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Population dynamics of sucking insect pests infesting rainfed groundnut

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Abstract
This experiment was conducted in Kharif 2019 at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh, to investigate the population dynamics of sucking insect pests of groundnut. The population dynamics of aphid (*Aphis craccivora* Koch), jassid (Empoasca kerri Pruthi), and thrips (*Caliothrips indicus* Bangall) concerning weather conditions in a crop cycle. Aphid populations ranged from 0.96 to 7.44/2 cm shoot/plant, peaking at the 9th week and declining towards crop maturity. Correlations revealed a significant negative relationship with bright sunshine hours, and positive correlations with humidity, minimum temperature and rain, while showing negative associations with maximum temperature and wind velocity. Jassid populations ranged from 0.52 to 7.32/3 leaves/plant, following a similar trend to aphids and displaying correlations with weather variables, notably positive associations with humidity and negative ones with sunshine hours, maximum temperature and wind velocity. Thrips populations ranged from 0.48 to 5.72/3 leaves/plant, with correlations paralleling those of aphids and jassids, showcasing sensitivity to weather parameters. This comprehensive analysis illustrates the interplay between pest populations and weather conditions throughout the crop cycle.

Keywords: Groundnut, aphid, jassid, thrips, population, standard weather week, temperature, rain, correlation, rainfed, incidence

Introduction
Groundnut (*Arachis hypogaea* Linnaeus) is an annual legume crop and belongs to the family Fabaceae. It is one of our country's most important food and cash crops, ranking sixth among the oilseed crops and 13th among the world's food crops (Ramanathan, 2001) [4]. Groundnut is the “King of Oilseeds”. In terms of production and acreage, groundnuts are the most popular crop in India. Groundnut insect pests can harm crops in the field as well as during storage. An estimated Rs. 1500 million is lost annually as a result of bug problems. In India, damage to groundnut crops is caused by over 115 insect pest species; of these, only 9 species—the tobacco caterpillar, leaf miner, white grub, thrips, aphid, jassids, gram caterpillar, red hairy caterpillar, and termites are deemed to be economically significant. (Wankhede *et al.*, 2020) [6]. Although it is an inexpensive commodity, it is a valuable source of all the nutrients. Wonder nut and poor man's cashew nut are other names for groundnut. The plant is harmed by insect pests, which also cause a loss in production in terms of quantity and quality. In India, records show that 52 different species of insect pests are known to infest groundnut crops. (Singh *et al*., 1990) [5]. The population of sucking pests on groundnut shows violent fluctuation in the natural environment, the population dynamics study helps to determine the relationship between the weather factors and population of these pests.

Materials and Methods
Methodology
To investigate the population dynamics of sucking pests in groundnut, the TG-37 variety was sown at the Instructional Farm, College of Agriculture, JAU, Junagadh during *Kharif* 2019. All recommended agronomical practices were adhered to, and the crop remained pesticide-free for the entire season.

Method of recording observation
To observe aphids, jassids, and thrips, five plants were randomly selected from each quadrate

and observed weekly, starting one week after germination until crop harvest. Thrips populations were recorded by counting the top three bud leaves of the five randomly selected plants in each quadrate using a 10X magnifying lens. Jassid populations, including nymphs and adults, were recorded through visual observations on the top three leaves of the five randomly selected plants in each quadrate without disturbing the plants. Aphid populations were recorded on the top 2 cm shoot length of the five randomly selected plants in each quadrate.

Statistical procedure

A simple correlation between the weekly average population of sucking pests and various weather parameters was calculated using the formula suggested by Panse and Sukhatme (1985) [3].

$$r_{xy} = \frac{\sum xy}{\sqrt{\sum x2y2}}$$

r_{xy} = simple correlation coefficient
x = various weather parameters
y = weekly pest population

Results and Discussion

The average populations of aphid (*Aphis craccivora* Koch), jassid (*Empoasca kerri* Pruthi), and thrips (*Caliothrips indicus* Bangall) are presented in Table 1. During the investigation, aphid (*A. craccivora* Koch), jassid (*E. kerri* Pruthi), and thrips (*C. indicus* Bangall) were consistently identified as the primary sucking insect pests of groundnut.

Aphid (*Aphis craccivora* Koch)

The results shown in Table 1 and Fig. 1 indicated that the aphid population varied from 0.96 to 7.44 per 2 cm of shoot per plant. The incidence of aphids commenced in the 32nd standard weather week *i.e*., 3rd week after sowing. Initially, the population was recorded 2.14 aphids/2 cm shoot/plant, which gradually increased and attained a peak of 7.44 aphids/2 cm shoot/ plant during the 38th standard weather week *i.e*., 9th week after sowing. Thereafter, it started to decline slightly and then it decreased towards maturity of the crop with 0.96 aphids/2 cm shoot/plant during the 44th standard weather week i.e., 15th week of sowing.

The correlation coefficient values presented in Table 2 indicated that the aphid population had a highly significant negative correlation with bright sunshine hours (r = -0.209). However, the aphid population showed a significant positive correlation with morning relative humidity (r = 0.315) and evening relative humidity (r = 0.571). Additionally, minimum temperature (r = 0.339) and rain (r = 0.004) exhibited a positive correlation with the aphid population. In contrast, the aphid population had a significant negative correlation with maximum temperature (r = -0.057) and wind velocity (r = -0.174).

Jassid (*Empoasca kerri* Pruthi)

The data shown in Table 1 and Fig. 2 indicated that the jassid population ranged from 0.52 to 7.32 per three leaves per plant. The incidence of jassid commenced in the 32nd standard weather week *i.e.*, 3rd week after sowing. Initially, the population was recorded 1.64 jassids/3 leaves/plant, which gradually increased and attained a peak of 7.32 jassids/3 leaves/ plant during the 37th standard weather week *i.e.*, 8th week after sowing. Thereafter, it started to decline slightly and then it decreased towards the maturity of the crop with 0.52 jassids/3 leaves/plant during the 44th standard weather week *i.e.*, 15th week of sowing.

The correlation coefficient values in Table 2 demonstrated that the jassid population had a significant negative correlation with maximum temperature (r = -0.149) and wind velocity (r = -0.337). Conversely, the jassid population exhibited a significant positive correlation with morning relative humidity (r = 0.369) and evening relative humidity (r = 0.576), while showing a negative correlation with bright sunshine hours (r = -0.229). Additionally, the jassid population displayed a positive correlation with minimum temperature (r = 0.255) and rainfall (r = 0.332).

Thrips (*Caliothrips indicus* Bangall)

The results shown in Table 1 and Fig. 3 indicated that the population of thrips varied between 0.48 and 5.72 per three leaves per plant. The incidence of thrips commenced in the 32nd standard weather week *i.e.*, 3rd week after sowing. Initially, the population was recorded 0.94 thrips/3 leaves/plant, which gradually increased and attained a peak of 5.72 thrips/3 leaves/ plant during the 38th standard weather week *i.e.*, the 9th week after sowing. Thereafter, it started to decline slightly and then it decreased towards maturity of the crop with 0.48 thrips/3 leaves/plant during 44th standard weather week i.e., the 15th week of sowing.

The correlation coefficient values in Table-2 reveal that the thrips population exhibited a highly significant negative correlation with bright sunshine hours (r = -0.170) and significant negative correlations with maximum temperature (r = -0.88) and wind velocity (r = -0.384). Conversely, there were significant positive correlations observed between thrips population and morning relative humidity (r = 0.380) as well as evening relative humidity (r = 0.605), along with a positive correlation with rain (r = 0.248).

The results indicate that pests remained active throughout the crop period. Initially, aphids, jassids, and thrips had a moderate to low population, but this increased gradually and stayed moderately active until the crop matured. The study revealed that aphid population had a negative correlation with temperature and rainfall but a positive correlation with relative humidity, although this correlation was not statistically significant. Jassid population was negatively correlated with temperature, while relative humidity and rainfall showed non-significant positive correlations. Thrips population had a negative correlation with temperature and a positive non-significant correlation with total rainfall, along with a positively significant correlation with relative humidity. Aphids and leafhoppers showed a significant negative correlation with maximum temperature and a significant positive correlation with relative humidity. The research highlighted that relative humidity and rainfall supported thrips multiplication, while temperature hindered the population growth of aphids, jassids, and thrips. The findings of the present investigation are in close conformity with the findings of Anita and Nandihalli (2008) [7], Meena *et al*. (2010) [8], Yadav *et al*. (2012) [9], Jadhao *et al*. (2015) [10], Ahir *et al*. (2017) [1] and Gocher and Ahmad (2019) [2].

Table 1: Weekly population of sucking pests in groundnut during *Kharif* 2019

Standard week	Week After sowing	Mean population of aphid	Mean population of jassid	Mean population of thrips
ss	2	0.00	0.00	0.00
32	3	2.14	1.64	0.94
33	4	2.72	1.92	1.32
34	5	2.04	1.56	2.42
35	6	3.48	2.42	3.54
36	7	2.22	3.76	4.24
37	8	4.88	7.32	5.16
38	9	7.44	5.16	5.72
39	10	3.38	4.62	4.56
40	11	1.94	3.02	3.64
41	12	1.88	2.18	1.84
42	13	1.72	1.68	0.96
43	14	1.04	0.86	0.76
44	15	0.96	0.52	0.48

Table 2: Correlation of sucking pests with abiotic factors in groundnut

Weather parameters	Aphid	Jassid	Thrips
Maximum temperature	-0.057*	-0.149*	-0.088*
Minimum temperature	0.339	0.255	0.298
Morning Relative Humidity	0.315*	0.369*	0.380*
Evening Relative Humidity	0.571*	0.576*	0.605*
Bright Sunshine Hours	-0.209**	-0.229	-0.170**
Wind velocity	-0.174*	-0.337*	-0.384*
Rain	0.004	0.332	0.248

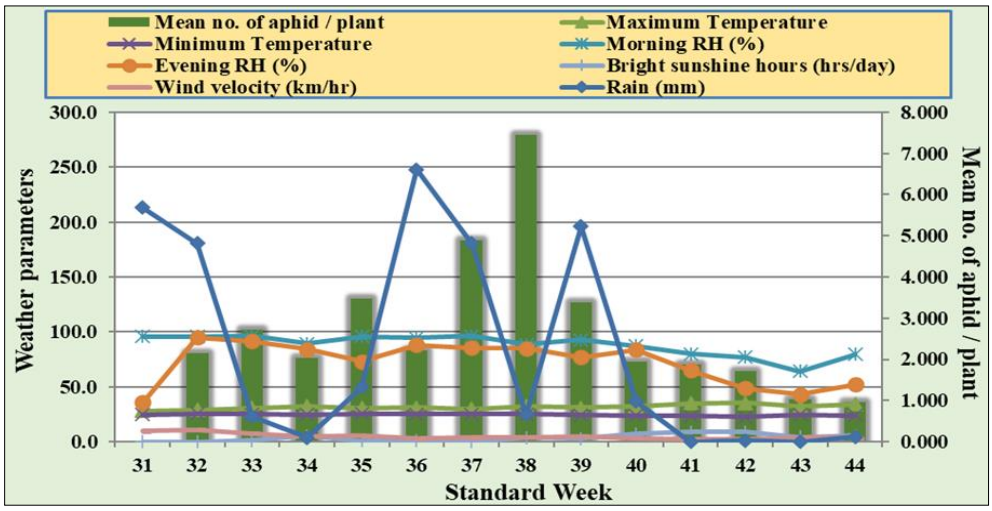

Fig 1: Correlation between weather parameters and population of aphid, *Aphis craccivora* on groundnut crop

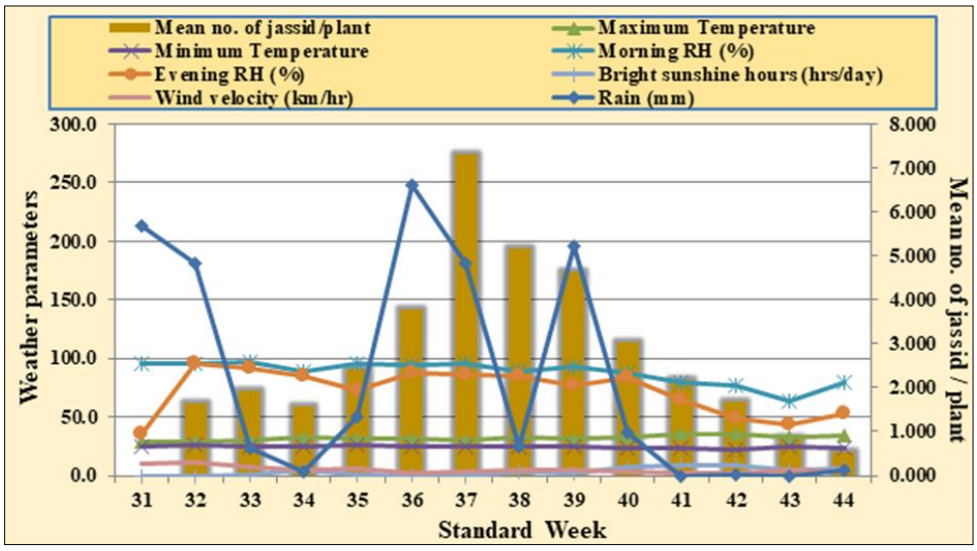

Fig 2: Correlation between weather parameters and population of jassid, *Empoasca karri* on groundnut crop

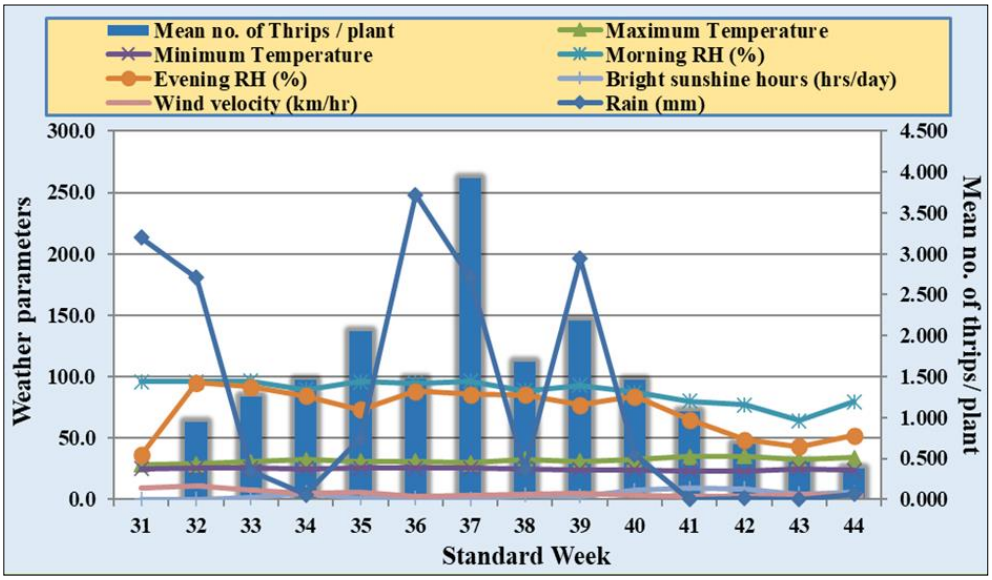

Fig 3: Correlation between weather parameters and population of thrips, *Caliothrips indicus* on groundnut crop

Conclusions

The study aimed to assess the occurrences of various sucking pests in groundnut. According to the findings, aphids (*Aphis craccivora*), jassids (*Empoasca* kerri), and thrips (*Caliothrips indicus*) initially appeared during the crop's vegetative growth stage. These pests exhibited a continuous increase until they reached their peak, after which their numbers steadily declined. Initially, the sucking pest population was low, gradually escalating and peaking during the reproductive phase of the crop. Subsequently, their numbers decreased, ultimately disappearing as the crop matured.

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