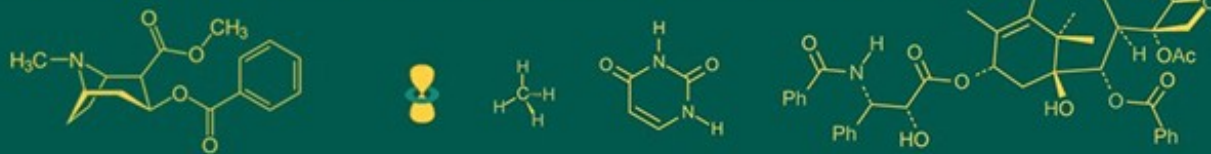


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Seasonal incidence of insect pests and natural enemies of okra (*Abelmoschus esculentus* L. Moench) in relation to weather parameters during kharif 2025

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ABSTRACT

A field investigation was carried out during Kharif 2025 at the Instructional Farm, Krishi Vigyan Kendra, Dhule (Maharashtra), to study the seasonal incidence of major insect pests and their natural enemies on okra cv. Hybrid Radhika and to work out their relationship with prevailing weather parameters. Leafhopper (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci* Gennadius) first appeared during the 30th to 31st Standard Meteorological Week (SMW) and attained peak populations (8.80, 18.20 and 8.00 per three leaves per plant, respectively) during the 37th SMW. The predatory ladybird beetle followed a similar trend, peaking (4.00 beetles/plant) in synchrony with its prey during the 37th SMW. Infestation by shoot and fruit borer (*Earias vittella* Fabricius) commenced during the 38th SMW (8.16% on number basis) and increased progressively to a maximum of 24.67% (number basis) and 25.37% (weight basis) by the 44th SMW. Correlation analysis showed that aphid and whitefly populations were significantly and negatively correlated with minimum temperature ($r = -0.419$ and -0.508 , respectively), while leafhopper, aphid and ladybird beetle populations were significantly and positively correlated with morning relative humidity ($r = 0.412$, 0.435 and 0.428 , respectively). Shoot and fruit borer infestation showed a highly significant correlation with minimum temperature on both number ($r = 0.710$) and weight ($r = -0.694$) bases. Rainfall showed a consistent, non-significant negative association with sucking pests and their predator. The findings provide a basis for weather-based forecasting and timely deployment of pest management interventions in okra.

Keywords: Okra, Seasonal incidence, Leafhopper, Aphid, Whitefly, *Earias vittella*, Correlation, Weather parameters

1. Introduction

Okra (*Abelmoschus esculentus* L. Moench), commonly known as bhindi or lady's finger, is an economically important vegetable crop of the family *Malvaceae*, valued for its nutrient rich tender fruits and wide adaptability to tropical and sub-tropical climates. In India, okra is grown extensively during the *kharif* and *summer* seasons due to its wide adaptability, short duration and high economic return. India is the world's leading producer, contributing over 60 per cent of global output, with the crop occupies an area of about 5.55lakh hectares with an annual production of approximately 73.08lakh metric tonnes and a productivity of 13.14metric tonnes per hectare during 2024–25. Maharashtra alone accounting for about 13,990 hectares, producing nearly 1,75,440metric tonnes annually with a productivity of 12.54metric tonnes per hectare under the crop (Anonymous, 2025a; Anonymous, 2025b) [1, 2]. Despite the availability of improved cultivars and agronomic packages, okra productivity remains constrained by a complex of more than seventy insect, mite and nematode species that attack the crop from the seedling stage to harvest.

Among these, the sucking pest complex comprising leafhopper (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci* Gennadius), together with the shoot and fruit borer (*Earias vittella* Fabricius), are considered the most economically damaging (Ounis et al., 2024) [3]. Population build-up of these pests is strongly governed by prevailing weather conditions, particularly temperature, relative humidity and rainfall, which influence the timing, magnitude and duration of pest outbreaks (Potai et al., 2018; Soni et al., 2025) [4, 5]. An accurate understanding of seasonal population trends and their weather correlates is, therefore, a prerequisite for developing weather-based forecasting models and for the timely and judicious deployment of management interventions, including need-based use of biorational products.

2. Materials and Methods

2.1 Experimental site and crop

The field experiment was conducted during *Kharif* 2025 at the Instructional Farm of Krishi Vigyan Kendra, Dhule (424 004), Maharashtra. Okra seed of the variety 'Hybrid Radhika' was sown by dibbling on 17 July 2025 at a spacing of 30 cm × 15 cm.

2.2 Seasonal incidence plot

For recording seasonal incidence, without any plant protection measures. Five plants were selected and tagged at random from plot, avoiding border rows and weekly observations were recorded of tagged plants.

$$\text{Damage (\% by Number)} = \left(\frac{\text{Number of Infested Fruits}}{\text{Total Number of Fruits}} \right) \times 100$$

$$\text{Damage (\% by Weight)} = \left(\frac{\text{Weight of Infested Fruits (kg)}}{\text{Total Weight of Fruits (kg)}} \right) \times 100$$

Corresponding meteorological data (maximum and minimum temperature, morning and evening relative humidity and rainfall) for each Standard Meteorological Week (SMW) were obtained from the Agronomy Section, Government College of Agriculture, Dhule.

3. Results and discussion

3.1 Leafhoppers, *Amrasca biguttula biguttula* Ishida

During *Kharif* 2025 season, the leafhoppers population first appeared during the 30th SMW 0.60 leafhoppers per three leaves per plant and increased steadily to reach a peak of 8.80 leafhoppers per three leaves per plant during the 37th SMW. Thereafter, the population remained fairly high (5.20 to 7.80 leafhoppers/3 leaves/plant) up to the 44th SMW, before declining sharply to 1.40 leafhoppers per three leaves per plant by the last week of October. These trends are in close agreement with Mahmood *et al.* (1990) [6], Patni (2000) [7], Potai *et al.* (2018) [4], Thara *et al.* (2019) [8], Bisen *et al.* (2020) [9], Gupta *et al.* (2024) [10] and Soni *et al.* (2025) [5], all of whom reported peak leafhopper activity around the 36th to 39th SMW on okra.

3.2 Aphids, *Aphis gossypii* Glover

Aphids population ranged from 2.80 to 18.20 aphids per three leaves per plant during the season, with initial appearance during the 30th SMW and a peak of 18.20 aphids per three leaves per plant during the 37th SMW, followed by a plateau at high density (13.00 to 15.80 aphids/3 leaves/plant) until crop termination. Similar peak periods were reported by Thara *et al.* (2019) [8], Bisen *et al.* (2020) [9] and Sonawane *et al.* (2021) [11], while Soni *et al.* (2025) [5] recorded a slightly delayed peak at the 39th SMW.

2.3 Recording of observations

The population of leafhopper, aphid and whitefly was recorded on three leaves (one each from the top, middle and bottom canopy) per plant at weekly intervals from the tagged plants. The population of the predatory ladybird beetle (*Coccinella* spp.) was recorded on a whole-plant basis from the same tagged plants at weekly intervals. Infestation by shoot and fruit borer was assessed at each of the eleven fruit pickings by separating healthy and infested fruits and computing per cent fruit infestation on both number and weight bases at the weekly interval. Fruit infestation by the shoot and fruit borer (*E. vittella*) was evaluated weekly from picking initiation to crop harvest. Numerical and weight-based damage percentages were computed as follows:

3.3 Whitefly, *Bemisia tabaci* Gennadius

During *Kharif* 2025 season, the whiteflies infestation commenced during the 31st SMW (0.20 whiteflies /3 leaves/plant) and increased to a maximum of 8.00 whiteflies per three leaves per plant during the 37th SMW, before gradually declining. Comparable peak periods (35th to 38th SMW) have been reported by Yadav *et al.* (2013) [12], Potai *et al.* (2018) [4], Bisen *et al.* (2020) [9] and Soni *et al.* (2025) [5].

3.4 Predatory ladybird beetle, *Coccinella* spp

During *Kharif* 2025 season, the ladybird beetle population appeared alongside the sucking pests from the 30th SMW (0.60 ladybird beetle /plant) and reached its peak (4.00 ladybird beetle /plant) during the 37th SMW, closely tracking the peak availability of its aphid and jassid prey. This close synchrony between predator and prey populations corroborates the findings of Gaikwad *et al.* (2020) [13]; Bisen *et al.* and is consistent with the general pattern of coccinellid build-up reported for okra agro-ecosystems.

3.5 Okra shoot and fruit borer, *Earias vittella* Fabricius

During *Kharif* 2025 season, the fruit borer damage commenced later in the season, during the 38th SMW, with 8.16 per cent infestation on number basis and 10.86 per cent on weight basis. Infestation increased progressively thereafter, reaching a maximum of 24.67 per cent (number basis) and 25.37 per cent (weight basis) during the 44th SMW, coinciding with the reproductive and late-fruited phase of the crop. This late-season build-up pattern is in agreement with Vastav *et al.* (2019) [14], Chaudhary *et al.* (2024) [15] and Sharma *et al.* (2025) [16].

Table 1. Seasonal incidence of various insect pests and natural enemies on okra during *kharif*-2025

Month	SMW	Leaf hoppers/ 3 leaves / plant	Aphids/3 leaves / plant	Whiteflies/ 3 leaves/ plant	Coccinellid predators/ plant	Av. % of Shoot & fruit borer damage		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
						No. basis	Wt. basis	Max.	Min.	Morning	Evening	
July	28	0.00	0.00	0.00	0.00	0.00	0.00	32.20	21.10	89.00	33.00	25.20
	29	0.00	0.00	0.00	0.00	0.00	0.00	33.70	20.70	89.00	35.00	0.00
	30	0.60	2.80	0.00	0.60	0.00	0.00	30.90	21.20	89.00	32.00	34.70
	31	3.80	11.60	0.20	2.80	0.00	0.00	31.30	20.10	92.00	34.00	3.60

(continued on next page)

Month	SMW	Leaf hoppers/ 3 leaves / plant	Aphids/3 leaves / plant	Whiteflies/ 3 leaves/ plant	Coccinellid predators/ plant	Av. % of Shoot & fruit borer damage		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
						No. basis	Wt. basis	Max.	Min.	Morning	Evening	
Aug.	32	4.00	13.80	2.40	3.60	0.00	0.00	33.80	20.30	89.00	34.00	4.80
	33	3.20	9.00	2.00	2.00	0.00	0.00	31.30	20.20	92.00	32.00	149.80
	34	5.60	15.00	4.80	3.20	0.00	0.00	30.70	20.20	91.00	31.00	10.10
	35	5.20	10.00	3.00	1.80	0.00	0.00	29.80	20.40	91.00	32.00	115.60
Sept.	36	8.00	15.20	7.80	3.80	0.00	0.00	29.00	19.20	91.00	30.00	41.40
	37	8.80	18.20	8.00	4.00	0.00	0.00	31.40	20.00	91.00	34.00	29.60
	38	7.00	14.00	6.40	2.60	8.16	10.86	31.60	20.20	91.00	31.00	86.80
	39	7.40	14.80	6.80	2.80	12.12	15.23	31.40	18.90	91.00	32.00	67.30
Oct.	40	7.80	15.80	7.00	3.00	16.67	17.05	31.70	14.70	90.00	34.00	3.20
	41	5.20	13.00	5.20	2.20	18.29	19.11	31.90	14.80	90.00	34.00	24.50
	42	5.40	14.00	6.00	2.20	22.73	23.97	33.40	17.20	90.00	35.00	0.00
	43	1.80	8.00	3.20	1.40	23.07	24.35	31.70	18.80	91.00	31.00	76.10
	44	1.40	4.60	1.80	1.00	24.67	25.37	30.00	18.80	91.00	30.00	104.60

3.6 Correlation of pest and predator populations with weather parameters

Correlation analysis (Table 2) revealed that maximum temperature had a consistently negative but non-significant association with leafhopper, aphid, whitefly and ladybird beetle populations, while showing a weak positive, non-significant relationship with shoot and fruit borer infestation. Minimum temperature was significantly and negatively correlated with aphid ($r = -0.419$) and whitefly ($r = -0.508$) populations and showed a highly significant positive correlation with fruit borer infestation on number basis ($r = 0.710^{**}$) and a highly significant negative correlation on weight basis ($r = -0.694^{**}$).

Morning relative humidity exerted a significant positive influence on leafhopper ($r = 0.412^*$), aphid ($r = 0.435^*$) and ladybird beetle ($r = 0.428^*$) populations, whereas its association with whitefly and fruit borer was positive but not significant. Evening relative humidity and rainfall showed, in general, weak and non-significant associations with all the pests and the predator studied. These findings broadly agree with Ratanpara *et al.* (1994) [17], Anitha (2007) [18], Sindhu *et al.* (2020) [19], Bisen *et al.* (2020) [9] and Gupta *et al.* (1998) [20], who similarly reported a dominant role of temperature and morning relative humidity in shaping the seasonal abundance of sucking pests and fruit borer on okra, with rainfall playing a comparatively minor role.

Table 2. Correlation of population of leafhoppers, aphids, whitefly, shoot and fruit borer and natural enemies with weather parameters during kharif-2025

Pest	Correlation of coefficient values (r)				
	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
Leaf Hopper	-0.265	-0.397	0.412*	-0.026	-0.108
Aphid	-0.140	-0.419*	0.435*	0.029	-0.206
Whitefly	-0.208	-0.508*	0.287	-0.104	-0.087
Ladybird beetle	-0.185	-0.242	0.428*	-0.023	-0.228
OSFB No. basis	0.092	0.710**	0.056	-0.063	0.064
OSFB Wt. basis	0.095	-0.694**	0.071	-0.078	0.081

OSFB - Okra shoots and fruit borer

* 5% level of significance df 15 = 0.412

**1% level of significance df 15 = 0.558

4. Conclusion

The sucking pest complex of okra leafhopper, aphid and whitefly along with the predatory ladybird beetle, appeared during the 30th to 31st SMW and attained peak populations synchronously during the 37th SMW, indicating a strong predator-prey relationship. Shoot and fruit borer infestation, in contrast, was a late-season phenomenon, commencing in the 38th SMW and peaking in the 44th SMW. Minimum temperature and morning relative humidity emerged as the key weather drivers of pest and predator abundance, while rainfall exerted little influence. These results can inform the timing of monitoring and biorational spray schedules, with sucking-pest management best initiated by the last week of July/first week of August and fruit-borer management from mid-September onward.

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