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Population dynamics of sucking pests, natural enemies, and the incidence of yellow mosaic disease on *Vigna radiata* (L.) Wilczek in relation to weather factors

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ABSTRACT: The investigation on population dynamics of sucking pests, their natural enemies, and the per cent disease incidence (PDI) of mung bean yellow mosaic disease (YMD) on *Vigna radiata* was conducted. During the harvest of the crop, the population of *Aphis craccivora*, *Empoasca kerri*, ladybird beetle, and the PDI of YMD was the highest on the 17th Standard meteorolo gical week (SMW). In contrast, the population of *Bemisia tabaci* was at its peak on the 15th SMW. The minimum temperature had highly significant positive correlation with the population of *A. craccivora*, *E. kerri*, *B. tabaci,* ladybird beetle, and the PDI of YMD. Moreover, there was a significant positive correlation between wind velocity and the population of ladybird beetles. Furthermore, a significant positive correlation was found between the PDI of YMD and the population of *B. tabaci*. © 2024 Association for Advancement of Entomology

KEY WORDS: Aphid, jassid, ladybird beetle, whitefly, yellow mosaic disease, PDI, correlation

Mung bean, *Vigna radiata* (L.) Wilczek is the third important pulse crop after chickpea and pigeon pea, cultivated extensively in Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra, Odisha, Karnataka, Andhra Pradesh, Gujarat, Bihar, Haryana, and Delhi during both *Kharif* and summer (Singh and Singh, 2015). In India, it occupied an area of 5.5 million ha having a total production of 3.17 million tons and productivity of 570kg/ha in 2022 (Anonymous, 2022). In Gujarat, it is grown in an area of 2.30 lakh ha with a production of 1.21 lakh tons and productivity of 526kg/ha (Anonymous, 2019). More than twelve species of insect pests were found to infest *V. radiata*. Among them, aphid, *Aphis craccivora* Koch., jassid, *Empoasca kerri* Pruthi, and whitefly, *Bemisia tabaci* Gennadius cause serious damage to *V. radiata* and are found at all crop growth stages (Parmar and Ghetiya, 2023). *A. craccivora* feed on the sap of leaves, shoots, flower and pods, causing withering shoots and malformed pods. Jassids, *E. kerri* also damage by sucking cell sap and injecting toxic saliva. *B. tabaci* not only feed on cell sap, but also transmit the Mung bean Yellow Mosaic disease (YMD) to *V. radiata* (Patil, 2006). Weather conditions in a region play a critical role in the occurrence and subsequent buildup of pests, natural enemies, and diseases. Understanding the population dynamics

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of pests, natural enemies, and disease incidence in relation to environmental factors is imperative for developing effective pest management strategies (Singh *et al.* 2023). Therefore, the present investigation was undertaken to study the population dynamics of sucking pests, natural enemies, and the incidence of YMD on *V. radiata* and their correlation with weather parameters.

The investigation was conducted at the Soil and Water Management Research Unit (SWMRU) farm, Navsari Agricultural University (NAU), Navsari, Gujarat, India during summer 2021-22. The farm is located at 20°92′ N latitude and 72°89′ E altitude. Green gram *var*. GM-4 (Gujarat Mung 4) was sown on 26/02/2021 during the Eighth Standard Meteorological Week (SMW). The crop was grown in a plot of size 20m × 20m (400m^2) with the recommended spacing of 45cm × 10cm. Fertilizers were applied at a rate of 20: 40: 00 kg ha^{-1} NPK with all recommended agronomic practices. The crop under the experiment was free from any insecticidal sprays.

The incidence of sucking pests, natural enemies, and YMD on *V. radiata* was recorded at weekly intervals starting from one week after sowing (ninth SMW) till the harvest of the crop (17th SMW). The whole plot was divided into four quadrates (10m × 10m) and 15 plants were randomly selected from each quadrate for observation. Three leaves from the top, middle, and bottom of each plant were observed for the presence of nymph and adult of *A. craccivora*. The population of *A. craccivora* was noted and classified into different grades based on the severity of the infestation, ranging from no aphids present on the plant to severe damage and withering of the plant. This classification was based on the aphid infestation index (AII) as described by Bakhetia and Sandhu (1973) and Parmar and Ghetiya (2023). Similarly, observations were made on the presence of *E. kerri* and *B. tabaci* adults and nymphs on three leaves of each plant. The presence of natural enemies on the leaves and other plant parts was also recorded. Additionally, the number of plants infected with YMD was noted, and the percentage disease incidence (PDI) was calculated using a specific formula.

$$\textit{Percent Disease Incidence (PDI)} = \frac{\textit{(Number of infected plants in a row)}}{\textit{(Total number of plants in a row)}} \times 100$$

Data on weather parameters, maximum and minimum temperature, morning and evening relative humidity, sunshine hours, and wind velocity were used to study the effect of weather parameters on the population of sucking pests, *A. craccivora*, *E. kerri,* and *B. tabaci* and the incidence of YMD. The simple correlation coefficient was worked out.

The population of *A. craccivora* (0.80 AII/ trifoliate leaves) appeared from the 12th SMW and remained active throughout the crop period. The pest population steadily increased, reaching its peak of 1.15 AII/ trifoliate leaves during the 17th SMW, coinciding with the peak of flowering and pod formation (Table 1). According to Tamang *et al.* (2017) in West Bengal, the *A. craccivora* population attained the peak during the peak stage of flowering and pod formation which supports the present findings. Borah (1995) in Assam, India observed that *A. craccivora* appeared on green gram in the first week after germination, with the population increasing until harvest. The peak population of 18.5 aphids/5 plants was in the third week of April. The differences might be due to variations in geographical location, climate, soil conditions, and other factors. Furthermore, the population of *A. craccivora* exhibited a highly significant positive correlation with minimum temperature (r = 0.940**) (Table 2). Similar results were reported by Kumar *et al.* (2000) who observed that the aphid population exhibited a positive correlation with temperature.

The *E. kerri* population on *V. radiata* commenced from the 10th SMW (0.60 *E. kerri*/ trifoliate leaves) and reached a peak (1.18 *E. kerri*/ trifoliate leaves) in the 17th SMW during the harvest of the crop (Table 1). The present findings are similar to those of Arvindarajan (2017) and Patel *et al.* (2021) who observed the peak population of jassid on the 7th and 6th Week After Sowing (WAS), respectively. Kumar *et al.* (2023) observed the peak population of jassid on the 6th and 7th WAS depending on seasons. The population of *E. kerri* on green gram exhibited a highly significant positive correlation with

Table 1. Population dynamics of *Aphis craccivora*, *Empoasca kerri*, *Bemisia tabaci*, and ladybird beetle on *Vigna radiata* per trifoliate leaves from 9th to 17th SMW during 2021-22

SMW	AII	*E. kerri* (no.)	*B. tabaci* (no.)	ladybird beetles (no.)
09	0.00	0.00	0.00	0.00
10	0.00	0.60	0.62	0.00
11	0.00	0.75	1.77	0.00
12	0.80	0.68	3.03	0.25
13	0.70	0.80	4.52	0.40
14	0.85	0.92	5.57	0.55
15	0.98	1.00	6.40	0.59
16	1.08	1.10	6.25	0.63
17	1.15	1.18	6.10	0.65

Note: SMW - Standard Meteorological Week; AII - *A.craccivora* infestation index

minimum temperature (r = 0.845**) (Table 2). In contrast, Manju *et al.* (2016) in Bikaner, Rajasthan reported that the minimum temperature showed a negative significant correlation with the *E. kerri* population, which deviated from the present findings. The differences might be due to differences in geographical location, climate, soil conditions, and other factors.

The population of *B. tabaci* (0.62 *B. tabaci*/ trifoliate leaves) appeared from the 10th SMW and remained active throughout the crop period. The pest population increased gradually and reached the peak population of 6.40 *B. tabaci*/ trifoliate leaves during the 15th SMW. Later on, it declined to 6.10 *B. tabaci*/ trifoliate leaves at the time of harvest of the crop (Table 1). These findings are similar to those of Arvindarajan (2017) and Patil *et al.* (2020) who observed the peak population of 7.23 *B. tabaci* per plant during the 7th WAS. Kumar *et al.* (2023) observed the peak population of whiteflies on the 6th and 7th WAS depending on seasons. The population of *B. tabaci* exhibited a highly significant positive correlation with minimum temperature (r = 0.986**) (Table 2). Kumar *et al.* (2004) also reported a positive correlation of the population of *B. tabaci* with temperature.

Table 2. Correlation coefficients of the population with weather parameters on *Vigna radiata* from 9th to 17th SMW during 2021-22

Weather parameters	Correlation coefficients				
	A. craccivora	*E. kerri*	*B. tabaci*	Beetle	PDI of YMD#
Temperature -Max	0.221	0.341	0.225	0.209	0.950**
Temperature -Mini	0.940**	0.845**	0.986**	0.992**	0.349
Morning RH	0.013	-0.347	-0.073	-0.098	0.916**
Evening RH	0.417	0.200	0.323	0.385	-0.204
Wind velocity	0.699	0.534	0.682	0.729*	0.261
Sunshine hours	-0.286	-0.146	-0.256	-0.234	0.587

*Significant at the level of 5% (r = ±0.707); **Significant at the level of 1% (r = ±0.834);
- Percent Disease Incidence (PDI) of Mung bean Yellow Mosaic disease (YMD) with the *Bemisia tabaci* population

Population of ladybird beetle (0.25/ trifoliate leaves) appeared from the 12th SMW and remained active throughout the crop period. The population increased gradually and reached the peak population of 0.65 ladybird beetle/ trifoliate leaves during the 17th SMW at the time of crop harvest (Table 1). This peak population of ladybird beetles could be attributed to the high population of its prey, such as *A. craccivora* and *E. kerri*. Tamang *et al.* (2017) also observed the peak level of ladybird beetle on the 10th WAS. The population of ladybird beetle exhibited a highly significant positive correlation with minimum temperature (r = 0.992**) and wind velocity (r = 0.729*) (Table 2). Shruthi *et al.* (2018) noticed a positive correlation between ladybird beetle population with temperature.

PDI of YMD (6.50%) appeared from the 11th SMW. The PDI increased gradually and reached a peak (32.35%) during the 17th SMW at the time of crop harvest. The rise in YMD incidence may be attributed to the high population of *B. tabaci*. Similarly, Patil *et al.* (2020) observed a peak of (44.5%) PDI on the 9th WAS. Furthermore, the PDI exhibited high significant positive correlation with the *B. tabaci* population (r = 0.950**) and minimum temperature (r = 0.916**) (Table 2). These findings are alike those of Patil *et al.* (2020).

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