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Impact of Weather Parameters on the Population Fluctuation of Major Sucking Pest in Summer Mung Bean [*Vigna radiata* (L.) Wilczek]

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ABSTRACT

Background: Mungbean may be grown in an extensive range of agro climatic zones in India and across the world. It is a crucial component of our diet. Because of its capacity to fix nitrogen, it also plays a vital role in managing soil fertility. Mung beans are one of the most significant crops for farmers as a cash crop. In order to implement control measures effectively and on schedule, it is crucial to monitor the population dynamics of major sucking pests, such as aphids, jassids and whiteflies in relation of weather parameters.

Methods: PDM-139 (Samrat) variety seeds were manually planted 5-7 cm deep in the ground. Weekly observations were made from 10 randomly chosen plants Split cage methods were used to record the observations of jassids and whiteflies and aphids from the top and bottom surfaces of the first three trifoliate plants were tallied. Averages population were computed.

Result: The incidence of pest population start on the 14-15th standard meteorological weeks which attain their peak population in 19th SMW. The insect-pest population was established positive correlation with the max and min temperature whereas population was negatively correlated with R.H. and Rainfall.

Key words: Aphid, Jassid, Mungbean, Population, Weather parameters, Whitefly.

INTRODUCTION

Pulses are an important source of protein in the diet of human being throughout the world which can be cultivated in wide range of agro-climate zone of India as well as world. Pulses are integrated part of our food and also plays a vital role for the management of soil fertility due to their nitrogen fixation ability. India is the largest pulse growing country in term of area and production (Yadav *et al.,* 2022) Among the pulses, Green gram or mung bean, *Vigna radiata* (L.) Wilczek (Family: Leguminosae, Sub-family: Papilionaceae) is a cash crop and one of the important crops for the farmers (Kumar *et al.,* 2023). A.P., Maharashtra, Orissa, Rajasthan, M.P., U.P. and Punjab is an important state of India where this pulse crop can be grown in all three season *viz. Kharif, Rabi* and Zaid (Summer). Globally, mungbeans are cultivated on around 7.3 million hectares, with an average yield of 721 kg/ha. Between India and Myanmar, 5.3 million tonnes of output are generated worldwide, accounting for 30% of the total. Other important producers are Kenya, Tanzania, Indonesia, Thailand, China and Kenya (Nair *et al.,* 2020). In India, it accounts for 11% of the total pulse output in 2021-2022 and is cultivated on around 40.38 lakh hectares, yielding a total production of 31.5 lakh tonnes at a productivity of 783 kg/ha. On an area of 33.37 lakh hectares, greengram output in 2022-2023 was 17.5 lakh tonnes (first advance estimates) (Anonymous, 2022). The low productivity of mung bean may be attributed to a wide range of factors, in which insects have paramount importance. Up t 64 *spp.* of insects has been reported in the mungbean crop (Mahore *et al.,* 2023).

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The insect pests noted on mungbean involve jassid (*Empoasca motti*, Pruthi), thrips (*Caliothrips indicus*, Bagnall), whitefly (*Bemisia tabaci*, Genn.), semilooper (*Plusia orichalcea*, Fab.), green bug (*Nezara viridula*, Linn.), stemfly (*Ophiomyia phaseoli*, Tryon.), pod borers

(*Helicoverpa armigera*, Hubner and *Maruca testulalis*, Geyer), tortricid moth (*Cydia ptychora*, Meyr), galerucid beetle (*Madurasia obscurella*, Jacoby) and cutworm (*Agrotis ipsilon*, Hufn) (Kumar *et al.,* 2004, Nitharwal *et al.,* 2013, Gehlot *et al.,* 2021). Insect pests have been estimated to cause 30% annual loss in mungbean and urd beans (Tamang *et al.,* 2017). In mungbeans the avoidable caused by insect pest complex varied from 27.03 per cent to 38.06 per cent with an average of 32.97 per cent (Duraimurugan *et al.,* 2014). Pest appearance, population fluctuations, infestation rate and crop yields are very much dependent on the time of sowing (Kabir *et al.,* 2014). Hence, it is very much important monitor the population dynamics of important sucking pest *viz.* Aphid, jassid and whitefly to carry the control measures well on time. Similarly, different biotic and abiotic factors or parameters are known to influence the population buildup and suppression. Keeping this in mind, an attempt has been made to study the impact of abiotic parameters on the population fluctuation of sucking pest in mung bean.

MATERIALS AND METHODS

The experiment was conducted at Crop Research Center of SVP University of Ag. and Tech., Meerut during *Summer*, 2021 and 2022. The area under investigation is situated 29°04′ N latitude and 77°42′E longitudes at an altitude of 237 meter above the mean sea level (MSL). The experiment was laid out in 100 m^2 plot with PDM-139 (Samrat) variety which was sown manually 5-7 cm deep in soil. The distance was maintained, keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively. The sowing was done on 23rd March 2021 for first and 25th March 2022 for the second year experiment. Observations were recorded from 10 randomly selected plants at weekly interval from the vegetative stage of plant when initial populations of insects start. The observations for jassid and whiteflies were recorded through split cage methods and Aphids was counted from upper and lower surface from the first three trifoliate of plants. Average populations were calculated. Meteorological data were collected from Department of Soil Science, SVPUAT, Meerut. Impact of abiotic parameters on the population fluctuation was carried out with simple correlation formula given by Gomez *et al.* (1984).

$$r = \frac{Sxy}{[(SX^2)(SY^2)]^{(1/2)}}$$

Where:

R= Simple correlation coefficient.

Sx^2= Correlated sum of squares for meteorological parameters.

Sy^2= Correlated sum of square for pest incidence.

Sxy= Correlated sum of cross products.

RESULTS AND DISCUSSION

Incidence of sucking insect pests started after 20 days of sowing and paramount occurrence of pest population were observed from the 14th and 15th Standard meteorological week till harvesting of crop in 2021 and 2022, respectively. The mean population of major sucking pest in mungbean *i.e.* aphid, jassid and whitefly were recorded and tabulated with weather parameters in Table 1 and Table 2.

Population fluctuation of aphids in summer mung 2021 and 2022

Aphid population was first time recorded in 14th S.M.W. of 2021 from the first three trifoliate of plant and calculated average population of aphid per leaf. The population of aphid was remains in the field till the harvesting of the crop. At the time of first appearance for aphid (2.87 aphid per leaf), max. and min. temperature were 35.09°C and 17.08°C, relative humidity at morning and evening was 48.57 per cent and 26.57 per cent, respectively were also recorded. There was no sign of rainfall during that period. The pest activity gradually increased from the 2nd week of April in 2021 and reached on its peak in 19th S.M.W. (2nd-3rd week of May) with 10.93 aphid per leaf, during this period max. and min. temperature was 36.14°C and 22.76°C while R.H. during morning and evening was 65.71 per cent and 47.14 per cent, respectively. The rainfall was recorded at the peak of aphid population was 3.80 mm. The population

Table 1: Population buildup for sucking insect-pests in relation of weather parameters during *Summer*-2021.

S.M.W.*	Dates	Per leaf	Per cage population		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
		Aphid	Jassid	Whitefly	Maximum	Minimum	Morning	Evening	
14	5 Apr-11 Apr	2.87	2.20	6.07	35.09	17.84	48.57	26.57	0.00
15	12 Apr-18 Apr	6.20	7.53	8.27	38.26	19.26	37.57	22.00	0.00
16	19 Apr-25 Apr	8.33	8.80	12.67	37.01	20.84	42.57	26.14	0.10
17	26 Apr-2 May	9.53	9.00	14.00	37.27	20.93	39.29	22.86	3.40
18	3 May-9 May	10.00	10.27	15.20	38.77	24.19	45.43	27.00	1.00
19	10 May-16 May	10.93	10.67	15.93	36.14	22.76	65.71	47.14	3.80
20	17 May-23 May	6.80	7.00	4.53	33.39	21.97	58.14	35.43	5.40
21	24 May-30 May	2.33	4.20	3.07	34.63	22.11	64.57	44.71	4.20
22	31 May-6 June	1.60	1.67	2.47	37.69	24.16	58.86	34.29	3.70

*Standard meteorological week.

of aphid was started to declining from 20th week S.M.W. when the population was 6.80 aphids per leaf and gradually decreased till 22th S, M.W. of 2021 (1.60 aphid per leaf), at this time the max and min temperature was 37.69°C and 24.16°C, R.H. during morning and evening was 58.86 per cent and 34.29 per cent, respectively. 3.70 mm rainfall had recorded.

In successive year, the aphid population ranged from 4.80 to 10.80 aphids per leaf during crop period. The data reported (Table 2) that first appearance of aphid (6.13 aphid/leaf) was in 15th S.M.W. of 2022 which was 3rd week of April. In this S.M.W. the max and min. temperature was 40.90°C and 20.06°C and R.H. in morning and evening was 39.00 per cent and 21.14 per cent, respectively. The 0.00 mm rainfall had been recorded. The population was rapidly increased and attained to the peak of 10.80 aphids per leaf in 19th S.M.W. (3rd week of May) when the max and min temperature was 41.94°C and 25.71°C, Relative humidity in morning and evening was 34.86 per cent and 15.86 per cent, respectively and rainfall was 0.00 mm. After attaining its peak, the population of started to decline and reached up to 4.80 aphid per leaf (23rd S.M.W.) just before harvesting of the crop. At this time the max and min temperature was 43.99°C and 26.84°C, Relative humidity in morning and evening was 38.29 per cent and 21.43 per cent, respectively. Rainfall (0.04 mm) also recorded during this time.

The preceding study investigated by Shanthi *et al*. (2020) and Sapkal *et al.* (2022) indicated that the aphid population in the summer crop reached its maximum in the 15th SMW (third week of April 2016). The outcomes of these discoveries are earlier also described in the similar of occurance by the Ojha *et al.* (2022) here. These investigations also strengthen by Priya *et al.* (2022) who noted maximum population of aphid during 17th-18th SMW.

Population fluctuation of Jassid in summer mung 2021 and 2022

Jassid appeared on mungbean crop in 14th S.M.W. (2.20 jassid/plant) *i.e.* 2nd week of April. Nymph and adult of jassid suck the sap from the plant and multiply their population. In 14th S.M.W., max and min temperature was 35.09°C and 17.84°C, morning and evening Relative humidity was 48.57 per cent and 26.57 per cent, respectively. Rainfall also recorded during this week which was 0.00 mm. This population reached at its peak in 19th S.M.W. where the population of jassid was 10.67 per cage. At peak level of jassid aphid, max., min. temperature, Humidity in morning and evening and rainfall was 36.14°C, 22.76°C, 65.71 per cent, 47.14 per cent and 3.80 mm, respectively. After this week, the population declined and reaches up to 1.67 jassid per cage in 22nd SMW of 2021 (1st week of June).

In next year the appearance was delayed due to late sowing. Here, the insect appear in the 15th SMW or 2nd and 3rd week of April (4.80 jassid per plant) when the weather parameters were same as appearance time of aphid. Soon this population reached on its peak which was 10.13 jassid per cage in 19th week of 2022. During this week (2nd week of May) the weather parameters also recorded *i.e.* max (41.94°C) and min (25.71°C) Temperature, Relative humidity in morning (34.86 per cent) and evening (15.86 per cent) and rainfall (0.00 mm), respectively. From 20th SMW the population started decreasing and during final observation for the jassid, population in 23rd SMW was 0.73 per cage and weather parameter was remain same as aphid's population during 6th June to 12 June in 2022.

The results of this study are consistent with the findings presented by Kumar *et al.*, (2016), who reported that the incidence of *E. kerri* peaked in the 20th Standard meteorological week and continued to rise until the 22nd Standard meteorological week, with the highest population reported during that week. The results are corroborated by Selvam *et al.* (2022), who observed that the summer crop's 15th SMW had maximum population of jassid adhering to which the population declined, Along with these scientist Singh *et al.,* 2022 also supported to this with the similar pattern of occurrence for the Jassid.

Population fluctuation of Whitefly in summer mung 2021 and 2022

Incidence of whitefly on mungbean was reported in 14th SMW of 2021 with 6.07 whiteflies per cage where the

Table 2: Population buildup for sucking insect-pests in relation of weather parameters during *Summer*-2022.

S.M.W.*	Dates	Per leaf	Per cage population		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
		Aphid	Jassid	Whitefly	Maximum	Minimum	Morning	Evening	
15	11 Apr-17 Apr	6.13	4.80	6.33	40.90	20.06	39.00	21.14	0.00
16	18 Apr-24 Apr	7.93	8.47	7.16	41.09	21.20	35.86	19.14	0.01
17	25 Apr-1 May	8.93	10.00	10.40	42.39	24.21	35.00	17.71	0.00
18	2 May-8 May	9.33	9.93	11.00	43.07	23.50	40.86	21.29	0.57
19	9 May-15 May	10.80	10.13	16.07	41.94	25.71	34.86	15.86	0.00
20	16 May-22 May	7.53	8.13	9.67	42.89	24.71	39.86	20.57	4.59
21	23 May-29 May	9.53	9.13	7.80	41.20	26.00	40.86	19.86	0.00
22	30 May-5 June	6.00	4.13	3.73	36.54	21.36	59.00	31.86	1.79
23	6 June-12 June	4.80	0.73	6.80	43.99	26.84	38.29	21.43	0.04

*Standard meteorological week.

weather parameters were similar at the time of aphid appearance. The whitefly's peak population was recorded during 10 to 16th May *i.e.*19th SMW where it was 15.93 whiteflies per cage. The min and max temperature (36.14 °C and 22.76°C), morning and evening humidity (65.71 per cent and 47.14 per cent) and Rainfall (3.80 mm) also recorded. The population after reaching its peak, sudden downfall has been observed and the population recorded before the harvesting was 2.47 whiteflies/cage during 22nd SMW when max and min temperature (37.69°C and 24.16 °C), relative humidity in morning (58.86 per cent) and evening (34.29 per cent) and 3.70 mm rainfall was also recorded.

Similarly, during the second year of investigation *i.e. summer,* 2022 the incidence of whitefly was observed initially in 15th SMW (3rd and 4th week of April) with mean population of 6.33 whiteflies/cage. It increased gradually and reached to peak (16.07 whiteflies/cage) on 19th SMW (2nd week of May) when max and min temperature, relative humidity at morning and evening and rainfall were 41.94 °C, 25.71°C, 34.86 per cent, 15.86 per cent and 0.00 mm, respectively. After 19th SMW, minimum population of whitefly recorded (6.80 whiteflies/cage) on 23rd Standard week of 2022. During the period, max (43.99°C) and min (26.84°C) temperature, relative humidity in morning (38.29 per cent) and evening (21.43 per cent) and rainfall (0.04 mm) also recorded.

The present findings are supported by Singh *et al.,* 2022 who stated that the peak of whitefly population was observed in the 19th SMW. Similarly, present findings are consistent with the findings reported by Ahirwar *et al.* (2016), who found that the peak incidence of whitefly (*B. tabaci*) detected on April 17. These results also concur with the results obtained by Sujatha *et al.* (2017), who observed that whitefly incidence, developed on the crop and persisted from the 13th to the 17th SMW.

Relationship of insect-pests population and weather parameters during summer 2021 and 2022

After analyzed data simple correlation between aphid population and weather parameters during summer 2021 and 2022 are concluded in the Table 3. The population had significant positive correlation (r= 0.303 and 0.185, respectively) with maximum temperature and minimum temperature during 2021 (r= 0.178) and 2022 (r= 0.282). Significant negative impact had been found with Morning R.H. (r= -0.280 and -0.403) and evening R.H (r= -0.113 and -0.597) during summer 2021 and 2022, respectively. Increased rainfall was one of the important reasons for declining population of aphid due to this, rainfall establish significantly negative correlation with fluctuation of aphid population in summer 2021 and 2022 *i.e.* r= -0.057 and -0.178, respectively.

The result of simple correlation (r) between the jassid and weather parameter demonstrated (Table 3) that relationship between max. temperature and jassid population had simple significant positive correlation (r= 0.314 and 0.155) whereas minimum temperature correlated (r= 0.205 and 0.073) with population less positive significantly. Weather factors other than temperature *i.e.* R.H. and rainfall was correlated negatively whereas the R.H. during morning time found significantly negatively correlated during 2021 (r= -0.267) and 2022 (-0.389). The correlation of evening R.H. with jassid population was non-significant negative during 2021 (r= -0.069*) and significant negative during 2022 (r= -0.549). Correlation of rainfall (r= -0.058* and -0.010*) was non-significantly negative with jassid population.

The analyzed data has been demonstrated that maximum (r= 0.485 and 0.525) and minimum temperature (r= 0.102 and 0.477) has been established a significant positive correlation with the population of whitefly in consecutive years whereas relative humidity and rainfall was negatively correlated with population buildup of whitefly. Morning humidity (r= -0.362 and -0.613) and Evening humidity (r= -0.190 and -0.744) was established significantly negative correlation with population of whitefly. The correlation of rainfall with incidence of whitefly was -0.057 and -0.085, respectively in summer 2021 and 2022 which was significant negative correlation.

The results of Mawtham *et al.* (2023) and Aulakh *et al.* (2024), which revealed that the populations of aphids and jassids exhibited a positive association with maximum temperature and minimum temperature whereas negative correlation with relative humidity, corroborate the current findings. The present studies are strengthened by Shilpakala *et al.* (2016), who report that these results are consistent with the findings that the aphid and leafhopper are significant, positively correlated with maximum temperature and negatively correlated with relative humidity and rainfall and this was also supported by Panickar *et al.,* (2023). Chakraborty (2011) and Deepika *et al.* (2013) have

Table 3: Correlation between insect-pests population with weather parameters during *Summer*, 2021 and 2022.

Weather parameters		*Summer*- 2021			*Summer*- 2022		
		Aphid	Jassid	Whitefly	Aphid	Jassid	Whitefly
Temperature (°C)	Maximum	0.303	0.314	0.485	0.185	0.155	0.525
	Minimum	0.178	0.205	0.102	0.282	0.073	0.477
Relative humidity (%)	Morning	-0.280	-0.267	-0.362	-0.403	-0.389	-0.613
	Evening	-0.113	-0.069	-0.190	-0.597	-0.549	-0.744
Rainfall (mm)		-0.057	-0.058	-0.288	-0.178	-0.010*	-0.085

Significant at 5% level (P = 0.05) ; *NS= Non significant.

also reported similar observations. While Bairwa *et al.* (2017) also supported the current study, which found that maximum temperature had a positive correlation with the population fluctuation of Aphid, Jassid and whitefly while all insects had a negative correlation with rainfall, Yadav *et al.* (2015) stated that the population of whiteflies established a positive correlation with the temperature, which is similar to the findings of the present study. The present study was also supported by Rajawat *et al.* (2020) and Mohaptra *et al.* (2018), who reported that the population of whiteflies and aphids favourably connected with temperature and negatively linked with rainfall and afternoon and evening humidity. Along with those supporting literature, Gehlot *et al.* (2021) also present to their findings which was similar with the present observations, noted that the population of aphid, jassid and whitefly was positively correlated with temperature but it was negatively correlated with the rainfall.

CONCLUSION

It is concluded that the starting incidence of population for sucking insect-pests reached on their peaks on 18th to 19th SMW of both year *i.e.* Aphid, Jassid and whitefly. The population of these pest was observed on the mungbean till the harvesting. Rainfall also decreased the population of sucking pest through washout which was responsible for the negative association with the insect population.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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