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Seasonal incidence of sap feeders and defoliators in black gram [*Vigna mungo* (L.) Hepper], at Pajancoa and RI, Karaikal, U.T. of Puducherry

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Abstract
Seasonal incidence of black gram feeder pests *viz*., bean aphids, *Aphis craccivora* and flower thrips, *Megalurothrips. usitatus* and defoliator pests like striped flea beetle, *Phyllotreta. striolata*, leaf folder *Omiodes indicata* and tobacco leaf caterpillar, *Spodoptera litura* were studied in the entire crop period during *Kharif* 2019 and *Rabi* 2019 -2020. The results indicated that the population of sap feeders reached a high peak at 38th and 36th standard week (SW); 12th and 11th SW during *Kharif* 2019 and *Rabi* 2019 - 2020. Defoliators reached high peak at 37th and 11th SW in both the seasons and *Spodoptera* infestation was high during 13th SW. The population of sap feeders and defoliators was recoded positive correlation with morning and evening relative humidity (RH) and rainfall and negative correlation with maximum and minimum temperature during *Kharif* 2019. During *Rabi* 2019 -2020, positive correlation was recoded with maximum and minimum temperature and rainfall and negative correlation with morning and evening RH.

Keywords: black gram, sap feeders, defoliators, seasonal incidence, meteorological parameters

Introduction
Pulses are the important sources of protein, vitamins and minerals and popularly known as "Poor man's meat" and "rich man's vegetable" (Singh *et al.*, 2013) [1]. Black gram (*Vigna mungo* L.), belonging to the family of Leguminaceae, is the third important crop among pulses, cultivated over an area of 5.44 million hectares and a production of 3.56 million tonnes with a productivity of 655 kg/ha. In Tamil Nadu, about 301.57 thousand tonnes of black gram were produced from an area of 426.34 thousand hectares with a productivity of 707 kg/ha. In Puducherry, 370 tonnes of black gram produced from 540 hectares with an average productivity of 691 kg/ha (INDIASTAT, 2019) [2].
The insect spectra that infest the black gram with more than 40 species of insect pests and cause economical damage on black gram (Mahalakshmi *et al.*, 2016) [3]. Karaikal district of Puducherry state lies at the tail end of Cauvery delta region where black gram is grown as rice fallow pulse crop which is damaged by aphids, thrips, striped flea beetle, leaf folder and tobacco leaf caterpillar. These pests appear in different stages of crop growth with various climatic conditions and cause damages. The present investigation was carried out to know the seasonal incidence of insect pests on black gram and their relationship with abiotic factors.

Materials and Methods
In order to study the population fluctuation of sap feeders and defoliators in black gram under field conditions in relation to abiotic factors, field experiment were carried out in the Eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA and RI), Karaikal, U. T. of Puducherry during *Kharif* 2019 and *Rabi* 2019 – 2020.
Black gram VBN (Bg) 5 was sown during *Kharif* 2019 (18.07.2019) and *Rabi* 2019 – 2020 (24.01.2020) with spacing 30 x 10 cm^2 and the crop were raised successfully by adopting recommended agronomical practices. For seasonal incidence, different insect-pests were recorded at weekly interval in ten randomly selected plants, each at five different locations interval from germination to harvesting of the crop. The sap feeders were recorded by counting the number of nymphs and adults per leaf during morning hours between 8 and 10 am on randomly selected plants.

For defoliators, leaf damage by the larvae was assessed based on the damaged leaves and number of beetle population also was assessed. In order to find out the specific impact of meteorological parameters on sap feeders and defoliators, the data on sucking pests and larval population recorded in the experimental plot were correlated with maximum and minimum temperature, morning and evening relative humidity (RH), and rainfal during *Kharif* 2019 and *Rabi* 2019 – 2020. Weather data were obtained from the meteorological observatory of PAJANCOA and RI, Karaikal, U.T. of Puducherry.

Results and Discussion

The incidence of the bean aphids, *A. craccivora* appeared first during 32rd SW of August and had a high peak during 38th SW of September (300 aphids/ 50 plant) during *Kharif* 2019. During *Rabi* 2019 - 2020, nymph and adult population of aphids appeared from the 8th SW of February and reached high peak at 12th SW of March 2020 (312 aphids/ 50 plants). In both the seasons aphids population had a decline at crop harvest at 40th SW of October 2019 and 15th SW of April 2020 (Table 1 and 2). The correlation study showed significant positive correlation with evening RH (0.74), rainfall (0.62) and non-significant with morning RH (0.72) during *Kharif* 2019. Non-significant negative correlation was recorded with maximum (-0.79) and minimum temperature (-0.68). During *Rabi* 2019 - 2020, significant positive correlation was observed with maximum temperature (0.61) and non-significant with minimum temperature (0.42). Non-significant negative correlation was recorded with morning (-0.29) and evening RH (-0.14) and rainfall (-0.001) was recorded. The Multiple linear regression analysis exhibited the significant variation of 71 and 85 per cent on population incidence of aphids with all the weather parameters during *Kharif* 2019 and *Rabi* 2019 -2020 (Table 3) (Fig 1 and 2).

Kumar and Singh (2016) [4] stated that aphid infestation appeared from 2nd week of August to 4th week of September and reached peak population at 1st week of September (17 aphids/ plant) on black gram 2014 at Varanasi. Rajawat *et al*. (2017) [5] expressed that aphids population started appearing from 2nd week of August (33rd SMW) and reached peak at 2nd week of September with 12.40 aphids/ plant (37th SMW) during *Kharif* 2016 to 2017 on black gram at Madhya Pradesh. Kishor *et al*. (2019) [6] stated that the aphid population reached to its peak (35.40 aphid/ plant/ 10 cm apical twigs) on 7th SMW and also reported that the aphid population had significant negative correlation with minimum and maximum temperature, while non-significant positive correlation with morning and evening RH with aphid population and regression analysis revealed that, all weather parameters collectively influenced the activity of aphid population to the extent of 82 per cent. These findings are in conformity with the present findings.

The incidence of the bean flower thrips, *M. usitatus* appeared first during 33rd SW of August and showed a high peak during 36th SW of September (196 thrips/ 50 plant) during *Kharif* 2019 (Table 1). During *Rabi* 2019 – 2020, the thrips population appeared from the 7th SW of February and reached high peak at 12th SW of March with (256 thrips/ 50 plants) (Table 2). In both the season, thrips population declined at crop harvest at 40th SW of October during kharif and 15th SW of April during rabi 2019 – 2020.The correlation study showed significant positive correlation with minimum temperature (0.53), rainfall (0.61) and non-significant with maximum temperature (0.20), morning RH (0.59) and evening RH (0.36) in *Kharif* 2019. During *Rabi* 2019 - 2020, among all the weather parameter significant positive correlation was observed with maximum temperature (0.53) and non-significant with minimum temperature (0.32) and rainfall (0.008). Non-Significant negative correlation in morning (-0.13) and evening RH (-0.35) was observed. The multiple linear regression analysis indicated that all the weather parameters were responsible for significant variation of 57 per cent and 79 per cent on incidence of thrips population (Table 3) (Fig 1 and 2).

Kumar and Singh (2016) [4] expressed that thrips infestation appeared from 4th week of August (36th SMW) and reached the peak population in 1st week of September (37th SMW) (3.27 nymph and adult/ 10 flowers) in black gram 2014. Patel *et al*. (2010) [7] also stated that population of thrips was recorded in the month of March (9th to 13th SMW) and reached to its maximum at fourth week of March (12th SMW) in 2007 on cowpea at Anand. Bairawa and Singh (2017) [8] stated that among the various weather parameters, maximum and minimum temperature showed a positive correlation and negative correlated with morning and evening RH and rainfall exhibited positive influence on population of thrips in green gram crop. These observations are in accordance with the present findings.

The incidence of the striped flea beetle, *P. striolata* appeared first during 31nd SW of July and high peak during 37th SW of September with (191 beetles/ 50 plants) during *Kharif* 2019. During *Rabi* 2019 - 2020, the beetle appeared from the 5th SW of January and reached high peak at 11th SW of March with (267 beetles/ 50 plants). In both the season population of beetle declined at crop harvesting stage at 40th SW of October during *Kharif* 2019 and 15th SW of April during *Rabi* 2019 - 2020 (Table 1 and 2). The correlation study showed that significant negative correlation was observed between *P. striolata* and maximum (-0.59) and minimum temperature (-0.61). Significant positive correlation was observed in morning RH (0.59) and rainfall (0.56) and non-significant with evening RH (0.51) in *Kharif* 2019 - 2020. During *Rabi* 2019 - 2020, among all the weather parameter non-significant positive correlation was observed with maximum (0.51) and minimum temperature (0.27), rainfall (0.32). Non-Significant negative correlation in morning (-0.25) and evening RH (-0.39) was observed. The multiple linear regression analysis indicated that all the weather parameters were responsible for significant variation of 61 and 69 per cent on incidence of beetle population (Table 3) (Fig 1 and 2).

Prodhan *et al.* (2008) [9] stated high infestation of flea beetle was observed during the Mid-August and September in black gram. Ghosh (2014) [10] expressed that flea beetle had a peak population during the 26th SW (last week of June) with 5.67 beetles/ plant and 37th SW (2nd week of September) with 3.33 beetles/ plant. Hossain *et al.* (2012) [11] stated that high peak infestation of *P. striolata* was observed during month of February, April and May with per cent leaf damage of 7.67, 10.33 and 13.60 per cent with different dates of sowing and that infestation exhibited highly positive correlation with maximum temperature and rainfall provided suitable conditions for the population build-up of the insect pest in Bangladesh. This result is in consonance with the present findings of *Kharif* 2019 and *Rabi* 2019-2020 seasonal incidence.

The incidence of the leaf folder, *O. indicata* appeared first during 31nd SW of July and with a high peak during 37th SW

of September (203 larvae/ 50 plants) during kharif 2019 (Table 1). During *Rabi* 2019 - 2020, larval incidence started from the 5th SW of January and reached a high peak at 11th SW of March 29 larvae/ 50 plants (Table 2). In both the season, larval population declined at crop harvesting stage at 40th SW of October and 15th SW of April during *Kharif* 2019 and *Rabi* 2019 – 2020. The correlation study showed that significant negative correlation was observed with minimum temperature (-0.65) and non-significant with maximum temperature (-0.73). Significant positive correlation was recorded with morning (0.65) and evening RH (0.64) and rainfall (0.55) in kharif 2019. During rabi 2019 – 2020, significant positive correlation was observed with maximum temperature (0.59), and non-significant with minimum temperature (0.35) and rainfall (0.46). Non-significant negative correlation was recorded with morning (-0.59) and evening RH (-0.36). The multiple linear regression analysis indicated that all the weather parameters were responsible for significant variation of 74 and 61 per cent on larval incidence of leaf folder during *Kharif* 2019 and *Rabi* 2019 -2020, respectively (Table 3) (Fig 1 and 2).

Brahman *et al.* (2018) [12] stated that the appearance of *O. indicata* on soybean crop was observed during 1st week of August and a peak population of 1.67 larvae/ mrl in third week of September, the population started declining from second week of October and reached to 0.33 larva/ mrl during last week of October and exhibited positive and significant correlation with maximum temperature (r = 56) and non-significant with minimum temperature (r= 0.164), morning (r = 0.31) and evening RH (r =0.91) and negative non-significant correlation was with rainfall (r = -0.27). Biswas (2013) [13] expressed that the larval activity of *O. indicata* was observed from the month of February and continued up to April, who also reported that higher temperature, lower RH and rainfall in 2010 than 2011 which provided suitable conditions for the population build-up of the insect pest. This result is in consonance with the present findings of *Kharif* 2019 and *Rabi* 2019-2020 seasonal incidence.

The incidence of the tobacco cutworm, *S. litura* appeared first at 8th SW of February and reached a high peak at 13th SW of March 103 larvae/ 50 plants. The larval population declined at crop harvesting at 15th SW of April, respectively. During rabi 2019 – 2020, significant positive correlation was observed with maximum temperature (0.59) and evening RH (0.68) and non-significant with rainfall (1.00). Non-significant negative correlation was recorded with minimum temperature (-0.52) and morning RH (-0.28). The multiple linear regression analysis indicated that all the weather parameters were responsible for significant variation of 94 per cent on larval incidence of *Spodoptera* during *Rabi* 2019 -2020, respectively (Table 2 and 3) (Fig 2).

Pazhanisamy *et al*. (2019) [14] reported that incidence of *S. litura* was noticed from 7th SW and the maximum population was observed at 13th SW (3.80 larvae/ meter row) followed by 10th SW (2.95 larvae/meter row) during *Rabi* 2010. Correlation analysis exhibited positive association with maximum and minimum temperature and rainfall for larval incidence of *S. litura.* Naresh *et al*. (2017) [15] stated that significant positive correlation was observed with evening RH and negative correlation with minimum temperature which provided suitable conditions for the population build-up of the insect pest and regression analysis revealed that, all weather parameters collectively influenced the activity of larval population to the extent of 88 per cent. This result is in consonance with the present findings of Rabi seasonal incidence.

Table 1: Seasonal incidence of sap feeders and defoliators on the black gram during *Kharif* 2019

Standard Week (SW)	Bean aphids, *A. craccivora* /50 plants	Flower thrips, *M. usitatus* / 50 plants	Striped flea beetle, *P. striolata* / 50 plants	Leaf folder *O. indicata* /50 plants	Temperature (ºC)		Relative Humidity (RH%)		Rainfall (mm)
***Kharif* 2019**					**Max**	**Min**	**Morn**	**Eve**	
29	-	-	-	-	36.41	26.37	77.43	51.57	18.50
30	-	-	-	-	36.56	26.54	75.14	44.43	0.00
31	-	-	19	10	37.29	27.14	74.43	43.14	0.00
32	38	-	36	38	36.81	26.76	71.57	41.71	0.50
33	50	23	56	68	36.04	25.64	81.71	52.14	26.50
34	90	43	87	112	34.61	24.64	89.86	58.71	78.50
35	134	68	123	165	34.90	26.39	76.14	51.00	0.00
36	254	196	187	198	35.63	26.14	78.00	50.71	14.40
37	198	123	191	203	35.09	24.53	89.29	57.43	107.30
38	300	103	165	198	33.33	25.24	91.00	68.14	57.00
39	221	56	122	165	32.30	24.81	87.71	72.29	99.30
40	154	23	79	123	33.90	25.60	86.00	66.40	3.50

Table 2: Seasonal incidence of sap feeders and defoliators on the black gram during *Rabi* 2019 – 2020

Standard week (SW)	Bean aphids, *A. craccivora* /50 plants	Flower thrips, *M. usitatus* / 50 plants	Striped flea beetle, *P. striolata* / 50 plants	Leaf folder *O. indicata* /50 plants	Tobacco leaf caterpillar, *S. litura* /50 plants	Temperature (ºC)		Relative Humidity (RH %)		Rainfall (mm)
***Rabi* 2019 – 2020**						**Max**	**Min**	**Morn**	**Eve**	
4	-	-		-	-	30.26	21.44	94.57	66.00	0.00
5	-	-	6	3	-	30.69	20.93	93.43	55.57	0.00
6	-	-	14	9	-	30.64	21.13	92.57	61.14	0.29
7	-	56	55	14	-	31.03	21.74	88.00	60.14	0.00
8	87	89	134	17	8	31.47	22.13	87.43	57.29	0.50
9	165	145	156	19	34	31.78	22.67	92.83	58.00	0.00
10	211	198	234	24	56	31.76	21.78	87.76	58.12	0.00
11	256	205	267	29	78	31.67	21.56	92.98	57.34	0.50

12	312	256	165	28	87	32.00	22.00	91.45	58.45	0.00
13	223	201	111	22	103	32.34	22.87	89.00	60.12	0.00
14	132	123	76	11	67	33.00	23.11	88.67	55.76	0.00
15	65	97	42	7	41	30.26	21.44	94.57	66.00	0.00

Table 3: Correlation and multiple linear regression between meteorological parameters and sap feeders and defoliators during *Kharif* 2019 and *Rabi* 2019 – 2020

Insects	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
***Kharif* 2019**					
A. craccivora	-0.79	-0.68	0.72	0.74*	0.62*
A. craccivora (popuation/50 plants)	$Y=858.21-95.21X_1+73.36X_2+15.90X_3-12.24X_4+0.64X_5$				0.71*
M. usitatus	0.200	0.53*	0.59	0.36	0.61*
M. usitatus (population/50 plants)	$Y=1344.7-56.1X_1+23.47X_2+10.88X_3-15.84X_4-10.34X_5$				0.57*
P. striolata	-0.59*	-0.61*	0.59*	0.5193	0.56*
P. striolata/ (population/50 plants)	$Y=2429.9-76.22X_1+0.483X_2+11.272X_3-13.55X_4+6.886X_5$				0.61*
O. indicata	-0.73	-0.65*	0.65*	0.64*	0.55
O. indicata (population/50 plants)	$Y=3532.7-94.98X_1-14.51X_2+11.18X_3-14.27X_4-0.36X_5$				0.74*
Rabi 2019 – 2020					
A. craccivora	0.61*	0.42	-0.29	-0.14	-0.001
A. craccivora (popuation/50 plants)	$Y=-7048.36+145.56X_1-75.43X_2+2.02X_3+21.44X_4+134.25X_5$				0.85*
M. usitatus	0.53*	0.32	-0.13	-0.35	0.008
M. usitatus (population/50 plants)	$Y=-4879.55+117.35X_1-61.97X_2-3.52X_3+16.72X_4+76.02X_5$				0.79*
P. striolata	0.51	0.27	-0.25	-0.39	0.32
P. striolata/ (population/50 plants)	$Y=-3817.49+95.41X_1-56.87X_2-5.85X_3+12.62X_4+190.55X_5$				0.69*
O. indicata	0.59*	0.35	-0.59	-0.36	0.46
O. indicata (population/50 plants)	$Y=-356.57+12.08X_1-7.81X_2-0.68X_3+1.38X_4+16.39X_5$				0.61*
S. litura	0.59*	-.0.52	-0.28	0.68*	1.00
S. litura (population/50 plants)	$Y=-2200+39.80X_1-23.62X_2+0.84X_3+7.41X_4+30.61X_5$				0.94

* Significance at 5 per cent level

X_1-Maximum temperature (^{0}C) X_2-Minimum temperature (^{0}C) X_3-Morning RH (%) X_4-Evening RH(%) X_5-Rainfall (mm)

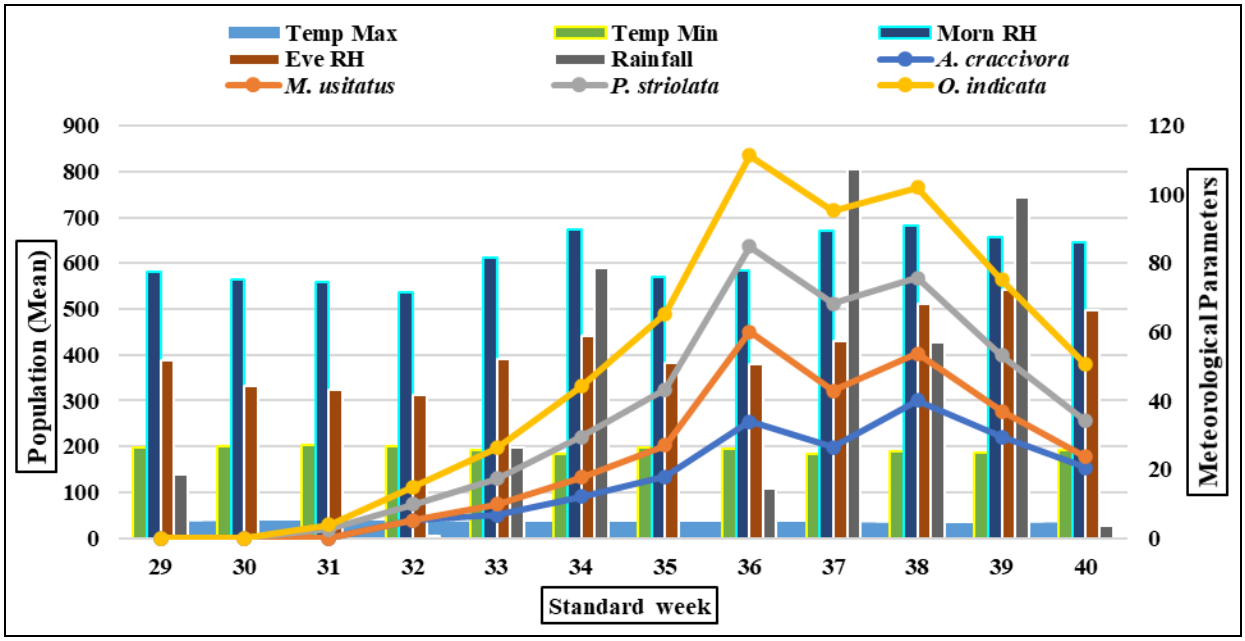

Fig 1: Seasonal incidence of sap feeders and defoliators in the black gram during *Kharif* 2019 on the basis of meteorological parameters

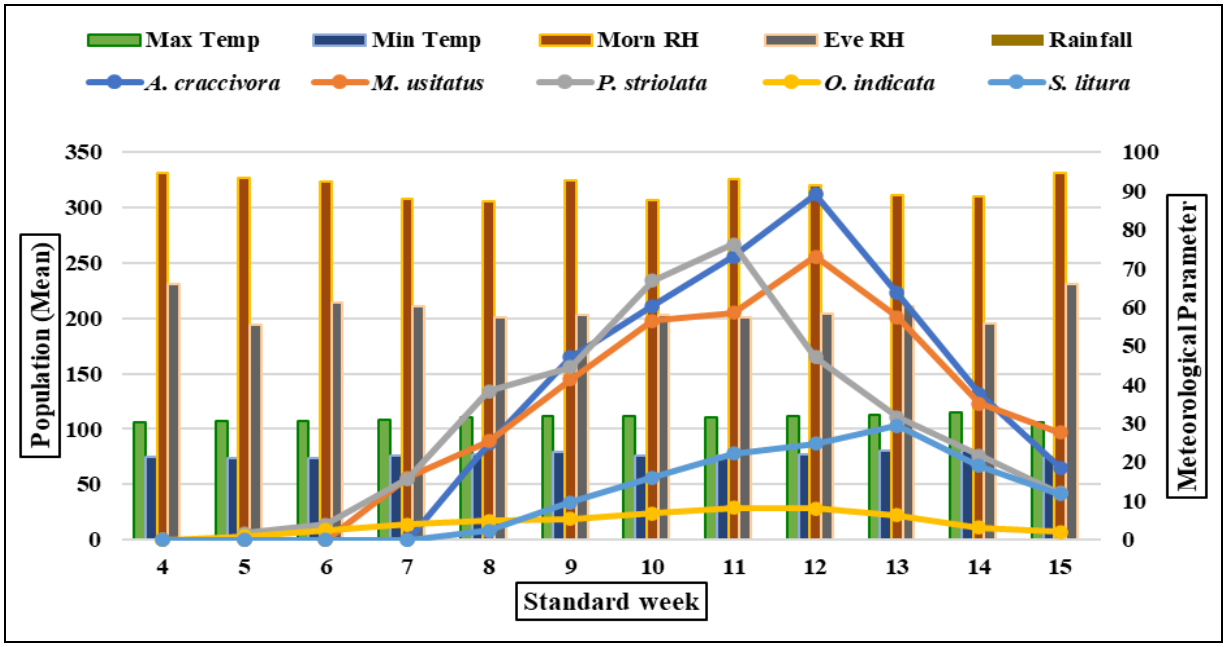

Fig 2: Seasonal incidence of sap feeders and defoliators in the black gram during *Rabi* 2019-2020 on the basis of meteorological parameters

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