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Seasonal incidence of major insect pests of Amaranthus in *Rabi* 2025-2026

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Abstract
A field study was conducted at the experimental farm of the College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, during *Rabi* 2025–26 to assess the seasonal incidence of major insect pests associated with Amaranthus. Weekly observations were recorded from the 40th to the 52nd standard meteorological week (SMW) under unprotected field conditions.The insect pests observed included aphids (*Aphis crassivora*), Tobacco leaf eating caterpillar (*Spodoptera litura)*, leaf webber (*Spoladea recurvalis*), semilooper (*Chrysodeixis acuta*), and horned coreid bug (*Cletus punctiger*). Ladybird beetles were also recorded during the study period.Among the recorded pests, aphids attained a maximum population of 5.80 individuals per three leaves during the 50th SMW. The leaf webber reached 4.90 larvae per plant, while semilooper and horned coreid bug recorded maximum populations of 3.20 and 4.30 individuals per plant, respectively, during the same week. In contrast, *S. litura* and ladybird beetles reached their maximum recorded populations during the 44th SMW, with 0.70 larvae and
1.60 beetles per plant, respectively. Correlation analysis revealed varying relationships between insect populations and weather parameters. Leaf webber and horned coreid bug showed negative correlations with maximum temperature, whereas *S. litura* exhibited positive correlations with relative humidity and wind speed. Overall, the findings highlight fluctuations in insect-pest populations during the *Rabi* season and emphasize the importance of regular field monitoring for effective pest management in Amaranthus.

Keywords: Amaranthus, *Rabi* season, seasonal incidence, insect pests, leaf webber, aphids, meteorological parameters

Introduction
Amaranthus is an important leafy vegetable cultivated in India and several other tropical and subtropical regions. Its leaves are the primary economic produce, making the crop particularly vulnerable to insect damage that affects foliage quality and market value. Different groups of insect pests, including sap-sucking insects and foliage-feeding caterpillars, are associated with its cultivation (Aderolu *et al.*, 2013; Nampeera *et al*., 2019) [1, 8].
Among the foliage-feeding insects, the leaf webber, *Spoladea recurvalis*, is an important pest of Amaranthus. Its larvae feed on the leaves and produce characteristic webbing, which can reduce the quality of marketable foliage. Halder *et al.* (2015) [4] reported the occurrence of leaf-feeding insects on Amaranthus. Similarly, Othim *et al.* (2018a) investigated the seasonal occurrence of lepidopteran defoliators associated with the crop. In a related study, Othim *et al.* (2018b) examined the response of different Amaranthus accessions to infestation by *S. recurvalis*.
Other foliage-feeding insects, including *Spodoptera litura*, may also contribute to crop damage. Manikandan and Kannan (2024) [7] investigated the seasonal incidence of *S. recurvalis* and *S. litura* on Amaranthus under Indian conditions. Clarke-Harris and Fleischer (2003) [3] examined sampling approaches and management strategies for lepidopteran pests of vegetable Amaranthus. Their work highlights the importance of monitoring insect populations to support timely pest-management decisions.
Weather conditions can influence the seasonal occurrence and population fluctuations of insect pests. Temperature, humidity, rainfall, and wind conditions may be associated with changes in insect activity and abundance. Lee *et al.* (2013) studied the temperature-dependent development of *S. recurvalis*, while Agbodzavu *et al.* (2020) [2] investigated the effects of temperature on the development and survival of its parasitoid, *Apanteles hemara*. Although these studies provide useful biological information, field observations are necessary to understand how pest populations fluctuate under particular agroclimatic conditions.
The occurrence and peak activity of insect pests may vary between growing seasons and locations. Kwon *et al.* (2021) examined seasonal pest occurrence and associated yield losses in *Amaranthus* in South Korea, demonstrating the relevance of studying pest populations under local conditions.
In view of the importance of insect pests in Amaranthus cultivation, the present investigation was undertaken to record the seasonal incidence of major insect pests during the *Rabi* season of 2025–26 at Parbhani, Maharashtra, and to examine their relationships with prevailing meteorological parameters. The findings are intended to provide locally relevant information for pest monitoring and the development of suitable management strategies.

Materials and Methods
1. Experimental site and season
The field investigation was conducted during the *Rabi* season of 2025–26 at the experimental farm of Department of Entomology,College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India. Observations on insect-pest incidence were recorded weekly from the 40 th to the 52 nd standard meteorological week (SMW).

2. Experimental details
The study was carried out on Amaranthus genotype IC-7437. The experimental plot measured 10 × 10 m, with a spacing of 20 × 15 cm between plants and rows. For

recording observations, the plot was divided into four quadrats, and five plants were selected randomly from each quadrat.

The experiment was conducted without replication. Recommended agronomic practices were followed, and no insecticidal treatments were applied during the observation period, allowing insect populations to be monitored under unprotected field conditions.

3. Recording of insect-pest observations

Weekly observations were taken to monitor the occurrence and population fluctuations of the major insect pests associated with Amaranthus. The insects recorded during the study included aphids, Tobacco leaf eating caterpillar, leaf webber, semilooper), and horned coreid bug Ladybird beetles were also recorded as associated insects.

Aphid populations were expressed as the number of individuals per three leaves. The populations of caterpillars and leaf webber were expressed as individuals per plant, while other insects were recorded using the sampling units specified in the original observations.

4. Meteorological observations

Meteorological data were obtained from the meteorological observatory of Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The weather parameters considered in the study included maximum temperature, minimum temperature, rainfall, morning relative humidity (RH-I), evening relative humidity (RH-II), and wind speed.

5. Statistical analysis

Correlation analysis was carried out to determine the relationships between insect-pest populations and the recorded meteorological parameters. Regression analysis was also considered in the original investigation. The interpretation of statistical significance was based on the statistical results obtained from the original dataset.

Results and Discussion

1. Seasonal incidence of aphids

Aphid populations fluctuated considerably during the *Rabi* observation period. The population was initially recorded at 1.90 aphids per three leaves during the 40 th SMW. It increased to 2.80 during the 41 st SMW before declining slightly to 2.50 during the 42 nd SMW. The population subsequently increased to 3.90 aphids per three leaves during the 44 th SMW.

A decline was observed during the following weeks, with the population falling to 2.10 during the 45 th SMW. Aphids were not recorded during the 46 th SMW. Their population increased again later in the season, reaching 3.60 during the 49 th SMW and a maximum of 5.80 aphids per three leaves during the 50 th SMW. The population subsequently declined to 3.20 during the 51 st SMW and 2.90 during the 52 nd SMW.

The results indicate that aphid incidence varied throughout the season, with the highest recorded population occurring during the 50 th SMW. Similar research has highlighted the importance of monitoring insect pests in leafy Amaranthus production systems (Nampeera *et al*., 2019). Kwon *et al.* (2021) [5] also investigated seasonal variations in insect-pest occurrence on Amaranthus. However, differences in location, crop conditions, and pest composition should be considered when comparing these findings.

Correlation analysis revealed negative relationships between aphid population and maximum temperature ($r = -0.164$), minimum temperature ($r = -0.017$), and rainfall ($r = -0.039$). Positive correlations were observed with morning relative humidity ($r = 0.519$), evening relative humidity ($r = 0.079$), and wind speed ($r = 0.205$).

Among the recorded weather parameters, morning relative humidity showed the strongest positive correlation with aphid population. Nevertheless, these results indicate associations rather than direct causal relationships. Further observations would help establish whether similar trends occur under different seasonal and environmental conditions.

2. Seasonal incidence of *Spodoptera litura*

The population of *Spodoptera litura* remained comparatively low during the *Rabi* season, although fluctuations were observed during the monitoring period. The maximum recorded population was 0.70 larvae per plant during the 44 th SMW.

The relatively low population recorded during the study suggests that *S. litura* was less abundant than some of the other insects monitored in the experimental plot. Manikandan and Kannan (2024) [7] studied the seasonal incidence of *S. litura* on Amaranthus, while Clarke-Harris and Fleischer (2003) [3] examined sampling and management strategies for lepidopteran pests of vegetable Amaranthus. These studies provide a useful background for understanding the importance of regular monitoring of foliage-feeding caterpillars.

The correlation analysis showed positive relationships between *S. litura* population and maximum temperature ($r = 0.161$), minimum temperature ($r = 0.441$), morning relative humidity ($r = 0.652$), evening relative humidity ($r = 0.563$), and wind speed ($r = 0.689$). Rainfall showed a weak negative correlation ($r = -0.020$).

Wind speed recorded the highest positive correlation coefficient, followed by morning relative humidity. These relationships suggest that the population fluctuations observed during the study period were associated with changes in certain weather parameters. However, the correlation coefficients alone do not establish that these parameters directly influenced the population.

3. Seasonal incidence of leaf webber, *Spoladea recurvalis*

Leaf webber was not observed during the 40 th SMW but appeared during the 41 st SMW, with an initial population of 0.30 larvae per plant. Its population subsequently increased and reached 2.60 larvae per plant during the 44 th SMW. After further fluctuations, the population increased to 3.40 larvae per plant during the 49 th SMW and attained its maximum of 4.90 larvae per plant during the 50 th SMW.

Following this peak, the population declined to 3.30 larvae per plant during the 51 st SMW before increasing slightly to 3.70 larvae per plant during the 52 nd SMW.Thus, the leaf webber remained an important foliage-feeding insect during the later part of the observation period.

The seasonal pattern observed in the present study is relevant to earlier investigations of *S. recurvalis* on Amaranthus. Halder *et al.* (2015) [4] documented foliage-

feeding insects associated with the crop, while Othim *et al.* (2018) investigated the seasonal occurrence of Amaranth lepidopteran defoliators. further examined differences in the response of selected Amaranthus accessions to leaf-webber infestation. Manikandan and Kannan (2024) [7] also investigated seasonal fluctuations in leaf-webber populations under Indian conditions.

The correlation coefficients showed negative relationships between leaf-webber population and maximum temperature (r = −0.707), minimum temperature (r = −0.543), rainfall (r = −0.269), evening relative humidity (r = −0.392), and wind speed (r = −0.141). Morning relative humidity showed a positive correlation (r = 0.244).

Maximum temperature showed the strongest negative correlation with leaf-webber population among the weather parameters examined. This relationship differed from the positive association reported during the kharif season in the present investigation. Such differences indicate that relationships between pest abundance and weather conditions may vary with season. However, further replicated observations are necessary before drawing broader conclusions about the influence of temperature on leaf-webber incidence.

4. Seasonal incidence of semilooper, *Chrysodeixis acuta*

The semilooper population showed fluctuations during the Rabi season. The population reached 2.10 larvae per plant during the 44 th SMW and subsequently varied over the following weeks. An increase was observed toward the later part of the season, with the population reaching a maximum of 3.20 larvae per plant during the 50 th SMW. It then declined to 2.10 larvae per plant during the 51 st SMW and 1.90 larvae per plant during the 52 nd SMW.

The higher population recorded during the 50 th SMW indicates that semilooper incidence increased toward the later part of the observation period. Previous studies have documented several foliage-feeding insects associated with *Amaranthus* (Aderolu *et al*., 2013; Halder *et al.*, 2015 [1, 4]; Othim *et al.,* 2018a). These studies provide a broader context for insect-pest occurrence in the crop, although they do not independently establish the seasonal pattern of *C. acuta* observed at Parbhani.

5. Seasonal incidence of horned coreid bug, *Cletus punctiger*

The horned coreid bug was not recorded during the 40 th SMW but appeared in subsequent observations. Its population increased during the later part of the season, reaching 2.20 bugs per plant during the 48 th SMW and 3.30 bugs per plant during the 49 th SMW. The population attained a maximum of 4.30 bugs per plant during the 50 th SMW. It subsequently declined to 3.50 bugs per plant during the 51 st SMW before increasing slightly to 3.80 bugs per plant during the 52 nd SMW.

The increase in population toward the end of the observation period suggests that the horned coreid bug became more prominent during the later weeks of the *Rabi* season. Kwon *et al*. (2021) [5] investigated the seasonal occurrence of insect pests associated with Amaranthus, providing a broader context for monitoring different insect groups in the crop. However, the specific population pattern of *C. punctiger* observed in the present study requires comparison with further location-specific investigations.

The correlation analysis revealed negative relationships between horned coreid bug population and maximum temperature (r = −0.856), minimum temperature (r = −0.781), rainfall (r = −0.439), evening relative humidity (r = −0.640), and wind speed (r = −0.410). Morning relative humidity showed a negligible positive correlation (r = 0.002).

Maximum temperature exhibited the strongest negative correlation coefficient among the weather parameters considered. Minimum temperature and evening relative humidity also showed negative relationships with bug population. These findings describe the associations observed during the study period; further investigations involving replicated plots and multiple seasons would help determine the consistency of these relationships.

6. Seasonal incidence of ladybird beetles

Ladybird beetle populations fluctuated during the *rabi* observation period. The maximum recorded population was 1.60 beetles per plant during the 44 th SMW. Another relatively high population of 1.40 beetles per plant was recorded during the 49 th SMW, followed by a decline to 0.80 beetles per plant during the 50 th SMW.

Ladybird beetles include predatory species that can contribute to the natural regulation of certain insect pests. Their occurrence is therefore relevant when considering the broader insect community in vegetable production systems. Research on natural enemies associated with Amaranthus pests, including the work of Othim *et al.* (2018b) highlights the importance of studying beneficial organisms alongside pest populations.

Table 1: Seasonal incidence of major insect pests and natural enemies on Amaranthus during *Rabi* 2025-26

SMW	Period	Aphids/ Three leaves	Tobacco leaf eating caterpillar/ plant	Leaf webber/plant	Semilooper/plant	Horned coreid Bug/plant	Ladybird beetle/plant
40	01 oct - 07 oct	1.90	0.00	0.00	0.00	0.00	0.30
41	08 oct-14 oct	2.80	0.10	0.30	0.00	0.40	0.00
42	15 oct -21 oct	2.50	0.40	0.50	0.10	1.20	0.40
43	22 oct -28 oct	3.30	0.60	1.30	0.30	0.80	0.00
44	29 oct- 04 nov	3.90	0.70	2.60	2.10	1.80	1.60
45	05 nov -11 nov	2.10	0.00	1.40	1.30	1.40	0.00
46	12 nov- 18 nov	0.00	0.00	0.00	0.00	1.20	0.00
47	19 nov -25 nov	0.70	0.00	0.00	0.50	1.40	0.00
48	26 nov - 02 dec	1.50	0.20	2.10	1.10	2.20	1.20
49	03 dec -09 dec	3.60	0.30	3.40	2.20	3.30	1..40
50	10 dec -16 dec	5.80	0.10	4.90	3.20	4.30	0.80
51	17 dec-23 dec	3.20	0.20	3.30	2.10	3.50	0.50
52	24 dec-30 dec	2.90	0.30	3.70	1.90	3.80	0.40

SMW- Standard meterological week

Table 2: Simple correlation and regression of weather parameters and aphid on amaranthus during *Rabi* 2025-26

Weather Parameter	Intercept (a)	Slope (b)	Correlation Coefficient (r)
Maximum Temperature (°C)	7.383	-0.159	-0.164
Minimum Temperature (°C)	2.687	-0.004	-0.017
Rainfall (mm)	2.653	-0.002	-0.039
RH-I (%)	-27.461	0.337	0.519
RH-II (%)	2.309	0.008	0.079
Wind speed(km/hr)	1.224	0.512	0.205

Table 3: Simple correlation and regression of weather parameters and tobacco leaf-eating caterpillar on amaranthus during *Rabi* 2025-26

Weather Parameter	Intercept (a)	Slope (b)	Correlation Coefficient (r)
Maximum Temperature (°C)	-0.507	0.024	0.161
Minimum Temperature (°C)	-0.002	0.017	0.441
Rainfall (mm)	0.225	-0.000	-0.020
RH-I (%)	-5.689	0.066	0.652
RH-II (%)	-0.137	0.009	0.563
Wind speed(km/hr)	-0.517	0.269	0.689

Table 4: Simple correlation and regression of weather parameters and leaf webber on amaranthus during *rabi* 2025-26

Weather Parameter	Intercept (a)	Slope (b)	Correlation Coefficient (r)
Maximum Temperature (°C)	24.690	-0.767	-0.707
Minimum Temperature (°C)	3.784	-0.148	-0.543
Rainfall (mm)	1.980	-0.016	-0.269
RH-I (%)	-14.018	0.177	0.244
RH-II (%)	3.594	-0.047	-0.392
Wind speed(km/hr)	2.890	-0.394	-0.141

Table 5: Simple correlation and regression of weather parameters and tobacco leaf-eating caterpillar on amaranthus during *rabi* 2025-26

Weather Parameter	Intercept (a)	Slope (b)	Correlation Coefficient (r)
Maximum Temperature (°C)	-0.507	0.024	0.161
Minimum Temperature (°C)	-0.002	0.017	0.441
Rainfall (mm)	0.225	-0.000	-0.020
RH-I (%)	-5.689	0.066	0.652
RH-II (%)	-0.137	0.009	0.563
Wind speed(km/hr)	-0.517	0.269	0.689

Table 6: Simple regression of weather parameters and horned coreid bug on amaranthus during *Rabi* 2025-26.

Weather Parameter	Intercept (a)	Slope (b)	Correlation Coefficient (r)
Maximum Temperature (°C)	24.892	-0.769	-0.856
Minimum Temperature (°C)	4.299	-0.176	-0.781
Rainfall (mm)	2.179	-0.021	-0.439
RH-I (%)	1.833	0.001	0.002
RH-II (%)	4.364	-0.064	-0.640
Wind Speed (km/hr)	4.549	-0.947	-0.410

Conclusion

The field investigation conducted during *Rabi* 2025–26 at Parbhani revealed fluctuations in the incidence of major insect pests associated with Amaranthus. Aphids, leaf webber, semilooper, and horned coreid bug reached their maximum recorded populations during the 50 th SMW, whereas *Spodoptera litura* and ladybird beetles peaked during the 44 th SMW.

The correlation analysis showed that the relationships between insect populations and weather parameters differed among the recorded insects. Leaf webber and horned coreid bug exhibited negative correlations with maximum temperature, while *S. litura* showed positive correlations with relative humidity and wind speed.

The results identify important periods for monitoring insect-pest populations in Amaranthus during the rabi season under the agroclimatic conditions of Parbhani. Further replicated studies across multiple seasons and locations are required to confirm these trends and support the development of reliable pest-monitoring and management strategies.

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