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Assessment of population dynamics of *Helicoverpa armigera* (H.) in *Kharif* groundnut

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Abstract
Investigation on "Assessment of Population Dynamics of *Helicoverpa armigera* (H.) in *Kharif* Groundnut" was carried out at Main Oilseed Research Station, Junagadh Agricultural University, Junagadh during *kharif*, 2024. The result of population dynamics on *H. armigera* indicated that the larval population of *H. armigera* initiated from 29th SMW and continued till 40th SMW *i.e.* 3rd week of July to 1st week of October. Larval population ranged from 0.05 to 3.54 larvae per plant during this period. There was gradual increase in the larval population which attained peak during 33rd SMW *i.e.* during 2nd week of August with the larval population of 3.53 larvae per plant. Reduction in the larval population of *H. armigera* was seen with 2.82 larvae during 34th SMW and thereafter, minimum larval population was observed *i.e.* 0.05 larvae per plant during 40th SMW *i.e.* during 1st week of October. The correlation analysis between weather parameters and larval population was significantly positive with morning relative humidity (r=0.544). However, non-significant positive correlation with evening and mean relative humidity (r=0.487 and r=0.529, respectively), wind speed (r=0.416), morning and evening vapour pressure (r=0.003 and r=0.230, respectively) and rainy days (r=0.201).

Keywords: Population dynamics, *Helicoverpa armigera*, *Kharif*, Weather parameters

Introduction
The sixteenth century marked the introduction of groundnut to India from Brazil. Other names for groundnut include earthnut, peanut, goobers, goober peas, pindas, jack nuts, manila nuts and monkey nuts, the latter of which is frequently used to refer to the entire pod. Being 'King of Oilseeds', it is 4th most important oilseed crop in the word. It is largest source of edible oil along with 13th rank among the food crops in the world (Ramanathan, 2001) [21]. The crop is cultivated between 40º N to 40º S of the equator as *kharif* and *rabi* crop. Groundnut is also grown in summer season according to the availability of the irrigation facilities. As a self-pollinating crop, groundnut produce flowers above ground, on fertilization pegs travel toward the soil and pods bearing seeds form and mature beneath the soil. It is the most important commercial oilseed crop mostly grown in the semi-arid tropical region like India. The crop can be grown successfully on the areas receiving rainfall from 600 to 1250 mm. The best soil for the production and productivity of groundnut crop is sandy loam, loamy and medium black (Anon., 1990) [1].
Groundnut is highly valued for its edible seeds and rich oil content. It is the world's third-most significant source of vegetable protein and the fourth-most significant source of edible oil. Globally, India ranks second in area and production of groundnut after China. Nearly 85 percent of India's groundnut acreage is farmed on marginal soils under rainfed conditions. Seven states Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Rajasthan and Madhya Pradesh consist of 95% of the groundnut land. The states of Gujarat, Rajasthan, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and Telangana are the major producers of groundnut based on the share of production in India. Total groundnut cultivated area in India was of 47.85 lakh hectares (*Kharif*) with an annual production of 103.60 lakh tonnes (*kharif*) and 113.12 lakh tonnes (*rabi*) (Anon., 2025a) [2]. According to UPAg 2025 estimation the average groundnut productivity across the India is 2067 kg/ha.
According to the current scenario in India, Gujarat has highest share percentage area and production with the productivity. In Gujarat, 19.17 lakh hectares of groundnuts are grown,

Yielding 52.25 lakh tonnes of production annually (Anon., 2025a) [2]. The average groundnut productivity across Gujarat is estimated at 3026.31 kg/ha (Anon., 2025b) [3]. Groundnut is grown as a monoculture in Gujarat state's *saurashtra* region and the region is also known as groundnut bowl of India as it produces the majority of state's groundnut. The major groundnut growing districts in this bowl are Junagadh, Rajkot, Amreli, Jamnagar and Gir-Somnath.

Nutritionally, groundnut seeds contain 43-55% oil content, 24-26% protein, 45-48% fat, 3% fibre and 15-18% carbohydrate (Shokunbi *et al*., 2012) [26]. It is a dietary source of calcium, magnesium, iron, zinc, phosphorus, vitamin E, riboflavin, thiamine and potash. This crop is also used in the form of fodder, seeds, straw and hay (Smith, 2002) [27]. Groundnuts are also referred as wonder nuts and poor man's cashew nut and in *saurashtra* it is known as Kathiyawadi Kaju.

Groundnut insect pests cause significant losses to the crop both directly, as defoliators, sap suckers, root feeders etc. and indirectly, as carriers of the dreaded viral diseases. In various places of the world, over 350 insect species harm crops (Stalker and Campbell, 1983) [28]. Due to the harmful species of insect's economic losses are caused at great extant. But only a small percentage of these species cause economic losses. It is also noticed that average yield loss is more during the *kharif* season as compared to *rabi* season as the insect pest infestation and diseases are seen increasing during *kharif* season due to the favourable environment. A number of factors contribute to the rise in pest outbreaks, but the main ones are the use of inappropriate management techniques, such as increased insecticide use, inefficient crop rotation and unfavourable storage conditions (Joshi, 2020) [13].

A major constraint to groundnut production is insect infestation. They have the potential to seriously harm the crop, resulting in lower yield, low-quality seed and monetary losses for producers. The groundnut plant's growth, development and general productivity are negatively affected by insects feeding on its leaves, stems, blossoms and pods. Insect pest management must be done well in order to reduce crop losses and increase profitability of groundnut cultivation. Population build-up of any insect is closely associated with the weather parameters prevailing during the preceding and corresponding periods.

Among lepidopterans, *H. armigera* and *S. litura* are extensively polyphagous pests occurring throughout the year, which feed on leaves causing substantial damage by defoliation. Both species are the most important constraints to groundnut production and has been developing resistance to most of the chemical insecticides in India (Mehrotra, 1989 and Sharma *et al*., 2005) [17, 25]. The American bollworm, *H. armigera* Hub. (Lepidoptera: Noctuidae) was also found to be the main pest based on crop damage intensity with 80-90% of the total damage (Kim *et al*., 2018) [15] and caused about 26 to 100 per cent yield losses (Dhir *et al*. 1992) [10]. As per the present scenario also *H. armigera* is acting as key pest. *H. armigera* larvae feed on the foliage, prefers flowers and buds. When tender leaf buds are eaten symmetrical holes or cuttings can be seen upon unfolding of leaflets. Severe infestations can lead to extensive damage, resulting in reduced yields and economic losses for groundnut farmers.

The most important oilseed crop in India is groundnut, which is essential for filling the gap in the nation's supply of vegetable oil. In India, 30% of all oilseeds produced are groundnut. In India, day by day lower yield of commercial crop production like groundnut production is observed due to severe insect-pests infestation as it is the main source of agricultural concern among biotic limitations. Across the country, excessive amounts of pesticides are utilized to control these insect-pests infestation. Given the significance of the groundnut crop to Gujarat State's agricultural economy and the severity of *H. armigera*'s effect on the crop, it is important to obtain thorough knowledge about these insect-pests.

The study was mainly focused on the assessment of population dynamics of a groundnut pest *H. armigera*. This provides insight into the application of low cost, cheap and safer techniques that can be effectively helpful for preventing the development of insect resistance towards chemical insecticides.

Materials and Methods

Our research study materials were collected from Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat to conduct the analysis of population dynamics of *H. armigera* on the groundnut variety GJG-9 during *kharif* season, 2024. In our experimental study the groundnut crop was sown during the last week of the June with the plot size of 10 m x 9 m keeping 45 cm x 10 cm spacing between row to row and plant to plant, respectively.

All the agronomical operations and other crop parameters were adopted as per the recommendations. In the groundnut crop under the experiment the pesticides application was avoided throughout the season for the infestation of *H. armigera*. To study the analysis of population dynamics of *H. armigera* in groundnut, the plot was divided into 50 equal quadrates of size 1.0 m x 0.9 m. The observations on number of larvae of *H. armigera* was recorded from first week after germination to the harvest of the crop at weekly interval on three randomly selected plants from each quadrate. Mean population of *H. armigera* larvae per plant was worked out separately.

Correlation of Weather Parameters with Pest Population

Correlation of weather parameters with pest population was compared with the weekly meteorological data which were obtained from the meteorological observatory of Junagadh Agricultural University, Junagadh to investigate the specific effect of various weather parameters on population dynamics of *H. armigera* in groundnut. With a view to study the impact of various weather parameters such as bright sunshine (BSS), rainfall (RF), wind speed (WS), temperature [maximum (MaxT) and minimum (MinT)], relative humidity [morning (RH_1) and evening (RH_2)], vapour pressure [morning (VP_1) and evening (VP_2)] and rainy days on pest population. According to the weekly obtained pest population data, a simple correlation was carried out between pest population and weather parameters as presented Table 1.

Table 1: Weekly meteorological data recorded at Junagadh Agricultural University, Junagadh during *kharif*, 2024

Was	SMW	Month	Temperature (°C)			Relative humidity (%)			BSS (HR)	RF (mm)	WS (km/h)	VP		Rainy days
			Max.	Min.	Mean	Mor.	Eve.	Mean				Mor.	Eve.	
2	28	July	32.30	26.10	29.2	82.00	72.00	77	0.70	102.50	6.2	26.9	26.2	7
3	29		31.00	25.10	28.1	96.00	86.00	91	0.60	527.40	5.9	26.1	26.4	7
4	30		29.40	25.80	27.6	94.00	89.00	92	0.00	184.60	9.1	25.5	26.2	7
5	31		30.30	25.00	27.7	94.00	85.00	90	0.20	56.10	8.9	25	25.6	7
6	32	August	30.80	24.80	27.8	93.00	82.00	88	0.30	19.70	8	24.1	24.5	7
7	33		31.70	24.60	28.2	94.00	78.00	86	1.30	30.40	5.5	24.4	24.9	6
8	34		32.80	24.90	28.9	92.00	78.00	85	4.00	64.10	4.5	24.2	25.5	3
9	35		29.20	23.90	26.6	95.00	84.00	90	1.50	274.30	11.1	24.2	24.9	5
10	36	September	31.50	24.40	28.0	90.00	77.00	84	3.60	11.40	4.6	24.0	25.1	3
11	37		32.10	24.60	28.4	89.00	62.00	76	7.50	5.60	5.8	23.5	22.0	3
12	38		33.40	23.80	28.6	87.00	57.00	72	8.60	0.00	4.3	22.9	21.6	0
13	39	October	30.70	23.60	27.2	96.00	79.00	88	1.80	250.50	4.1	23.9	24.8	5
14	40		33.70	25.00	29.4	86.00	62.00	74	8.20	0.00	3.7	23.4	23.5	0

Results and Discussion

Our research study titled "Assessment of Population Dynamics of *Helicoverpa armigera* (H.) in *Kharif* Groundnut" was conducted during the *kharif* season of 2024 under field conditions at the Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. Our findings reported are outlined here and examined in context with previous research studies conducted elsewhere, as well as in both direct and indirect relation to the current investigations. The results obtained are shown in Table 2 and depicted in Fig. 1.

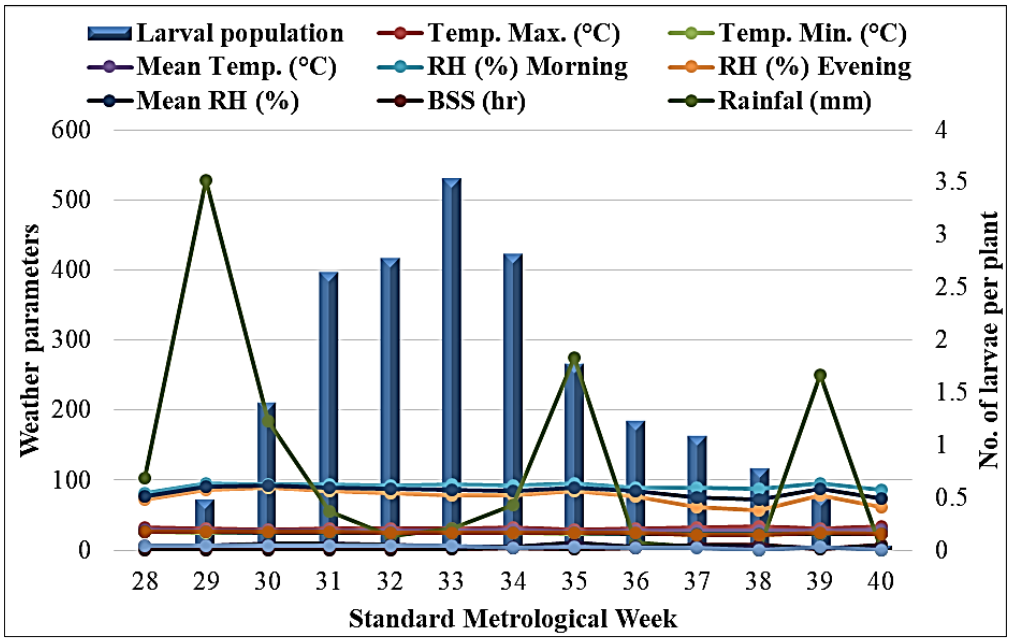

Fig 1: Population dynamics of *H. armigera* in relation to weather parameters during *kharif*, 2024

The results showed that the population abundance of *H. armigera* larvae commenced from 29th SMW *i.e.* 3rd week after sowing. The population of *H. armigera* was ranged from 0.05 to 3.54 larvae per plant during the time period of 29th SMW to 40th SWM *i.e.* 3rd week of sowing to 14th week of sowing.

The data from Table 2 and Fig. 1 revealed that the incidence of *H. armigera* began from the 3rd week of sowing (29th standard week *i.e.* 3rd week of July) with 0.49 larval population per plant. Afterwards the population of larvae kept rising gradually during each succeeding week *i.e.* 30th to 32nd standard week (4th, 5th and 6th week after sowing) with the attainment of peak at 33rd SMW *i.e.* 2nd week of August (7th week after sowing). The larval population recorded during peak was 3.54 larvae per plant. A sudden decline in the population of *H. armigera* was recorded after the attainment of peak with the record of 2.82 larval population per plant during 34th SMW *i.e.* 3rd week August (8th week after sowing). When the crop entered the period of maturity gradual decline in *H. armigera* population was observed during 35th to 40th SMW *i.e.* 4th week of August to 4th week of September. When the crop was matured larval population further declined to 0.05 larvae per plant in 40th SMW *i.e.* 1st week of October and disappeared during 41st SMW *i.e.* 2nd week of October (15th week after sowing).

The results were supported by Bhople *et al.* (2025) [6] observed that the infestation of

Table 2: Population dynamics of *H. armigera* in groundnut during *kharif*, 2024

WAS	SMW	Month	No. of *H. armigera* larvae/ plant
2	28	July	0.00
3	29		0.49
4	30		1.41
5	31		2.65
6	32	August	2.78
7	33		3.54
8	34		2.82
9	35		1.78
10	36	September	1.24
11	37		1.10
12	38		0.79
13	39		0.52
14	40	October	0.05
15	41		0.00

Note: WAS: Week after Sowing SMW: Standard Meteorological Week

H. armigera in soybean commenced during second week of August (32nd SMW) and remained until 3rd week of September (38th SMW). The pest population attained peak level (4.60 larvae/plant) during the last week of September (35th SMW). Rathor *et al.* (2024) [23] revealed that *H. armigera* in soybean initiated with mean larval population of 0.33 larva per plant in 32nd standard week and attained peak during last week of August (35th SMW) with larval population of 3.00 larvae per plant. Priyanka *et al.* (2023) [20] reported that the larval population of *H. armigera* in groundnut initiated at 43rd SMW with 0.2 larvae per plant and peak was observed during 47th SMW with 1.8 larvae per plant. Similarly, Zuhaib *et al.* (2023) [29] concluded that from 29th Standard meteorological week (SMW) pod borer larvae were seen (0.40 per three leaves per plant) which reached its peak level of 2.67 per three leaves per plant during 33rd SMW. Also, Mishra *et al.* (2023) [18] revealed that the first incidence of
H. armigera in groundnut was in fourth week of August *i.e.* 34th SMW and attended peak (5.02 larvae per mrl) during the first week of October *i.e.* 40th SMW. Bangale (2019) [5] strongly suggested that the infestation initiated in the 3rd week of July and the population increased up to the 1st week of September (2.4 larvae/plant). Luna (2018) [16] ascertained that the incidence of *H. armigera* in groundnut at Junagadh began in the 4th week of July, with 0.12 larvae per plant and ascended progressively until reaching a first peak of 1.53 larvae per plant in the 3rd week of August, then it started to decline slightly but during the 1st week of September, it increased and attained second peak with 1.73 larvae per plant. Baburao (2017) [4] strongly supported our results in which the incidence of *H. armigera* in groundnut commenced from the 2nd week of July and attained a peak at 2.2 larvae per plant per quadrat during the 36th SMW. According to Harish *et al.* (2015) [12] population of *H. armigera* achieved peak at 46th standard week (5.5 moths per trap) which also supported our research findings. Anon. (2016) concluded that the peak activity of *H. armigera* in groundnut was observed during 33rd SMW. Dabhade (2009) [9] observed that the seasonal incidence of gram pod borer in groundnut initiated from 3rd week of July (0.02 larvae/plant) and attained a peak of 1.90 larvae per plant during 4th week of August. Rathod (2006) [22] reported the incidence of *H. armigera* during 2nd week of July and peak was observed during 3rd week of August with 1.20 larvae per plant in the year 2003 and on last week of July with 2.80 and 1.30 larvae per plant in year 2004. These results are in line with current finding.

Results of Correlation of Weather Parameters with Pest Population

Further, the data on population was correlated with various weather parameters (Table 1) to study their effects on the variation in larval incidence of *H. armigera* in groundnut (Table 3). The results indicated that morning relative humidity had significantly positive correlation with *H. armigera* larval population (r=0.544). While wind speed, morning and evening vapour pressure, mean and evening relative humidity and rainy days had non-significant positive correlation with *H. armigera* larval population (r=0.416, 0.003, 0.230, 0.529, 0.487 and 0.201, respectively). Statistically, negative non-significant correlation was exhibited by *H. armigera* with maximum, minimum and mean temperature, bright sunshine hours and rainfall (r=-0.364, -0.091, -0.366, -0.339 and -0.198, respectively).

Table 3: Correlation matrix of weather parameters and *H. armigera* population

Weather parameter	Correlation
	No. of *H. armigera* larvae/ plant
Maximum Temperature (°C)	-0.364
Minimum Temperature (°C)	-0.091
Mean Temperature (°C)	-0.366
Morning Relative humidity (%)	0.544*
Evening Relative humidity (%)	0.487
Mean Relative humidity (%)	0.529
Bright Sunshine hours (hr)	-0.339
Rainfall (mm)	-0.198
Wind speed (km/hr)	0.416
Morning Vapour Pressure (mm in Hg)	0.003
Evening Vapour Pressure (mm in Hg)	0.230
Rainy days	0.201

Note: *Significant at 5% (r = ±0.532) n = 14

The results are found to be coincide with Bijjur and Verma (1996) [7] recorded that population of *H. armigera* on pigeon pea was positively correlated with wind speed and negatively correlated with maximum temperature, minimum temperature and rainfall. Chatar *et al.* (2010) [8] record somewhat similar observations which showed *H. armigera* during rainy season on chickpea had highly significant negative correlation with maximum temperature, while, it showed significant negative correlation with minimum and mean temperature. Pest population also showed highly significant positive correlation with morning, evening and mean relative humidity, while non-significant negative correlation with bright sunshine hours. Gadhiya *et al.* (2014) [11] reported significantly positive correlation of *H. armigera* in groundnut with morning, evening and mean vapour pressure which supported our study. Kalyan and Ameta (2017) [14] reported that in soybean the population of *H. armigera* showed significant negative correlation with maximum temperature (r=-0.80) and sunshine (r=-0.97). Luna (2018) [16] reported that in groundnut a non-significant negative correlation with bright sunshine hours (r=-0.109), rainfall (r=-0.116), mean temperature (r=-0.037) and maximum temperature (r=-0.133) and a non-significant positive correlation with morning (r=0.311), evening (r=0.392) and mean relative humidity (r=0.369). Similarly, Bangale *et al.* (2019) [5] reported that in soybean correlation between the pest population of *H. armigera* and morning relative humidity (r=0.630) and evening relative humidity (r=0.606) was positively significant, while, rainy days (r=0.248) had non-significant positive correlation. The pest population showed significant negative correlation with bright sunshine hours (r=-0.646) and negatively non-significant correlation with maximum and minimum temperature (r=-0.543 and r=-0.263, respectively). Sapekar *et al.* (2020) also observed that soybean exhibits non-significant and positive correlation with morning relative humidity (r=0.026) and evening relative humidity (r=0.154) while, maximum temperature (r=-0.151) and minimum temperature (r=-0.006) were non-significant negatively correlated with *H. armigera*. Mishra *et al.* (2023) [18] concluded that minimum temperature (r=-0.176), minimum relative humidity (r=-0.219) and rainfall (r=-0.285) were negatively and non-significantly correlated with larval population of *H. armigera*. Parmar *et al.* (2023) [19] also reported negatively non-significant correlation with rainfall (r=-0.27) and positively non-significant correlation with mean relative humidity (r=0.37). According to Zuhaib *et al.* (2023) [29] also the incidence of *H. armigera* was non-significantly positively correlated with evening relative humidity (RH) (r=0.315) and significantly positive correlation with morning RH (r=0.599) and significantly negative with rainfall (r=-0.42).

Conclusion

Based on our research finding it can be concluded that the 33rd SMW *i.e.* 2nd week of August recorded the peak incidence of *H. armigera* (3.54 larvae/plant) and a significant positive correlation with morning relative humidity was observed, while non-significant positive correlation with evening and mean relative humidity, morning and evening vapour pressure, rainy days and wind speed was recorded. Maximum, minimum and mean temperature, bright sunshine hours and rainfall showed non-significant negative correlation with the pest population. So, the findings may be used for further benefits of farmers to support sustainable agriculture.

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