POPULATION DYNAMICS OF ARTHROPODS IN GREEN GRAM [*VIGNA RADIATA* (L.)] AND THEIR CORRELATION WITH METEOROLOGICAL DATA AT JABALPUR DISTRICT OF MADHYA PRADESH, INDIA

ABSTRACT: Field experiment was carried out to study the population dynamics of arthropods on green gram [*Vigna radiata* (L.)] at Jabalpur district of Madhya Pradesh, India during the *kharif* season 2022-23. The result revealed that the highest population of whitefly, jassid and ladybird beetle were observed in the 37th standard meteorological week (SMW) with a population of 6.87 adult / plant, 6.56 adult / 6 leaves and 0.76 adult / plant respectively. The highest population of yellow mosaic virus and damselfly were observed during the 43rd and 40th SMW respectively, with a population of 22.87% and 1.83 adult / sweep respectively. Spider and dragonfly were during the 41st SMW with a population of 0.36 adult / plant and 1.5 adult / sweep respectively. Correlation studies revealed that the whitefly showed a significant positive correlation with wind speed jassid showed a significant positive correlation with evening relative humidity, wind speed and rainy days while the dragonfly showed a significant positive correlation with evaporation. Damselfly showed a significant positive correlation with maximum temperature and ladybird beetle showed a significant positive correlation with whitefly, suggesting potential biocontrol relationships. These findings provide valuable insights into how climate variables influence arthropod populations, which can inform more targeted pest management strategies for green gram cultivation.

Keywords: Standard meteorological mean, Population dynamics, Arthropods, Yellow mosaic virus, Correlation

INTRODUCTION

Mung bean, [*Vigna radiata* (L.)] Wilczek (Family: Leguminosae, Subfamily: Papilionaceae). It is third important pulse crop of India grown in nearly 16% of the total pulse area of the country (Anonymous, 2021). India is the world's largest mung bean producer covering 65% of the world's acreage and 54% of global production, (Jayappa *et al*., 2017). According to Vavilov (1926), mung bean is native to India and Central Asia. In India, it is grown in about 4.5 million hectares with a total production of 2.5 million tons with a productivity of 584 kg/ha (Anonymous 2021). In Madhya Pradesh mung bean area is 4.18 lakh hectares with a production of 3.46 lakh tons and the productivity is 828 kg/ha (Anonymous, 2022). In Jabalpur mung bean area is 428 ha with a production of 241 metric tons and the productivity is 563 kg/ha (Anonymous, 2021).

Mung bean is attacked by a variety of insect pests including jassid (*Empoasca kerri)*, thrips (*Caliothrips indicus)*, whitefly (*Bemisia tabaci)*, semilooper (*Plusia orichalcea)*, cutworm (*Agrotis ipsilon)*, galerucid beetle (*Madurasia obscurella)*, tortricid moth (*Cydia ptychora)*, pod borer (*Maruca testulalis)*, pod borer (*Helicoverpa armigera)*, stem fly (*Ophiomyia phaseoli)*, green bug (*Nezara viridula)* (Nitharwal and Kumawat, 2013), out of which the most significant are sucking pests (jassid and whitefly) (Islam *et al*., 2008). Jassid nymphs and adults suck the cell sap from the ventral surface of leaves, causing "Hopper burn" if they do so for an extended period. As a result of their feeding, the affected parts turn yellow, the leaves wrinkle and curl downwards and eventually fall off. Also, whitefly nymphs and adults infest plants by draining the fluids from new growth, resulting in stunted development, leaf yellowing, and reduced yields. Plants become weak and susceptible to disease. Whitefly serves as a vector for the spread of MYMV (Sekar and Nalini, 2017). The yield losses caused by insect pest complexes on various mung bean cultivars have been reported to be 32.97% on average (Duraimurugan and Tyagi, 2014). All sucking insect pests cause leaf blistering and cupping, as well as a loss of plant vitality during the early growth stage.

MATERIAL AND METHODS

The field experiment was carried out at the Integrated Farming System Unit of the Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh) during the *kharif* season 2022, which is situated between 22 ° 49 ' and 24 ° 8 ' north latitude and 78 ° 21' and 80 ° 58 ' East longitude and at an altitude of 411.78 m above the mean sea level. Mung bean variety Shikha was shown on the plot size 11×6 m^2 with 30 cm row-to-row and 10 cm plant-to-plant distance. Plant protection equipment and insecticides were not used during the field experiment. Observation of insect pests and natural enemies was recorded on 25 randomly selected plants twice in a Standard week from the germination to maturity of the crop in a compact plot. Observation of jassid population was recorded on two leaves per plant from each (uppers, middle, and lower) sections. The population of whitefly was counted using a caging method based on the number of adults per plant. Ladybird beetle and spider were recorded by visual counting the adult per plant while dragonfly and damselfly were recorded per 3 sweeps. Yellow mosaic virus infestation (%) was calculated by tagging each plant in the plot.

$$\text{Yellow mosaic infection (\%)} = \frac{\text{Yellow mosaic infected plants in a plot}}{\text{Total no. of plants in a plot}} \times 100$$

Source: The weather data was gathered from agro meteorological observatory, JNKVV, Jabalpur. Insects was identified with the help of ZSI (Zoological Survey of India).

Analysis of data:

Correlation and regression of the abiotic factors on major insects were worked out by using the formula as suggested by Snedecor and Cochran (1967).

$$\text{Correlation 'r'} = \frac{\sum XY - \frac{\sum X . \sum Y}{n}}{\sqrt{\left\{\sum X^2 - \frac{\{\sum X\}^2}{n}\right\}\left\{\sum Y^2 - \frac{\{\sum Y\}^2}{n}\right\}}}$$

Where,

X = Mean of first factor, Y = Mean of second factor, n = Total no. of observations, r = Correlation coefficient

$$\text{Regression } \hat{Y} = a + bx \ (R^2)$$

a = Intercept, b = Regression coefficient, R^2 = Coefficient of multiple determination

Test of significance 'r'

$$t = \frac{r}{\sqrt{1-r^2}}\sqrt{N-2}$$

RESULTS AND DISCUSSION

Table 1. Incidence of major insect pest and natural enemies on green gram during 2022-23

SMW	Insect pests		Yellow mosaic virus affected plants (%)	Natural enemies			
				Ladybird beetle	Spider	Dragonfly	Damselfly
	Whitefly	Jassid		Adult /plant		Adult/sweep	
	(Adult/plant)	(Adult / 6 leaves)					
35	2	3.56	0.00	0.1	0.01	0.17	1.17

36	3.89	4.32	0.00	0.1	0.06	0.83	1
37	6.87	6.56	0.00	0.76	0.22	1.17	0.83
38	5.65	5.89	0.00	0.62	0.32	0.5	0.5
39	3.45	3.12	0.00	0.66	0.26	0.17	1.17
40	4.12	4.78	5.56	0.72	0.3	0.17	1.83
41	5.12	5.23	14.48	0.68	0.36	1.5	0.83
42	3.65	4.45	19.21	0.5	0.28	0.83	0.5
43	3.32	2.34	22.87	0.3	0.12	0.33	0.33
SE(d)	2.72	1.26	8.84	0.3	0.12	0.46	0.43
Mean	4.23	4.47	6.90	0.49	0.21	0.63	0.91

Table 2. Correlation (r) of abiotic factors on major insect pests and their natural enemies on green gram during, 2022-23

Weather parameter	Whitefly	Jassid	Yellow mosaic virus affected plants (%)	Natural enemies			
				Ladybird beetle	Spider	Dragonfly	Damselfly
	(Adult/plant)	(Adult / 6 leaves)		Adult /plant		Adult/sweep	
Maximum Temperature (℃)	-0.19	-0.02	-0.47	-0.32	-0.41	-0.06	0.74*
Minimum Temperature (℃)	0.31	0.55	-0.90	0.11	-0.02	0.12	0.55
Sunshine (hrs)	-0.29	-0.49	0.93	0.03	0.18	0.07	-0.30
Rainfall (mm)	0.38	0.57	-0.51	-0.03	-0.26	0.39	0.16
Morning relative humidity (%)	0.40	0.52	-0.81	0.36	0.24	0.07	0.29
Evening relative humidity (%)	0.54	0.72*	-0.89	0.26	0.10	0.17	0.38
Wind speed (Km/hr)	0.67*	0.71*	-0.63	0.36	0.11	0.45	-0.0005
Morning VP (mm)	0.28	0.50	-0.92	0.05	-0.10	0.07	0.52
Evening VP (mm)	0.30	0.54	-0.94	0.08	-0.05	0.05	0.52
Evaporation (mm)	0.22	0.39	0.13	0.19	0.14	0.70*	0.20
Rainy days	0.55	0.69*	-0.56	0.12	0.09	0.17	-0.17

* Significant at 5%

Table 3. Relationship (r) between major insect pests and natural enemies of green gram during 2022-23

Natural enemies	Whitefly	Jassid
	(Adult/plant)	(Adult / 6 leaves)
Ladybird beetle (Adult /plant)	0.69*	0.56
Spider (Adult /plant)	0.57	0.49
Dragonfly (Adult /sweep)	0.63	0.60
Damselfly (Adult /sweep)	-0.19	0.02

* Significant at 5%

Whitefly, *Bemisia tabaci* (Hemiptera: Aleyrodidae)

Whitefly population was observed from 35th to 43rd SMW. The lowest population was recorded in the 35th SMW with a mean population of 2 adult/plant and the highest population was observed during the 37th SMW with a mean population of 6.87 adult /plant. Correlation analysis showed that the population of whiteflies was positively significant with wind speed (r = 0.67) and showed non-significant correlation with other weather parameters.

The results are in alignment with that of Yadav and Singh (2015) revealed that the whitefly population ranged from 0.2-5.2/plant. Kumar and Singh (2016) reported the mean whitefly at its peak of 8.07 adult/plant at 37th SMW.

Jassid, *Empoasca kerri* (Hemiptera: Cicadellidae)

The incidence of jassid population was observed from 35th to 43rd SMW. The lowest population was recorded in 43rd SMW with a mean population of 2.34 adult/ 6 leaves and the highest population was observed during 37th SMW with a mean population of 6.56 adult/ 6 leaves. Correlation studies showed that the population of jassid was positively significant with evening relative humidity and wind speed and rainy days (r = 0.72, 0.71 and 0.69) and showed a non-significant correlation with other weather parameters.

The results are in alignment with that of Kumar and Singh (2016) they revealed that the highest population of jassid 1.43 nymphs and adult/plant was recorded during the 37th SMW. Kundu *et al*. (2021) Studied correlation and indicated that the jassid population had a significant positive correlation with relative humidity.

Infection of yellow mosaic virus in green gram.

The infection of the yellow mosaic virus was recorded at 40th to 43 SMW. The lowest infection was recorded during the 40th SMW with 5.56% and the peak infection during 43rd SMW was 22.87%. The relationship between YVMV infection percent and major weather parameters showed a non-significant correlation.

The present findings are in accordance with Marabi *et al.* (2017) revealed that severe attacks of whiteflies occurred as pest outbreaks and yellow mosaic virus incidence as epidemic forms on black gram due to erratic abiotic factors.

Slender skimmer dragonfly, *Orthetrum sabrina* (Odonata: Libellulidae)

Activity of dragonfly was observed from 35th to 43rd SMW. The lowest population was observed during 35th, 39th and 40th SMW with the mean of 0.17 adults/sweep and the highest population was observed during 41st SMW with the mean population of 1.5 adults/ sweep.

Correlation analysis revealed that the dragonfly population showed a significant positive correlation with evaporation (r = 0.70) and showed a non-significant correlation with other weather parameters.

The results are generally consistent with those of Moses *et al.* (2019) who found the dragonfly population attained its peak at 32nd SMW and was reported as the most common and dominant predator of the rice ecosystem. Dragonflies were observed most active during the kharif season.

Coromandel marsh dart damselfly *Ceriagrion coromandelianum* (Odonata: Coenagrionidae)

Activity of damselfly was observed from 35th to 43rd SMW. The lowest population was observed during the 43rd SMW with a mean of 0.33 adults/ sweep and the highest population was observed during the 40th SMW with a mean population of 1.83 adults/ sweep. Correlation analysis revealed that the damselfly population showed a significant positive correlation with maximum temperature (r = 0.74) and showed a non-significant correlation with other weather parameters.

The results are generally consistent with those of Moses *et al.* (2019) who found this damselfly population attained its peak at 31st SMW, and reported the most common and dominant predator of rice ecosystem. Damselfly were observed most active during kharif season.

Ladybird beetle complex:

Occurrence of the ladybird beetles *i.e.* transverse ladybird beetle (*Coccinella transversalis*) and zigzag ladybird beetle (*Cheilomenes sexmaculata*) were observed from 35th to 43rd SMW. The lowest population was observed during 35th and 36th SMW with the mean of 0.1 adult/plant and the highest population was observed during 37th SMW with the mean population of 0.76 adult/plant. Correlation analysis revealed that the ladybird beetle population showed significant

positive correlation with whitefly (r = 0.69). While non-significant correlation with other weather parameters.

The findings are similar to the findings of Jat and Rana (2018). They found beetle population attained its peak at 37th SMW. They also reported positive correlation of these beetles' population with minimum temperature and relative humidity. Mohapatra *et al*. (2018) found that the rainfall had a non-significant negative correlation. Choudhary *et al.* (2021) found that the ladybird beetle population showed a positive significant correlation with the population of whiteflies (r=0.722).

Spider, *Oxyopes birmanicus* (Araneae: Oxyopidae)

The activity of the spider was observed from 35th to 43rd SMW. The lowest population was recorded during the 35th SMW with a mean of 0.01 adult/plant and the highest population was observed during the 41st SMW with a mean population of 0.36 adult/plant. Correlation studies revealed that the population of spiders was showed a non-significant correlation with all-weather parameters.

The findings are more or less in relevance to Kapoor and Shankar (2019), Jat and Rana (2018), who found this spider's population attained its peak at 37th SMW.

CONCLUSION

The findings revealed the highest population of whitefly (6.87 adult / plant), jassid (6.56 adult / 6 leaves) and ladybird beetles (0.76 adult / plant) were observed during 37th SMW and highest population of yellow mosaic virus (22.87 adult / plant) was observed during 43rd SMW while spider (0.36 adult / plant) and dragonfly (1.5 adult / sweep) were during 41st SMW and damselfly (1.83 adult / sweep) was during 40th SMW. Correlation studies revealed that the whitefly showed a significant positive correlation with wind speed and jassid showed a significant positive

correlation with evening relative humidity, wind speed and rainy days while the dragonfly showed a significant positive correlation with evaporation, damselfly showed a significant positive correlation with maximum temperature and ladybird beetle showed a significant positive correlation with whitefly population.

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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