Eco. Env. & Cons. 30 (July Suppl. Issue) : 2024; pp. (S439-S443)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i04s.073

Influence of Climatic Factors on Population Dynamics of White fly (*Bemisia tabaci*) and Jassid (*Amrascabiguttula biguttula*) Infesting *Vigna mungo* (L.) Hepper

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(Received 7 December, 2023; Accepted 2 February, 2024)

ABSTRACT

The study focused on the population dynamics of the whitefly (*Bemisia tabaci*) and jassid (*Amrascabiguttula biguttula*) affecting black gram (*Vigna mungo* L.) crops. The investigation spanned from July to October 2020 and took place at the experimental farm of the Agricultural Research Station in Ummedganj, Kota, Rajasthan. The findings from the study indicate that the whitefly population first appeared during the 1st week of August (31st SMW), registering a mean population of 0.26 whiteflies per 5 plants. The population reached its peak (12.53 whiteflies per 5 plants) in the 1st week of September (36th SMW). The infestation demonstrated a positive correlation with morning relative humidity (r = 0.26) and evening relative humidity (r = 0.60), as well as with rainfall (r = 0.10) and minimum temperature (r = 0.39). In contrast, there was a negative correlation with the maximum temperature (r = -0.48). In the case of jassid population, the initiation of incidence (0.13 jassid per 5 plants) began after the 1st week of August (31st SMW), reaching its peak population (4.8 jassid per 5 plants) after the 4th week of August (35th SMW). The infestation exhibited a positive correlation with morning relative humidity (r = 0.15) and evening relative humidity (r = 0.37), as well as with rainfall (r = 0.45) and minimum temperature (r = 0.46). Conversely, there was a negative correlation with the maximum temperature (r = -0.59).

Key words: *Black gram, Correlation, White fly, Jassid, Population dynamics, Correlation*

Introduction

Black gram (*Vigna mungo* (L.) Hepper) holds a significant position as the third most important pulse crop in India, following chickpea and pigeon pea. This leguminous crop, commonly known as urd bean, is often referred to as the "queen of pulses" owing to its notable nutritional quality. The popularity of black gram (*Vigna mungo* (L.) Hepper) is primarily attributed to its exceptional nutritional quality. This pulse crop stands out for its versatility, as it can be cultivated in various cropping systems, including mixed crops and intercrops, in addition to sole cropping, due to its short duration. Black gram is rich in nutrients, comprising 24% protein, 3.2% minerals, and 59.6% carbohydrates. Per 100 grams of split dal, it contains 154 mg of calcium, 9.1 mg of iron, and 38 mg of β-carotene (Nene, 2006). Black

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gram exhibits nitrogen-fixing capabilities, with the potential to fix 30 to 60 kg per hectare of nitrogen, influenced by soil and environmental conditions (Panikkar *et al.,* 1990). Throughout its various growth stages, numerous insect pests emerge, as noted by Dhuri and Singh in 1983. However, the significant damage is attributed to around a dozen specific insect pests, as highlighted by Singh and Singh in 1977. Annually, an average of 2.5 to 3.0 million tonnes of pulses face losses due to pest-related issues, as reported by Rabindra *et al.,* 2004. The monetary impact of this loss is substantial, amounting to nearly Rs. 6,000 crores, primarily attributed to the damage caused by the insect pest complex (Reddy, 2009). Both biotic and abiotic factors pose challenges to the production and productivity of black gram. Notably, losses attributed to insect pests and diseases are particularly alarming among biotic stresses. In India, black gram (*Vigna mungo* L.) faces the onslaught of 60 different insect species throughout various stages of its growth. Among these, the major pests that significantly impact on its cultivation include whitefly (*Bemisia tabaci*), thrips (*Thrips tabaci*), leafhopper (*Empoascakerri*), defoliator (*Madurasiaobscurella*), spotted pod borer (*Maruca vitrata*), pea butterfly (*Lampidesboeticus*), tobacco caterpillar (*Spodoptera litura*), and gram pod borer (*Helicoverpa armigera*) (Soundararajan and Chitra, 2014). Whitefly and jassid contribute to damage in black gram by directly feeding on plant sap, thereby reducing the vitality of the plants. Additionally, these pests have indirect effects by transmitting the yellow mosaic virus. The cumulative impact of insect pests, including whitefly and jassid, results in an annual yield loss of approximately 30 percent in both black gram and mung bean, as reported by Gailce *et al*., 2015. The study was initiated to evaluate the incidence of whitefly and jassid on black gram during the kharif season in Rajasthan. This investigation was prompted by the expanding cultivation of black gram in the region and the observed prevalence of biotic stress, particularly during the vegetative and podding stages, resulting in a significant reduction in economic yield. The study aimed to understand the relationship between the incidence of whitefly and jassid and abiotic stresses during the kharif season of 2020-21. Temperature stands out as a pivotal abiotic factor among various environmental elements, playing a crucial role in regulating insect population dynamics, developmental rates, and seasonal occurrences. Recognizing the necessity for updated information on sucking pests in black gram to implement effective management strategies, the current investigation was initiated with the aim of addressing these concerns and enhancing our understanding in this regard.

Materials and Methods

The field experiment took place at the Agricultural Research Station, Ummedganj-Kota, located approximately 12 km east of Kota. The station is situated at an altitude of 258 meters above mean sea level, positioned at 25°11′0'' N Latitude and 75°50′0'' E Longitude. This region falls within Agro-climatic Zone V, specifically the Humid South Eastern Plain Zone of Rajasthan.

In the *kharif* season of the year 2020-21, a field experiment was conducted to investigate the population dynamics of whitefly and Jassidin black gram crops, and to analyse their correlation with climatic factors. This experiment took place at the experimental farm of the Agriculture Research Station in Ummedganj-Kota, Rajasthan. The Pratap urd – 1 black gramvariety was used. The experimental design employed was a Randomized Block Design (RBD), with a planting arrangement of 30 x 10 cm and plot dimensions of 4.2 x 5.0 m². Throughout the entire growth season of the black gram crop, continuous monitoring was conducted to observe the fluctuations in the populations of whitefly and jassid. The observation of whitefly (adults) and jassid (nymphs and adults) populations involved monitoring five randomly selected and tagged plants within a plot. These observations were recorded at weekly intervals, commencing from 7 days after germination and continuing until the harvest of the crop. The mean population of these insect pests was calculated and correlated with various weather parameters. Throughout the study, the data collected was analyzed for correlations with different weather conditions. The weather data used was obtained from the meteorological observatory situated at the Agriculture Research Station in Kota. The collected data underwent further statistical analysis, including the calculation of correlation coefficients, to discern potential relationships between the collected variables.

Results and Discussion

Data on population dynamics of whitefly and

Jassidon black gram is presented in Table 1 and Figure 1.

Whitefly

The presence of whitefly was noted during the 31st Standard Meteorological Week (SMW), which corresponds to the first week of August. At that point, the average population was recorded at 0.26 whiteflies per 5 plants. Subsequently, the infestation gradually escalated, reaching its zenith in the first week of September (36th SMW) with a population of 12.53 whiteflies per 5 plants, when the maximum temperature (34.29), minimum temperature (22.93), morning relative humidity (84.14), evening relative humidity (82.29) and rainfall was 93 mm. Thereafter, the infestation declined and reached to its minimum levels

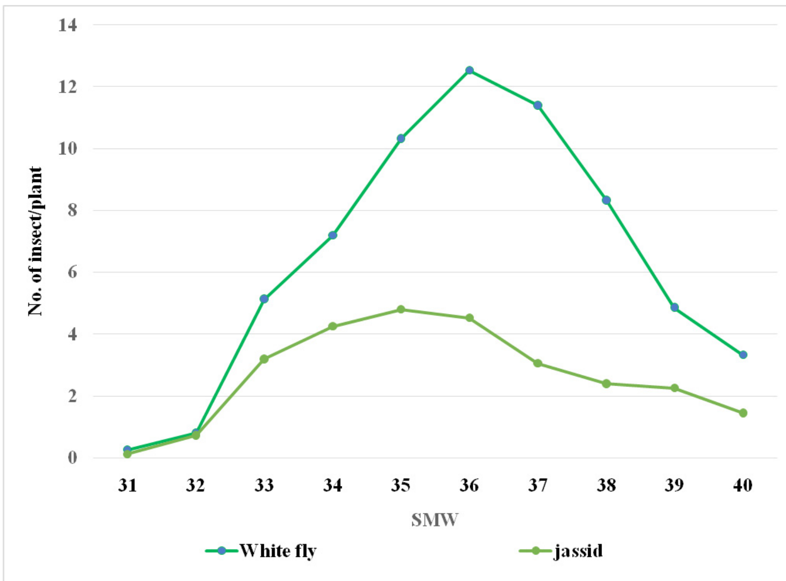

Fig. 1. Population dynamics of major insect pests infesting black gram variety Pratap urd – 1 during *kharif* 2020

Table 1. Population dynamics of major insect pests infesting black gram variety Pratap urd – 1 during *kharif* 2020

SMW (Duration)	Date of observation	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Sucking (Insect pest No. of / 5 plant)	
		Max.	Min.	Morn.	Even.		White fly	Jassid
31(30Jul–05 Aug)	3-8-2020	35.43	22.79	79.00	55.86	63	0.26	0.13
32(06Aug–12 Aug)	10-8-2020	34.71	21.90	80.14	67.86	11	0.80	0.73
33(13Aug–19Aug)	17-8-2020	35.40	23.69	65.71	57.14	111	5.13	3.20
34(20 Aug –26 Aug)	24-8-2020	34.64	23.14	84.83	64.57	107.5	7.20	4.26
35(27 Aug – 02 Sep)	31-8-2020	34.29	22.86	84.29	77.29	43.1	10.33	4.80
36(03 Sep – 09 Sep)	7-9-2020	34.29	22.93	84.14	82.29	93	12.53	4.53
37(10 Sep – 16 Sep)	14-9-2020	34.86	23.21	81.71	76.14	0.00	11.40	3.06
38(17 Sep – 23 Sep)	21-9-2020	35.80	23.00	81.71	75.14	0.00	8.33	2.40
39(24 Sep – 30Sep)	28-9-2020	35.67	23.43	88.57	78.71	24.6	4.86	2.26
40(01 Oct – 07 Oct)	5-10-2020	35.39	22.50	82.14	78.14	0.00	3.33	1.46
Total					64.17	26.83		
CorrelationCoefficient (r)								
Max. temp. (°C)					-0.481	-0.593		
Min. temp. (°C)					0.399	0.469		
Morning R.H. (%)					0.262	0.151		
Evening R.H. (%)					0.600	0.374		
Rainfall (mm)					0.108	0.456		

(3.33 whitefly/ 5 plant) during 1st week of October (40th SMW). The infestation of whitefly exhibited positive correlations with various weather parameters, including morning relative humidity (r = 0.26), evening relative humidity (r = 0.60), rainfall (r = 0.10), and minimum temperature (r = 0.39). In contrast, there was a negative correlation observed with the maximum temperature (r = -0.48). These findings suggest that certain weather conditions, characterized by higher humidity and lower maximum temperatures, may contribute to increased whitefly infestation. The correlation study aligns with previous research conducted by Kumar and Singh *et al*. (2016), which also found positive correlations between whitefly infestation and relative humidity (maximum and minimum for both morning and evening) with respective correlation coefficients of 0.88 and 0.48. Additionally, their study showed a positive correlation with rainfall (r = 0.034). Similar results were obtained by Singh *et al.* in 2017, with a reported positive correlation between whitefly infestation and rainfall (r = 0.46). These consistent findings across studies reinforce the significance of weather parameters in influencing whitefly populations. Bairwa and Singh 2017 found that the white fly population showed positive correlation with minimum temperature (r =0.65). Yadav *et al.,* 2015 showed positive correlation with relative humidity morning (r = 0. 0.36) and evening (r =0.69) along with minimum temperature (r = 0.6) and rainfall (r = 0.36).

Jassid

Jassid made its initial appearance during the 31st Standard Meteorological Week (SMW), which corresponds to the first week of August. At that time, the average population was recorded at 0.13 Jassids per 5 plants. Subsequently, the infestation gradually increased, reaching its peak in the fourth week of August (35th SMW) with a population of 4.8 Jassids per 5 plants, when the maximum temperature (34.29), minimum temperature (22.86), morning relative humidity (84.29), evening relative humidity (77.29) and rainfall 43.1 mm. Thereafter, the infestation declined and reached to its minimum population (1.46 Jassid/ 5 plant) during 1st week of October (40th SMW). The infestation of jassid demonstrated positive correlations with various weather parameters, including morning relative humidity (r = 0.15), evening relative humidity (r = 0.37), rainfall (r = 0.45), and minimum temperature (r = 0.46). Conversely, there was a negative correlation observed with the maximum temperature (r = -0.59). These findings are in line with a study conducted by Kumar and Singh *et al*. in 2016, where they reported positive correlations (r = 0.89, r = 0.40, and r = 0.087, respectively) between jassid infestation and morning relative humidity, evening relative humidity, and rainfall.Bairwa and Singh 2017 found that the jassid population showed positive correlation with minimum temperature (r= 0.55) and along with rainfall (r = 0.066). Yadav *et. al.,* 2015 showed positive correlation with relative humiditymorning (r = 0. 0.26) and evening (r =0.64) along with minimum temperature (r = 0.57) and rainfall (r = 0.22).

Conclusion

The incidence of whitefly (0.26 whitefly/5 plants) and jassid (0.13 jassid/5 plants) populations commenced after the first week of August in black gram (31st SMW) and reached their peak populations of 12.53 whitefly/5 plants after the first week of September (49th SMW) and 4.80 jassid/5 plants in the fourth week of August (35th SMW). Whitefly and jassid populations exhibited a negative correlation with maximum temperature, while minimum temperature, rainfall, morning relative humidity, and evening relative humidity showed positive correlations. These findings underscore the intricate relationship between insect populations and various climatic factors in the black gram ecosystem.

Acknowledgements

The authors express their gratitude to all the faculty members of the Entomology Department, the Dean of the College of Agriculture, and the Director of Research at AU, Kota, for providing essential facilities and encouragement.

Declaration of Conflicting Interests

The author(s) have stated that there are no conflicts of interest regarding the research, authorship, and publication of this article.

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