An Emerging Pestilence of Solanum Fruit Fly (*Bactrocera latifrons)* (Hendel, 1920) in Akabare Chili Production in Nepal

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Abstract

Solanum fruit fly, *Bactrocera latifrons* (Hendel, 1920) (Diptera: Tephritidae), mostly infests the crops belonging to the Solanaceae family preferably the *Capsicum* Spp. Recently, a recurrence pestilences of *B. latifrons* have been observed in Akabare chili in Nepal. However, its systematic study has not yet been performed. It has been observed that feedings of the solanum fruit fly maggots damage the chili fruits in different parts of the country. The incidences of the solanum fruit fly in Akbare chili have been observed in Kathmandu (mid-hill), Sarlahi (terai) and Sankhuwasabha (mid-hill) districts of Nepal. *B. latifrons* has been identified morphologically and verified by molecular analysis. The accession numbers (PQ108473.1, PP956865.1 and PQ108461.1) are available in the GeneBank.

Keywords: Akabare chili, Fruit fly, Iidentification, Tephritidae, Threat

Introduction

Akabare chili (*Capsicum* spp.) cultivation is recently taking place a kind of emerging agricultural enterprise to support rural livelihoods in the hilly areas of Nepal (Poudyal et al., 2023). In Nepal, it was grown in 1,481 ha with 9,233 mt fresh fruit production in 2021 (MoALD, 2022). However, various challenges have threatened its yield and fruit quality. Both biotic and abiotic stresses are major contributors to the low productivity of Akabare chili: a very noticeable biotic threat being the fruit fly, particularly *Bactrocera latifrons* (Hendel, 1920) (Diptera: Tephritidae). *B. latifrons*, native to South and Southeast Asia, has recently spread to regions such as Japan, Hawaii, and parts of Africa (CABI, 2024; Liquido et al., 1994), known as the solanum fruit fly, it targets a variety of hosts within the Solanaceae family, including chili, eggplant, and tomato (Mziray et al., 2010).

There are 30 species of fruit flies including *B. latifrons* (solanum fruit fly) in Nepal which are prone to attack on the horticultural crops (Adhikari, 2024 and Adhikari et al., 2022). The solanum fruit fly has caused significant damage to Akabare chili, and is becoming a major biotic challenge to its cultivation in the recent past years in Nepal (Adhikari and Joshi, 2024). The fruit fly deposits eggs inside the chili fruit, where the developing larvae feed resulting severely reducing its quality, yield, and market value (Shimizu et al., 2007). Infested fruits show puncture marks, discoloration, and decay, making them unfit for consumption and sale. Maggot feedings in the fruit's inner tissues also lead to early fruit drops and considerable yield losses, directly impacting farm income. The spread of *B. latifrons* is rapid, as adults can take a long distance flight, and an addition, maggots infested fruits are often transported across districts (Peck and McQuate, 2004).

This pest has already invaded key Akabare chili-growing districts in Nepal, warranting for its regular monitoring and management efforts in fields. As being reasonably a new pest to Akabare chili, a specific management strategy against *B. latifrons* is lacking, and as a repercussion this fruit fly is causing extensive chili fruits damages in Nepal. This study, therefore, provides an initial understanding of *B. latifrons* as a pest to Akabare chili in Nepal with a highlight on the field identification characters of the fruit fly that may be helpful to support its field detection and management initiatives.

Materials and methodology

1. Maggots infested sample collection

This study involved rearing pupae from Akabare Chili fruits infested with fruit fly maggots. Fruits, exhibiting

infestation symptoms, such as surface punctures, discoloration, or early dropping, were collected from Kathmandu, and Sankhuwasabha districts (Table 1, Figure 1). Samples were gathered from selected field areas in each district and taken to the laboratory for study.

2. Rearing maggots and collection of adult flies

In the laboratory, the infested chili fruits were cut open to observe the maggots of the fruit fly. The 3rd instar maggots were reared in 1liter plastic jar each containing 1/3rd volume of sawdust in Kathmandu, and 1/3rd volume of soil in Sankhuwasabha. The containers with the rearing medium were maintained at the moisture level of 20-25% and room temperature of 25±2 °C to allow the fruit fly development from pre-pupae to adult stage. The setup was regularly checked, and once adult flies emerged, they were identified morphologically. The fruit fly specimens from Sarlahi district were also collected during monitoring in para-pheromone trap (Table 1).

Table 1: Locations of the fruit fly maggots infested Akabare Chili field.

S.N.	Location and date of collection	Location and date of rearing
1	Kirtipur-6, Kathmandu on July, 2024	PQPMC laboratory[1], Hariharbhawan, Lalitpur on July-August, 2024
2	Tropical Horticulture Centre, Nawalpur, Sarlahi on April, 2023	Trapped in para-pheromone (methyl eugenol) trap in cucurbit field on April, 2023
3	Khandbari-5, Sankhuwasabha on July, 2024	AKC[2] Sankhuwasabha, on July-August, 2024
4	2024	2024

[1]Plant Quarantine and Pesticide Management Centre

[2]Agriculture Knowledge Centre

Figure 1: a. Akabare chili plant, b. Fruit fly maggot infested fruit and c. maggot

3. Morphological identification

Adult flies, following established taxonomy guidelines for *Bactrocera* species (Drew and Romig, 2013) were examined under a trinocular stereomicroscope to verify their identity using morphological traits. Key features analyzed included body coloration, distinct markings on the thorax and abdomen, and wing patterning. These characteristics of *B. latifrons* were compared with published descriptions and identification keys specific to fruit flies.

4. Molecular identification

Morphologically identified fruit flies' specimens were sent to the laboratory at Center for Molecular Dynamics Nepal, Thapathali, Kathmandu for molecular identification.

Results and Discussion

1. Solanum fruit fly (*Bactrocera latifrons*)

This fly was first described from Taiwan by Hendel in 1912 as *Dacus parvulus* Hendel, 1912. It is native to Asia (EPPO, 2024). *B. latifrons* belongs to the subgenus *Bactrocera* and may therefore be cited as *B.* (*B.*) *latifrons*. (White and Liquido, 1995). *B. latifrons* is primarily distributed across South and Southeast Asia. Waterhouse (1993) noted its presence in Indonesia, though without specifying a particular region. Since this species has been recorded

in Sabah and West Malaysia, it is likely also present in areas like Kalimantan and Sumatra. In Africa, *B. latifrons* has been documented only in Tanzania and Kenya, with its presence in other African regions still unknown (Meyer et al., 2007). This species was also recently introduced to Hawaii, where it was first detected in 1983 (Liquido et al., 1994).

2. Taxonomic classification

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Subphylum: Uniramia
Class: Insecta
Order: Diptera
Family: Tephritidae
Genus: *Bactrocera*
Species: *Bactrocera latifrons*

Preferred Scientific Name: *Bactrocera latifrons* (Hendel)
Preferred Common Name: Solanum fruit fly
International Common Names: Malaysian fruit fly

Source: CABI, 2024

3. Distribution of solanum fruit fly (*B. latifrons*)

The solanum fruit fly has been described from 28 countries in the world (CABI, 2024) including Nepal. As per the updated report from CABI till 02 April 2024 this pest has been reported from Bangladesh, Brunei, Burundi, Cambodia, China, Congo, France, Hong Kong, India, Indonesia, Italy, Japan, Kenya, Laos, Malaysia, Myanmar, Pakistan, Singapore, South Africa, Sri Lanka, Taiwan, Tanzania, Thailand, Timor- Leste, Uganda, United States and Vietnam (Figure 2).

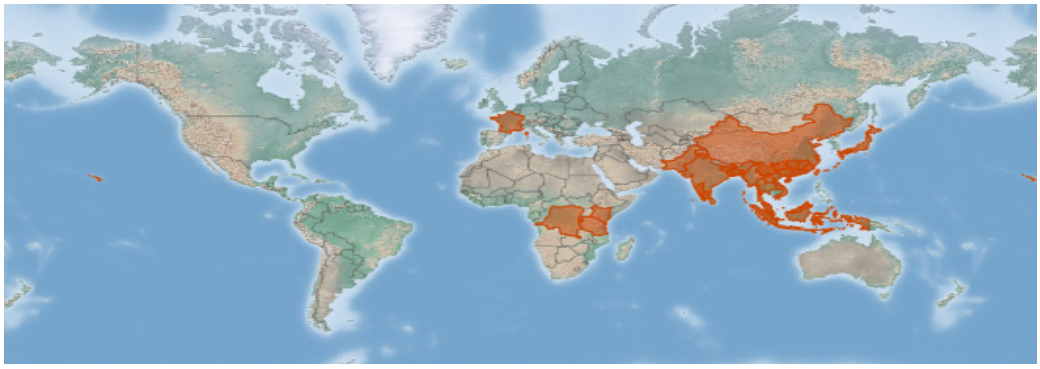

Figure 2: Distribution map of Solanum fruit fly, Bactrocera latifrons

Source: CABI, 2024

4. Host plants

It is known that this fruit fly pest species infests fruits in the Solanaceae and Cucurbitaceae families (Drew and Romig, 2013). *Capsicum* species (*C. annuum*, *C. chinensis*, and *C. frutescens*) and *Solanum* species (*S. lycopersicum*, *S. melongena*, and *S. aethiopicum*) are the main host plants in the Solanaceae family. Other families' host plants are regarded as minors. There are 68 host plants solanum fruit fly in 12 families (Combretaceae, Cucurbitaceae, Lamiaceae, Lithomyrtus, Lythraceae, Oleaceae, Passifloraceae, Punicaceae, Rhamnaceae, Rubiaceae, Rutaceae, and Solanaceae) of (CABI, 2024). However, 3 solanum crops are main host plants, namely *Capsicum* (peppers), *Capsicum annuum* (bell pepper) and *Solanum nigrum* (black nightshade) (CABI, 2024). The solanum fruit fly is a significant pest that requires quarantine (PM 7/142, 2020).

5. Morphological description of Solanum fruit fly (*B. latifrons*)

This fruit fly species is medium in size (6-7 mm). Face fulvous with two large oval black spots. **Thorax:** The scutum is mostly black, without medial vitta, 2 lateral vittae; scutellum is completely pale yellow.

Legs: The femora completely pale, can be completely pale to pale with a pre-apical dark spot to darkened (either black or red-brown) throughout the apical region.

Abdomen: Orange-brown to fuscous is the predominant color of the abdomen. Tergites are not fused. The abdomen is not slender-waisted. No distinct T pattern in the dorsal abdomen.

Wing: Expanded into an area at the apex, with a full costal band that does not extend below R2+3. Anal stripe on the wing. Transverse marks are absent (Figures 3 and 4).

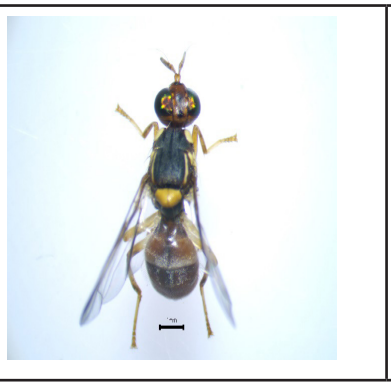

Figure 3. Solanum fruit fly, B. latifrons (a. male, b. female) **Figure 4**. Lateral view of B. latifrons

6. Molecular identification of solanum fruit fly (*B. latifrons*)

Following the molecular analysis of fruit fly specimens, the Basic Local Alignment Search Tool (BLAST) was employed to conduct a homologous nucleotide search for taxonomic identification. The search for highly similar sequences revealed that the obtained sequence most closely matches *B. latifrons*, as indicated in Table 2.

Table 2: NCBI BLAST result of the sequence with most significant alignment

Location of collection	Query length (bp)	BLAST matched Accession	Scientific name	Common name	Query coverage	Percent identity
Kathmandu	681	MZ621835.1	*B. latifrons*	Solanum fruit fly	100%	99.12%
Sarlahi	577	ON586734.1	*B. latifrons*	Solanum fruit fly	100%	99.83%
Sankhuwasabha	675	ON586734.1	*B. latifrons*	Solanum fruit fly	100%	100%

The fruit fly species *Bactrocera latifrons* was accurately identified through detailed morphological examination and subsequently confirmed using molecular analysis techniques. The genetic data associated with this identification have been submitted to and are accessible in the GeneBank database under the accession numbers PQ108473.1, PP956865.1, and PQ108461.1 for the fruit fly from Kathmandu, Sarlahi and Sankhuwasabha respectively, providing a reliable reference for future research and verification.

The attraction of fruit fly species to methyl eugenol traps in the Sarlahi district has shown inconsistent and contradictory results, as CABI (2024) reported. Notably, this particular species has been observed to exhibit no significant attraction to neither methyl eugenol nor cue lure. In contrast, a study of Kar et al., (2024) documented the collection of the same species from two locations in West Bengal, India. Specimens were retrieved from infested *Capsicum* (Solanaceae) at Chinsurah, Hooghly, and from methyl eugenol traps set up at Ruhia, Murshidabad. The genetic sequences of these specimens have been cataloged and are available in the NCBI GenBank under the accession numbers OL440711 and PP499261, respectively. These findings highlight regional and behavioral variations in fruit fly attraction patterns and offer valuable information for further study.

Conclusion

The solanum fruit fly (*Bactrocera latifrons)* presents a significant pest threat to Akabare Chili production in Nepal, broadly in the solanaceous crops across the Terai and mid-hill regions. This study provides valuable insights into the distribution of *B. latifrons* across Kathmandu, Sarlahi and Sankhuwasabha districts, confirming its presence through both the morphological and molecular identifications. The molecular data have been cataloged in GeneBank, adding to the foundation for future research and pest management strategies. The back-up information on the pest's ability to spread through adult flight and transportation of infested fruits from origin to elsewhere suggest further investigation into sustainable and effective management practices to protect the economic viability of Akabare Chili cultivation.

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