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Population dynamics of major insect pests of summer mungbean

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Abstract
The field experiment was conducted at the Breeder seed production farm, Department of Plant Breeding, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh) during the summer season of 2024. Mungbean variety PDM-139 was sown in a 75 m^2 plot, damage of insect pests was recorded and correlated with the weather data. The results revealed that the peak incidence whitefly (12.6 adults/cage) and jassid (6.8 jassids/cage) recorded during 19th and 20th SMW, respectively and peak population of green sting bug (2.6 bugs/plant) and Thrips (11.9 thrips/5 flowers) recorded during 21st and 20th SMW, respectively when crop at reproductive stage. White spotted leaf beetle (2.9 beetles/plan) and ladybird beetle (1.8 beetls/plant) recorded during 21st and 20th, respectively. Correlation analysis was revealed that jassid and thrips population were significantly positive correlated with evening relative humidity, while thrips population were significantly negative correlated with sunshine hours.

Keywords: Mungbean, weather factors, insect pests and correlation

Introduction
Green gram, scientifically known as *Vigna radiata* (Linn.) Wilczek, is a significant legume belong to the Fabaceae family and the Papilionaceae subfamily. This crop is vital for its role in enhancing soil fertility through biological nitrogen fixation, facilitated by *Rhizobium* spp. bacteria present in the plant root nodules (Patel *et al.*, 2021) [11]. Mungbean is cultivated on 7.3 million hectares (M ha) globally, with a total worldwide production of 5.3 million tonnes (MT). In India, the area of mungbean cultivation was 5.5 M ha (2022), production of 3.17 MT with a productivity with of 570 kg/ha. In Madhya Pradesh, the total area under mungbean is 0.16 M ha, producing 0.12 MT with productivity of 741 kg/ha. In Jabalpur district, the total area under mungbean is around 1,000 ha, yielding 627 T with productivity of 450 kg/ha (Anonymous, 2022) [1].

Mungbean production is influenced by various factors such as adverse climatic conditions, poor-quality water, sub optimal seeds, diseases and pest infestations. Among these, losses caused by both insect and non-insect pests are major contributors to yield reduction. In India, a total of 64 species of insect pests have been reported to attack mungbean crops in the field. Key pests include whitefly (*Bemisia tabaci*), leaf hopper (*Empoasca kerri*), black aphid (*Aphis craccivora*), cutworm (*Agrotis segetum*), stem fly (*Ophiomyia phaseoli*), bihar hairy caterpillar (*Spilactria obliqua*), tobacco caterpillar (*Spodoptera litura*), sphinx moth (*Agrius convolvuli*), grey weevil (*Myllocerus discolor*), gram pod borer (*Helicoverpa armigera*), spotted pod borer (*Maruca testulalis*) and blue butterfly (*Lampides boeticus*) (Pawar *et al.*, 2023) [12].

Insect pest infestations can cause substantial yield losses in green gram, with losses potentially reaching up to 30%. Duraimurugan and Tyagi (2014) [3], Saini *et al.* (2023) [14] and Pawar *et al.* (2023) [12] were reported a significant yield loss of 54.9% in mungbean due to pest infestations. For, managing the pest population of these pest below the economic threshold level (ETL) is essential for getting higher yield and returns for profitable cultivation. Thus, the present study was undertaken to assess the population dynamics of major insect pests of mungbean.

Materials and Methods

A field experiment was carried out at the Breeder Seed Production Farm, Department of Plant Breeding, JNKVV, Jabalpur (MP). The experiment took place during the summer season, from April 2024 to June 2024. Observations of various insect pest were recorded twice a week, from germination to maturity or until the pests were no longer present. Data was collected from 10 randomly selected plants. The population of various insect pest was recorded using observation methods. The number of adult whiteflies and jassids were recorded at five spots per plot with the help of a cage. Thrips (adults) were recorded the number of thrips per 5 flowers per plant (Rajak *et al.*, 2024) [13]. The green sting bug population was recorded as the number of bugs per plant (Kumar *et al.*, 2023) [6]. The white-spotted leaf beetle population was recorded as the number of beetles per plant. Additionally, the ladybird beetle complex population was recorded as the number of beetles per plant (Singh *et al.*, 2022) [15]. Weather data was collected from the Department of Agrometeorology, College of Agricultural Engineering, JNKVV, Jabalpur, MP. The correlations between weather parameters and the population dynamics of insect pests were calculated and analysis using OPSTAT software.

Results and Discussion

The field experimental results revealed that the population dynamics of Whitefly, *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae) incidence was firstly observed during the 15th SMW (0.3 adult per cage), and they remained on the crop until harvest in the 23rd SMW (1.6 adult per cage). The peak population of whiteflies were observed in 19th SMW (12.6 adult per cage). Similar to the present findings of Singh *et al.* (2022) [15] reported the peak population of whitefly as 11.40 whiteflies per cage (17th SMW) (Table 1). However, contrasting results were observed in previous studies: Brishbhan and Bhowmick (2016) [2] also found that the maximum population of whitefly in the 17th SMW, while Manju *et al.* (2016) [9] observed the peak population in the 3rd week of August. Tamang *et al.* (2017) [16] reported the peak whitefly population occurring from the 2nd week of February to the 1st week of March. The correlation study showed a non-significant correlation with all-weather parameters (Table 2). It is conformity to the findings Gehlot *et al.* (2021) [4]. However, Manju *et al.* (2016) [9] reported a significant positive correlation between whitefly populations and relative humidity, which contrasts with the present results.

The incidence of Jassid, *Amrasca biguttula biguttula* (Ishi.) (Hemiptera: Cicadellidae), was firstly recorded during the 16th SMW (1.2 jassids per cage), and they present on the crop until harvest in the 23rd SMW (1.6 jassids per cage). The peak population of jassids, were observed in the 20th SW (6.8 per cage) (Table 1). In contrast to the present findings, Gehlot *et al.* (2021) [4] reported the peak population of jassids in the 2nd week of September, while Kumar *et al.* (2018) [7] observed the peak population in the 19th SMW. The correlation study revealed a significant positive correlation between the mean jassid population and evening relative humidity (r = 0.77*) (Fig. 1 and Table 2). It is conformity to the findings Manju *et al.* (2016) [9] and Gehlot *et al.* (2021) [4]. Whereas Manju *et al.* (2016) [9] reported significant positively correlated with rainfall which is in contrast with the present findings.

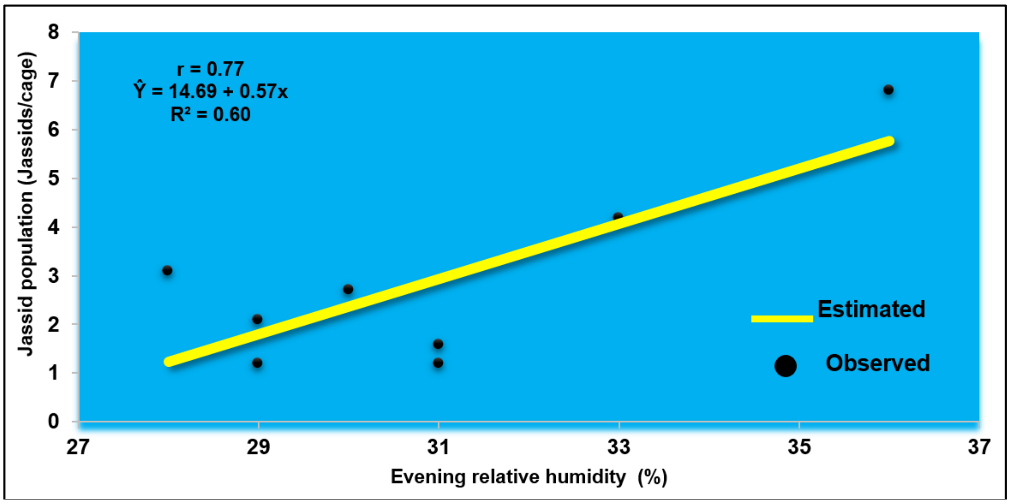

Fig 1: Regression of evening relative humidity on Jassid population (Jassids/cage) on summer mungbean

The incidence of White spotted leaf beetle, *Monolepta signata* (Olivier) (Coleoptera; Chrysomelidae), was firstly recorded during the 15th SMW (0.4 beetles per plant), and they present on the crop until harvest in the 23rd SMW (0.5 beetles per plant). The peak population of white spotted leaf beetles, were observed in the 21st SMW (2.9 beetles per plant) (Table 1). The correlation study showed that the mean population of the white-spotted leaf beetle had no significant correlation with all-weather parameters (Table 2). Additionally, there is a lack of literature regarding the incidence of the white-spotted leaf beetle on mungbean.

The incidence of green stink bug, *Nezara viridula* (Linn.) (Hemiptera; Pentatomidae), was firstly recorded during the 17th SMW (0.2 bugs per plant), and they present on the crop until harvest in the 23rd SMW (0.7 bugs per plant). The peak population of green stink bug, was observed in the 21st SMW (2.6 bugs per plant) (Table 1). Whereas, Hadiya *et al.* (2020) [5] found that the green stink bug population was lowest during the last week of February. The study also showed that the mean population of the green stink bug had non-significant correlation with all-weather parameters (Table 2).

The incidence of Thrips, *Caliothrips indicus* (Pergande) (Thysanoptera; Thripidae), was firstly recorded during the 17th SMW (3.9 thrips/5 flowers), and they present on the crop until harvest in the 23rd SMW (3.4 thrips/5 flowers).

The peak population of thrips, were observed in the 20th SMW (11.9 thrips/5 flowers) (Table 1). It is similarity to the findings Kumar and Singh (2020) [7] reported the peak thrips population eight weeks after sowing, with 18 thrips per 5 plants, while Singh *et al.* (2022) [15] found the peak population to be 12.40 thrips per 10 flowers (19th SMW). In contrast, Manju *et al.* (2016) [9] observed the peak thrips population in the second week of September and Tamang *et al.* (2017) [16] recorded the highest population from the second week of February to the first week of March. The correlation study revealed a significant positively correlated with evening relative humidity (r = 0.76*), and a significant negatively correlated with sunshine hours (r =-0.67*) (Fig. 2,3, Table 2). Consistent with the present findings, Manju *et al.* (2016) [9] also reported a significant positive correlation between thrips population and evening relative humidity. In contrast, Singh *et al.* (2022) [15] found a significant positively correlated with minimum temperature, Brishbhan and Bhowmick (2016) [2] reported a positive correlation with sunshine hours, and Manju *et al.* (2016) [9] observed a significant positively correlated with rainfall.

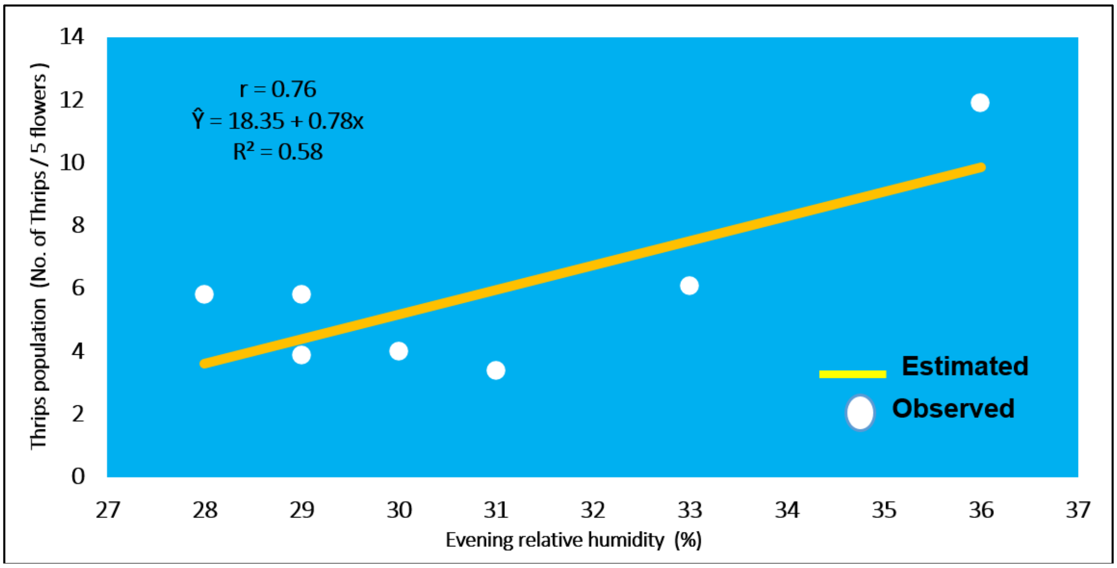

Fig 2: Regression of evening relative humidity on Thrips population (No. of thrips/5 flowers) on summer mungbean

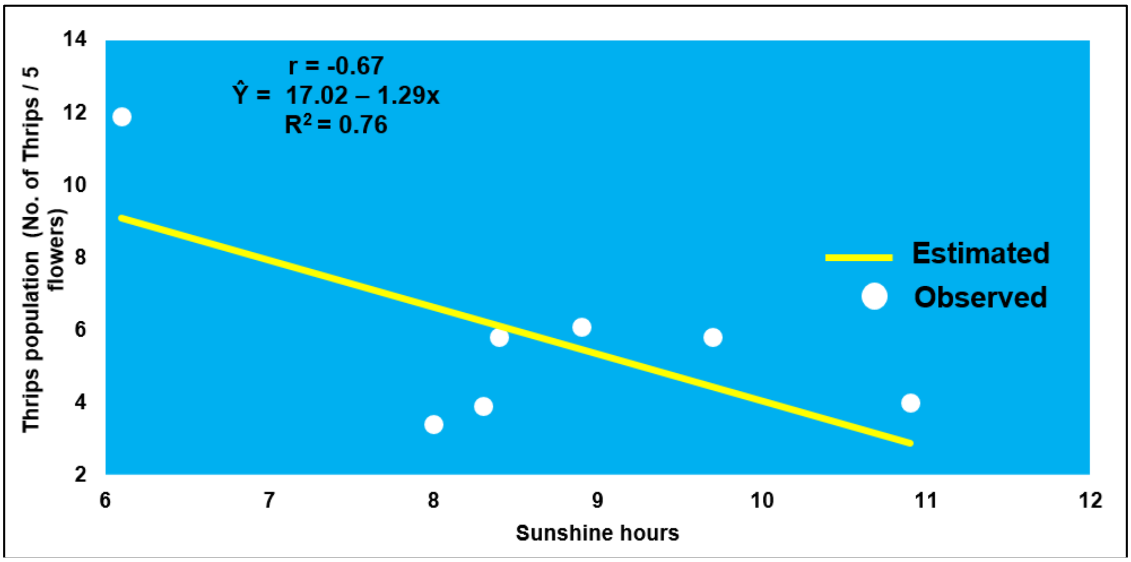

Fig 3: Regression of sunshine on Thrips population (No. of thrips/5 flowers) on summer mungbean

The incidence of Ladybird beetle complex, *Coccinella* spp. (Coleoptera; Coccinellidae), was firstly recorded during the 17th SMW (0.5 beetles per plant), and they present on the crop until harvest in the 23rd SMW (0.2 beetles per plant). The peak population of ladybird beetle complex, were observed in the 20th SMW (1.8 beetles per plant) (Table 1). In contrast with present findings Mohapatra *et al.* (2018) [10] reported that lady bird beetle population peaked at 2nd week of October. The correlation study showed that the mean population of ladybird beetles had a non-significant positive correlation with all-weather parameters (Table 2). In contrast, Mohapatra *et al.* (2018) [10] reported a significant negative correlation between ladybird beetles and relative humidity.

Table 1: Population dynamics of insect pests and their natural enemies on summer mungbean

SMW	Crop Stage	Crop age (DAG)	White fly (adults/cage)	Jassid (jassids/cage)	Green sting bug (bugs/plant)	Thrips (no. of thrips/5 flowers)	White spotted leaf beetle (beetles/plant)	Ladybird beetle complex (beetles/plant)
14	VS	4	0.0	0.0	0	0.0	0.0	0.0
15	VS	11	0.3	0.0	0	0.0	0.4	0.0
16	VS	18	3.2	1.2	0	0.0	0.8	0.0
17	VS	25	5.2	1.2	0.2	3.9	1.3	0.5
18	VS	32	8.4	2.7	0.6	4.0	1.8	0.9
19	RS	39	12.6	3.1	1.2	5.8	2.1	1.4
20	RS	46	9.5	6.8	2.1	11.9	2.3	1.8
21	RS	52	10.5	4.2	2.6	6.1	2.9	1.3
22	MS	59	6.5	2.1	1.7	5.8	1.6	1.1
23	MS	66	1.6	1.6	0.7	3.4	0.5	0.2

Note: SMW = Standard meteorological week, VS = Vegetative stage, RS = Reproductive stage and MS = Maturity stage

Table 2: Correlation studies between the insect pests and their natural enemies of summer mungbean and weather parameters

Weather parameters	Correlation coefficient (r)					
	White fly	Jassid	Green sting bug	Thrips	White spotted leaf beetle	Ladybird beetle
n	9	8	7	7	9	7
Max. Temperature (°C)	0.365^{NS}	-0.093^{NS}	0.332^{NS}	-0.254^{NS}	0.382^{NS}	-0.207^{NS}
Min. Temperature (°C)	0.200^{NS}	0.116^{NS}	0.429^{NS}	0.044^{NS}	0.257^{NS}	-0.077^{NS}
Morning RH (%)	-0.182^{NS}	0.149^{NS}	-0.275^{NS}	0.050^{NS}	-0.128^{NS}	-0.057^{NS}
Evening RH (%)	-0.330^{NS}	0.778*	0.616^{NS}	0.760*	-0.127^{NS}	0.472^{NS}
Rainfall (mm)	-0.645^{NS}	-0.346^{NS}	0.588^{NS}	-0.055^{NS}	-0.612^{NS}	0.052^{NS}
Sunshine hours	0.296^{NS}	-0.544^{NS}	-0.349^{NS}	-0.671*	0.147^{NS}	-0.223^{NS}
Wind speed (km/h)	0.281^{NS}	0.010^{NS}	-0.050^{NS}	-0.138^{NS}	0.144^{NS}	-0.127^{NS}
Morning VP (mm)	0.122^{NS}	0.536^{NS}	0.602^{NS}	0.154^{NS}	0.333^{NS}	-0.044^{NS}
Evening VP (mm)	0.099^{NS}	0.430^{NS}	0.660^{NS}	0.199^{NS}	0.331^{NS}	0.056^{NS}
Evaporation (mm)	0.320^{NS}	-0.303^{NS}	-0.179^{NS}	-0.619^{NS}	0.236^{NS}	-0.490^{NS}

Note: NS = non-significant, * = Significant at 5%, n = Number of observations, Max.= maximum, Min. = minimum, RH = Relative humidity and VP = Vapor pressure

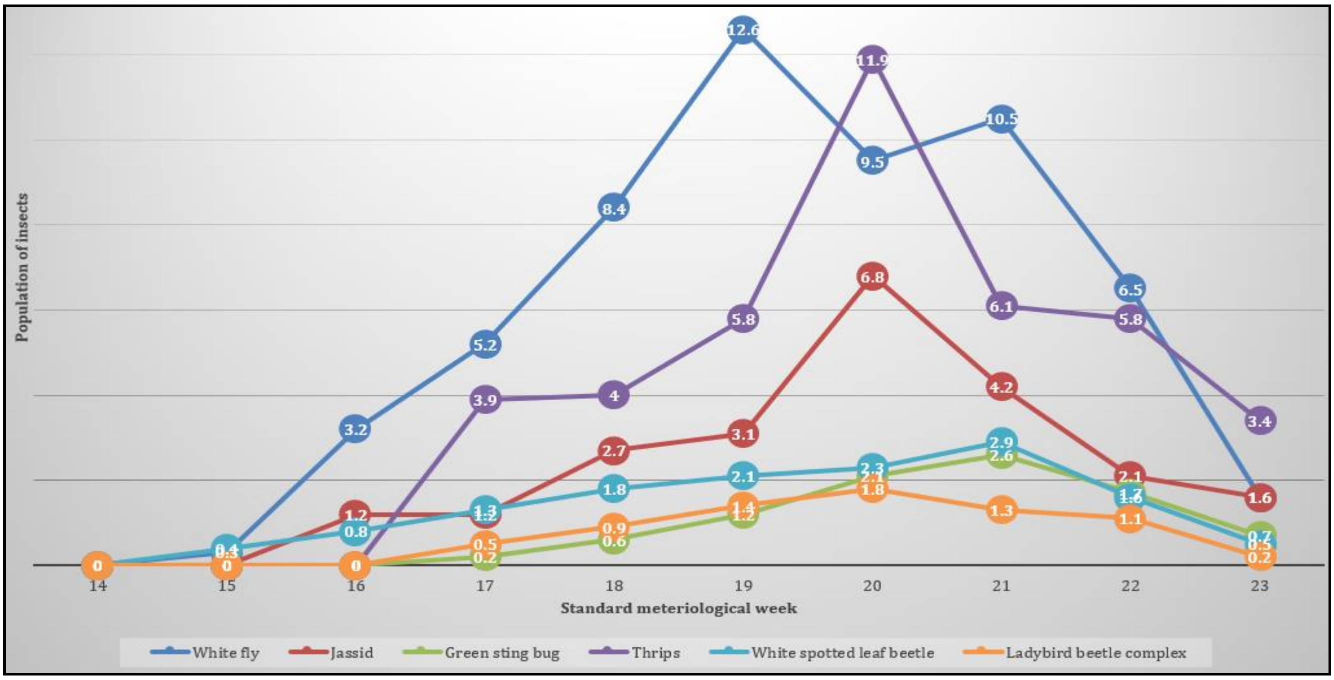

Fig 4: Population dynamics of insect pests and their natural enemies on summer mungbean.

Conclusion

The present study concluded that the population dynamics of key insect pests affecting mungbean, including whiteflies, jassids, green stink bug, thrips and white-spotted leaf beetle, were influenced by various meteorological factors. Correlation analysis revealed both significant and non-significant positive and negative relationships between pest populations and weather conditions. These findings enhance the understanding of factors driving pest dynamics and can aid in the development of effective pest management strategies.

Authors' Contribution

Contribution to conception, wrote the manuscript, analysis, interpretation and acquisition of data (Mr. Firoj); Drafting manuscript, contributed data or analysis tools (Dr. A. K.

Sharma); Analysis and interpretation of data (Mr. Vinay Ingole and Miss Subhashree Patnaik); performed the analysis (Mr. Dhruv Kumar Patel).

Declaration
The authors declare that they have no conflict of interests.

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