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Population dynamics of sucking pest's complex in greengram (*Vigna radiata* (L.) Wilczek) during *summer*

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Abstract
The population dynamics of sucking pests complex in greengram (Var: TRCRM 147) during 2023 *summer*. The results revealed that sucking pests *viz.* whitefly, leafhopper, aphids and pod bug population was significantly high during crop sown on D_1 (14th January) which recorded 2.83, 3.35, 2.51 and 2.96 of average population, respectively. On contrary less population of above mentioned pests (1.58, 1.17, 1.13 and 1.07/leaf respectively) was recorded on crop sown during D_3. However maximum thrips population (1.12 adult / leaf) was recorded on D_1 and minimum (0.98 adult/ leaf) was from D_2 (29th January). Thus, results of above findings is indicated that mid late sowing *i.e.* 3rd date of sowing (13th February) is the best sowing time for greengram cultivation during *summer* to reduce pest load and gain higher yield (7.44 q/ha).

Keywords: Greengram, Sucking pests, D (Date of sowing)

1. Introduction

Pulses, often referred to as the "poor mans meat" and "rich man vegetables" are a crucial source of protein, vitamins and minerals and play a significant role in vegetarian diets and contribute substantially to the country's nutritional security.The pulses are a vital crop for the growth of agriculture due to resource-conservation and environmentally friendly characteristics. It is important to increase pulse production in order to enhance food availability, improve soil health and ensure proper nutritional quality and safety. Hence, pulses are not just food crops; they are a key element in our pursuit of a sustainable future. Greengram (*Vigna radiata* L.) is one of the 3rd most important pulse crops after chickpea and pigeonpea and it is also called mung or mungbean or golden gram. Productivity levels of greengram in India are subjected to fluctuations due to a variety of biotic and abiotic factors which include cultivation under rainfed conditions on marginal lands (Singh *et al.*, 2016) [2], which makes it susceptible to monsoon vagaries and the incidence of insect pests and diseases. Damage by insect pests is a serious limiting factor in pulse cultivation leading to reduced production and productivity. Approximately 65 species of insects have been recorded on greengram (Siddapaji *et al.*, 1979) [6], including the sucking pests like the Jassid, *Empoasca motti Helic,* thrips, *Caliothrips indicus* (Bagnall), whitefly, *Bemisia tabaci* (Genn), aphids, *Aphis crassivora* (Koch), pod bug and also *Clavigralla gibbosa* are the major sucking pests. The crops sown in the *summer* are particularly vulnerable to sucking pests and the yellow mosaic virus disease, which can result in productivity losses of up to 80 per cent. Global climate patterns have been undergoing significant shifts over time, which has likely influenced pest populations across the various crops including greengram. As the cropping pattern evolves farmers are showing an increased interest in cultivating greengram during the *summer*. The appearance of pests and crop yield are very much dependent on sowing time and most of the farmers usually, sown greengram just after harvesting the *rabi* crops without considering optimum sowing dates. Therefore, the present study was undertaken.

2. Materials and Methods

The research on population dynamics of sucking pests complex in greengram (Var: TRCRM 147) during 2023 *summer* was carried out at the research field of Krishi Vigyan Kendra, Kalaburagi, under the auspices of the University of Agricultural Sciences, Raichur. The experiment was sown in four different dates at every 15 days interval from January to February (D_1: 14th January, D_2: 29th January, D_3: 13th February and D_4: 28th February) during *summer* were considered as different treatments and each treatment was laid out with an plot size of 6 x 8 m in five replications with 30 (row to row) x 10 cm (plant to plant) spacing followed and from each replication 10 plants were observed for insect pests, The activity of pests were monitored from 15 days after sowing, with weekly intervals throughout the cropping season, which spanned from the fourth week of January 2023 until harvest, The number of whiteflies and leafhoppers population were counted on three compound leaves (upper, middle and lower) from each plant. The aphids population were recorded from 10 cm growing tip / plants while thrips population were counted on one 1 cm^2 area of leaf/plant and the pod bug population recorded as number of bugs /plant at weekly interval, later data of five quadrants from each treatment were analysed by Randomized Block Design (RDB). All the recommended agronomic practices were followed except plant protection measures against insect pests.

3. Results and Discussion

3.1 Influence of sowing dates on whitefly population

Whitefly population was commenced from 2nd week after sowing in the crop sown during D_1, D_2 and D_4, while it was late by one week in D_3. The initial average population observed was 0.61, 0.70, 0.60 and 0.90 whiteflies per plant in D_1, D_2, D_3 and D_4 respectively. Later, the population of whitefly increased gradually in all the sowing dates. The population was peak during the 6th week after sowing on both D_1 (9.10), D_2 (5.20) and D_4 (7.63), while on D_3 maximum population was recorded at 7th week after sowing (4.12). Whitefly population ranged from 0.61- 9.10 in D_1, 0.70-5.20 in D_2, 6.60 -4.12 in D_3 and for D_4 population ranged from 0.90-7.63 (Table 1 and fig.1).

3.2 Influence of sowing dates on leafhopper population

Leafhopper incidence was observed from 2nd week after sowing with an initial population of 1.22, 0.81, 0.52 per plant and 0.92 in D_1, D_2, D_3 and D_4 respectively. The leafhopper population gradually increased in all the sowing dates (Table 1 and Fig.1). Thereafter, The population was peak during the 6th week after sowing in D_2 and D_4 with the population of 6.87 in D_2 and 8.42 in D_4 on the other hand Leafhopper population was maximum at 5th week after sowing in D_1 (10.20) and 7th week after sowing in D_3 (4.30). The leafhopper population ranged from 1.22-10.20 in D_1, 0.81-6.87 in D_2, 0.52 -4.30 in D_3 and 0.92- 8.42 in D_4.

3.3 Influence of sowing dates on aphids population

Aphids population were first appeared during 3rd week after sowing in all four dates of sowing with an initial population of 0.70 in D_1, 0.61 in D_2, 0.51 in D_3 and 0.50 per plant in D_4 (Table 2 & Fig. 1). Later, the population was increased gradually in all the sowing dates. The population was peak during the 6th week after sowing in D_1 (8.83), D_2 (5.31) and D_4 (7.12) sown crop, while in D_3 (2.93) maximum population was observed at 7th week after sowing. The aphid population ranged from 0.70-8.83 in D_1, 0.61-5.31 in D_2, 0.51-2.93 in D_3 and 0.50-7.12 in D_4 sown crops.

3.4 Influence of sowing dates on thrips population

Thrips population were appeared during 3rd week after sowing in both D_1 and D_2 sown crops with the initial population of 0.61 and 0.62 per plant respectively. Later, the population increased gradually in all the sowing dates. The population was peak during the 6th week after sowing in both D_1 (3.92) and D_2 (2.40) sown crops. The thrips population ranged from 0.61-3.92 in D_1 and 0.62-2.40 in D_2 sown crops (Table 2 and Fig.1).

The incidence of the thrips population was observed only in the D_1 and D_2 sown crop but in D_3 and D_4 there was no incidence of thrips. It might be due to as the thrips population required dry spell with high temperature and low humidity which are optimum for population build-up and further rainfall reduces the thrips incidence. The D_3 and D_4 sown crops received the rainfall [March (16.2 mm) and April (60 mm)], which might led to complete washout of the thrips population. The present results are in line with Vennila *et al.* (2007) reported the high temperature with low humidity and no rainfall which favours the population in cotton.

3.5 Influence of sowing dates on pod bug population

Pod bug population was first appeared during 4th week after sowing on all four dates of sowing with the initial population of 0.63 (D_1), 0.72 (D_2), 0.52 (D_3) and 0.73 (D_4) per plant presented in Table 3 and Fig.1. The peak population was observed 8th week after sowing in D_1 and D_4 sown crop with population of 8.40 and 6.41 respectively, while 7th week after sowing in D_2 (3.25) and in D_3 (2.69). The population of bug ranged from 0.63-8.40 in D_1, 0.72-3.25 in D_2, 0.52-2.69 in D_3 and 0.73-6.41 in D_4 sown crops.

The results of the present investigations are in consonance with Tamang *et al.* (2017) [8] and Hadiya *et al.* (2019) who reported the highest number of whiteflies was found in crop sown on 1st week of February (early sown) while lower number of whitefly recorded on crop sown on 3rd week of February (mid-late) in greengram. Similarly Kansagara *et al.* (2018) [3] Biswas and Banerjee, (2019) [1] also reported in greengram.

Table 1: Influence of sowing dates on whitefly and leafhopper population

Observations taken week after sowing	Whitefly population /3 leaves/plant				Leafhopper population /3 leaves/plant			
	D_1: 14th Jan	D_2: 29th Jan	D_3: 13th Feb	D_4: 28th Feb	D_1: 14th Jan	D_2: 29th Jan	D_3: 13th Feb	D_4: 28th Feb
II	0.61 (1.05)*	0.70 (1.10)	0.00	0.90 (1.18)	1.22 (1.31)	0.81 (1.14)	0.52 (1.01)	0.92 (1.19)
III	1.10 (1.26)	1.22 (1.31)	0.60 (1.05	1.72 (1.49)	1.90 (1.55)	1.30 (1.34)	1.00 (1.22)	2.30 (1.67)
IV	2.32 (1.68)	1.90 (1.55)	1.40 (1.38)	2.60 (1.76)	3.31 (1.95)	2.42 (1.71)	1.52 (1.42)	3.10 (1.90)
V	4.62 (2.26)	2.61 (1.76)	2.00 (1.58)	4.31 (2.19)	10.20 (3.27)	3.80 (2.07)	2.00 (1.58)	4.40 (2.21)
VI	9.10 (3.10)	5.20 (2.39)	2.84 (1.83)	7.63 (2.85)	5.70 (2.49)	6.87 (2.71)	2.91 (1.85)	8.42 (2.99)
VII	3.30	3.00	4.12	2.40	3.80	2.83	4.30	2.80

	(1.95)	(1.87)	(2.15)	(1.70)	(2.07)	(1.82)	(2.19)	(1.82)
VIII	2.00 (1.58)	2.10 (1.61)	2.50 (1.73)	1.60 (1.45)	2.01 (1.58)	1.90 (1.55)	1.70 (1.48)	1.84 (1.53)
IX	1.80 (1.52)	1.30 (1.34)	0.80 (1.14)	0.90 (1.18)	1.50 (1.41)	1.10 (1.26)	1.02 (1.23)	1.00 (1.22)
X	0.93 (1.20)	0.40 (0.95)	0.00 (0.00)	0.41 (0.95)	0.50 (1.00)	0.60 (1.05)	0.43 (0.96)	0.50 (1.00)
Mean	2.86	2.05	1.58	2.50	3.35	2.40	1.17	2.81
S.Em(±)	0.06	0.08	00.7	0.05	0.07	0.06	0.08	0.07
C.D @ 5%	0.20	0.24	0.21	0.16	0.22	0.18	0.24	0.22

*Figure in parentheses are square root (√x + 0.5) transformed value, D - Date of sowing

Table 2: Influence of sowing dates on aphids and thrips population

Observations taken week after sowing	Aphid population / 10 cm growing tip of the plant				Thrips population /1 cm^2 area			
	D_1: 14th Jan	D_2: 29th Jan	D_3: 13th Feb	D_4: 28th Feb	D_1: 14th Jan	D_2: 29th Jan	D_3: 13th Feb	D_4: 28th Feb
II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
III	0.70 (1.10)*	0.61 (1.05)	0.51 (1.00)	0.50 (1.00)	0.61 (1.05)	0.62 (1.06)	0.00	0.00
IV	1.42 (1.39)	1.50 (1.41)	1.00 (1.46)	1.20 (1.30)	1.03 (1.24)	1.00 (1.22)	0.00	0.00
V	2.30 (1.67)	2.10 (1.61)	1.62 (1.45)	2.10 (1.61)	2.30 (1.67)	1.53 (1.42)	0.00	0.00
VI	8.83 (3.05)	5.31 (2.41)	2.00 (1.58)	7.12 (2.76)	3.92 (2.10)	2.40 (1.70)	0.00	0.00
VII	4.30 (2.19)	3.21 (1.93)	2.93 (1.85)	4.10 (2.14)	2.80 (1.82)	1.91 (1.55)	0.00	0.00
VIII	3.10 (1.90)	1.30 (1.34)	1.42 (1.39)	3.21 (1.93)	1.30 (1.34)	1.00 (1.22)	0.00	0.00
IX	1.31 (1.35)	0.50 (1.00)	0.71 (1.10)	1.02 (1.23)	0.80 (1.14)	0.00 (0.00)	0.00	0.00
X	0.60 (1.05)	0.00	0.00	0.61 (1.05)	0.52 (1.01)	0.00	0.00	0.00
Mean	2.51	1.61	1.13	2.21	1.48	0.94	0.00	0.00
S.Em (±)	0.09	0.07	0.06	0.08	0.06	0.07	0.00	0.00
C.D @ 5%	0.27	0.21	0.18	0.24	0.19	0.21	0.00	0.00

*Figure in parentheses are square root (√x + 0.5) transformed value, D - Date of sowing

Table 3: Influence of sowing dates on pod bug population

Observations taken week after sowing	Pod bug population /plant			
	D_1: 14th Jan	D_2: 29th Jan	D_3: 13th Feb	D_4: 28th Feb
II	0.00	0.00	0.00	0.00
III	0.00	0.00	0.00	0.00
IV	0.63 (1.06)	0.72 (1.10)	0.52 (1.01)	0.73 (1.11)
V	1.10 (1.26)	1.30 (1.34)	1.13 (1.28)	1.51 (1.42)
VI	2.62 (1.77)	2.00 (1.58)	1.60 (1.45)	2.30 (1.67)
VII	4.71 (2.28)	3.25 (1.94)	2.69 (1.79)	3.83 (2.08)
VIII	8.40 (2.98)	2.21 (1.65)	1.84 (1.53)	6.41 (2.63)
IX	5.84 (2.52)	1.50 (1.41)	1.20 (1.30)	2.80 (1.82)
X	3.32 (1.95)	0.82 (1.15)	0.62 (1.06)	0.92 (1.19)
Mean	2.96	1.31	1.07	2.06
S.Em(±)	0.05	0.07	0.08	0.07
C.D @ 5%	0.15	0.21	0.25	0.21

*Figure in parentheses are square root (√x + 0.5) transformed value, D - Date of sowing

4. Correlation between the incidence of pests and weather parameters

Every insect pest that appeared on the greengram during the study period was the subjected for a correlation analysis, the findings of which are shown below.

4.1 Pest population on first date of sowing (January 14th) in greengram

Among all the pests recorded in greengram, pod bug population only was negatively correlated with the evening relative humidity (r= -0.679*). All the pests had positive correlation with the maximum temperature, minimum temperature and morning relative humidity, whereas, whitefly and leafhopper shown the positive correlation with evening relative humidity and negative correlation with the rainfall which are not significant. The aphids and thrips had significant negative correlation with evening relative humidity and positive correlation with the rainfall (Table 4).

The present results are supported by results of Kumar *et al.* (2007) [4] also found that there was significant positive correlation between whitefly and maximum temperature, relative humidity and rainfall in greengram which corroborates the present findings

4.2 Pest population on second date of sowing (January 29th) in greengram

The pod bug population had negative correlation with evening relative humidity with r= -0.709* and r= -0.789* respectively. The correlation study's findings showed that while there was a positive relationship between morning relative humidity and rainfall, there was a non-significant and negative correlation between whitefly, leafhopper, aphids and thrips and maximum temperature, minimum temperature, and evening relative humidity. On the other hand, the maximum temperature, minimum temperature, and rainfall all showed positive relationships with pod bugs, but the relationship between them and nighttime relative humidity was non-significant (Table 4).

Yadav *et al*. (2015) [9] showin the whitefly population was non-significant positive correlation with evening relative humidity, rainfall and minimum temperature showed non-significant negative correlation in blackgram.

4.3 Pest population on third date of sowing (February 13th) in greengram

There was a significant positive correlation of pod bug population was observed with maximum temperature (r= 0.672*), minimum temperature (r=0.727*) and negatively with morning RH (r=-0.783*). there was a non-significant positive relationship between flea beetles, aphids, whiteflies and leafhoppers (Table 5).

Present investigations are in agreement with results of Misra and Das, (2001) [5] who reported negative impact of relative humidity on the pest population, in our findings also relative humidity exhibited significant negative relationship with pest population.

4.4 Pest population on fourth date of sowing (28th February) in greengram

In the last date of sowing, significant positive correlation was observed in population of aphids with maximum (r= 0.743*) and minimum temperature (r= 0.687*). Significant positive correlation with maximum (r= 0.706*) and minimum temperature (r= 0.672*) was noticed in pod bug population (Table 5).

Whitefly and leafhopper shown non-significant positive correlation with maximum temperature, minimum temperature and negative relation with the morning relative humidity, evening relative humidity and rainfall. In aphids non-significant negative relation with the morning relative humidity, evening relative humidity and rainfall was observed. Whereas, pod bug shown the non-significant positive relation with the relation with the evening relative humidity and rainfall but negative relation with the morning relative humidity.

5. Influence of sowing dates on greengram yield

The grain yield of greengram significantly varied with different sowing dates and insect pest infestation (Table 6). The data indicated that the D_3 (mid-late sown) sown crop recorded a significantly higher grain yield (7.44 q/ha) followed by D_2 sown crop recorded the yield (7.06 q/ha), whereas, the lowest yield was noticed in early sowing *i.e.* D_1 (5.81 q/ha).

The present study similar with earlier results of who reported that early and late sown greengram crops received higher infestation of insect pest and gained less grain yield.

Table 4: Correlation between pests activities with meteorological parameters in greengram sown on 14th & 29th January

PESTS	Crop sown on 14th January (D_1)					Crop sown on 29th January (D_2)				
	Temperature (°C)		RH (%)		Rain fall (mm)	Temperature (°C)		RH (%)		Rain fall (mm)
	Max.	Min.	Morning	Evening		Max.	Min.	Morning	Evening	
1. Whitefly	0.156	0.142	0.493	0.044	-0.108	-0.437	-0.417	0.440	-0.420	0.558
2. Leafhopper	0.073	0.052	0.555	0.346	-0.167	-0.415	-0.455	0.557	-0.410	0.625
3. Aphids	0.169	0.135	0.523	-0.181	0.083	-0.367	-0.383	0.486	-0.483	0.575
4. Thrips	0.296	0.249	0.577	-0.609	-0.372	-0.391	-0.218	0.257	-0.564	-0.184
5. Pod bug	0.238	0.251	0.469	-0.679*	0.314	0.088	0.233	-0.224	-0.789*	0.219

* Significant at 5%; ** Significant at 1%

Table 5: Correlation between pests activities with meteorological parameters in greengram sown on 13th & 28th February

PESTS	Crop sown on 13th February (D_3)					Crop sown on 28th February (D_4)				
	Temperature (°C)		RH (%)		Rain fall (mm)	Temperature (°C)		RH (%)		Rain fall (mm)
	Max.	Min.	Morning	Evening		Max.	Min.	Morning	Evening	
1. Whitefly	0.329	0.387	-0.663	-0.415	-0.342	0.496	0.559	-0.527	-0.389	-0.359
2. Leafhopper	0.211	0.314	-0.641	-0.274	-0.320	0.488	0.563	-0.543	-0.435	-0.388
3. Aphids	0.275	0.354	-0.654	-0.412	-0.357	0.743*	0.687*	-0.356	-0.174	-0.038
4. Pod bug	0.672*	0.727*	-0.783*	-0.256	-0.116	0.706*	0.672*	-0.237	0.125	0.235

* Significant at 5%; ** Significant at 1%

Table 6: Influence of sowing dates on greengram yield

Date of sowing	Yield (q/ha)
D_1: 14th January	5.80c
D_2: 29th January	7.06a
D_3: 13th February	7.44a
D_4: 28th February	6.53b
S.Em (±)	0.08
C.D @ 5%	0.24

Date of sowing

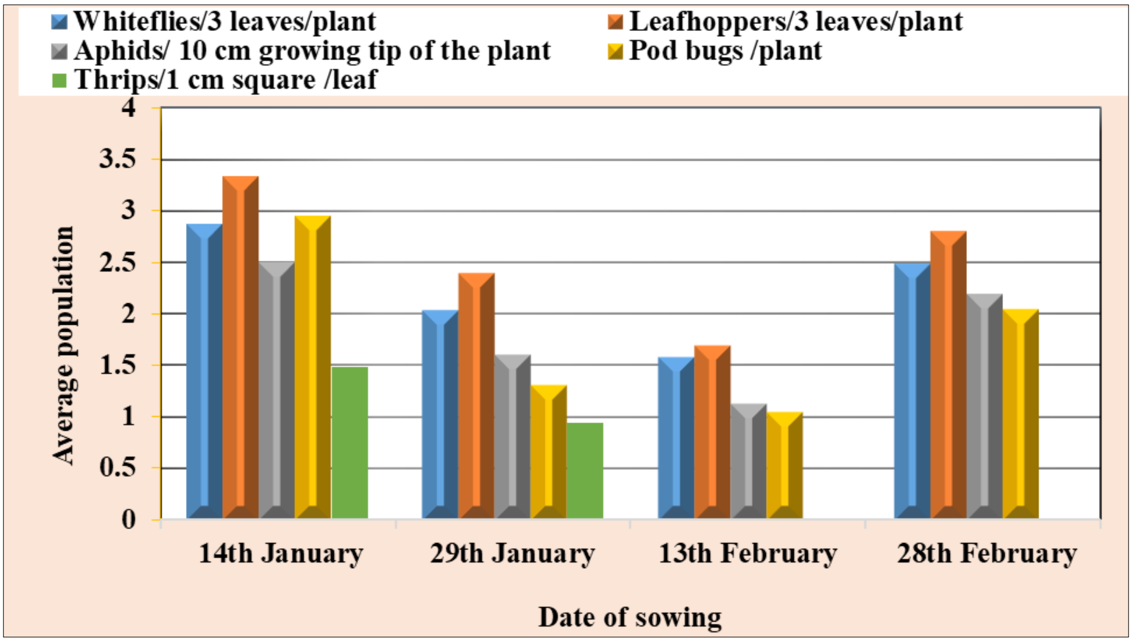

Fig 1: Influence of sowing dates on incidence of sucking pests in greengram

6. Conclusion

The current research concluded that weather factor influences the seasonal activity and population growth of sucking pests. The correlation studies clearly demonstrate the significance of weather factors in predicting the sucking pests incidence in greengram ecosystem. Thus, results of our study indicated that the mid late sowing *i.e.* 3rd date of sowing is the best sowing time for cultivation of greengram during *summer.*

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