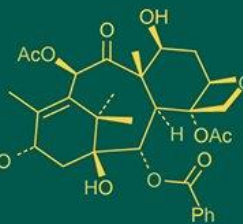
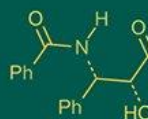


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2026): 5.29
 IJABR 2026; 10(7): 434-436
www.biochemjournal.com
 Received: 12-05-2026
 Accepted: 15-06-2026

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Population dynamics of soybean girdle beetle (*Obereopsis brevis* Swedenbord) in soybean crop

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7f.9054>

Abstract

Soybean (*Glycine max* L. Merrill) is one of the world's most important oilseed and protein-rich leguminous crops, contributing significantly to food security and agricultural sustainability. However, its productivity is severely constrained by the soybean girdle beetle (*Obereopsis brevis* Swedenbord), whose incidence is strongly influenced by prevailing weather conditions. The present investigation was conducted during the *kharif* seasons of 2024 and 2025 at the Research Farm, School of Agriculture Science, Bhopal, Madhya Pradesh, to study the seasonal population dynamics of the girdle beetle in relation to meteorological parameters. Weekly observations on pest infestation were recorded from Standard Meteorological Week (SMW) 33 to SMW 42 by estimating the percentage of girdled plants in soybean variety JS 20-116. Weather data, including maximum and minimum temperature, relative humidity, and rainfall, were obtained from ICAR-CIAE, Bhopal. In both years, girdle beetle infestation commenced during SMW 33 with 3.41% (2024) and 3.63% (2025) plant damage and increased progressively, reaching peak infestations of 44.44% and 45.49%, respectively, during SMW 42. Correlation analysis revealed that in 2024, maximum temperature showed a highly significant positive association with pest incidence ($r = 0.803$), whereas average relative humidity ($r = -0.904$) and rainfall ($r = -0.667$) exhibited significant negative correlations. During 2025, minimum temperature ($r = -0.850$), relative humidity ($r = -0.846$), and rainfall ($r = -0.821$) were negatively and significantly correlated with girdle beetle infestation, while maximum temperature showed a weak, non-significant positive relationship ($r = 0.168$). The findings demonstrate that warm and comparatively dry environmental conditions favor the development and multiplication of *O. brevis* Swedenbord, whereas higher humidity and rainfall suppress its population. These results provide valuable information for forecasting girdle beetle outbreaks and developing weather-based integrated pest management strategies to improve sustainable soybean production under changing climatic conditions.

Keywords: Soybean, *Obereopsis brevis* Swedenbord, girdle beetle, population dynamics, weather parameters, correlation

Introduction

Soybean (*Glycine max* L. Merrill), a member of the family Fabaceae, is one of the world's oldest and most economically significant leguminous crops. Widely recognized as the "golden bean" or "miracle crop," it serves as the foremost global source of vegetable oil and plant-based protein, thereby making an indispensable contribution to food, nutritional, and economic security. In India, soybean has emerged as a commercially important oilseed crop owing to its remarkable adaptability, high productivity, and multifaceted industrial applications. It ranks among the country's leading oilseed crops after groundnut and mustard and constitutes a vital component of the agricultural economy. Nutritionally, soybean is exceptionally rich, containing nearly 40% high-quality protein and approximately 20% oil, along with essential amino acids, vitamins, minerals, and carbohydrates. Furthermore, its ability to fix atmospheric nitrogen through symbiotic association with *Rhizobium* enhances soil fertility, reduces dependence on chemical fertilizers, and promotes sustainable agricultural production (Swathi *et al.*, 2020; Dugje *et al.*, 2009) ^[1, 2]. Globally, soybean production is dominated by Brazil, which contributes approximately 169 million metric tonnes, accounting for nearly 40% of the world's total production. The United States occupies the second position with about 118.84 million metric tonnes (28%), followed by Argentina with 50.9 million metric tonnes (12%). China contributes around 20.65 million metric tonnes (5%), while India produces approximately 12.58 million metric tonnes,

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representing nearly 3% of global output. These production trends underscore the strategic importance of soybean in international agricultural trade and its expanding role in meeting the increasing global demand for edible oil, livestock feed, and industrial raw materials (U.S. Department of Agriculture, 2024-25). In India, soybean cultivation covered approximately 126.90 lakh hectares during the 2024-2025 crop season, reflecting increasing farmer preference due to favorable market prospects, improved varieties, and supportive government policies promoting oilseed self-reliance. Madhya Pradesh, popularly known as the "Soybean Bowl of India," accounts for the largest cultivated area (53.48 lakh hectares), followed by Maharashtra (51.36 lakh hectares) and Rajasthan (11.25 lakh hectares). Karnataka, Gujarat, and Telangana also contribute significantly to soybean cultivation. In terms of production, Maharashtra ranks first with an estimated output of 56.53 lakh tonnes, followed closely by Madhya Pradesh with 52.86 lakh tonnes. Rajasthan, Gujarat, Karnataka, and Telangana collectively strengthen India's soybean production landscape, highlighting the crop's growing significance in enhancing edible oil production and supporting rural livelihoods (Soybean Outlook, 2025, Professor Jayashankar Telangana Agricultural University). Despite its substantial economic importance, soybean productivity is frequently constrained by insect pests, whose incidence and population dynamics are profoundly influenced by prevailing meteorological conditions. Climatic variables such as maximum and minimum temperature, relative humidity, rainfall, and the frequency of rainy days directly regulate pest survival, reproduction, dispersal, and infestation intensity throughout different crop growth stages. Consequently, understanding the intricate relationship between weather parameters and pest populations is essential for predicting pest outbreaks and developing climate-resilient Integrated Pest Management (IPM) strategies. Such knowledge facilitates timely intervention, minimizes crop losses, reduces indiscriminate pesticide use, and enhances sustainable soybean production. Therefore, the present investigation was undertaken to evaluate the extent of damage caused by major insect pests in relation to prevailing weather parameters, with the objective of generating scientific insights that support predictive pest forecasting and environmentally sustainable crop protection under changing climatic conditions (Swathi *et al.*, 2020) ^[1].

Materials and Methods

The study on the population dynamics of soybean girdle beetle, *Obereopsis brevis* Swed., was conducted at the Research Farm of the School of Agriculture Science, Bhopal, Madhya Pradesh, during the kharif seasons of 2024 and 2025. The experimental site is situated at 23.26° N latitude and 77.41° E longitude, at an altitude of approximately 500 m above mean sea level. The region experiences a subtropical climate with an average annual rainfall of about 1104 mm, most of which is received during the southwest monsoon. The experimental field comprised predominantly black cotton soil with good drainage and nearly neutral pH.

Soybean variety JS 20-116 was sown manually on 1 July 2024 and 3 July 2025 at a seed rate of 75 kg ha⁻¹ with a spacing of 45 × 5 cm. The crop was raised following the recommended package of practices, including the

application of 30:60:40 kg N:P₂O₅:K₂O ha⁻¹ as basal fertilizer. The experiment was conducted in 10 × 10 m plots under uniform agronomic management.

The population dynamics of *O. brevis* were monitored at weekly intervals from the vegetative stage until crop maturity. Pest incidence was recorded by randomly selecting three one-meter row lengths from each plot and counting the number of girdled and total plants. The percentage infestation was calculated using the following formula:

$$\text{Percent infestation (\%)} = \frac{\text{Number of girdled plants}}{\text{Total number of plants}} \times 100$$

Results and Discussion

The seasonal incidence and population dynamics of the soybean girdle beetle (*Obereopsis brevis* Swedenborg) were systematically monitored during the kharif seasons of 2024 and 2025 by estimating the percentage of girdled plants at weekly intervals. Observations were recorded from three randomly selected one-meter row lengths in each experimental plot. In both years, the pest exhibited a consistent pattern of appearance, gradual population build-up, and peak infestation, demonstrating a strong association with prevailing meteorological conditions. During kharif 2024, the initial occurrence of the girdle beetle was recorded during Standard Meteorological Week (SMW) 33, when the crop experienced moderate temperatures, high relative humidity, and intermittent rainfall. Under these conditions, stem girdler damage was minimal (3.41%), indicating the commencement of pest activity. Thereafter, infestation increased progressively with crop advancement, rising from 9.87% in SMW 34 to 19.01% in SMW 36, despite the persistence of relatively humid conditions. As the season progressed, a gradual decline in relative humidity and rainfall, accompanied by increasing maximum temperatures, created a more conducive environment for pest multiplication. Consequently, stem girdler damage escalated steadily from 23.41% in SMW 37 to 37.01% in SMW 40, ultimately reaching a seasonal peak of 44.44% during SMW 42 (Table 1). The highest infestation coincided with elevated daytime temperatures, negligible rainfall, and comparatively dry atmospheric conditions, indicating that warm and moisture-deficient environments substantially enhanced pest proliferation. Correlation analysis for 2024 further substantiated the influence of climatic variables on girdle beetle incidence. Maximum temperature exhibited a strong and highly significant positive correlation with stem girdler damage ($r = 0.803$), suggesting that elevated daytime temperatures promoted pest development and feeding activity. Conversely, minimum temperature showed a weak and non-significant positive relationship ($r = 0.054$ NS), indicating its limited contribution to pest population dynamics. Average relative humidity demonstrated a highly significant negative correlation ($r = -0.904$), while rainfall also exhibited a significant negative association ($r = -0.667$), confirming that humid and rainy conditions suppressed pest incidence, either by directly affecting insect survival or by enhancing the activity of natural enemies and entomopathogens (Table 3). A comparable seasonal trend was observed during kharif 2025. The girdle beetle first appeared in SMW 33, registering only 3.63% stem damage under conditions of high relative humidity and substantial rainfall. Thereafter, infestation increased gradually through successive meteorological weeks, reaching 18.91% in SMW

36 and 31.92% in SMW 39. The continued prevalence of warm temperatures, declining atmospheric humidity, and diminishing rainfall accelerated pest multiplication during the latter part of the cropping season. Consequently, stem girdler damage increased sharply to 44.43% in SMW 41, attaining the highest infestation level of 45.49% in SMW 42. These observations clearly indicate that prolonged warm and relatively dry environmental conditions favored rapid population growth and severe crop damage (Table 2). The correlation analysis for 2025 revealed a slightly different response of the pest to individual weather parameters. Maximum temperature exhibited a weak and non-significant positive correlation ($r = 0.168$ NS), indicating that daytime temperature alone was not a decisive determinant of pest abundance during this season. In contrast, minimum temperature showed a strong and highly significant negative correlation ($r = -0.850$), suggesting that lower night

temperatures favored girdle beetle activity (Table 3.0). Similarly, average relative humidity ($r = -0.846$) and rainfall ($r = -0.821$) displayed highly significant negative correlations with pest incidence, reaffirming that increased atmospheric moisture and precipitation effectively suppressed population build-up. Similarly, Kumawat *et al.*, (2010) [4] reported girdle beetle infestation initiation in 32nd SM. and Kumar *et al.*, (2020) [3] also reported girdle beetle infestation start in the 32nd SMW. Similarly Panwar *et al.*, (2021) [5] also reported infestation of girdle beetle was started in 31st SMW, thereafter the increasing trend of infestation of the girdle beetle was observed and it continued up to 38th SMW. The maximum infestation of plants due to girdle beetle was observed during 39th SMW. Panwar *et al.*, (2021) [5] reported that maximum temperature had exhibited a positive correlation with infestation of girdle beetle.

Table 1: Population dynamics of girdle beetle (*Obereopsis brevis* Swedenbord) in soybean crop (*Glycine max*) during *kharif*, 2024

SM W	Maximum temperature (°C)	Minimum temperature (°C)	Average Relative Humidity (%)	Rain fall (mm)	Mean plant infestation (%) by girdle beetle
33	30.57	23.85	88.84	15.7	3.41
34	31.71	24.42	86.75	27	9.87
35	30.42	23.28	86.49	24.1	12.88
36	31.28	23.85	88.14	18.2	19.01
37	30.28	23.14	87.84	35.1	23.41
38	31.85	19.14	78.92	27.2	27.77
39	32.71	24.57	80.87	0.9	32.02
40	33.85	30.85	75.87	0	37.01
41	33.28	22.57	70.85	0	42.41
42	32.85	22.14	74.55	1.4	44.44

Table 2: Population dynamics of girdle beetle (*Obereopsis brevis* Swedenbord) in soybean crop (*Glycine max*) during *kharif*, 2025

SM W	Maximum temperature (°C)	Minimum temperature (°C)	Average Relative Humidity (%)	Rain fall (mm)	Mean plant infestation (%) by girdle beetle
33	31.57	24.28	85.14	40.8	3.63
34	29	27	89.57	13.7	10.21
35	30.42	23.85	89.28	36.5	13.87
36	29.71	23.14	90.42	12.8	18.91
37	32.21	23.42	80.42	10.7	22.45
38	32.28	22.85	84.42	10	26.38
39	31.14	23.42	78	6.3	31.92
40	31.14	22	80.41	10	38.89
41	30.28	17.71	69.71	0	44.43
42	31.14	19	72.85	0	45.49

Table 3: Correlation among weather factors and girdle beetle (*Obereopsis brevis* Swedenbord) in soybean crop (*Glycine max*) during *kharif*, 2024 & 2025

Weather Parameter	2024	2025
Maximum Temperature (°C)	0.803**	0.168 ^{NS}
Minimum Temperature (°C)	0.054 ^{NS}	-0.850**
Average Relative Humidity (%)	-0.904**	-0.846**
Rain fall (mm)	-0.667*	-0.821**

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