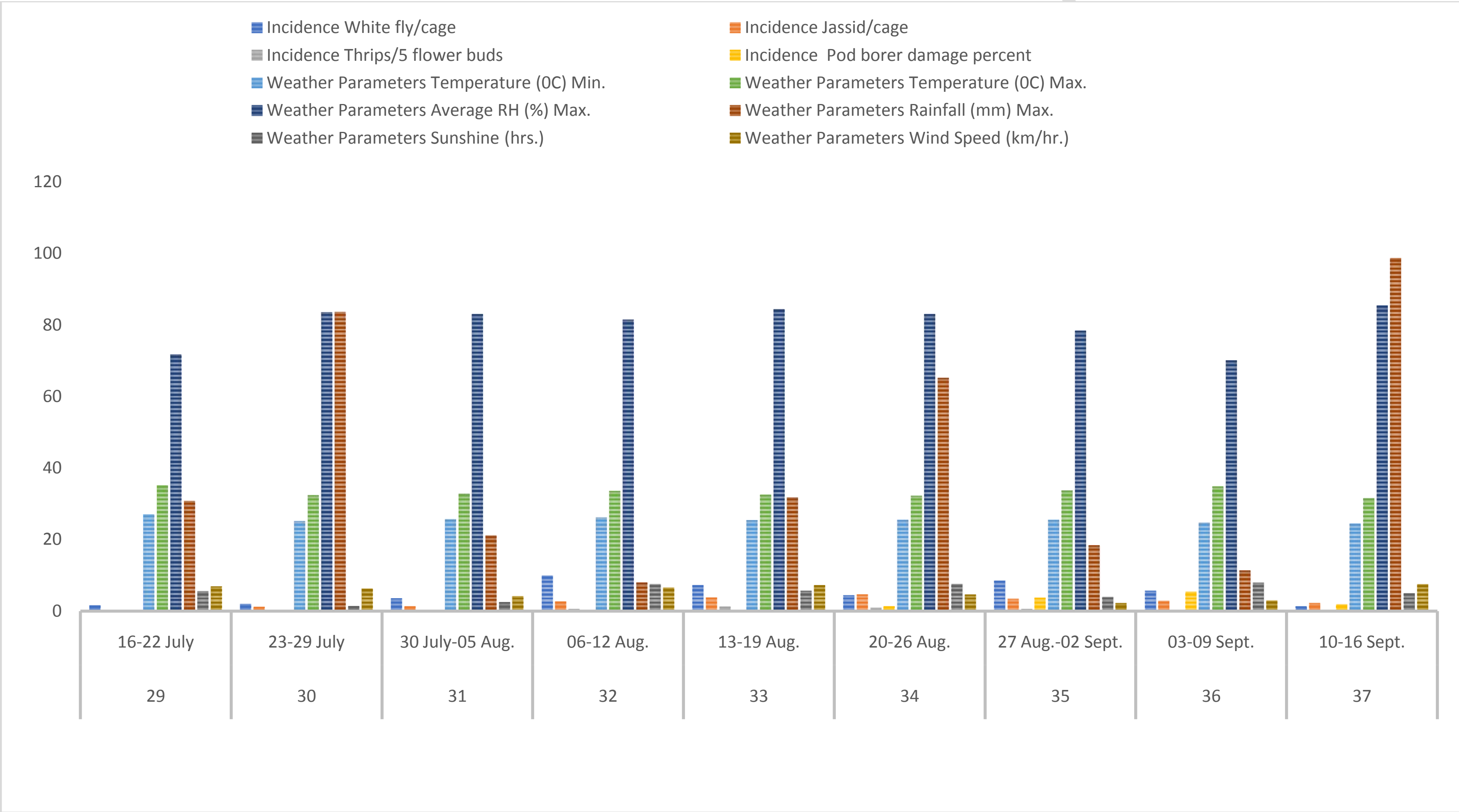
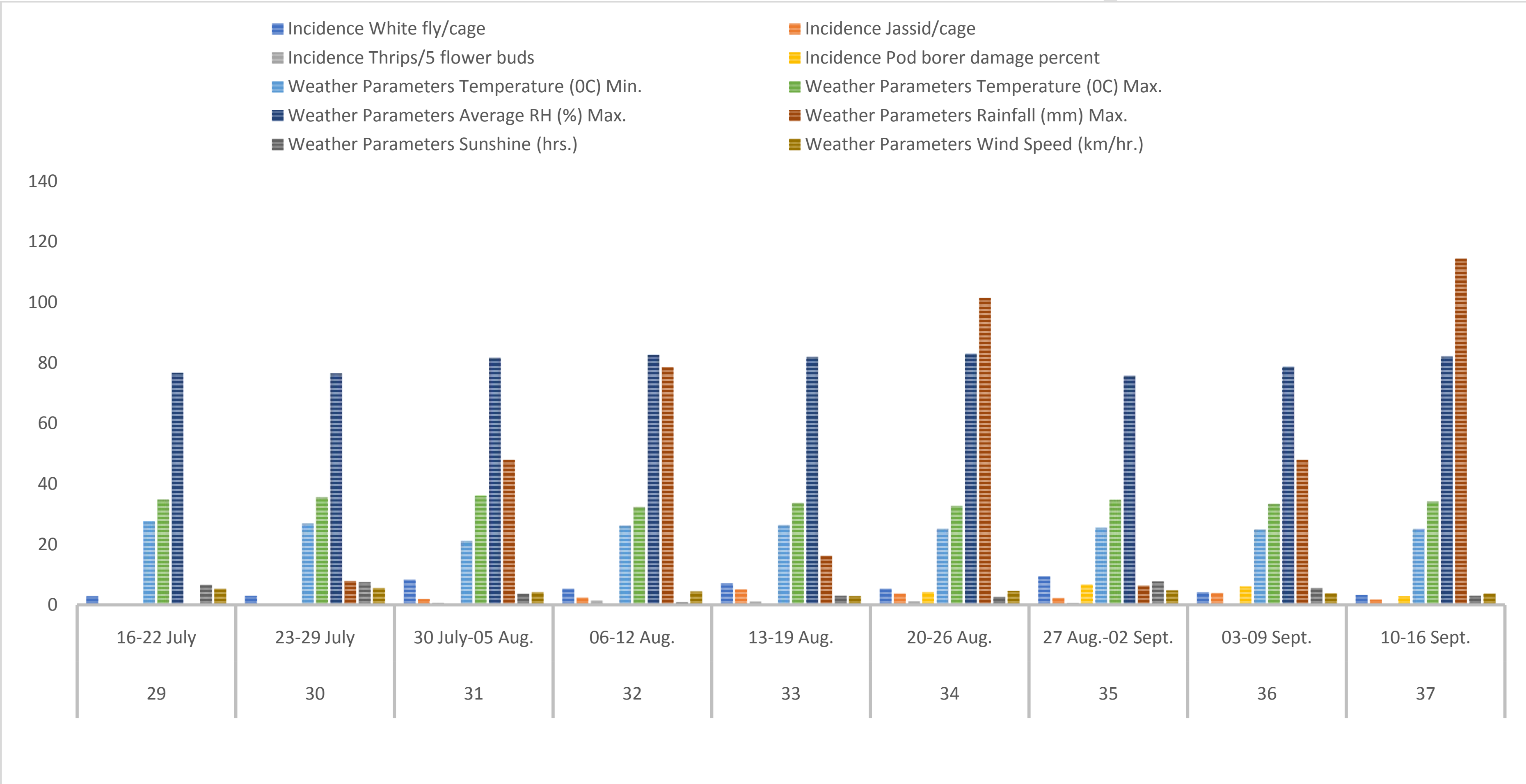


Figure 2: Seasonal incidence of major insect pests on mungbean in relation to weather parameters during *Kharif*,2023



Incidence of Thrips

The data was recorded from the time of occurrence of thrips to the maturity of the crop. The thrips population and meteorological data of *Kharif* 2022 are presented in Table 1a and Fig.1 revealed that the incidence of thrips was noticed for the first time at 32th SMW (0.6 thrips/5 flower buds). The mean population of thrips showed its peak of 1.2 thrips/5 flower buds during the 33th SWM when minimum andmaximum temperature was 25.4 ºC & 32.5 ºC, 84.4per centrelative humidity, 31.8 mm rainfall, 5.7 hrs of sunshineand wind speed of 7.2 km per hours. The minimum population was observed during32th and 35th SMW (0.6 thrips/5 flower buds). It is evident from data presented in Table 1b, the population of thripshad a non significant positive correlation with minimum temperature (r=0.103), average relative humidity (r=0.357) and sun shine hours (r=0.386). There was negative and non-significant relationship with other weather parameters.

The thrips population was ranged from 0.7 to 1.4 thrips per 5 flower buds during *Kharif* 2023 (Table 2a, Fig 2). The incidence of thrips was started from 31th SMW (0.7 thrips/5 flower buds) and reached its peak of 1.4 thrips per 5 flower buds in 32th SMW (*i.e.* 06th to 12th August)followed by 1.2 and 1.1 thrips per 5 flower buds in 34th and 33rd SMW, respectively. Correlation with weather parameters study revealed that thrips had a significant negative correlation with sun shine hours (r=-0.683). There was non-significant negative correlation with minimum and maximum temperature and wind speed whereas RH%(r=0.625) and rainfall (r=0.266) showed non-significant positive correlation (Table 2b).

These results are in partial agreement with the findings of Ojha *et al.,* (2022) who revealed that thrips activity seen during the 33rd SMW, at the vegetative stage, and lasted until crop maturity, i.e., the 38th SMW. The largest population, however, was seen during 35th SMW),with an average of 7.00 thrips/plant.Sharma *et al.,* (2019) also reported that the infestation of thrips started in the fourth week of August (35th SMW) with a mean population of 3.87 thrips/flower. The population increased gradually and recorded its peak with a mean of 5.20 thrips/flower during the second week of September (37th SMW). Bairwa and Singh (2017) investigated that maximum temperature had positive correlation with population dynamics of thrips while rainfall and sunshine had negative effect.

Pod borer damage per cent

During the first year of studies i.e. *Kharif* 2022, the pod borer damage was observed first time during 34th SMW (1.3 %) and ranged between 1.3 to 5.3 per cent. The peak damage was recorded during 36th SMW (5.3 %) (Table 1a, Fig. 1). During 36th SMW, the minimum temperature and maximum temperature was 24.7°C &34.8°C, respectively whereas, the relative humidity was 70.1%, rainfall 11.4 mm, sunshine 7.9 hrs and wind speed 3.0 km per hrs. Correlation studies revealed that sunshine had exhibited significantly negative correlation (r= -0.707) with the pod borer damage while minimum temperature, average relative humidity and rainfall had non significant negative correlation. Sunshine hours and maximum temperature showed non significant positive correlation with pod borer damage (Table 1b).

In *Kharif* 2023, the pod borer damage was observed first time during 34th SMW (4.3 %). The peak damage was recorded during 35th SMW (6.7 %) whereas, the minimum temperature and maximum temperature was 25.5°C &34.7°C, respectively and the relative humidity was 75.7%, rainfall 6.4 mm, sunshine 7.7 hrs and wind speed 4.8 km per hrs (Table 2a, Fig. 2). The minimum damage(2.9%) was noted in 37th SMW. Correlation studies revealed that all the abiotic factors were positive or negative correlated with pod borer damage, but statistically found to be non-significant(Table 2b).

The present finding are in accordance with the findings of Yadav and Singh (2013) who revealed that the incidence of spotted pod borer was observed from 33 standard week with a peak of 2.4 larvae/plant during 36 standard week. The correlation of spotted pod borer with weather factors exhibited significantly negative correlation with minimum relative humidity and positive significant with sunshine and evaporation. Meena *et al.* (2021) also reported the population of pod borer appeared in the 31st standard meteorological week (0.50 larvae/ ten plants). The population gradually increased and reached the peak (8.50 larvae/ten plants) in 36th standard meteorological week when the minimum temperature, maximum temperature and relative humidity was 22.90 ºC, 30.50 ºC and 81 percent, respectively.

Conclusion

During the both year of studied season, four insect species were observed infesting mungbean crop at various phases of crop growth. Sap feeders such as whitefly (*Bemisiatabaci*, Genn.), jassid (*Empoascakerri*, Pruthi), thrips (*Caliothrips indicus*, Bagnall) and pod borer (*Maruca vitrata*Fabricius) were found during the *Kharif* 2022 and 2023. The current study revealed that whiteflywas commenced from the second fortnight of July during the vegetative stage and persisted until crop maturity, *i.e.*, the 37th SMW. The *B. tabaci*population gradually rose and touched the peak at 32th (9.8whitefly per cage) and 35th SMW (9.4 whitefly per cage)in both the year, respectively. The populations of *B. tabaci*had a significant negative correlation with rainfall (r= -0.699) in *Kharif* 2022. However, other weather parameters had a non significant positive or negative effect on whitefly population in both years.The jassidhad the highest population in 34th SMW (4.6 jassid/cage) in *Kharif* 2022, while in second year, maximum jassid population of 5.1 jassid/cage wasrecorded during 33rd SMW. Wind speed had a significant and negative effect (r=-0.804) on the population of jassid during *Kharif* 2023.Seasonal abundance of thrips showed that, in first year (2022), the thrips activity commenced from 32nd SMW (i.e. first fortnight of August) at flowering stage of the crop and reached maximum at 33rd SMW (1.2 trips/5 flower buds).In next season, thrips incidence was started from 31st SMW with peak population of 1.4 thrips per 5 flower buds at 32nd SMW. The correlation study duringboth the season *Kharif* 2022 and 2023 revealed that all the studied factors *viz*. minimum temperature, maximum temperature, relative humidity, rainfall, sunshine hours and wind speed were non significant positively or negatively correlated with thrips population except the sunshine hours (r= -0.683) in 2023 which showed significant and negative effect on thrips population. Pod borer damage was noticed from 34th SMW, at the reproductive stage and persisted until crop maturity, *i.e*., in 37th SMW during both the season. Peak damage was observed in 36th SMW (5.3%) and 35th SMW (6.7%) during 2022 and 2023, respectively. Correlation between pod borer damage and weather parameters showed that wind speed had negative and significant (r= -0.707) effect on borer damage in first year while in second year there was non significant negative effect. Other weather parameters had non significant effect. With the purpose of creating effective pest management strategies against insect pests of the mungbean crop for increased production efficiency, profit, and environmental safety, the information generated in this study will be useful in understanding the establishment of insect pest populations in contrast to weather factors.

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