



Plant Archives

Journal homepage: <http://www.plantarchives.org>DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.2.060>

SEASONAL INCIDENCE OF RED PUMPKIN BEETLE *Aulacophora foveicollis* LUCAS (COLEOPTERA: CHRYSOMELIDAE) ON CUCUMBER (*Cucumis sativus* L.)

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(Date of Receiving-04-06-2026; Date of Revision-29-07-2026; Date of Acceptance-19-08-2026)

ABSTRACT

The red pumpkin beetle, *Aulacophora faecalis* Lucas (Coleoptera: Chrysomelidae), is a major pest of cucurbit crops, causing serious damage during the early growth stages. A field study was conducted during the spring season of 2026 at Krishi Vigyan Kendra, Kotwa, Azamgarh-I, Uttar Pradesh, to investigate the seasonal incidence of *A. foveicollis* on cucumber (*Cucumis sativus* L.) and its relationship with prevailing weather parameters. Weekly observations on adult beetle population and leaf damage were recorded from crop emergence to maturity. The beetle population first appeared during the 6th Standard Meteorological Week (SMW) with 0.42 adult beetles' plant⁻¹, gradually increased to a peak of 5.38 adult beetles' plant⁻¹ during the 12th SMW, and subsequently declined towards crop maturity. Leaf damage followed a similar trend, increasing from 3.84% to a maximum of 58.74% during the same period. Pearson's correlation analysis revealed a strong positive association between adult beetle population and leaf damage ($r = 0.99$). Principal component analysis explained 94.3% of the total variation in the first two principal components and indicated a closer association of beetle incidence with temperature than with relative humidity and rainfall. The study provides useful information for forecasting pest incidence and developing timely integrated management strategies for spring-grown cucumber.

Key words: *Aulacophora foveicollis*, cucumber, seasonal incidence, leaf damage, weather parameters, Pearson's correlation, principal component analysis.

Introduction

Cucumber (*Cucumis sativus* L.) is an economically important vegetable crop belonging to the family Cucurbitaceae, which comprises approximately 118 genera and over 825 species distributed across tropical and subtropical regions of the world (Khan *et al.*, 2015). Owing to its short duration, high yield potential, nutritional value and adaptability to diverse agro-climatic conditions, cucumber has become an integral component of vegetable production systems. The fruits are consumed fresh, processed into pickles and valued for their high-water content, dietary fibre, vitamins, minerals and bioactive compounds exhibiting antioxidant, anti-inflammatory,

antimicrobial and antidiabetic properties (Sari *et al.*, 2021).

Globally, cucumber cultivation has expanded considerably during the past decade. According to FAOSTAT (2025), the world produced approximately 94 million tonnes of cucumbers and gherkins in 2023, with China accounting for the largest share of global production. India ranks among the major cucumber-producing countries, cultivating the crop over 1.27 lakh hectares with an annual production of approximately 1.71 million tonnes during 2022–23 (NHB, 2023). Furthermore, India's horticulture sector recorded a production of 353.19 million tonnes during 2023–24, reflecting the increasing

contribution of vegetable crops to agricultural growth and nutritional security (MoA & FW, 2023–24).

Despite its economic importance, cucumber productivity is substantially constrained by insect pests, diseases and adverse environmental conditions. Among these, insect pests are responsible for considerable quantitative and qualitative losses throughout the crop growth period. The major insect pests infesting cucumber include the melon fruit fly (*Bactrocera cucurbitae* Coquillett), red pumpkin beetle (*Aulacophora foveicollis* Lucas), black pumpkin beetle (*Aulacophora atripennis* Fabricius), pumpkin caterpillar (*Diaphania indica* Saunders), serpentine leaf miner (*Liriomyza trifolii* Burgess), aphids (*Aphis* spp.) and blister beetles (*Mylabris* spp.) (Ram *et al.*, 2009). Among these, the red pumpkin beetle is regarded as the most destructive pest during the seedling and early vegetative stages of cucurbit crops.

The red pumpkin beetle, *Aulacophora foveicollis* Lucas (Coleoptera: Chrysomelidae), is a highly polyphagous pest distributed widely throughout South and Southeast Asia. Both adults and larvae damage cucurbit crops, although the nature of injury differs. Adults feed on cotyledons, tender leaves, flowers and young fruits, producing irregular feeding holes that reduce the photosynthetic area and impair plant growth, whereas larvae feed on roots, underground stems and fruits in contact with the soil. Heavy infestation during the seedling stage may completely destroy young plants, often necessitate repeated sowing and result in substantial economic losses. Depending on crop stage and environmental conditions, yield losses ranging from 30 to 100% have been reported in cucurbit crops due to this pest (Khan *et al.*, 2010; Rashid *et al.*, 2014).

Population dynamics of insect pests are greatly influenced by abiotic factors, particularly temperature, relative humidity and rainfall, which regulate insect survival, reproduction, development and dispersal. Consequently, the abundance of *A. foveicollis* varies considerably across locations and seasons. Reliable information on its seasonal incidence and peak activity period is therefore essential for forecasting pest outbreaks and implementing timely integrated pest management (IPM) interventions. Monitoring pest populations in relation to prevailing weather conditions enables precise scheduling of surveillance and control measures, thereby improving management efficiency while reducing unnecessary insecticide applications (Sahoo *et al.*, 2021; Gurjar *et al.*, 2022).

Although several studies have documented the biology

and management of *A. foveicollis*, information on its seasonal incidence under different agro-climatic conditions remains limited. Regional variations in climate, cropping patterns and cultivation practices significantly influence pest population dynamics, highlighting the need for location-specific investigations to generate reliable ecological information for pest forecasting and sustainable management.

Therefore, the present investigation was undertaken to study the seasonal incidence and population dynamics of the red pumpkin beetle (*Aulacophora foveicollis* Lucas) on cucumber and to evaluate the influence of major abiotic weather parameters on its population fluctuations under field conditions. The information generated from this study will provide a scientific basis for developing timely and location-specific integrated pest management strategies for sustainable cucumber production.

Materials and Methods

The present investigation on the seasonal incidence of the red pumpkin beetle, *Aulacophora foveicollis* Lucas, was conducted during the *spring* season of 2026 at the experimental farm of Krishi Vigyan Kendra (KVK), Kotwa, Azamgarh-I, Uttar Pradesh, India (25°38' N, 82°40' E; 77.65 m above mean sea level). The experimental site falls under the Middle Gangetic Plains and is characterized by a subtropical climate with hot summers, cool winters and an average annual rainfall of approximately 1031 mm.

The experiment was conducted in an open field measuring 20 m × 10 m (200 m²). Seeds of cucumber (*Cucumis sativus* L.) hybrid BSS-647 were sown during the first week of February 2026 at the recommended spacing of 2.0 m × 0.5 m, accommodating approximately 200 plants. The crop was raised following the recommended package of practices, including irrigation, nutrient management, intercultural operations and weed control. No insecticidal treatment was applied throughout the experimental period to allow the natural establishment and population build-up of the red pumpkin beetle.

Observations on the seasonal incidence of *A. foveicollis* were recorded at weekly intervals from seedling emergence to crop maturity following a 'W'-shaped random sampling pattern. During each observation, five plants were selected randomly and permanently tagged for recording pest incidence. Adult beetles present on the cotyledons, leaves, tender shoots, flowers and developing fruits of each tagged plant were counted visually during the morning hours (07:00–09:00 h), and the observations were expressed as the mean number of adult beetles per plant.

Table 1: Seasonal incidence of red pumpkin beetle (*Aulacophora foveicollis* Lucas), leaf damage and prevailing meteorological parameters on cucumber (*Cucumis sativus* L.) during the spring season of 2026.

SMW	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Adult beetles plant ⁻¹	Leaf damage (%)
	Maximum Temp.	Minimum Temp.	Morning RH	Evening RH			
6 th	24.63	10.84	90.82	51.46	0.00	0.42	3.84
7 th	26.18	12.37	88.74	48.91	0.00	0.96	8.72
8 th	28.42	14.16	86.35	45.82	2.40	1.68	15.43
9 th	30.57	15.91	83.61	42.73	0.00	2.46	24.68
10 th	32.31	17.68	80.94	39.81	0.00	3.52	36.84
11 th	33.96	19.32	77.88	36.94	0.00	4.64	48.26
12 th	35.41	20.96	74.76	34.67	1.80	5.38	58.74
13 th	36.82	22.54	71.84	32.46	0.00	4.82	54.16
14 th	38.21	24.08	68.93	30.28	0.00	3.96	46.58
15 th	39.48	25.42	66.25	28.14	0.00	2.84	35.42
16 th	40.36	26.73	63.71	26.83	3.60	1.94	24.36
17 th	39.84	26.18	65.42	29.57	10.80	1.12	15.28
18 th	38.46	24.91	69.88	33.94	18.40	0.36	8.64

SMW= Standard Meteorological Week, RH= Relative humidity, Temp. = Temperature

Leaf damage caused by the red pumpkin beetle was assessed simultaneously on each tagged plant by recording the total number of leaves and the number of damaged leaves. The percentage of leaf damage was calculated according to the method described by Ali *et al.*, (2011) using the following equation:

$$\text{Leaf damage (\%)} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves observed}} \times 100$$

Weekly meteorological data comprising maximum temperature (°C), minimum temperature (°C), morning relative humidity (%), evening relative humidity (%) and rainfall (mm) were obtained from the agrometeorological observatory located adjacent to the experimental farm. The relationship between the seasonal incidence of *A. foveicollis* (adult population and leaf damage) and the prevailing weather parameters was assessed using Pearson's correlation analysis. Correlation coefficients (*r*) were computed to determine the magnitude and direction of association between pest incidence and individual meteorological variables, and their significance was tested using standard statistical procedures.

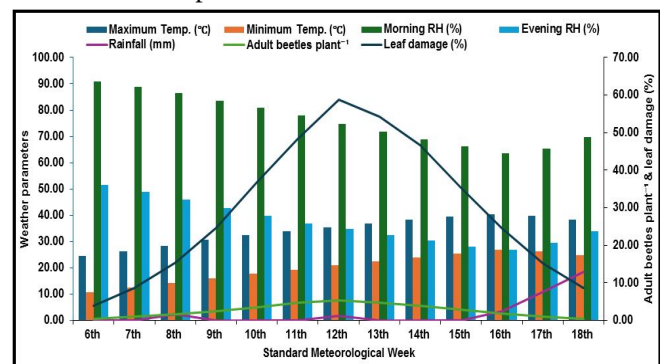
Results and Discussion

Seasonal incidence of red pumpkin beetle (*Aulacophora foveicollis* Lucas)

The seasonal incidence of the red pumpkin beetle, *Aulacophora foveicollis* Lucas, on cucumber and the prevailing meteorological conditions during the spring season of 2026 are presented in Table 1 and Fig. 1. The beetle population was first recorded during the 6th Standard Meteorological Week (SMW) with a mean population of 0.42 adult beetles' plant⁻¹ under prevailing weather conditions of 24.63°C maximum temperature,

10.84°C minimum temperature, 90.82% morning relative humidity, 51.46% evening relative humidity and no rainfall. Thereafter, the population increased steadily, reaching 0.96, 1.68, 2.46, 3.52 and 4.64 adult beetles' plant⁻¹ during the 7th, 8th, 9th, 10th and 11th SMWs, respectively. The maximum population (5.38 adult beetles' plant⁻¹) was recorded during the 12th SMW, corresponding to 35.41°C maximum temperature, 20.96°C minimum temperature, 74.76% morning relative humidity, 34.67% evening relative humidity and 1.80 mm rainfall. Thereafter, the population declined gradually and reached 0.36 adult beetles' plant⁻¹ during the 18th SMW.

Leaf damage closely followed the trend of adult beetle abundance. The initial damage of 3.84% recorded during the 6th SMW increased progressively with crop growth and reached a maximum of 58.74% during the 12th SMW. Subsequently, leaf damage declined steadily to 8.64% by the 18th SMW. During the observation period, weekly maximum temperature increased from 24.63°C to

**Fig. 1:** Seasonal incidence of red pumpkin beetle (*Aulacophora foveicollis* Lucas), leaf damage and prevailing meteorological parameters on cucumber (*Cucumis sativus* L.) during the spring season of 2026.

40.36°C, while minimum temperature increased from 10.84°C to 26.73°C. In contrast, morning and evening relative humidity gradually decreased from 90.82 to 63.71% and 51.46 to 26.83%, respectively. Rainfall remained negligible throughout most of the crop season, except for intermittent showers during the 8th, 12th, 16th, 17th and 18th SMWs.

The gradual increase in beetle population from crop emergence to flowering, followed by a decline during the later stages of crop growth, suggests that the vegetative to early fruiting stage was the most favourable period for pest development under the prevailing agro-climatic conditions. Similar observations were reported by Pansara *et al.*, (2022), who recorded the appearance of *A. foveicollis* on cucumber during the 11th SMW, with peak populations during the 15th and 18th SMWs. Likewise, Khursheed *et al.*, (2013) observed the initial occurrence of the beetle during the first fortnight of March and maximum infestation during April under mid-hill conditions. Continuous beetle activity throughout the cropping period with peak infestation during May has also been reported by Saha *et al.*, (2018) on cucumber in Bihar. Similarly, Patel (2020) recorded the initiation of red pumpkin beetle infestation during the 10th SMW on bottle gourd, with persistence up to the 18th SMW. Minor variations in the period of occurrence and peak infestation among studies may be attributed to differences in sowing time, host crops, climatic conditions and geographical location.

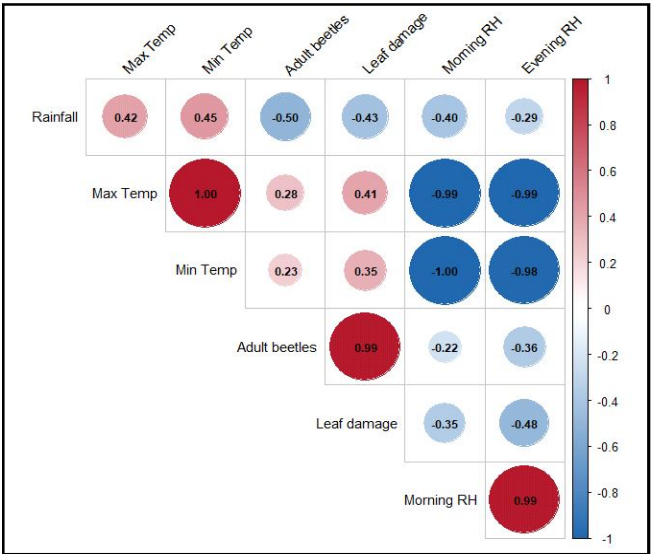


Fig. 2: Heatmap correlation matrix showing the relationship between adult population of red pumpkin beetle (*Aulacophora foveicollis* Lucas), leaf damage and prevailing meteorological parameters on cucumber during the spring season of 2026. (**Max Temp**= Maximum temperature, **Min Temp** = Minimum Temperature, **RH**= Relative humidity)

The present findings indicate that spring-grown cucumbers are particularly vulnerable to *A. foveicollis* infestation between the 10th and 13th SMWs, when beetle population and leaf damage attained their highest levels. These observations provide valuable baseline information for scheduling surveillance and implementing timely management interventions against red pumpkin beetles under the agro-climatic conditions of eastern Uttar Pradesh.

Relationship between red pumpkin beetle incidence and meteorological parameters

The relationship between adult beetle population, leaf damage and prevailing meteorological parameters is presented in Fig. 2. Adult beetle population was closely associated with leaf damage ($r = 0.99$), indicating that feeding injury increased with increasing beetle abundance. The beetle population showed weak positive correlations with maximum ($r = 0.28$) and minimum temperature ($r = 0.23$), whereas morning relative humidity ($r = -0.22$), evening relative humidity ($r = -0.36$) and rainfall ($r = -0.50$) were negatively associated with beetle abundance. A similar pattern was observed for leaf damage, which was positively correlated with maximum ($r = 0.41$) and minimum temperature ($r = 0.35$) and negatively correlated with morning relative humidity ($r = -0.35$), evening relative humidity ($r = -0.48$) and rainfall ($r = -0.43$).

The weather variables also exhibited distinct

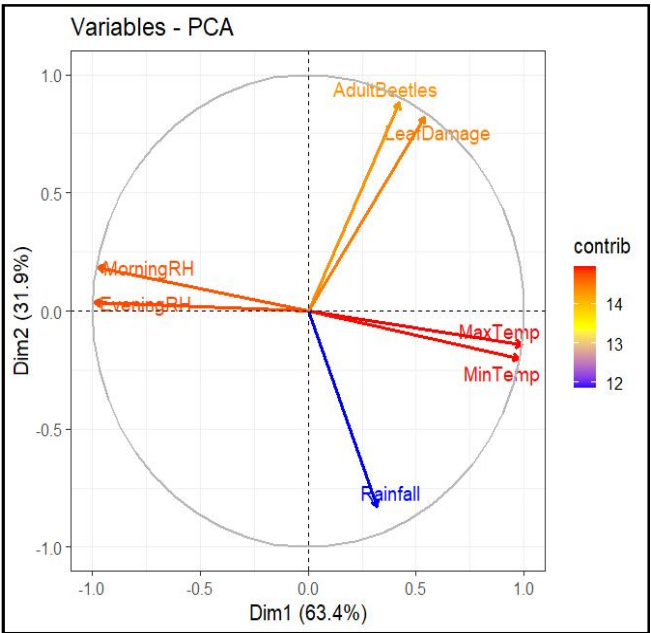


Fig. 3: Principal component analysis (PCA) showing the relationship among meteorological parameters, adult population of red pumpkin beetle (*Aulacophora foveicollis* Lucas) and leaf damage on cucumber during the spring season of 2026.

relationships. Maximum and minimum temperatures were positively associated with each other ($r = 0.45$), while both showed strong inverse relationships with morning and evening relative humidity. Morning and evening relative humidity were highly correlated ($r = 0.99$), whereas rainfall showed a moderate positive association with temperature and a negative association with relative humidity.

The observed relationship between beetle incidence and weather parameters is largely consistent with earlier reports. Positive effects of temperature on red pumpkin beetle population, accompanied by negative effects of relative humidity and rainfall, have been reported by Rathod and Borad (2010), Yadav *et al.*, (2017), Kumar and Saini (2018), Saha *et al.*, (2018) and Pansara *et al.*, (2022). Pansara *et al.*, (2022) further reported that maximum temperature and wind speed had a highly significant positive influence on beetle activity, while bright sunshine hours and evapotranspiration were also positively associated with population build-up. Similar trends observed in the present investigation suggest that warmer conditions favour the development and activity of *A. foveicollis* during the spring season.

However, some earlier studies have reported contrasting relationships between beetle incidence and individual weather variables. Khursheed *et al.*, (2013) observed a significant negative association with minimum temperature, whereas Dubale *et al.*, (2018) and Patel (2020) reported variable responses of beetle population to temperature, humidity and other meteorological factors. Such inconsistencies are expected because insect population dynamics are influenced by several interacting factors, including crop phenology, host species, sowing time, seasonal weather patterns and agro-climatic conditions.

Overall, the present study indicates that temperature was the most favourable weather factor associated with the seasonal activity of *A. foveicollis*, whereas higher relative humidity and rainfall were generally associated with reduced beetle incidence. The strong relationship between adult beetle population and leaf damage further suggests that monitoring beetle abundance can provide a useful basis for forecasting crop damage and planning timely management interventions.

Principal component analysis (PCA)

Principal component analysis (PCA) was performed to elucidate the association between meteorological variables, adult beetle population and leaf damage (Fig. 3). The first two principal components explained 94.3% of the total variability, with PC1 and PC2 accounting for

63.4% and 31.9% of the variance, respectively. Adult beetle population and leaf damage were closely clustered, indicating a strong association between beetle abundance and feeding injury. Maximum and minimum temperatures were oriented in the same direction as adult beetle population and leaf damage, whereas morning and evening relative humidity were positioned in the opposite direction. The close alignment of the humidity vectors indicated a strong positive association between these two variables. Rainfall was distinctly separated along the negative axis of PC2, suggesting a comparatively independent contribution to the observed variation.

The PCA ordination corroborated the results of the correlation analysis by demonstrating a closer association of beetle incidence with temperature variables than with relative humidity and rainfall. Similar multivariate relationships between weather variables and insect population dynamics have been reported in cucurbit ecosystems by Yadav *et al.*, (2017), Saha *et al.*, (2018) and Pansara *et al.*, (2022), who also identified temperature as the principal factor associated with red pumpkin beetle activity. The present findings further support the role of temperature as an important driver of seasonal population fluctuations of *Aulacophora foveicollis* under spring cucumber cultivation.

Conclusion

The present study demonstrated that *Aulacophora foveicollis* infestation on spring-grown cucumber commenced during the 6th SMW, reached its peak during the 12th SMW and declined thereafter. Adult beetle population was closely associated with leaf damage, while temperature favoured pest activity, whereas relative humidity and rainfall exhibited negative associations. These findings provide a scientific basis for forecasting pest incidence and identifying the 10th to 12th SMWs as the critical period for timely monitoring and implementation of integrated pest management strategies in cucumber.

Acknowledgement

The authors express their sincere gratitude to the Director of Extension, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, for granting permission and extending institutional support for this study. The authors are also thankful to the Senior Scientist and Head, Krishi Vigyan Kendra, Kotwa, Azamgarh-I, for providing the necessary research facilities, guidance and encouragement throughout the investigation. The technical assistance and cooperation extended by the staff of Krishi Vigyan Kendra, Kotwa, Azamgarh-I, are gratefully acknowledged.

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