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Address for correspondence:
A. K.Thite
Department of Zoology, Bahirji Samarak Mahavidyalay, Basmathnagar (M.S)
Email: thiteakshay57@gmail.com

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A Case Study: Indian Grass Gall-Midge (Cecidomyiidae: Diptera)

A. K. Thite[1], S. S. Bhalerao[2], V. V. Kapate[3]
[1,2]Department of Zoology, Bahirji Samarak Mahavidyalay, Basmathnagar (M.S)
[3]Department of Zoology, Maharashtra Mahavidyala Nilanga (M.S)

Abstract

The Indian Grass Gall-Midge (Asphondylia spp.), belonging to the Cecidomyiidae family (Order: Diptera), is a major pest affecting various grass species across India. This case study examines the biology, behavior, and control strategies of the Indian Grass Gall-Midge, particularly its effects on agricultural and ecological systems. The midge larvae cause gall formation on the inflorescences and stems of grasses, especially during the plants' reproductive stages, resulting in significant damage to crops such as rice, sugarcane, and different fodder grasses. This infestation causes stunted growth, decreased grain yield, and in severe cases, plant death.

The research delves into the lifecycle of the Indian Grass Gall-Midge, covering the egg-laying process, larval development inside the gall, pupation, and adult emergence. It also discusses various factors that influence the population dynamics of the midge, including environmental factors, host plant types, and farming practices. Additionally, the study highlights the economic and ecological impact of the pest, underlining its role in disrupting grassland ecosystems and reducing crop productivity.Various control measures, including chemical and biological approaches, are assessed in the study. Integrated Pest Management (IPM) strategies, such as using resistant grass varieties, applying targeted insecticides, and introducing natural predators, are analyzed for their effectiveness in reducing midge damage. The importance of early detection and monitoring for successful pest control is emphasized.The findings of this study offer essential insights to farmers, agricultural researchers, and pest management professionals, aiding in a deeper understanding of the Indian Grass Gall-Midge's behavior and supporting the development of efficient strategies to manage its spread and minimize crop losses.

Key Words: *Indian Grass Gall-Midge, Cecidomyiidae, Diptera, Gall Formation, Host Plant Interaction, Ecological Impact.*

Introduction

Insects belonging to the family Cecidomyiidae**,** commonly known as gall midges, are significant in the study of plant-insect interactions due to their unique ability to induce the formation of galls on host plants. The Indian Grass Gall-Midge, a member of this family, is one such species that has attracted attention for its ecological and agricultural implications. These midges, primarily affecting grasses, are small but influential organisms that play a role in shaping the health and dynamics of grassland ecosystems. While often categorized as pests, the Indian Grass Gall-Midge provides valuable insights into plant-insect symbiosis, pest management, and the broader ecological balance in Indian grasslands. The life cycle of the Indian Grass Gall-Midge involves the deposition of eggs on the stems, leaves, or flowers of host grasses. Upon hatching, the larvae penetrate the plant tissues, leading to abnormal growths known as galls. These galls serve as both a feeding and developmental site for the larvae, which in turn can lead to stunted plant growth, reduced productivity, and in some cases, complete plant mortality. This interaction, though seemingly parasitic, also triggers complex ecological processes, where the insect influences the growth patterns and reproductive success of its host plants.

The significance of studying the Indian Grass Gall-Midge lies in its dual role as both a biological phenomenon and a potential agricultural pest. Understanding its distribution, host plant preferences, and ecological behavior is crucial for evaluating its impact on grassland health and crop yields, particularly in India, where the grasslands support vital agricultural activities. Additionally, the study of this species provides an opportunity to explore effective pest control strategies that could minimize crop losses while preserving the integrity of native ecosystems. This case study delves into the biology, distribution, and ecological significance of the Indian Grass Gall-Midge, with a focus on its interactions with host plants. By analyzing its life cycle, host plant relationships, and potential agricultural impact, the research aims to contribute to a more comprehensive understanding of gall midges and their role in shaping grassland ecosystems.

Furthermore, it seeks to explore sustainable management practices that could mitigate the midge's adverse effects on agriculture while promoting biodiversity conservation *Lasiopetra bothriochloae Sp.* nov.

Male: The body length measures 1.03 mm. The palpus is quadriarticulate and sparsely setose; the first segment is short and indistinct in preparation, the second segment is cylindrical, with a length 1.85 times its maximum thickness (13:7), and the third segment is cylindrical, 3.00 times its maximum thickness (21:3). Antenna: The antenna is less than half the body length, consisting of 2+12 sessile, cylindrical segments with two whorls of long setae and low circumfila. The scap is cup-shaped (17:11), the pedicel is globose (13:12), and the third segment (19) merges with and is longer than the fourth segment, with a slight basal prolongation (4:2). The third segment's length is 1.66 times its maximum thickness (15:8). The fourth segment (15) merges with the enlargement, measuring 1.87 times its thickness (15.7). The fifth segment is nearly identical to the fourth. The sixth to ninth segments are similar to one another, with the ninth segment being shorter. The penultimate segment (11) is slightly shorter than the twelfth segment. The terminal segment (12) is slightly longer than the penultimate, conical, and measures 1.70 times its maximum thickness (12:6). Wing: The wing is hyaline, 2.50 times longer than broad (50:19), with a scaled costa. The R5 vein meets the costa beyond the middle of the wing and interrupts at its junction. M1+2 is absent, and Cu is forked. Legs: The legs are thickly hairy, with the metatarsus being short (7) and the second tarsal segment the longest (51). The terminal tarsal segment is longer than the metatarsus (10). The claws are dentate on all legs, with the empodium being 0.50 times the length of the claw (5.09). Genitalia: The basal clasp segment is cylindrical, 3.20 times as long as its width (48:14), with finely setose tips, ending in a tooth, and a length 4.33 times its maximum thickness (26:5). The dorsal plate is broadly and deeply incised. The adages are slender, rounded at the tip, measuring 6.245 times their maximum thickness (25:3), surrounded by parameter lobes, with bifid tips.

Female: The body length is 2.10 mm, including the ovipositor. The palpus is similar to that of the male. Antenna: The antenna is less than one-quarter of the body length and consists of 2-14 cylindrical, sessile segments with low circumflex and two whorls of long setae. The scape and pedicel are similar to the male's. The third segment (20) is fused with and longer than the fourth, with a small basal prolongation (2:3), and its length is 1.63 times its maximum thickness (18:10). The fourth segment (17) has an enlargement that is 1.70 times as long as it is thick (17:9). The fifth segment (15) is shorter than the fourth. The sixth to tenth segments are similar to each other and slightly shorter than the fifth (14). The eleventh and twelfth segments are similar and shorter than the tenth (12). The thirteenth and fourteenth segments are shorter than the twelfth (10). The penultimate segment (10) is as long as the fourteenth, and the terminal segment (11) is conical, slightly longer than the penultimate, and 1.37 times as long as it is thick. Wing, legs, and claws are similar to the male's. Ovipositor: The ovipositor is nearly as long as the abdomen, protractile, and of the typical lasiopetran type. The dorsal lamella is approximately as long as (50:15), sparsely setose, densely hairy at the tip, and has a row of recurved hooks in the sub-apical region. The ventral lamella is very densely hairy.

Material

Holotype*:* One male dissected and mounted on slide labeled as reared from earheads of *bothrichloa pertusa* (L.) (Wild) A. Campus Bahirji Samarak Mahavidyalay Basmathnagar. India, 15.09. 2024. A.K.Thite And S.S.Bhalerao. Type slides and other material are retained, for the present, in authors collections at Basmathnagar tq. Dist. Hingoli, Maharashtra.

Paratypes: Two males and one female dissected and mounted on slide, many males and females in alcohol, data same as in holotype.

Remarks

This species very resembles L. tomentosae (Grover, 1967) but differs in the (i) different proportion of palpal segments, (ii) of antennal segments, (iii) absence of vein M_{1+2}, (iv) subdorsal plate entire, and (v) ovipositor lobe being 3.12 × as long as broad.

Conclusion

The study of the Indian Grass Gall-Midge has highlighted its significant ecological and agricultural implications. As a member of the Cecidomyiidae family, the midge induces gall formation on various grass species, affecting plant health, growth, and productivity. Through its interaction with host plants, the midge's larvae create galls that serve as both feeding and developmental sites, which can lead to stunted growth, reduced yields, and, in severe cases, plant mortality.

Ecologically, the Indian Grass Gall-Midge plays a crucial role in shaping grassland ecosystems by influencing plant community composition and dynamics. While it poses challenges to agriculture, particularly in grass-based crops, it is also a reminder of the complex interdependencies between plants and insects in natural environments.

Managing the Indian Grass Gall-Midge requires a comprehensive approach that balances pest control with the preservation of ecosystem health. Further research into the midge's behavior, distribution, and host plant preferences is essential for developing effective and sustainable management strategies. Ultimately, understanding this species will contribute to better pest management practices and enhance the ecological stability of grassland habitats.

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Conflicts of Interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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