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Population Dynamics of Whitefly, *Bemisia tabaci* and Spotted Pod Borer, *Maruca vitrata* on blackgram (*Vigna mungo*) in relation to Abiotic Factors

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ABSTRACT: In view of increase in extent of area under black gram during *rabi* season in Telangana and prevalence of biotic stress at vegetative and podding stage leading drastic reduction of economic yield. A study on seasonal incidence of whitefly and spotted pod borer on blackgram was conducted during *rabi* season, 2021 at Regional Agricultural Research Station, Warangal, PJTSAU. The results revealed that the incidence of whitefly on blackgram started from 15 days after sowing *i.e.*, 43rd standard meteorological week with initial population being 0.68 whitefly per plant and from thereafter the population was gradually increased and reached its peak during 47th SMW with 5.2 whitefly per plant. The prevailed weather conditions during this period was 22.8°C to 33.4°C temperature, 67.9% to 92.7% relative humidity and this may favoured for gradual increase and multiplication of whitefly population in blackgram ecosystem. The incidence of spotted pod borer was started at flowering stage *i.e.*, during 46th SMW with initial population being 0.38 larvae per plant and reached its peak population (2.38 larvae/plant) during 49th SMW when the temperature was 18.4°C to 30.5°C and relative humidity was 53.7% to 88.6% respectively. Correlation studies showed maximum temperature, minimum temperature and relative humidity (morning and evening) had positive influence and sunshine hours had negative influence on whitefly population dynamics, whereas, spotted pod borer influenced positively with sunshine hours, temperature and negatively with relative humidity. The results revealed that weather parameters like temperature, relative humidity and sunshine hours played as limiting factors for population build-up of whitefly and *M. vitrata* on black gram during *rabi* season.

Keywords: Blackgram, whitefly, spotted pod borer, incidence, population dynamics.

INTRODUCTION

Blackgram (*Vigna mungo* L. Hepper) is commonly known as urdbean in India belongs to family leguminosae, sub family Papilionaceae. It is the fourth most important short-duration pulse crop grown in India because of its nutritional and industrial values (Nene, 2006). India is the largest producer (accounting >70% of the global production) and consumer of black gram in the world. In India, blackgram is one of the multipurpose pulse crops grown on 4.11 m. ha. with annual production of 2.45MT and average productivity of 596 kg/ha (AICRP on MULLaRP, Annual Report, 2020-21).

The production and productivity of blackgram is hindered by both biotic and abiotic factors. Among biotic stresses, losses due to insect pests and diseases are quite alarming. In India, 60 insect species are known to attack black gram crop at different stages of crop growth. The major pests of blackgram are whitefly (*Bemisia tabaci*), thrips (*Thrips tabaci*), leaf hopper (*Empoasca kerri*), defoliator (*Madurasia obscurella*), spotted pod borer (*Maruca vitrata*), pea butterfly (*Lampides boeticus*), tobacco caterpillar (*Spodoptera litura*) and gram pod borer (*Helicoverpa armigera*) (Soundararajan and Chitra 2012). Among which whitefly and spotted pod borer are consistently in their amount of loss caused. Whitefly damages directly by sucking sap from leaves and lowering the vitality of plants, and indirectly through transmitting yellow mosaic virus (Nariani, 1960). Spotted pod borer basically a hidden pest feeds on flowers, buds and pods by webbing together, its entrance hole on pod is plugged with excreta (Sreekanth *et al.* 2015). The annual yield loss due to the insect pests was about 30 per cent in black gram and mung bean (Gailce *et al.*, 2015).

In view of increase in extent of area under black gram during *rabi* season in Telangana and prevalence of biotic stress at vegetative and podding stage leading

drastic reduction of economic yield. The present study was undertaken to assess the incidence of whitefly and spotted pod borer on blackgram in relation to abiotic stresses during *rabi* season, 2021.

MATERIALS AND METHODS

The present study was carried out at A24 block of Regional Agricultural Research Station, Warangal, (GPS coordinates 18.0125 ̊N latitude and 79.59 ̊E longitude). Popular blackgram variety, LBG-752 was sown in 100 Sq. meters duly following recommended agronomic practices under unprotected conditions. The sowing was carried out in *rabi* season, on 12th October, 2021 with spacing 30 cm between the rows and 10 cm between the plants. To record the observations the entire 100 m^2 plot was divided into 10 quadrates each of 1m × 1m. Five plants were selected in each quadrate of 1m ×1m, thus a total of 50 plants were tagged and observations on whitefly and spotted pod borer incidence was recorded early in the morning from their first appearance till harvesting of the crop at a weekly interval.

The population of whitely was recorded by counting the nymphs and adults on two leaves each from top, middle and lower canopy of five randomly selected and tagged plants in each quadrate visually and by using magnifying lens at weekly interval. Apart from visual observation, whitefly incidence was also recorded by erecting yellow sticky traps at the field above crop canopy. Incidence of *M. vitrata* was recorded by counting the number of larvae of five randomly selected and tagged plants in each quadrate. The cumulative population of whitefly and *M. vitrata* was calculated and weekly data on temperature, relative humidity (RH), and sunshine hours were obtained. Statistical analysis of data was analyzed through simple correlations between population dynamics of whitefly and abiotic parameters, maximum temperature, minimum temperature, relative humidity (morning and evening) and sunshine hours.

RESULT AND DISCUSSION

Influence of abiotic factors on whitefly, *B. tabaci*: The data on population dynamics of whitefly *B. tabaci,* (Gennadius) on blackgram studied during *Rabi,* 2021-22 revealed that the incidence of whitefly on blackgram started from 15 days after sowing (DAS) and the dynamics of whitefly population was in the range of 0.5-5.2 per plant during the study period (*Rabi* season). The first observation was recorded on 43rd SMW (second fort night of October) *i.e*., 15 DAS with 0.68 whitefly per plant and the population was gradually increased and reached its peak during 47th SMW (fourth week of November) with 5.2 whitefly per plant (Fig. 1). The weather conditions prevailed during that period was 33.4°C maximum temperature, 22.8°C minimum temperature, 92.7% RHI and 67.9% RHII, which may favoured for gradual increase and multiplication of whitefly population. A gradual decline in the pest population was evident thereafter (Table 1). Whitefly prefers to suck the phloem sap from the succulent part of the plant and as the plant became older its dry matter accumulation is increased with the age of the plant and thus reduces population of whitefly and its infestation as well (Latif and Akhatar 2013). The present findings are partially corroborate with the results of Kumar *et al.* (2004) who noted that highest population of whitefly was recorded on 32.5° maximum temperature, 20.8° minimum temperature and 82% relative humidity respectively.

The yellow sticky trap data revealed that whitefly catches per trap was in the range of 12.4 to134.1 per trap per week. The first observation was recorded on 43rd SMW (second fort night of October) with initial population of 21.2 whitefly per trap and the trap catches were gradually increased and reached its peak during 47th SMW (fourth week of November) with 134.1 catches per trap. A gradual decline in the pest population was evident thereafter (Table 1, Fig. 2 and Plate 2).

Correlation studies between whitefly population and abiotic factors (Table 2) revealed that the whitefly population showed positive correlation with maximum temperature (r = 0.730), minimum temperature (r = 0.710) and relative humidity (morning, r = 0.394 and evening, r = 0.693) while, negative correlation with sunshine hours (r = -0.779). Similarly, correlation coefficient between whitefly catches on sticky traps and abiotic factors revealed positive correlation with respect to maximum temperature (r = 0.386), minimum temperature (r = 0.440) and relative humidity (morning and evening r = 0.259, r = 0.550, respectively), while sunshine hours (r = -0.365) prevailed during the seasons showed negative correlation. This proved abiotic factors *viz*., temperature, relative humidity and sunshine hours influence population build-up of whitefly in blackgram ecosystem. Byrne (1991) stated that the weather parameters such as temperature, wind speed, rainfall and relative humidity play important roles towards the population dynamics of whiteflies.

The results are in accordance with the findings of Yadav *et al.* (2015) who reported that whitefly incidence in blackgram has non-significant positive correlation with temperature (maximum and minimum) and relative humidity (morning and evening), however, SSH has non-significant negative correlation. Patil *et al.* (2021) reported that whitefly population in mungbean showed non-significant positive correlation with temperature (maximum and minimum) and RH. Similarly, Suyal *et al.* (2018) reported that population of whitefly indicated positive correlation with all the weather parameters except SSH which showed negative correlation in soybean. The abiotic factors viz., maximum temperature, minimum temperature, RHI, RHII and rainfall exhibited positive correlation with whitefly population in clusterbean.

Table 1: Mean population of whitefly in relation to abiotic factors during *rabi*, 2021.

SMW	Weather parameters					Whitefly population/plant	Trap count
	Tmax	Tmin	RHI	RHII	SSH		
43, (22-28, Oct)	31.6	20.0	86.1	48.1	9.2	0.68	21.2
44, (29th, octo - 04thNov)	31.0	20.9	90.1	67.1	3.1	1.1	51.3
45, (05-11, Nov)	29.9	18.8	87.4	53.6	0.0	2.08	62.2
46, (12-18, Nov)	30.3	22.5	92.4	67.9	0.0	3.45	115.6
47, (19-25, Nov)	33.4	22.8	92.7	75.1	0.0	5.2	134.1
48, (26th, Nov – 02nd Dec)	29.9	18.7	84.9	56.6	1.9	2.5	78.2
49, (03-09, Dec)	30.5	18.4	88.6	53.7	8.2	1.42	34.2
50, (10-16, Dec)	29.1	18.1	87.7	51.1	6.6	0.50	12.4
51, (17-23, Dec)	28.0	12.2	87.0	37.0	8.5	00	00
52, (24-31, Dec)	27.5	17.9	92.4	56.8	5.6	00	00

Table 2: Correlation of whitefly population on blackgram and yellow sticky traps catches with abiotic factors during *rabi* 2021-22.

Sr. No.	Weather parameters	Correlation coefficient of whitefly	Correlation coefficient of yellow sticky trap data
1	Temperature (maximum)	0.730	0.386
2	Temperature (minimum)	0.710	0.440
3	Relative humidity (morning)	0.394	0.259
4	Relative humidity (evening)	0.693	0.550
5	Sun shine hours	-0.779	-0.365

Influence of abiotic stress spotted pod borer, *M. vitrata* on blackgram: The results revealed that spotted pod borer population on blackgram ranged from 0.22-2.38 larvae per plant during the study period. The incidence of spotted pod borer was started from 46th SMW with initial population being 0.38 larvae per plant (2nd week of November) and was gradually increased and attained its peak during 49th SMW (1st week of December) with 2.38 larvae per plant. During the peak period, the weather parameters prevailed are 30.5°C maximum temperature, 18.4°C minimum temperature, 88.6% RHI and 53.7% RHII which may favoured for the increase and multiplication of larval population (Fig. 3 & Table 3).

Correlation studies revealed that the spotted pod borer haspositive correlation with sunshine hours (r = 0.212), maximum (r = 0.297) and minimum (r = 0.128) temperature while, negative correlation with morning (r = -0.458) and (r = -0.660) evening relative humidity. The present results are in accordance with Shejulpatil *et al.* (2020) who reported that maximum temperature and sunshine hours showed significant positive correlation with larval population and per cent pod damage whereas, morning relative humidity showed significant negative correlation with larval population. Kapoor and Shankar (2019) who reported that larval population indicated significant positive correlation with maximum temperature and minimum temperature, significant negative correlation with morning and evening relative humidity in blackgram. Similarly, Kantegari *et al.* (2020) on Indian bean reported that spotted pod borer population showed positive correlation with maximum and minimum (significant) temperature and negative correlation with RH and rainfall (Table 4).

Table 3: Mean population of spotted pod borer on black gram in relation to abiotic factors during *rabi*, 2021.

SMW	Weather parameters					Larvae/plant
	Tmax	Tmin	RHI	RHII	SSH	
46, (12-18, Nov)	30.3	22.5	92.4	67.9	0.0	0.38
47, (19-25, Nov)	33.4	22.8	92.7	75.1	0.0	0.86
48, (26, Nov - 02nd Dec)	29.9	18.7	84.9	56.6	1.9	1.44
49, (03-09, Dec)	30.5	18.4	88.6	53.7	8.2	2.38
50, (10-16, Dec)	29.1	18.1	87.7	51.1	6.6	1.4
51, (17-23, Dec)	28.0	12.2	87.0	37.0	8.5	0.22
52, (24-31, Dec)	28.5	17.9	92.4	56.8	5.6	00

Table 4: Correlation coefficient of spotted pod borer population on blackgram with abiotic factors during *rabi* 2021-22.

Sr. No.	Weather parameters	Correlation coefficient
1	Temperature (maximum)	0.297
2	Temperature (minimum)	0.128
3	Relative humidity (morning)	-0.458
4	Relative humidity (evening)	-0.660
5	Sunshine hours	0.212

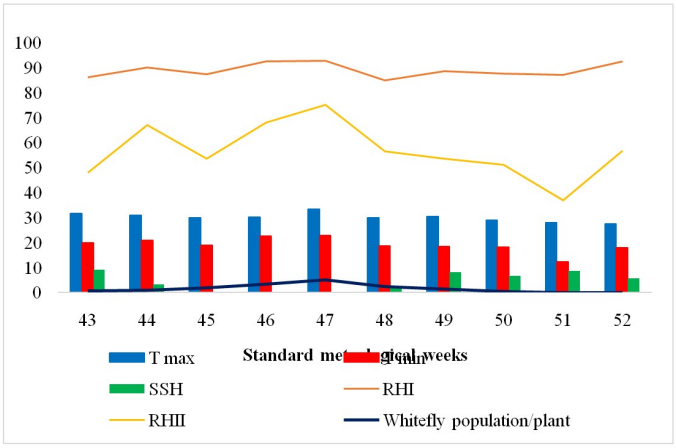

Fig. 1. Population dynamics of whitefly population on blackgram in relation to weather factors during *rabi,* 2021-22.

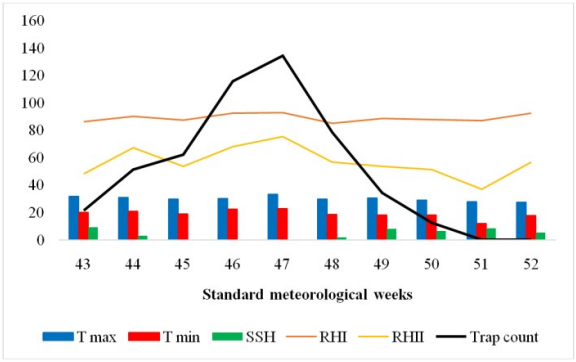

Fig. 2. Population dynamics of whitefly catches on yellow sticky traps in relation to weather factors during *rabi,* 2021-22.

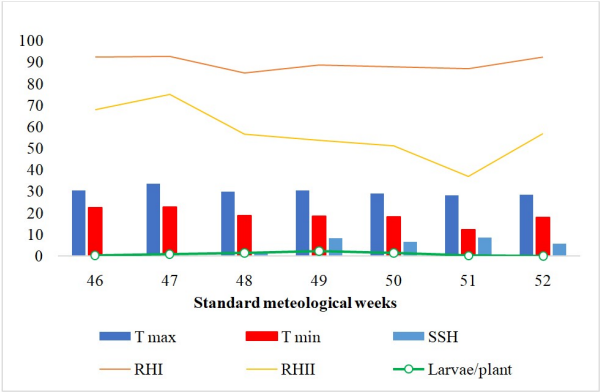

Fig. 3. Population dynamics of spotted pod borer on blackgram in relation to weather factors during *rabi*, 2021-22.

Plate I: Larva of spotted pod borer.

Plate II: Whitefly catches on yellow sticky traps.

SUMMARY AND CONCLUSION

Favorable environmental conditions were played a significant role in development of whitefly and *M. vitrata* population in blackgram sown during *rabi* season. Temperature and relative humidity are very vital in population buildup of whitefly while temperature and sunshine hours in case of *M. vitrata* during *rabi* season.

FUTURE SCOPE

The study generates data base on seasonal dynamics of major insect pests in black gram and their correlation with abiotic factors during *rabi* season which will aware farmers to implement timely management practices against whitefly and spotted pod borer and to achieve potential yield during rabi season in Telangana.

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Conflict of Interest. None.

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