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RESEARCH ARTICLE

FIRST RECORD OF *HERMETIA ILLUCENS* (LINNAEUS, 1758) – BLACK SOLDIER FLY, FROM NEPAL

Biplov Sapkota[a*], Shristi Upadhyaya[a], Anuj Lamichhane[a], Rajendra Regmi[b], Kuldip Ghimire[c], Raj Kumar Adhikari[d]

[a]*Agriculture and Forestry University*
[b]*Department of Entomology, Agriculture and Forestry University*
[c]*Plant Quarantine Office, Ministry of Agriculture and Cooperatives, Government of Nepal*
[d]*Value Chain Development Project, Government of Nepal*
[*]*Corresponding Author Email: bplv624@gmail.com*

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ABSTRACT

Hermetia illucens (Linnaeus, 1758)- Black soldier fly is a beneficial insect which has been used in simple systems, to treat organic waste efficiently and rapidly, and to produce animal feed ingredient and fertilizer as end products. These flies are naturally found in warmer parts of the globe. The incidence of Black soldier fly was recorded for the first time in Nepal in between April and May 2020 in the sub urban area of Chitwan District, Nepal. Identification of the insect was done in the Laboratory of Department of Entomology, Faculty of Agriculture, Agriculture and Forestry University, Nepal. Both adult and larval forms of the insect were identified based on the study of morphological characteristics of captured specimens using simple microscope and stereomicroscope. The record of this insect in Nepal opens up a new dimension for its use in bio-systems to treat organic waste and produce more sustainable ingredient for animal feeding, and rich fertilizer to be used in agriculture.

KEYWORDS

Insects, Nepal, New Record, Black soldier fly.

1. INTRODUCTION

Hermetia illucens (Linnaeus, 1758), commonly called Black soldier fly (BSF), belongs to the family Stratiomyidae. They have a wasp like appearance and are sleek and glossy looking with a blackish coloration. Black soldier flies have two wings and does not possess a stringer (Diclaro & Kaufman, 2012). The fly is native to the Neotropics, but at present found throughout the warmer parts of the globe following decades of spread (Marshall et.al., 2015). Adults of the fly inhabit and mate near larval habitat. It is not recognized as a pest since the adult of the fly is not attracted to human habitation or foods (Furman et.al., 1959). The adults do not need to eat as they rely on the fat stored from the larval stage. The larva of this fly is a voracious consumer of decaying organic matter including kitchen waste, spoiled feed, decaying fruits and vegetables, animal manure and human excreta (Newton et.al., 1977; Diener et al., 2011). In the last few decades, there has been considerable interest in using larvae of *H. illucens* for organic waste control, composting, and as animal food supplements (Marshall et al., 2015). The larva of Black soldier fly can be used as an alternative source of protein ingredient in the making of poultry, fish and other livestock feed. Feeding studies with chickens, pigs, catfish and tilapia have shown that the larvae or larval meal of this fly was a suitable replacement for a high proportion of conventional protein and fat sources (Hale, 1973; Newton et.al., 1977; Bondari & Sheppard, 1987). Black soldier fly has not been reported in any places of Nepal. The major objective of this study is to report the incidence of *Hermetia illucens* (Linnaeus, 1758) in Nepal.

2. METHODOLOGY

The first record of Black soldier fly was an incidental occurrence. It was made in afternoon hours in the semi-urban setting of Chitwan District, Nepal. The insect was seen near the organic waste collection and composting pit of a local resident's house. The major flora around the record site were *Mangifera indica, Musa spp., Zea mays,* and *Citrus limon*. The first sighting was recorded using a mobile camera device (Redmi Note 8 Pro, 64 MP Camera Sensor). The Global Positioning System (GPS) data of location, time and date were recorded on the picture. Following this incidence, another incidence was recorded nine days after the first record during which two black soldier flies were sighted on the same place again. Three days after the second incidence, a Black soldier fly was found performing oviposition on the wall of the waste collection and composting bin. This observation developed a suspense of previous egg-laying by other flies and subsequent larval growth in the waste collection and composting bin. The upper layer of the waste in the bin was removed and numerous larvae of Black soldier flies along with few Housefly (*Musca Domestica*) larvae were seen. Some larvae were collected and rinsed with water for further observation. Two adult flies were captured for detailed study, which was performed under LEICA GZ6 stereomicroscope and simple microscope under 10x and 20x at the Department of Entomology, Agriculture and Forestry University, Nepal. All specimens were preserved and stored in the Department's laboratory for future references.

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3. Result and Discussion

As larvae, *Hermetia illucens* eat decaying organic material, like food scares and kitchen waste due to which adults of the flies are seen near to places where such waste is ample. The observed insect was identified as Black soldier fly adults on the basis of morphological descriptions given by Sheppard et. al (2002). The adult flies had a wasp-like appearance and were blackish blue in coloration. They also had two typical translucent "windows" located on the first abdominal segment. The flies were observed to be 1cm to 1.5 cm in length. The adult's antennae were elongated, and legs had typical white coloration near the end.

The larvae of the Black soldier fly were also identified on the basis of their morphology. They were dull-whitish in color, with a small projecting head containing chewing mouthparts and had segmentations throughout their body. These observations were in line with descriptions given by Hall and Gerhardt (2002).

Table 1: Details of Incidence of Black soldier fly

Location	Elevation	Date	Time	Stage	Number	Sex	Activity
27.6887, 84.45133	212 masl	April 25, 2020	3:27 PM	Adult	1	M/F	Sitting
		May 4, 2020	2:38 PM	Adult	2	M/F	Sitting
		May 7, 2020	1:52 PM	Adult	1	F	Ovipositing
		May 7, 2020	4:03 PM	Larva	Many	M/F	Feeding

Figure 1: An adult Black soldier fly (dorsal aspects) found near the organic waste bin

Figure 2: An adult Black soldier fly (lateral aspects) found ovipositing on the crevices of waste-bin wall

Figure 3: An adult Black soldier fly being held in hand where its white-edged feet and reproductive prominence can be seen.

Figure 4: Organic waste collection pit where Black soldier fly and larva were recorded.

Figure 5: Numerous Black soldier fly larvae feeding on organic waste as seen on the waste bin

Figure 6: Few larvae of Housefly seen along with numerous Black soldier fly larva inside an eggshell

Figure 7: Larvae and prepupae of Black soldier fly extracted from waste bin (after cleaning)

Figure 8: Prepupae of Black soldier fly extracted from waste bin (after cleaning)

Figure 9: Ventral view of Black soldier fly captured from the site of incidence

Figure 10: Dorsal view of Black soldier fly captured from the site of incidence

3.1 Basis of identification

One of the captured flies (Female, 13mm) preserved in 70% ethanol solution. It was dissected and the parts were studied under stereomicroscope and simple microscope (10x and 20x). Wings were observed under 10x lens, where peculiar venation with a small discal cell was seen (Fig. 11). The antenna had a spatulated apical flagellum (Fig. 12). Pulvillus, empodium and claw were observed under 20x lens in the limbs of the fly (Fig. 13). All observations made were in accordance with the Black soldier fly identification key (De Carvalho & De Mello-Patiu, 2008).

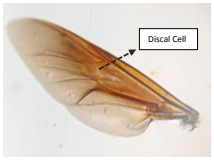

Figure 11: Wings of the captured fly where discal cell can be seen in the middle

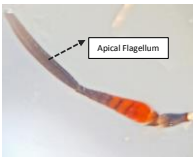

Figure 12: Antenna of the captured fly with spatulated apical flagellum

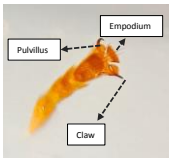

Figure 13: Tip of limb of the captured insect with its parts

Similarly, larva preserved in 70% ethanol solution (23mm) was observed under a stereomicroscope. The larva had a flattened and roughened body with setose teguments (Fig. 8 and 14) and had a sclerotized cephalic region. The observations made were in line with the Black soldier fly larva identification key (Velásquez et.al., 2010).

Figure 14: Cephalic region of the captured larva observed under stereomicroscope

4. Conclusions

The captured fly and larval specimens were confirmed to be the adult and larval stages of Black soldier fly respectively. The presence of Black soldier fly population in Nepal was previously not reported or mentioned in any literatures. This record can be a milestone for further studies in relation to distribution of the fly in the country. The presence of Black soldier fly could be an indication of the benefits Nepal can get, through deployment of this fly species for organic waste management and its subsequent bioconversion to protein feed ingredient and organic fertilizer. This evidence justifying the presence of wild Black soldier fly population may validate the feasibility of commercial insect rearing protocols in the region.

Conflict of Interest

The authors declare no conflict of interest.

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