J. Asiat. Soc. Bangladesh, Sci. **49**(1): 1-11, June 2023 DOI: https://doi.org/10.3329/jasbs.v49i1.67591

BLACK FUNGUS GNAT – AN INVASIVE PEST OF FRENCH BEAN IN BANGLADESH

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Abstract

French bean is an important vegetable in most tropical and subtropical countries and is a food source for humans and animals. A survey was carried out on the Patuakhali Science and Technology University (PSTU) campus, Narsingdi, Sylhet, Hobigonj, and Mowlovibazar districts of Bangladesh to know the incidence pattern of insect pests of French bean from November 2016 to January 2017. Field screening of nine French bean varieties against major insect pests was conducted in the Regional Horticulture Research Centre, BARI, Shibpur, Narsingdi, from November 2017 to January 2018. Seven varieties viz., BARI Jharsheem-1, BARI Jharsheem-2, BARI Jharsheem-3, Sylhet local-4, Sylhet local-5, Sylhet local- 6 and Sylhet local-7 were used as study materials to evaluate against major insect pests of French bean under natural field condition. Results revealed that black fungus gnat was first noticed on 13th December, 2016 and the prevalence continued upto the 12th January, 2017. The highest incidence (21/plant) of black fungus gnat was found in Habiganj and the lowest (9/plant) was on the PSTU campus. The highest number of black fungus gnats were captured at 38 DAS (89/trap) and the lowest number (56/trap) of black fungus gnats were at 28 DAS using a yellow sticky trap. The variety BARI Jharshim-3 had the highest population of Black fungus gnats, which indicated that the variety was highly susceptible to Black fungus gnats, while Sylhet local-7 had the lowest population of black fungus gnats indicating least susceptible to Black fungus gnats. Among all tested varieties, none showed complete resistance against black fungus gnats.

Keywords: Black fungus Gnat, French bean, Incidence, Susceptible, Variety

Introduction

French bean (*Phaseolus vulgaris* L.) belong to the Fabaceae (syn. Leguminosae) family and is additionally called a bush bean, common bean, dry bean, dwarf bean, field bean, garden bean, hariot bean, kidney bean, pole bean but the immature pods of those beans are called green beans, snap beans, string beans in numerous parts of the planet (Salunkhe *et al.*, 1987). It's a serious vegetable that provides one of the foremost important sources

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of protein (Arulbalachandran and Mullainathan, 2009) and is rich in vitamins, minerals and dietary fiber (Ndegwa *et al.,* 2006). They're important foods in most tropical and subtropical countries and are second only to cereals as a food source for humans and animals (Graham and Vance, 2003). They're also important for his or her nitrogen fixing capabilities (Amanuel *et al.,* 2000), and might be employed in crop rotation systems to boost soil conditions. The organic process of legume crops offers an alternative to nitrogen fertilizers which can present a significant environmental problem (Brentrup *et al.,* 2001). Black or Darkwinged fungus gnats *Bradysia impatiens*, insects that belong to the family Sciaridae of the fly Diptera, occur around damp, decaying vegetation, algae, and fungi (Orkin, 2018). Black fungus gnat may be a newly introduced insect pest of haricots verts in Bangladesh. It's of a big mosquito, but its long abdomen and abdomen are striped. It sucks cell sap from the leaf, green stem or other plant parts. Fungus gnats are comparatively weak fliers and remain adjacent to plants running or resting on growing media, leaf, or plant litter. These tiny gnats can appear in large numbers in or around buildings, prompting complaints, and can also be an issue in greenhouses, nurseries, and interior plant scapes. They need mandibles for gnawing and tunneling. They eat organic mulch, leaf mold, grass clippings, compost, root hairs, algae, and fungi (MBG, 2018). Fungus gnats infest soil and container media, where larvae go after organic matter and roots, feeder roots, and root hairs. If conditions are especially moist and fungus gnats are abundant, larvae can leave slime trails on the surface of media that seem like trails from small snails or slugs. They'll enter buildings as flying adults and develop indoors through all life stages. Adult fungus gnats are a nuisance as they do not bite people or animals and aren't known to hold human pathogens. Adults feed little, consuming only liquids, like water or flower nectar Page 1 of 3 Source (MBG, 2018). The life cycle of Fungus gnats is completed through four stages: egg, larvae (four larval stages or instars), pupa, and adult. They produce many generations in an exceedingly year. Adult females lay tiny 30 to 200 whitish-yellow eggs singly or in clusters in crevices or cracks on the surface of growing media in potting soil and moist, organic debris (MBG, 2018). The ¼-inch-long larvae have an elongated, whitish-to-clear, legless body with a shiny black head. After hatching, larvae begin feeding on fungus or the foundation hairs of plants but eventually fulfill the plant's roots, as edible organic material in the soil (Orkin, 2018). The larvae feed for about 2 weeks and pupate near the soil surface within thread chambers. Adult gnats emerge after 3 to 7 days within the pupal stage, and live for about 8 days. Adult fungus gnats are dark, delicate-looking insects and are about 1/8 to 1/16-inch long with light gray to clear wings. They are similar in appearance to mosquitoes. The common species have a Y-shaped wing vein. They need slender legs and segmented antennae that are longer than their heads. The gnats develop

from egg to adult in 3 to 4 weeks, depending on temperature. The developmental time increases as temperature decreases (MBG, 2018). These adult fungus gnats continue the mating cycle, increasing the population of their species. Because fungus gnats are extremely small, their presence can go undetected until previously healthy plants show signs of wilting and disease (Orkin, 2018). Fungus gnat larvae are most damaging to seedlings, cuttings, and young plants. Plant symptoms indicate fungal gnats resulting sudden wilting, loss of plant vigor, poor growth, and yellowing because of larval feeding on plants. When their preferred food choices run out, they prey on roots as a source of nutrients, stunting plant growth, and causing foliage to turn yellow and leaves to drop. Larvae prey on the roots of alfalfa, carnation, clover, corn, cucumbers, easter lillies, geraniums, lettuce, nasturtium, peppers, poinsettias, potatoes, soybeans, wheat and other organic matter (Orkin, 2018). Larval damage may be severe in greenhouses, nurseries, and sod farms, where they harm seedlings, cuttings, and young plants without fully developed root systems. Larvae of some species kill fungi in overwatered soil. Both larvae and adults can spread plant pathogens and will promote disease in commercial crops. They must be implicated in the transmission of plant fungal diseases, including black plant disease, *Pythium* blight, *Verticillium* wilt, Botrytis blight, and wilt (MBG, 2018). Outdoors, little serious damage is completed by fungus gnat larvae. Natural predators, weather and seasonal changes control their population. Any root feeding in gardens or landscapes is sometimes minor as compared with the gnats' beneficial role as decomposers converting dead vegetation into nutrients for plant growth, as important pollinators, and as food for tiny animals like birds, reptiles, and beneficial insect predators (MBG, 2018). Colored sticky traps that reflect certain wavelengths of yellow, blue, white, and red are most frequently wont to attract and catch insect pests like winged aphids, whiteflies, thrips, leaf miners, 8 fungus gnats, and shore flies, e.g., *Scatella stagnalis* (Fallen) Ephydridae, Diptera (Rodriguez Saona *et al.*, 2012; Taha *et al.*, 2012). It's suggested that yellow traps be utilized in a monitor program that included whiteflies and fungus gnats. Traps can also be accustomed to controlling some pests, or at minimum, slowing the speed of pests increase like whiteflies (Pasian and Lindquist, 2009). Considering the facts, the present study was undertaken to know the occurrence and incidence of black fungus gnats on French beans.

Materials and Methods

A survey was carried out on the Patuakhali Science and Technology University campus, Narsingdi, Sylhet, Hobigonj, and Mowlovibazar districts (Plate 1) of Bangladesh to know the incidence pattern of insect pests of French beans from November 2016 to January

2017. Field screening of nine French bean varieties against major insect pests was conducted in the Regional Horticulture Research Centre, BARI, Shibpur, Narsingdi from November 2017 to January 2018. Seven varieties *viz.*, BARI Jharsheem-1, BARI Jharsheem-2, BARI Jharsheem-3, Sylhet local-4, Sylhet local-5, Sylhet local- 6 and Sylhet local-7 were used as study materials to evaluate against major insect pests of French bean under natural field condition. The seeds of French beans were collected from Pulse Research Centre, BARI, Joydebpur, Gazipur. The yellow sticky trap was collected from Ispahani Agro Ltd. The experiment was laid out in a randomized complete block design with 3 replications. The whole field was divided into 3 equal blocks with 1 m space between the blocks, and each block was again subdivided into 7 plots (4 x 3 m plots) as treatment plots with a space of 0.5 m between plots. The seeds were sown on 15 November 2017 in plots in double rows with a spacing of 20 cm between plants within the row. The usual cultural practices were done according to the crop requirements to ensure that an even stand of plants was established in the field plots. The plants were side dressed with fertilizer and the rows were irrigated with a drip irrigation system which supplied water throughout the growing season. The yellow sticky trap was used for monitoring purposes and to capture fungus gnats.

During the survey and field screening experiment, numerous black fungus gnats (Plate 2) were observed on French bean fields in study sites, and data were collected in two ways: 1) by counting the number of adult black fungus gnats per plant by inspecting the individual plant, and 2) by counting the number of adult black fungus gnats captured in a yellow sticky trap placed in the experimental filed (Plate 3). Data on captured black fungus gnats by yellow sticky trap were recorded at 28, 38, 48, and 58 days after sowing (DAS).

Statistical analysis

Data were analyzed statistically following the analysis of variance (ANOVA) using WASP 1.0 software program and means were separated by CD (critical difference) values.

Results and Discussion

Seasonal abundance of black fungus gnats: Seasonal abundance of black fungus gnats per plant is shown in Figure 1. The infestation of black fungus gnats started on 13th December on a highly susceptible variety (BARI Jharshim-3) of French beans. It is revealed from the figure that the black fungus gnat was first noticed on 13th December 2016 and the prevalence was continued up to the 12th January, 2017. At the beginning of

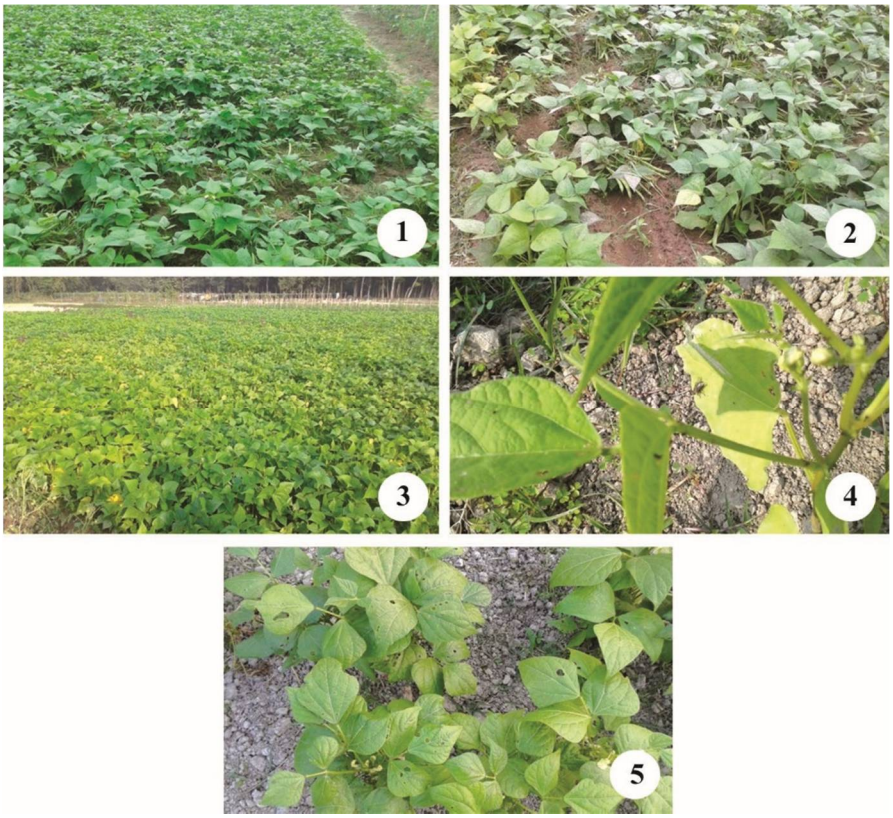

Plate 1. Shown the sample fields of five survey locations. 1. Field 1-Sylhet, 2. Field 2-Moulabibazar, 3. Field 3- Habiganj, 4. Field 4-PSTU campus, 5. Field 5 -Narsingdi.

Plate 2. Adult black fungus gnats on the leaf of French bean.

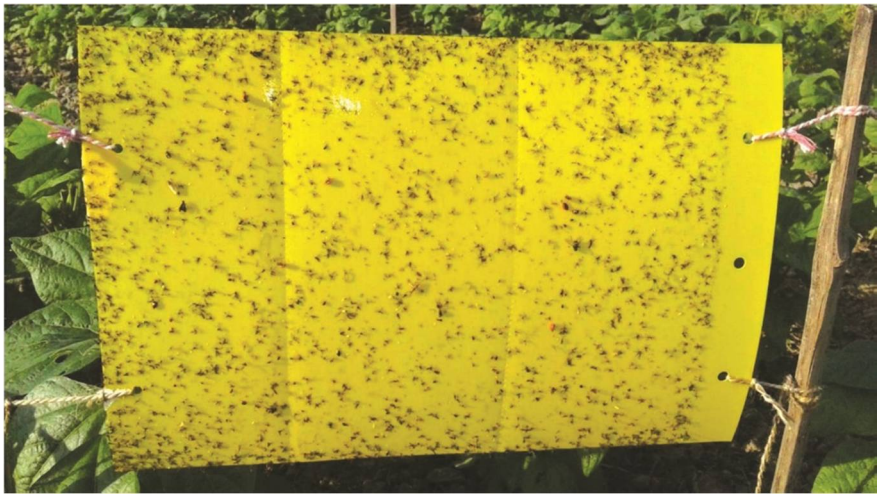

Plate 3. Captured adult black fungus gnats by using a yellow sticky trap on a French bean

the season, an increasing trend was found at the vegetative stage up to 2nd week of January. The prevailing temperature and relative humidity were 20.5-22.75°C and 44-75.5% at the peak period (Fig. 1). The highest population of black fungus gnat per plant in the field was observed in the 2nd week of January, 2017 (Fig. 1). It was revealed that number of black fungus gnat was higher at high temperature and low relative humidity.

Incidence of black fungus gnats by individual plant observation: The mean number of black fungus gnats was maximum (21/plant) in Habiganj, followed by Moulavibazar (18/plant) and Sylhet (15/plant). In comparison, the minimum number (9/plant) was observed in PSTU campus, followed by Narsingdi (13/plant) (Fig. 2).

Incidence of black fungus gnats captured by yellow sticky trap: The highest number of black fungus gnats were captured at 38 DAS (89/trap), followed by 48 DAS (75/trap), while the lowest number of black fungus gnats were at 28 DAS (56/trap) followed by 58 DAS (62/trap) (Fig. 3).

Population of Black fungus gnats on different varieties of French bean: Mean number of Black fungus gnats per plant was recorded on different French bean varieties on different days after sowing (DAS) and is presented in Table 1. At 28 DAS, the highest number of Black fungus gnats was observed in the variety BARI Jharshim-2 (1.33) and BARI Jharshim-3 (1.33), followed by BARI Jharshim-1 (1.00), and Sylhet local-6 (1.00). Here BARI Jharshim-2 and BARI Jharshim-3 were statistically identical. However, the lowest number of Black fungus gnats was observed in the variety of Sylhet local -5 (0.33)

followed by Sylhet local-6 (0.67) and Sylhet local-4 (0.67), which were also statistically identical.

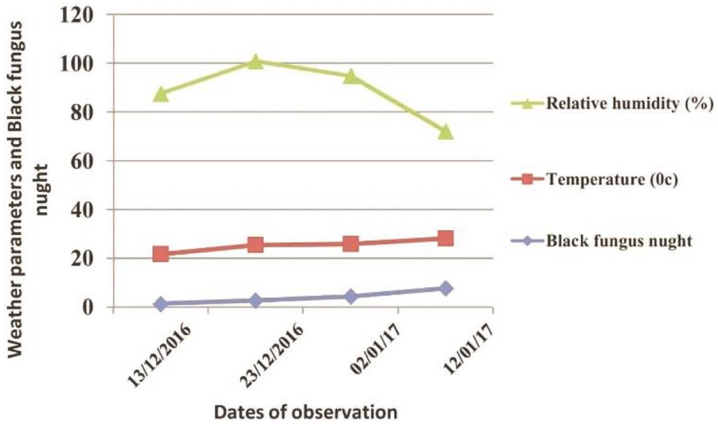

Fig. 1. Relationship between Black fungus gnat with mean temperature (°C) and mean relative humidity (%) on a highly susceptible variety of BARI Jharshim-3.

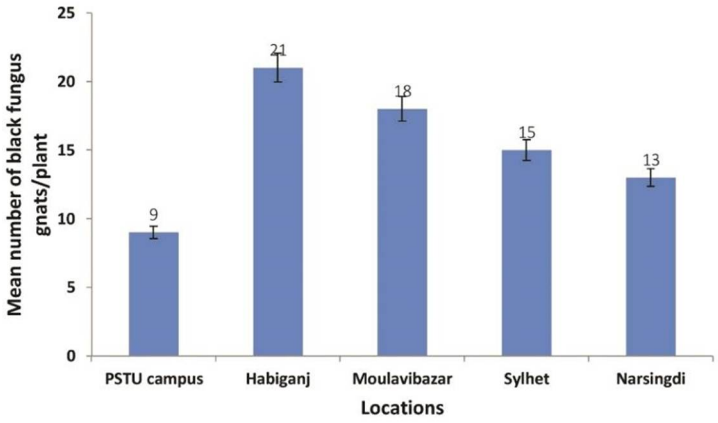

Fig. 2. Incidence of black fungus gnats recorded by individual plant observation.

At 38 DAS, the highest population of Black fungus gnat was recorded in the variety of BARI Jharshim-3 (2.67) and Sylhet local-4 (2.67), which was statistically identical and followed by Sylhet local-6 (2.33). However, the lowest number of Black fungus gnats was found in the variety of Sylhet local -7 (1.67) and BARI Jharshim-2 (1.67), which was

statistically identical and followed by BARI Jharshim-1 (2.00) and Sylhet -5 (2.00) were also statistically identical (Table 1).

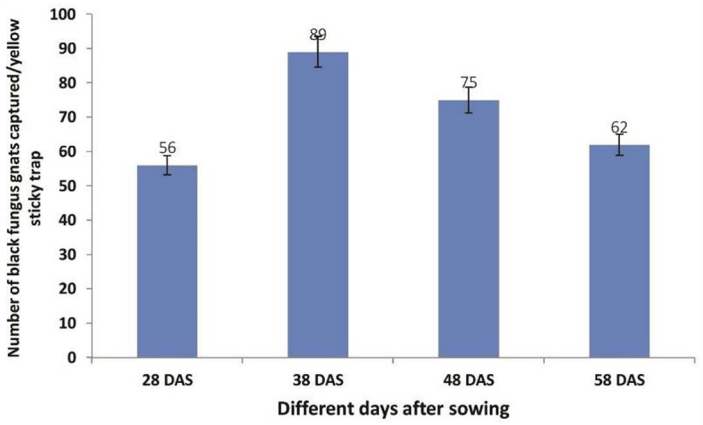

Fig. 3. Number of black fungus gnats captured by yellow sticky trap on different days after sowing (DAS) in Narsingdi

At 48 DAS, the highest population of Black fungus gnat was recorded in the variety of BARI Jharshim-3 (4.33) followed by BARI Jharshim-2 (4.00), BARI Jharshim-1 (3.33) and Sylhet local-6 (3.33). Here BARI Jharshim-1 and Sylhet local-6 were statistically identical. However, the lowest number of Black fungus gnats was found in the variety of Sylhet local-7 (2.67) followed by Sylhet local-4 (3.00) and Sylhet local-5 (3.00), which was also statistically identical (Table 1).

At 58 DAS, significantly the highest population of Black fungus gnat was recorded in the variety of BARI Jharshim-3 (7.67) followed by Sylhet local-6 (5.00), BARI Jharshim-1 (4.33) and BARI Jharshim-2 (4.33). Here BARI Jharshim-1 and BARI Jharshim-2 were statistically identical. However, the lowest number of Black fungus gnats was found in the variety of Sylhet local-5 (3.33) and Sylhet local-7 (3.33), followed by Sylhet local-4 (3.67). Here Sylhet local-5 and Sylhet local-7 were similar (Table 1).

From the mean of all varieties regarding the Black fungus gnat population, it was evident that the variety BARI Jharshim-3 had the highest population of Black fungus gnats, followed by BARI Jharshim-2 and Sylhet local-6, which indicated that these varieties were highly susceptible to Black fungus gnat. On the other hand, Sylhet local-7 had the lowest population of black fungus gnats, followed by Sylhet local-5, Sylhet local-4, and BARI Jharshim-1, which indicated that these varieties were less susceptible to black fungus gnats. Among all tested varieties, none showed complete resistance against black

fungus gnat. However, Sylhet local-5 and Sylhet local-7 showed the least susceptible to black fungus gnats comparatively.

Table 1. Mean number of Black fungus gnats attacking different varieties of French bean on different dates of observation

Varieties Name	Number of Black fungus gnats /plants at different DAS				Mean
	28 DAS	38 DAS	48 DAS	58 DAS	
BARI JARSIM 1	1.00	2.00	3.33	4.33b	2.67
BARI JARSIM 2	1.33	1.67	4.00	4.33b	2.83
BARI JARSIM 3	1.33	2.67	4.33	7.67a	4.00
Sylhet local 4	0.67	2.67	3.00	3.67b	2.50
Sylhet local 5	0.33	2.00	3.00	3.33b	2.33
Sylhet local 6	1.00	2.33	3.33	5.00b	2.76
Sylhet local 7	0.67	1.67	2.67	3.33b	2.26
Level of significance (5%)	NS	NS	NS	*	NS
CV (%)	64.57	31.94	14.14	31.76	26.37

*Significant at 5% level, NS- Non significant. Means within the column followed by the same letter are not significantly different from one another by CD (critical difference) values. Values are average of three replications.

Suggested management strategies for black fungus gnats

Use physical and cultural controls to manage the gnats: Dead stuff and debris must be picked up. Over watering and sloppy irrigation have to be avoided. To kill larvae, allow the soil to dry the maximum amount possible (without damaging plants) between waterings. Greenhouse floors should be dried, weed-free, and well-drained to eliminate breeding larvae.

Avoid problems: don't bring infested plant containers indoors.

Traps: Adult flies can be caught using yellow sticky traps to monitor their population.

Azadirachtin: Apply neem oil @ 5 ml/L of water as a soil drench to effectively control of gnat larvae.

Biological controls: Use biological control agents like nematodes, rove beetles, and mites to regulate fungus gnats. *Bacillus thuringiensis* subspecies *israelensis* is effective against larvae feeding on plants grown in pots. It's toxic for two days and doesn’t kill parturition

adults, so repeat applications are necessary. It's best used as prevention. *Steinernema feltiae* is an insect-killing nematode that may be applied as a drench treatment. The best results come from a primary planting application, followed by 2 to 3 weekly applications. Ineffective when wont to reduce a heavy infestation. A small, soil-dwelling predatory mite, *Hypoaspis miles,* feeds on gnat larvae. It covers the growing media surface at planting. The predatory mites are very effective at low density of gnat populations. It's compatible with *Bt* and *S. feltiae*.

Use chemical measures: Nitro 505 EC @ 1 ml/L of water is incredibly effective in controlling black fungus gnats. Sprays containing pyrethrins control adult fungus gnats. As new adults emerge daily, repeated spraying at few days intervals can reduce gnat populations.

Acknowledgment

The authors are grateful to UGC for providing financial assistance to conduct the survey.

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(Revised copy received on 05.01.2023)