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Population dynamics of important insect-pests on black gram in relation to weather parameters during pre-kharif season in terai region of West Bengal, India

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Abstract
Population dynamics of insect pests on black gram was studied in relation with weather parameters during *pre-kharif 2018* and 2019 in terai region of West Bengal, India. The result revealed that the peak population of whiteflies (7.20/trifoliate/plant) was observed on 14th SMW in 2018, while it was 6.30/trifoliate/plant on 15th SMW in 2019. The peak population of jassids was noticed in 16th SMW in both the year and the population ranged from 4.37 to 4.57/trifoliate/plant. The aphid population started appearing on 8th SMW and increased gradually to reach highest level (24.57/10cm twig/plant and 41.90/10cm twig/plant in 2018 and 2019 respectively) on 10th SMW. The highest larval population of spotted pod borer (1.53/plant and 1.45/plant) and damage (16.07% and 16.29%) to the pod were found during 19th SMW in both the year. Correlation studies indicated that white fly, aphids and spotted pod borer larval population exhibited a significant negative correlation with temperature, relative humidity and rainfall, while Jassid population had a significant positive correlation with temperature, relative humidity and rainfall. Therefore, it can be stated that weather variables had a significant impact on population fluctuation of pest population in black gram crop.

Keywords: insect-pests, weather parameters, pre-kharif, black gram

Introduction
Black gram *Vigna mungo* (Linn.) Hepper (urdbean, mash, mashkalai) is the representative of the sub family Papilioniaceae of family Fabaceae. Its nutritional and industrial values made the crop the fourth most important short-duration pulse crop grown in India that contributes 10% of national pulses production (Nene 2006) [1]. The important black gram growing states of India are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and West Bengal. In the world, India is the largest producer and consumer of black gram (Singh and Singh 1977) [2]. As per Fourth Advance Estimates, black gram is grown in about 31.92 lakh ha area in India with production of about 18.3 lakh tonnes and productivity of 485 kg/ha (Anonymous 2011) [3]. The insect pests are considered as one of the major constraints for low productivity in black gram. Nearly twelve insect species among the pest affecting pulse crops, cause considerable yield loss in black gram. Damage of crop is noticed in both field (from sowing to harvest) and storage (Lal and Sachan, 1987) [4]. The black gram are infested by various insect pests such as whitefly (*Bemisia tabaci*), jassid (*Empoasca spp.*), green leaf hopper (*Nephotettix spp.*), Grasshopper (*Atractomorpha spp.*), blister beetle (*Mylabris pustulata*), leaf webber (*Grapholita critica*), grey weevil (*Myllocerus spp.*), tobacco caterpillar (*Spodoptera litura*), spotted pod borer (*Maruca vitrata*) hairy caterpillar (*Spilosoma obliqua*), gram caterpillar (*Helicoverpa armigera*), and Epilachna beetle (*Epilachna spp.*), which appear as foliage feeders. Moreover, flower thrips (*Caliothrips spp.*) and leaf miner (*Chromatomyia horticola*) are classified as pollen feeder and tissue borer respectively (Kumar *et al.* 2007) [5]. Black aphids *Aphis craccivora* incidence is generally noticed during vegetative stage (Singh and Kumar 2003) [6]. Infestation by thrips is found from flowering to pod filling stage (Chandra and Rajak, 2004) [7].
Keeping this view the present study was undertaken to know the population dynamics of insect pests on black gram in relation to weather parameters during pre-kharif season in terai region of West Bengal.

Materials and Method

Experimental Design

The study was conducted during *pre-kharif* crop seasons of 2018 and 2019. The commonly cultivated variety of black gram, Saroda, was taken for the study. The study was conducted in the Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India. The experimental domain is situated between $26^0$19′86″N latitude and $89^0$23′53″E longitude at an elevation of 43.0 m above mean sea level. The plot size for the experiment was 10m x 3m and replicated thrice. The sowing was made on 6th SMW (standard meteorological week) in pre-kharif season.

Black gram seeds were bioprimed with bioinoculant consortium of *Rhizobium* (URH), *Trichoderma viride* (UBT-18) and phosphate solubilising bacteria (UBPS-9) @ 5g/kg of seed for 30 minutes under shade and sown immediately after drying. The bioinoculants were collected from the Department of Plant Pathology of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar. Standard agronomic packages were followed, while raising the crop.

Methods of recording data on the insect pet incidence

Pest populations were recorded at seven days intervals during morning hours from 30 randomly selected and tagged plants from each plot.

The incidence of aphid *Aphis craccivora* was recorded from 10 cm twig per plant. The populations of white fly *Bemisia tabaci* and jassid *Empoasca kerri* were recorded from three fully formed leaves of upper, middle and lower canopy per plant and presented as number per trifoliate per plant. Total number of larval populations of spotted pod borer *Maruca vitrata* was recorded from each plant. The pods damaged by pod borer were recorded and converted into per cent pod damage by following formula.

% Pod damage = (Number damaged pods/Number of total pods) x 100

The data on pest population subjected to correlation analysis after necessary transformation. Daily weather parameters like temperature (maximum and minimum), relative humidity (morning and evening), rainfall and bright sunshine hour were collected from the Meteorological Observatory of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar.

Statistical analysis

Statistical significance of Pearson's correlation coefficients between pest population and weather parameters of 1-lag week (preceding week) were calculated using statistical software SAS ver. 9.2.

Results and Discussion

Continuous monitoring of insect pests in black gram grown during pre-kharif revealed the incidence of differentpests at various crop growth stages.

Aphid (*Aphis craccivora*)

The aphid population appeared in the field on 8th SMW in both the year and the population ranged from 2.97 to 16.57/10 cm twig/plant (Figure 1). The population increased gradually and reached highest level in 10th SMW (24.57/10 cm twig/plant and 41.90/10 cm twig/plant in 2018 and 2019 respectively) during 2nd week of March, when the crop age was 4weeks old. The population remained in the crop till 14th SMW with minimal population ranging from 1.03 to 2.33/10 cm twig/plant. The aphid population was found to be negatively and significantly correlated with maximum (r=0.378 and 0.644) and minimum temperature (r=0.310 and 0.588), evening relative humidity (r=0.191 and r=0.189) and rainfall (r=0.234 and r=0.174), while the bright sunshine hour had a strong positive association (r=0.110 and r=-0.261) in both the years (Table 1). The morning relative humidity (r=0.207) imparted positive significant influence on aphid population fluctuation in 2019. (Kumar and Singh, 2016) [8] also found significant negatively correlation of *A. craccivora* with maximum temperature.

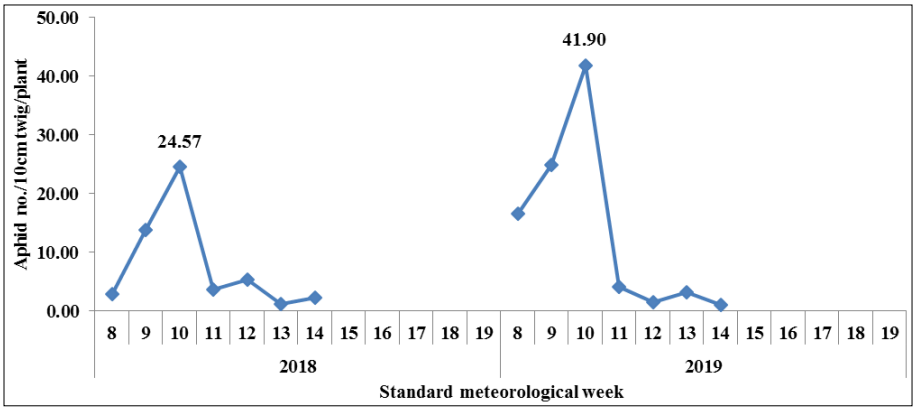

Fig 1: Incidence of aphid population on pre-kharif black gram during 2018 and 2019

White fly (*Bemisia tabaci*)

White fly population started appearing from 8th SMW (0.87/trifoliate/plant in 2018 and 0.97/trifoliate/plant in 2019). The highest white fly population density was recorded as 7.20/trifoliate/plant on 14th SMW (1st week of April) during 2018. In 2019, the population had two peaks, one on 5 weeks old crop in 11th SMW (6.20/trifoliate/plant) and the other on 9 weeks old crop in 15th SMW (6.30 /trifoliate/plant) (Figure 2). The correlation analysis (Table 1) revealed that white fly population had significant negative correlation with morning relative humidity (r=0.244) and evening relative humidity (r=0.165) in 2018. However, significant negative correlation was found with maximum temperature (r=0.120), minimum temperature (r=189) morning relative humidity (r=0.155), evening relative humidity (r=0.188) and weekly rainfall (r=0.157) in 2019. Yadav and Singh (2013) [9] also reported that whitefly was negatively correlated with maximum temperature on mungbean. (Patidar, 2015) [10] Observed a negative correlation between maximum temperature and whitefly. Similarly, same trend was found with rainfall. In

contrary, minimum temperature and relative humidity had a positive correlation with whitefly population on blackgram. However, (Mohapatra *et al.*, 2018) [11] found non-significant negative correlation between whitefly population and relative humidity. But they reported non-significant positive correlation with temperature (maximum and minimum) and rainfall.

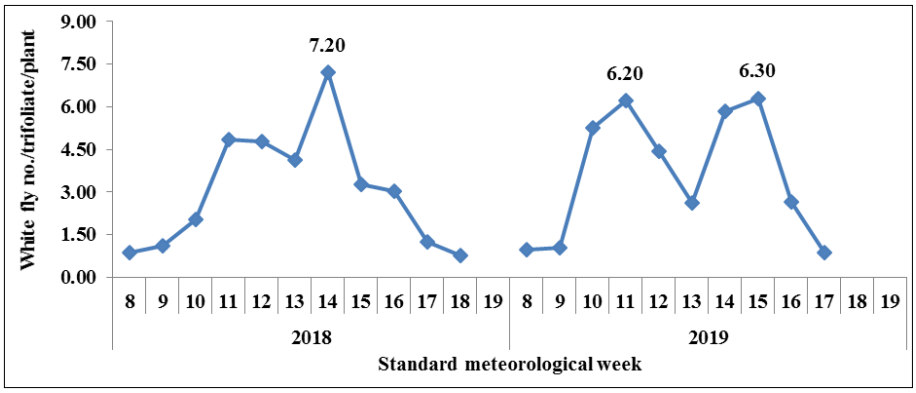

Fig 2: Incidence of white fly population on pre-kharif black gram during 2018 and 2019

Jassid (*Empoasca kerri*)

The jassid infestation (Figure 3) was initiated on 13th SMW (1.37/trifoliate/plant) in 2018 and on 14th SMW (0.07/trifoliate/plant) in 2019. However, peak population was noticed (4.57 /trifoliate/plant in 2018 and 4.37 /trifoliate/plant in 2019) during 3rd week of April (16th SMW), when the crop was 10 weeks old.

The jassid population had significant positive correlation with maximum temperature (r=0.249) and minimum temperature (r=0.220), while significant negative relation with bright sunshine hour (r=0.130) was observed in 2018. However, the population showed significant positive correlation with maximum temperature (r=0.362), minimum temperature (r=0.317), evening relative humidity (r=0.144) and weekly rainfall (0.448), while significant negative correlation is noticed with bright sunshine hour (r=0.111) in 2019 (Table 1). This is in conformity with the studies of (Yadav and Singh, 2006) [12] and (Anandmurthy *et al.*, 2018) [13], where jassids exhibited significant positive correlation with maximum and minimum temperature.

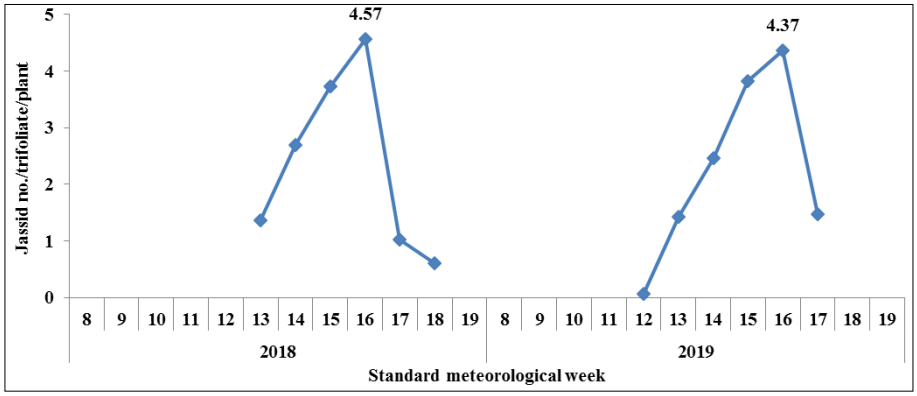

Fig 3: Incidence of jassid population on pre-kharif black gram during 2018 and 2019

Spotted pod borer (*Maruca vitrata*)

The spotted pod borer, *M. vitrata*, started infesting the crop on 3rd week of March (13th SMW). The larvae started to bore the pods from 2nd week of April (15th SMW) at 8 weeks after showing and the damage continued till harvest (Figure 4). The highest larval population and pod damage were observed during 19th SMW in both the year 2018 and 2019, which ranged from 1.45 to 1.53/plant and 16.07% to 16.29% respectively.

The *M. vitrata* infestation (population and damage) and its correlation with weather factors of 1-lag week revealed same trend in both the years (Table 1). The strong positive relation was observed with maximum temperature (r=0.164 and 0.211 in 2018 and r=0.346 and 0.531 in 2019), minimum temperature (r=0.461 and 0.733 in 2018 and r=0.537 and 0.814 in 2019), morning relative humidity (r=0.246 and 0.483 in 2018 and r=0.263 and 0.434 in 2019), evening relative humidity (r=0.488 and 0.818 in 2018 and r=0.473 and 0.724 in 2019) and rainfall (r=0.215 and 0.406 in 2018 and r=0.394 and 0.634 in 2019). However, negative and significant relationship was found with bright sunshine hour (r=0.270 and 0.444 in 2018 and r=0.220 and 0.292 in 2019). The work of (Sravani *et al.*, 2015) [14] showed that *M. vitrata* larval population had a positive relation to maximum temperature, minimum temperature and morning relative humidity. (Umbarkar *et al.* 2010) [15] stated that weather factors like relative humidity (maximum and minimum) and rainfall exhibited non significant negative effect, while temperature (maximum and minimum), wind speed, sunshine hours and evaporation posed positive non significant impact on *M. vitrata* population fluctuation.

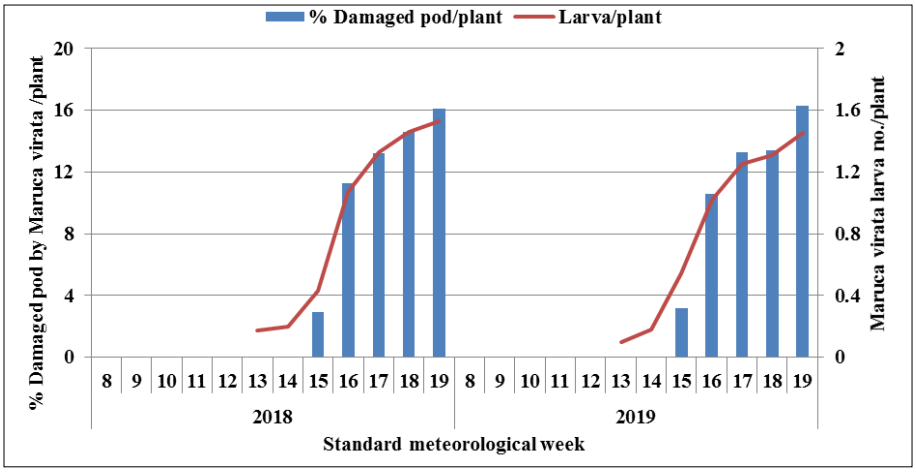

Fig 4: Incidence of spotted pod borer (*Maruca vitrata*) population on pre-kharif black gram during 2018 and 2019

Table 1: Correlation between insect pests population with different weather parameters in blackgram crop

Weather parameters of 1-lag week	2018					2019				
	Pearson Correlation Coefficients, N = 360 Prob > |r| under H0: Rho=0									
	Aphid/10 cm twig	White fly/ trifoliate/ plant	Jassid/ trifoliate/ plant	*Maruca* larva/ plant	% Damaged pod	Aphid/10 cm twig	White fly/ trifoliate/ plant	Jassid/ trifoliate/ plant	*Maruca* larva/ plant	% Damaged pod
Tmax	-0.378	0.083	0.320	0.164	0.211	-0.644	-0.120	0.249	0.346	0.531
	<.0001	0.117	<.0001	0.002	<.0001	<.0001	0.023	<.0001	<.0001	<.0001
Tmin	-0.310	-0.055	0.300	0.461	0.733	-0.588	-0.189	0.220	0.537	0.814
	<.0001	0.296	<.0001	<.0001	<.0001	<.0001	0.000	<.0001	<.0001	<.0001
RH I	0.062	-0.244	-0.080	0.246	0.483	0.207	-0.155	-0.063	0.263	0.434
	0.241	<.0001	0.131	<.0001	<.0001	<.0001	0.003	0.231	<.0001	<.0001
RH II	-0.191	-0.165	0.199	0.488	0.818	-0.189	-0.188	0.030	0.473	0.724
	0.000	0.002	0.000	<.0001	<.0001	0.000	0.000	0.567	<.0001	<.0001
RF	-0.234	-0.020	0.529	0.215	0.406	-0.174	-0.157	0.001	0.394	0.634
	<.0001	0.709	<.0001	<.0001	<.0001	0.001	0.003	0.982	<.0001	<.0001
BrSH	-0.110	0.081	0.018	-0.270	-0.444	0.135	-0.019	-0.130	-0.220	-0.292
	0.038	0.127	0.738	<.0001	<.0001	0.010	0.716	0.014	<.0001	<.0001

Tmax =Maximum temperature (°C); Tmin =Minimum temperature (°C); RH1 = Morning Relative humidity (%); RH2 = Evening Relative humidity (%); RF= Rainfall (mm); BrSH= Bright sunshine hour

From above result it can be said that the incidence pattern of the insect-pests attacking black gram during pre kharif season in terai region of West Bengal varied in two years of study and the weather parameter of the experimental period had profound significant effect on population fluctuation.

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