***Short communication***

**UNIQUENESS OF ASSOCIATION OF FERN AND INSECT IN THE FIELD**

**Abstract-**

Initial analysis of fern–insect herbivore interactions ﬁrst appeared in the 1970s–1980s. The ferns were actually the primary food supply for the herbivorous sauropods during the Mesozoic epoch. Given their ability to contain a large amount of energy in tiny packaging, fern spores have been shown to be rich in lipids. The presence of simple phenolics, which can be regarded as one of the primary causes of repulsion, makes insect phytophagy on ferns a rare occurrence.Unlike angiosperms, ferns contain special chemicals. The level of specialisation of insects that currently feed on ferns is well illustrated.

The study on insects found feeding on ferns conducted in the field is presented in the publication. It was found that the number of different insects, such as beetles, flea beetles, sawflies, bugs and mealybugs, infested different ferns. Despite the increased toxicity, some insects, such as snails and grasshoppers, can consume mature ferns on a daily basis.

 Further study has to be carried out to find how these insects affect the growth and metabolism of the ferns. Fern-insect interactions can be explained by their evolutionary ties. Only four Lepidopteran families exhibit the rare phenomenon known as fern-spore-feeding (FSF). Fern proteins regulate insects that are resistant to Bt insecticidal proteins, indicating different methods and/or areas of action and perhaps providing a novel method of managing insect pests.

**KEYWORDS**: Insects, Ferns, interaction, phytophagy, angiosperms, Fern-spore-feeding

**Introduction**

Ferns (*Pteridophyta*, including both *Lycopodiophyta* and *Polypodiophyta* in the broad sense) are the second largest group of vascular plants, just after angiosperms ([Dai et al.](file:///C%3A%5CUsers%5CHP%5CDownloads%5CRev_UPJOZ_4932_Pra_A.docx#B6425121) 2020). The first known ferns are thought to have appeared at least 423 million years ago (Nitta *et al*., 2022). Interactions between ferns and insect herbivores were initially examined in the 1970s and 1980s (Cooper-Driver, 1978). The majority of the primary herbivore feeding strategies had evolved by the end of the Pennsylvanian, approximately 300 Ma, to include chewing, sucking and piercing, boring, galling, and spore ingestion. Previously, only insects with sucking and piercing mouthparts could devour ferns and fern relatives (Labandeira, [2002](file:///C%3A%5CUsers%5CHP%5CDownloads%5CRev_UPJOZ_4932_Pra_A.docx#nph20361-bib-0011)).Plant-animal interaction is often observed chronologically with the evolution of different groups of plants and animals. However, animals generally do not like ferns. The presence of simple phenolics, which can be regarded as one of the primary causes of repulsion, makes insect phytophagy on ferns a rare occurrence.  Soon after the land flora appeared, the terrestrial vegetation was attacked by a variety of insects, as evidenced by the harm that different insects caused to different areas of fern plants and fern allies.

. In recent years different cases of interaction between insects and extant ferns and fern allies have been reported. The level of specialisation of insects that currently feed on ferns is well illustrated by (Porto et al, 2024) (Fuentes-Jacques et al., 2022). Fern-insect interactions can be explained by their evolutionary ties. Insect orders belonging to the Endopterygota clade tended to interact with similar fern species, which may be due to the inheritance of Endopterygota ancestors due to phylogenetic niche conservationism. In an ecological setting, fern specialisation developed in response to climate stability, precipitation, and temperature. The evolutionary grouping of the fern species in understanding the regional variety of insect-fern interactions in that environment may be a key factor. (Robert J. Marquis et [et.al](http://et.al). 2024).

In this communication, some observations of fern and insect have been reported to understand whether it could help us to understand their effect on ferns as well as on the environment.

**OBSERVATION**

During a fern collection tour along the Dehradun district from 2008 to 2011, the authors, on careful observations, noticed some larvae were actively feeding on the undersurface of the lamina of these ferns, and some of the insects were noticed on the upper surface as well as on the undersurface of the leaves. Apart from that study was done consulting the herbarium from BSI, Dehradun, and a literature survey was also done for further studies, such as Stegelmeier, BL, 2014; Patra B and Bera S, 2007; and Walker, 2010.

**FINDINGS**

 Some of the interesting aspects also came out during the field study, such as the insect and fern relationship and also by herbarium consultations.

 (a) Beetle infestation on *Christella dentata* (Forssk.) Brown (FIG-2) and *Drynaria propinqua* (Wall. ex Mett.) (FIG-1)

 (b) *Adiantum lunulatum* Burm. infested by larvae of beetles.

(c) *Lygodium japonicum* (Thumb.) Sw. common insects found in association are flea beetles and sawflies.

(d) *Pteridium revolutum* (Bl.) Nakai (FIG-4) and *Pteris vittata* L. infested by bugs

(e) *Pyrrosia costata* (C. Presl ex Bedd.) Tagawa & K. Iwats. Shield bugs are found in association.

(f) The caterpillars feed on *Osmunda regalis* L.

 (g) On the underside of a frond of Silver Fern, an adult female Silver Fern mealybug, *Crisiococcus* sp. (FIG-3)



**FIG-1 :** *Drynaria propniqua* (Wall. ex Mett.)



 **FIG-2 :** Beetle infestation on *Christella dentata* (Forssk.) Brown



 **FIG-3 :** On the underside of a frond of Silver Fern an adult female Silver fern mealybug, *Crisiococcus* sp.



**FIG-4 :** *Pteridium revolutum* (Bl.) Nakai

Insects and ferns have a complicated relationship that includes both positive and negative interactions. Ferns' chemical defences against herbivores remain unclear. Unlike angiosperms, ferns contain special chemicals. (Wei et al., 2023). Despite the increased toxicity, some insects, such as snails and grasshoppers, can consume mature ferns on a daily basis. The primary dietary source for herbivorous sauropods during the Mesozoic era was ferns. Fern herbivores may be insect species that specialise in ferns or generalist insects that are generally found in the insect orders Coleoptera, Hemiptera, and Lepidoptera.Strong mutualistic relationships exist between ants and *the Microgramma* subgenus *Solanopteris* in the New World and *Lecanopteris* in the tropical regions of the Old World; a third, more facultative association has just been reported for *Antrophyum* in Costa Rica. Only four Lepidopteran families exhibit the rare phenomenon known as fern-spore-feeding (FSF). The most specialised family, Stathmopodidae, contains FSF species, and its subfamily, Cuprininae, is exclusively devoted to FSF ( Zong-Yu Shen et al., 2024).

 Insect orders that are part of the Endopterygota clade tend to interact with similar fern species. Indicating that insects in this clade have similar diets, which might be a result of the inheritance of Endopterygota ancestors due to phylogenetic niche conservationism ( Gabriela Fraga Porto et al., 2024).

The susceptibility of fern-insect interactions is another illustration of how distinctive ecological interactions may be lost before the different fern species are recorded. For both ferns and insects, targeted sampling of interactions conducted in an aphylogenetic framework appears to be the most fruitful. Comparing fern clades that originated before with those that evolved after the emergence of angiosperms might also be instructive. If and how fern chemistry differs from flowering plant chemistry, as well as how these substances contribute to the structuring of fern herbivore assemblages and the damage they do, can be determined once such data are accessible. The effects of plant size, deciduousness, the great variation of leaf form and size, and environment between species of ferns. It has been demonstrated that these elements affect herbivore damage in angiosperms (Chaves et al., 2025).

. According to Portot al. (2024), because these relationships are the most specialised and least investigated, research and conservation efforts should concentrate on tropical ferns and their insect partners. The restricted climatic niches of low-to-mid elevation tropical forests are expected to make fern–insect interactions the most vulnerable to climate change (Grinder & Wiens, 2023). The susceptibility of fern-insect interactions is another illustration of how distinctive ecological interactions may be lost before the species of fern are recorded. Since ferns generate a number of highly efficient defensive compounds, such as substances that imitate insect growth hormones and obstruct caterpillar and other insect growth, they are immune to many insect pests. However, the caterpillar of the Florida fern may overcome these defences and can seriously defoliate Boston ferns and other fern species. (Romulo et al., 2022).

Fern proteins regulate insects that are resistant to Bt insecticidal proteins, indicating different methods and/or areas of action and perhaps providing a novel method of managing insect pests. (Jun-Zhi Wei et al., 2023).

 Steroidal compounds which are closely related structurally to ecdysone are grouped as ecdysteroids. Phytoecdysteroids are distributed in a large number of land plants (6%). Phytoecdysteroids have been recorded from 27 families of pteridophytes. Ecdysteroids are not found in all fern families, but in Polypodiaceae, they are very common. Ferns *like Pteridium aquilinum, Polypodium vulgare, Schizaea dichotoma, Cheilanthes farinosa, Cheilanthes tenuifolia, Microsorum scolopendria, Adiantum pedatum, Dryopteris nipponensis, Adiantum raddianum, Asplenium aethiopicum, Cyclosorus interruptus, Dicranopteris linearis, and Diplazium polypodioides,* etc., more commonly synthesise ecdysteroids. One major drawback is that some plants' phytoecdysteroids might discourage beneficial insects and other insect predators that are not suited. [One](http://suited.One) major drawback is that some plants' phytoecdysteroids might discourage beneficial insects and other insect predators that are not suited. (Sahayaraj, K. 2022).

**CONCLUSION**

The study on insects found feeding on ferns conducted in the field is presented in the publication. It was found that the number of different insects, such as beetles, flea beetles, sawflies, bugs and mealybugs, infested different ferns. Despite the increased toxicity, some insects, such as snails and grasshoppers, can consume mature ferns on a daily basis. Further study has to be carried out to find how these insects affect the growth and metabolism of the ferns.

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1.

2.

3.

**Data availability statements**

Data source and support are not used for this work.

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