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Abundance and diversity of arthropod pests in sesame crop field

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Abstract

Sesame (*Sesamum indicum* L.) is susceptible to a wide range of arthropod pests that can significantly reduce yield and quality. This study aimed to assess the diversity, seasonal abundance, and pest status of arthropod pests in sesame fields during the Kharif-I season 2023 at Gazipur Agricultural University (GAU), Bangladesh. The experiment was conducted in a Randomized Complete Block Design with 18 plots (3 m × 2 m) with three replications. Pest populations were monitored at 15-day intervals from seedling to harvest. A total of 15 arthropod pest species were recorded, representing five orders: Hemiptera (6 species), Coleoptera (4), Lepidoptera (3), Diptera (1), and Trombidiformes (1). Major pests included flea beetle (80.0%), whitefly (36.9%), jassid (14.2%), bihar hairy caterpillar (30.9%), sphinx caterpillar (30.3%), and leaf webber/capsule borer (28.7%). Minor pests such as leaf miner, epilachna beetle, aphid, red pumpkin beetle, red spider mite, and weevils were also observed. Seasonal abundance peaked on 15 May, with total pest counts reaching 97.3 individuals per plot. Whitefly was the most abundant species (22.4%), followed by red pumpkin beetle (13.2%), jassid (13.1%), and bihar hairy caterpillar (9.8%). Pest richness was the highest at early crop establishment stage (20.1 species), declining to 6.3-6.0 species as the crop matured, while abundance remained steady (0.6 individuals per plant) and evenness was low (0.2), indicating dominance of a few key pests. These findings highlight the complex pest ecosystem in sesame fields, with early-season minor pests giving way to highly adaptable sucking and lepidopteran pests that dominate later in the season.

Keywords: Arthropod, seasonal abundance, *Sesamum indicum*, pest diversity, species richness.

Introduction

Sesame (*Sesamum indicum* L.) is one of the most important oilseed crops cultivated globally, valued for its high-quality oil and nutritious seeds. Its cultivation supports the livelihoods of smallholder farmers in many tropical and subtropical regions. As one of the earliest oil crops used by humans, sesame is appreciated for its mild flavor and nutritional value, making it a popular dietary component (Wei *et al*. 2022). Globally, the area under sesame cultivation has more than doubled over the past six decades, expanding from 4.96 million hectares in 1961 to 12.97 million hectares in 2021 (FAOSTAT 2024).

In Bangladesh, sesame is the second most important oilseed crop, grown for both oil and dietary protein during the Kharif-I-1 (pre-monsoon) and Rabi (winter) seasons (Roy *et al*. 2022). Sesame seeds are rich in oil (42–50%), protein (25%), essential linoleic acid (42%), and carbohydrates (16–18%), making them valuable for food, nutrition, and biomedicine (Roy 2021). In Bangladesh, sesame is grown in almost all districts but thrives particularly well in Khulna, Faridpur, Pabna, Barisal, Rajshahi, Jessore, Comilla, Dhaka, Rangpur, Sylhet, and Mymensingh, with commercial cultivation concentrated in Pabna, Khulna, Faridpur, and Rajshahi districts (Roy *et al*. 2022).

Currently, about 28.3 thousand hectares are under sesame cultivation in Bangladesh, producing 27.5 thousand metric tons with an average yield of 0.97 MT ha^{-1} (BBS 2024). In Bangladesh, it is typically grown during the early Kharif-I season, following the Aman rice harvest, particularly in low-lying coastal districts such as Khulna, Patuakhali, and Barisal (Monim *et al*. 2010).

Despite its adaptability and economic importance, sesame yield in Bangladesh is constrained by multiple factors, with insect pests being a major limiting factor from seedling to fruiting stages. All parts of the plant-including leaves, stems, flowers, and pods are susceptible to pest attacks. Various insect pests and mites have been reported, including semi-looper, sesame hawk moth, fruit borer, jassid, whitefly, leaf miner, epilachna beetle, hairy caterpillar, thrips, stink bug, flea beetle, and plant bug. Among these, green stink bug, whitefly, hairy caterpillar, hawk moth, and semi-looper are considered the most serious pests, as severe pod borer infestation can significantly hamper pod development and seed viability (Kraft and Pfleger 2001).

To date, about 39 insect pest species have been recorded in sesame in Bangladesh, with eight identified as major pests. The most damaging insects include hawk moth, hairy caterpillar, leaf roller, pod bug, stink bug, green semi-looper, defoliator, and whitefly, which attack during vegetative, flowering, and pod formation stages. Annually, insect and mite pests are estimated to cause a 15–20% loss of total sesame production (Biswas *et al*. 2000).

Understanding the diversity, seasonal abundance, and pest status of arthropod pests is essential for developing timely and effective integrated pest management (IPM) strategies. Seasonal monitoring and population assessments provide insights into pest dynamics, peak infestation periods, and the relative dominance of different pest species, which are crucial for implementing targeted control measures efficiently. Despite the economic importance of sesame in Bangladesh, comprehensive studies on documenting pest diversity, temporal abundance, and pest status remain limited. Therefore, this study aimed to investigate the arthropod pest community in sesame fields, assess their seasonal abundance, and determine their pest status to support ecologically sound and sustainable pest management interventions.

Materials and methods

The study was conducted in the research field of the Department of Entomology of Gazipur Agricultural University (GAU), Gazipur. The study was carried out during the Kharif-I-I season, from March to June 2023. Gazipur experiences a tropical climate characterized by a dry season (February-May), a rainy season (June-September), and winter (December-January). During the study period, the mean temperature was 25.8 °C, with average maximum and minimum temperatures of 36.0 °C and 12.7 °C, respectively. Relative humidity ranged from 65-70%, and the site received an average annual rainfall of 2036 mm (Afroz *et al*. 2019). The experimental site falls within the Madhupur tract (Agroecological Zone 28). The soil texture varied from silty clay loam to clay, with pH ranging from 5.8 to 6.5, indicating slightly to moderately acidic conditions.

The field was thoroughly prepared by ploughing, cross-ploughing, leveling, and laddering to ensure uniform tilth. All residual weeds and crop debris were removed, and basal doses of recommended fertilizers were applied prior to sowing. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replications. A total of 18 plots were established, each measuring 3 m × 2 m. Fertilization of the experimental plots was carried out following the recommendations of BARC for BARI Til 4. Urea was applied at 125 kg ha^{-1}, triple super phosphate (TSP) at 150 kg ha^{-1}, murate of potash (MoP) at 50 kg ha^{-1}, gypsum at 110 kg ha^{-1}, zinc sulphate at 5 kg ha^{-1}, and boric acid at 10 kg ha^{-1}.

The full doses of urea, TSP, MoP, and bio-fertilizer were applied as basal during land preparation to ensure adequate nutrient availability at the initial stages of crop growth. Seeds were sown in well-prepared seedbeds in continuous lines at a depth of approximately 5 cm, maintaining 30 cm row-to-row spacing. After germination, seedlings were thinned to maintain 6 cm spacing between plants within a row. Intercultural operations included periodic weeding to break soil crusts, remove weeds, and maintain soil aeration. The first weeding was conducted 20 days after sowing, followed by subsequent weedings at 15-day intervals. Irrigation was applied after the first weeding, and any stagnant water was drained to prevent waterlogging.

Data were collected from some pre-selected parameters, such as number of pests and natural enemy with crop growing season, rate of plant infestation by different pests. The observations on the incidence of insect pests and their natural enemies were counted visually with the help of magnifying 10x lens at a 15-day interval recorded from their appearance' on plants to till harvest. Sample was taken from randomly selected 2 rows and then converted to 6 rows per plot (3 × 2 m^2) to express rate of plant infestation and number of arthropods pests per plot. The insect pests were identified through comparison to museum specimens as well as by relevant literature and photographs. The arthropods pests were categorized as major (>25%) and minor (<25%) according to the rate of plant infestation (Hasan *et al*. 2021).

Shannon-Weaver diversity index (Shannon and Weaver 1962) and Margalef's richness index (Margalef 1958) were calculated for the insect pests recorded in different observation days.

The indices were computed using the following formulae:

Shannon-Weaver diversity index (H´):

$$H' = -\sum_{i=1}^{S} [P_i] \ln [P_i]$$

Where, S = Total number of species = Species richness, Pi = The relative abundance of each species, P is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), ln is the natural log, and Σ is the sum of the calculations.

The formula for Pielou's Evenness Index is given by:

$$J = H' / \ln(S)$$

Where H´ is the Shannon-Weiner diversity index and S is the total number of species in the sample.

Margalef's species richness index (D^{mg}) is:

$$D^{mg} = \frac{S-1}{\ln N} \text{ or } D^{mg} = \frac{S-1}{\log e(N)}$$

Where, S = Total number of species, N = Total number of individuals in the sample, ln = Natural logarithm.

The data were analyzed using SPSS software to perform analysis of variance (ANOVA). The significance of differences was assessed using the F-test, and mean values were compared using Tukey's HSD post hoc test.

Results and discussion

A total of 15 arthropod pest species were recorded in sesame fields during the Kharif-I season 2023 at Gazipur, Bangladesh (Table 1). These pests belonged to five taxonomic orders, with Hemiptera being the most dominant group, represented by six species: aphid (*Aphis craccivora*), jassid (*Amrasca biguttula*), whitefly (*Bemisia tabaci*), green stink bug (*Nezara viridula*), red cotton bug (*Dysdercus cingulatus*), and squash bug (*Anasa tristis*). The order Coleoptera comprised four species, namely flea beetle (*Monolepta signata*), red pumpkin beetle (*Aulacophora foveicollis*), epilachna beetle (*Epilachna varivestis*), and weevil (*Blosyrus inaequalis*). Three economically important pests from the order Lepidoptera were also observed, including leaf webber and capsule borer (*Antigastra catalaunalis*), sphinx caterpillar (*Acherontia styx*), and Bihar hairy caterpillar (*Spilosoma obliqua*). In addition, one species each from the orders Diptera (*Liriomyza brassicae*) and Trombidiformes (*Tetranychus urticae*) was recorded. The presence of both sucking and chewing pests across multiple taxonomic groups reflects the complexity of the sesame pest ecosystem in the study area. The pest composition observed in the present study closely agrees with earlier reports from Bangladesh and neighboring regions.

Ahmed *et al*. (2014) recorded several important insect pests of sesame, including *Spilosoma obliqua*, *Nezara viridula*, *Monolepta signata*, and other pentatomid and pyrrhocorid bugs, which are consistent with the species documented in the current investigation. They also reported the occurrence of *Dysdercus* spp. and *Piezodorus hybneri* from Lalmonirhat, further supporting the wide distribution of these hemipteran pests in sesame-growing areas of Bangladesh.

Similarly, Mishra *et al*. (2015) reported that sesame crops in India are attacked by as many as 29 insect pest species at different growth stages, with *Antigastra catalaunalis* identified as the most destructive pest across all major sesame-growing regions. The occurrence of *A. catalaunalis*, *Acherontia styx*, and *Spilosoma obliqua* in this study confirms their continued importance as key lepidopteran pests in South Asian sesame agroecosystems. Dilipsundar *et al*. (2019) reported an updated checklist of 201 insect pest species associated with sesame. Foliage feeders were the dominant group (54%), comprising both sucking pests (*Bemisia tabaci*, and *Aphis gossypii*) and defoliators (*Antigastra catalaunalis*, *Spilosoma obliqua*, *Acherontia lachesis*, and *A. styx*), while pod-feeding

Table 1. Insect pests prevailed in the sesame field during kharif-I season 2023 at Gazipur, Bangladesh

Common name	Scientific name	Family	Order
Flea beetle	*Monolepta signata* (Olivier, 1808)	Chrysomelidae	Coleoptera
Red pumpkin beetle	*Aulacophora foveicollis* (Lucas,1849)	Chrysomelidae	Coleoptera
Epilachna beetle	*Epilachna varivestis* (Mulsant,1850)	Coccinellidae	Coleoptera
Weevils	*Blosyrus inaequalis* (Boheman,1845)	Curculionidae	Coleoptera
Leaf miner	*Liriomyza brassicae* (Riley, 1885)	Agromyzidae	Diptera
Aphid	*Aphis craccivora* (Koch, 1854)	Aphididae	Hemiptera
Jassid	*Amrasca biguttula* (Ishida, 1913)	Cicadellidae	Hemiptera
Whitefly	*Bemisia tabaci* (Gennadius, 1889)	Aleyrodidae	Hemiptera
Green stink bug	*Nezara viridula* (Linnaeus ,1758)	Pentatomidae	Hemiptera
Red cotton bug	*Dysdercus cingulatus* (Fabricius, 1775)	Pyrrhocoridae	Hemiptera
Squash bug	*Anasa tristis* (De Geer, 1773)	Coreidae	Hemiptera
Leaf webber/ roller & capsule borer	*Antigastra catalaunalis* (Duponchel, 1833)	Pyraustidae	Lepidoptera
Hawkmoth/ Sphinx caterpillar	*Acherontia styx* (Westwood, 1847)	Sphingidae	Lepidoptera
Bihar hairy caterpillar	*Spilosoma obliqua* (Walker, 1855)	Erebidae	Lepidoptera
Red spider mite	*Tetranychus urticae* (Koch, 1836)	Tetranychidae	Trombidiformes

bugs (*Elasmolomus sordidus*, *Clavigralla gibbosa*, and *Dolycoris indicus*) accounted for 16% of pests.

The incidence and status of arthropod pests in untreated control plots during the Kharif-I season 2023 are presented in Table 2. Pest infestation began as early as 10 days after treatment (DAT) and continued up to the fruiting and harvest stages, indicating continuous pest pressure throughout the crop growth period. Flea beetle infestation started at the seedling stage (10 DAT) and showed the highest plant infestation rate (80.0%), categorizing it as a major pest. Bihar hairy caterpillar (30.9%), whitefly (36.9%), leaf webber and capsule borer (28.7%), and sphinx caterpillar (30.3%) were also recorded as major pests due to their comparatively higher infestation levels. Several pests were classified as minor pests, including leaf miner (15.3%), epilachna beetle (20.0%), aphid (8.7%), jassid (14.2%), red pumpkin beetle (33.3%), red spider mite (15.7%), and weevils (14.0%), which appeared mainly from the seedling to flowering stages. Red cotton bug and squash bug were observed only during the flowering to fruiting stage and were considered casual visitors, as no measurable infestation was recorded.

Ramzan *et al*. (2024) reported that flea beetles (*Monolepta signata* and other *Monolepta* spp.) are polyphagous and economically important foliage feeders with a broad host range. They documented that flea beetles cause considerable vegetative damage in several crops, including cotton and maize, particularly during the early growth stages. This evidence supports the exceptionally high infestation rate of flea beetle observed at the seedling stage in the present study and indicates the strong potential of *Monolepta* species to exert severe early-season pressure on susceptible hosts under favorable environmental conditions. Similarly, the major pest status of whitefly and leaf webber roller /capsule borer observed in the present study is strongly supported by the findings of Dwarka *et al*. (2024), who comprehensively reviewed the key insect pests of sesame and identified *B. tabaci* as a dominant sucking pest and *Antigastra catalaunalis* as the most destructive lepidopteran pest across major sesame-growing regions. They further reported that lepidopteran pests cause severe defoliation and capsule damage, leading to substantial yield losses, which is in close agreement

Table 2. Status of arthropod pests in sesame in untreated control plots (3×2m^2) during kharif-I season 2023

Common name	Crop stages of infestation	Initiation of infestation (DAT)	Rate of plant infestation (%)	Status
Flea beetle	Seedling to plant establishment	10	80.0	Major
Leaf miner	Seedling to plant establishment	15	15.3	Minor
Epilachna beetle	Seedling to plant establishment	20	20.0	Minor
Aphid	Seedling to plant establishment	20	8.7	Minor
Jassid	Seedling to Flowering	30	14.2	Minor
Bihar hairy caterpillar	Plant establishment to flowering	25	30.9	Major
Red pumpkin Beetle	Plant establishment to flowering	30	33.3	Minor
Whitefly	Plant establishment to flowering	30	36.9	Major
Red spider mite	Plant establishment to flowering	30	15.7	Minor
Leaf webber/ roller & capsule borer	Flowering to harvest	45	28.7	Major
Weevils	Flowering to fruiting	40	14.0	Minor
Sphinx caterpillar	Flowering to fruiting	40	30.3	Major
Red cotton bug	Flowering to fruiting	45	–	Casual visitor
Squash bug	Flowering to fruiting	50	–	Casual visitor

*DAT= Days after treatment

with the high infestation levels of these pests recorded in the untreated control plots of the present investigation.

Seasonal monitoring of arthropod pests in sesame during Kharif-I-I 2023 showed distinct fluctuations across five observation dates (Table 3). Early in the season (April 1–15), flea beetle caused high infestation at the seedling stage (4.3–7.3 individuals per plant), indicating strong early-season pressure. Leaf miner, epilachna beetle, aphids, and Bihar hairy caterpillar appeared by mid-April, marking the onset of pest build-up. By May, populations of jassid, whitefly, red pumpkin beetle, and Bihar hairy caterpillar increased sharply, with whitefly recording the highest seasonal abundance (72.0 individuals). Lepidopteran pests peaked in mid-May to early June. Minor pests such as weevils and squash bug occurred at low levels. Overall pest pressure reached its maximum on May 15 (97.3 individuals), identifying mid-May as the most critical period for pest management. The dominance of sucking pests (*B. tabaci*, *A. craccivora*, and *A. biguttula*) highlights their major role in reducing crop vigor, while chewing pests mainly caused defoliation and reproductive damage. Ramzan *et al*. (2024) noted that *Monolepta* species exert strong early-season pressure on seedlings due to their polyphagous nature and high foliage consumption. Dwarka *et al*. (2024) highlighted *B. tabaci* and *A. catalaunalis* as major pests in sesame, supporting the dominance of these species in mid-season abundance. Seasonal incidence studies in India showed peak populations of *B. tabaci*, *A. catalaunalis*, and *A. styx* during flowering and early reproductive stages (Pandey *et al*. 2025).

Figure 1 presents the rank abundance curve of arthropod pests recorded in sesame fields during the Kharif-I 2023 season. Whitefly was the most abundant species (22.4%), followed by red pumpkin beetle (13.2%), jassid (13.1%), Bihar hairy caterpillar (9.8%), red spider mite (8.9%), leaf webber and capsule borer (8.9%), and sphinx caterpillar (6.9%). Less abundant species included red cotton bug, leaf miner, flea beetle, green stink bug, epilachna beetle, weevils, aphid, and squash bug.

Seasonal surveys in sesame have shown that both whitefly and jassid exhibit strong positive associations with environmental conditions, especially temperature, and build up significant populations throughout key crop stages, which helps explain their dominance over other pests in rank abundance patterns (Ram *et al*. 2025). The lower abundance ranks of epilachna beetles, weevils, aphids, and squash bug can be partly attributed to strong natural enemy regulation, where predators and parasitoids

Table 3. Relative seasonal abundance of arthropod pests in sesame in untreated control plots (3×2m^2) through visual searching during Kharif-I season 2023

Arthropod pests	Time in cropping season					Total	Mean
	01 April	15 April	01 May	15 May	01 June		
Flea beetle	4.3	7.3	0.0	0.0	0.0	11.6	2.3
Leaf miner	3.3	11.0	0.0	0.0	0.0	14.3	2.8
Epilachna beetle	0.0	4.7	0.0	0.0	0.0	4.7	0.9
Aphid	0.0	3.0	0.0	0.0	0.0	3.0	0.6
Jassid	0.0	20.0	22	0.0	0.0	42.0	8.4
Bihar hairy caterpillar	0.0	5.7	7.0	13.0	5.0	30.7	6.1
Red pumpkin beetle	0.0	7.3	7.0	12.0	16.0	42.3	8.4
Whitefly	0.0	9.0	18.0	33.0	12.0	72.0	14.4
Red spider mite	0.0	6.0	4.0	11.0	6.3	27.3	5.4
Leaf webber/ roller & capsule borer	0.0	0.0	5.3	6.7	15.3	27.3	5.4
Weevils	0.0	0.0	2.0	1.0	1.0	4.0	0.8
Sphinx caterpillar	0.0	0.0	4.3	12.0	7.0	23.3	4.6
Red cotton bug	0.0	0.0	4.3	5.3	6.3	15.9	3.1
Squash bug	0.0	0.0	0.0	1.0	1.0	2.0	0.4
Total	7.6	74.0	73.9	97.3	73.2	-	-

Only the symptoms of leaf miner were observed, but not the insect; in case of spider mite and whitefly, infested leaf was counted; in case of aphid, clusters of aphids were counted.

suppress populations of smaller herbivores like aphids, preventing large outbreaks despite their presence in the field (Barascou *et al*. 2025). Additionally, these pests often have narrower host preferences, specialized feeding niches, or are less competitive for resources compared to highly adaptable sap-sucking pests like whitefly or jassid; limited host availability and resource concentration can restrict their population growth (Rusch *et al*. 2010).

The abundance, richness, diversity, and evenness of insect pests in sesame varied across the Kharif-I season 2023 (Table 4). The lowest abundance (0.1±0.0) was observed on 1 April, corresponding to the early crop establishment phase. Pest abundance increased markedly from 15 April onwards and remained steady at 0.6±0.0 through 1 June, indicating that a smaller number of species became numerically dominant as the crop matured. In contrast, pest richness was highest at the start of the season (20.1±1.2 on 1 April), suggesting the presence of a wide variety of insect species early in the crop cycle. Richness declined sharply in subsequent observations, reaching 6.3-6.0 from 15 April to 1 June. Pest diversity remained relatively stable (0.6-0.7), while evenness stayed low (0.2±0.0), indicating that pest populations were unevenly distributed, with a few dominant species accountings for most individuals. These trends indicate that numerous minor pests occur early in the season, but as the crop develops, a few dominant species, particularly whitefly, jassid, and leaf webber/capsule borer outcompete others and prevail in the pest complex. Ram *et al*. (2025) observed that sucking pests like whitefly and jassid show rapid population buildup as the crop matures, while early-season minor pests decline due to competition, predation, or narrower host windows. Reddy and Singh (2018) reported that early-season high species richness in sesame often declines over time as a few dominant pests establish and exploit available resources. Pandey *et al*. (2025) also highlighted that lepidopteran pests such as *A. catalaunalis* and *Spilosoma obliqua* become numerically dominant later in the season due to high reproductive potential and efficient colonization of reproductive structures.

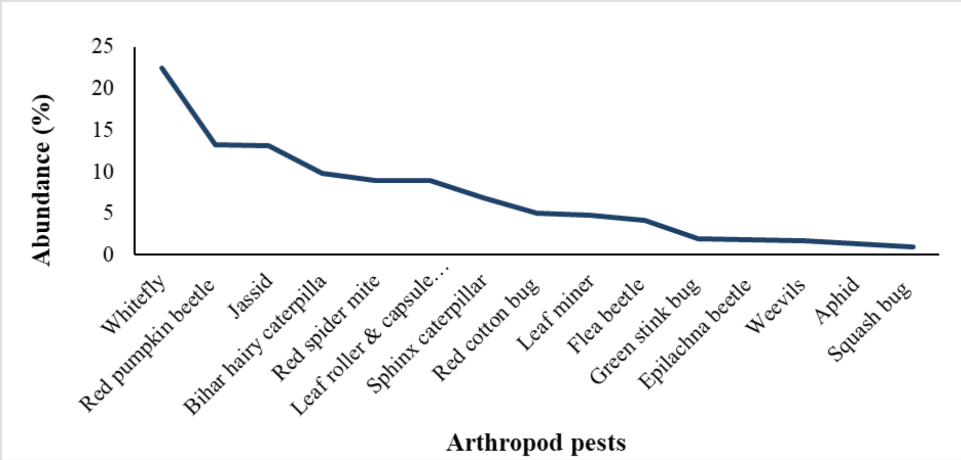

Figure 1. Rank abundance curve of the arthropod pests in sesame field during Kharif-I season 2023.

Table 4. The abundance, richness and diversity of insect pests in sesame in untreated control plots ($3\times2m^2$) through visual searching during Kharif-I season 2023

Observation date	Insect pests			
	Abundance	Richness	Diversity	Evenness
01 April	0.1±0b	20.1±1.2a	0.7±0a	0.2±0a
15 April	0.6±0a	6.3±0.1b	0.6±0a	0.2±0a
01 May	0.6±0a	6.3±0.1b	0.6±0a	0.2±0a
15 May	0.6±0a	6.0±0.1b	0.7±0.1a	0.2±0a
01 June	0.6±0a	6.0±0.1b	0.7±0a	0.2±0a

Means within a column followed by the same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

Conclusion

The study revealed a diverse arthropod pest complex in sesame fields during the Kharif-I 2023 season at Gazipur, Bangladesh, comprising 15 species across five orders, with Hemiptera being the most dominant. Major pests, including flea beetle, whitefly, jassid, Bihar hairy caterpillar, sphinx caterpillar, and leaf webber/capsule borer, exerted significant pressure throughout the crop cycle, particularly during seedling and mid-season stages. Seasonal abundance peaked in mid-May, highlighting critical periods for targeted pest management. These findings emphasize the need for integrated pest management strategies focusing on the key dominant pests to minimize crop damage and improve sesame productivity.

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