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RESEARCH PAPER

Screening of French bean Varieties against Major Insect Pests

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ABSTRACT

Field screening of nine French bean varieties against major insect pests was conducted in RHRC, Narsingdi during November 2017 to January 2018. Results revealed that among high yielding varieties, BARI Jarsheem-2 (16.17 plant^{-1}) and BARI Jarsheem-1 (17.50 plant^{-1}) were found to have lower whitefly infestations and considered as less susceptible/tolerant to whitefly whereas among Sylhet local varieties, Sylhet local 3 variety (7.25 plant^{-1}) was the least susceptible or most tolerant to whitefly. The highly susceptible varieties to whitefly were BARI Jarsheem-3 (20.92 plant^{-1}) and Sylhet local 4 (14.92 plant^{-1}), respectively. In case of jassid, among high yielding varieties, BARI Jarsheem-1 (3.75 plant^{-5}) was less susceptible/tolerant to jassid and among Sylhet local varieties, Sylhet local 4 (3.00 plant^{-5}) and 3 (2.25 plant^{-5}) varieties were less susceptible or tolerant to jassid. The highly susceptible variety to jassid was BARI Jarsheem-3 (7.25 plant^{-5}). All Sylhet local varieties of French bean had lowest number of leaf beetles/ 5 plants compared to high yielding varieties. Among high yielding varieties, BARI Jarsheem-1 and BARI Jarsheem-2 (3.75 plant^{-5}) and 3.75 plant^{-5}) had lowest number of leaf beetle/ 5 plants indicating less susceptible to leaf beetle compared to BARI Jarsheem-3 (4.75 plant^{-5}). On the basis of yield performance, BARI Jarsheem-2 variety of French bean (1.51 ton ha^{-1}) was the best and BARI Jarsheem-1 was better compared to BARI Jarsheem-3 and all other local varieties.

Key words: BARI Jarsheem, French bean, jassid, leaf beetle, whitefly

Introduction

Legume crops grown for human consumption belongs to the fabaceae (formerly Leguminaceae) family. They are important foods in most tropical and subtropical countries of the world and are second only to cereals as a food source for humans and animals (Graham and Vance, 2003). The French bean, *Phaseolus vulgaris* (Linnaeus) is synonymized as common bean, bush bean, dry bean, dwarf bean, field bean, garden bean, green bean, haricot bean, kidney bean, pole bean, kuthu bean and snap bean. The French bean provides one of the most important sources of protein (Boudoin and Maquet 1999, Arulbalachandran and Mullainathan 2009) and is rich in vitamins, minerals and dietary fibre (Kelly and Scott 1992, Ndegwa et al. 2006). The immature pods of these beans are also an important food source in many locations around the world. French beans have a short growing season of between 50 and 60 days and many of these bean varieties grown in developing countries are introduced from cooler regions (CIAT 1992). It is generally cultivated during kharif season on hills.

However, with the development of new genotypes, the crop has been introduced in northern plains during rabi season also. It is grown by both small and large scale farmers for fresh and processing market. Both biotic and abiotic factors affect the production of crop. Pest and disease problems present major constraints to agricultural productivity of the common bean, particularly in the tropics (Graham and Vance 2003). Worldwide, yield losses due to insect pests alone have been estimated to be from 35% to 100% annually (Singh and Schwartz 2011). Pest incidence is the major factor responsible for yield reduction in French bean. The crop is attacked by a number of insect pests during its life span. Koonee and Chhabra (1980) listed 12 species of defoliators, pod borers, leaf hopper, aphids and stem borer as pests of beans in India. About 30 species of insects have been reported damaging French bean (Srivastava and Butani 1998) including sucking insect pests like, Aphid (*Aphis craccivora* Koch), leafhopper (*Empoasca dolichi*), thrips (*Megalurothrips sijostedti* Trybom), whitefly (*Bemisia tabaci* Gennadius) and mite (*Tetranychus urticae* Koch) are common one.

Chemical control is generally being advocated for the management of insect pests of French bean. Many workers have tried to control this pest with varying degrees of success by frequent application of insecticides as foliar treatments (Chowdhury and Roy 1975). The indiscriminate use of pesticides results in pest outbreaks, environmental pollution and health hazards due to the presence of residues in vegetables. Due to high yield loss caused by insect pests, the deleterious effects of insecticides and the inability of small scale farmers to afford expensive chemical pesticides, there is a need of developing a sustainable strategy for controlling insect pests. The best approach to controlling pest problems in beans is through an integrated pest management system, combining several techniques known to be effective in keeping pest problems to a minimum. The use of resistant varieties is one of several techniques which provide a practical and less costly method of pest control in the French bean. In this study efforts were undertaken to find out the most tolerant varieties of French bean against major insect pests through screening.

Materials and Methods

The study was conducted at the experimental field of Regional Horticulture Research Centre, Shibpur, Narsingdi during the period of November 2017 to January 2018. Nine varieties viz., BARI Jharsheem-1, BARI Jharsheem-2, Sylhet local-1, Sylhet local-2, Sylhet local-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 study was laid out in randomized complete block design with 3 replications. The varieties were planted in 4x 3m plots in double rows with spacing of 20 cm between plants within the row. The rows were 1.5 m apart.

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 plants were not treated with insecticides in order to determine their resistance or susceptibility to insect pests. They were evaluated on the basis of the level of tolerance displayed by their performance in the field. Insect pests observed on the plants were photographed. These photographs were then compared to photographs located through an internet search of the literature on pests of the green gram.

Data on various parameters were taken from 5 randomly selected plants from each plot. Populations of insect pests were recorded at weekly intervals. The number of infested and healthy plants per meter square was counted from each plot of all varieties. The number of infested and healthy of leaves was counted from 5 randomly selected plants and the per cent leaf infestation was determined using the following formula:

$$\% \text{ leaf infestation} = \frac{\text{Number of infested leaves}}{\text{Total number of leaves}} \times 100$$

Results and Discussion

Insect pests observed on French bean

In entire rabi season during November 2017 to January 2018 total 8 insect pests species were recorded (Table 1). Observed insect pests species belong to the orders Coleoptera, Hemiptera and Diptera. The most damaging insect pest of French bean was leaf beetle belong to family Chrysomelidae under order Coleoptera among which three were identified as *Monolepta signata*, *Ceratoma trifurcata* and *Phyllotreta striolata* while other one was unidentified in species level. It fed on cotyledons and leaves by making holes. The black bean aphid (*Aphis fabae* Scopoli) belong to family Aphididae under order Hemiptera caused damage to different plant parts (Leaflet, leaf, branch and pod) of French bean by sucking cell saps. The whitefly, *Bemisia tabaci* Gennadius belong to family Aleyrodidae under order Hemiptera caused damage to leaflets and leaves by sucking cell saps from undersides of trifoliate leaves. Black fungus gnat is a insect that belong to fly family under order Diptera. Fungus gnat larvae do damage plants. They harm seedlings, cuttings, and young plants without fully developed root systems. Both larvae and adults can spread plant pathogens and may promote disease in commercial crops.

Number of whiteflies per plant among varieties on various dates of observation

Figure 1 reveals the lowest number of whiteflies/plant on Sylhet local 1 variety (2.33 plant^{-1}) followed by Sylhet local 2, 3, BARI Jarsheem-2 and BARI Jarsheem-1 while the highest number was on BARI

Table 1. Occurrence of insect pests observed on French bean

Sl . No.	Common name	Scientific name	Family	Order
1	Monolepta leaf beetle	*Monolepta signata*	Chrysomelidae	Coleoptera
2	Striped leaf beetle	*Phyllotreta striolata*	Chrysomelidae	Coleoptera
3	Striped leaf beetle	*Ceratoma trifurcata*	Chrysomelidae	Coleoptera
4	Striped leaf beetle	unidentified	Chrysomelidae	Coleoptera
5	Whitefly	*Bemisia tabaci* Gennadius	Aleyrodidae	Hemiptera
6	Jassid/leafhopper	*Empoasca dolichi*	Cicadellidae	Hemiptera
7	Black fungus gnat	*Bradysia impatiens*	Sciaridae	Diptera
8	Black bean aphid	*Aphis fabae* Scopoli	Aphididae	Hemiptera

Jarsheem-3 (7.33 plant^{-1}) followed by Sylhet local 4 on 12 December 2017. On 19 December 2017, lowest number of whiteflies/plant was recorded on Sylhet local 3 (6.33 plant^{-1}) variety followed by Sylhet local 1 and 2 while the highest number was on BARI Jarsheem-3 (21.67 plant^{-1}) followed by BARI Jarsheem-2, BARI Jarsheem-1 and Sylhet local 4. On 26 December 2017, lowest number of whiteflies/plant was recorded on Sylhet local 3 variety (8.67 plant^{-1}) followed by Sylhet local 2 and 1 while the highest number was on BARI Jarsheem-3 (24.00 plant^{-1}) followed by BARI Jarsheem-1, BARI Jarsheem-2 and Sylhet local 4. Similar trend of whiteflies population on different varieties of French bean was also found on 2nd January 2018. From this figure it was observed that among high yielding varieties, BARI Jarsheem-2 was less susceptible/tolerant to whitefly and among Sylhet local varieties, Sylhet local 3 variety was the least susceptible or most tolerant to whitefly. The highly susceptible varieties to whitefly were BARI Jarsheem-3 and Sylhet local 4, respectively.

Number of jassid among different varieties on various dates of observation

No jassid population was observed on Sylhet local 1 and Sylhet local 3 varieties of French bean while the lowest number of jassid plants^{-5} was recorded in Sylhet local 2, 4 and BARI Jarsheem-1 (1.00 plant^{-5}) while the highest number was on BARI Jarsheem-3 and BARI Jarsheem-2 (2.00 plant^{-5}) on 12 December 2017. On 19 December 2017, similar trend of jassid population on different varieties of French bean was also found. On 26 December 2017, lowest number of jassid/5 plants was recorded on Sylhet local 1 variety, Sylhet local 3 and 4 (3.00 plant^{-5}) while the highest number was on BARI Jarsheem-3 (10.00 plant^{-5}) followed by BARI Jarsheem-2 (6.00 plant^{-5}), BARI Jarsheem-1 (5.00 plant^{-5}) and Sylhet local 2 (4.00 plant^{-5}). On 2nd January 2018, lowest number of jassid/5 plants was recorded on Sylhet local 3 variety (4.00 plant^{-5}) followed by Sylhet local 1, 2 and 4 (5.00 plant^{-5}) while the highest number was on BARI Jarsheem-3 (12.00 plant^{-5}) followed by BARI Jarsheem-2 (8.00 plant^{-5}), and BARI Jarsheem-1 (6.00 plant^{-5}). From this figure it was evident that among high yielding varieties, BARI Jarsheem-1 was less susceptible/tolerant to jassid and among Sylhet local varieties, Sylhet local 4 and 3 varieties were less susceptible or tolerant to jassid. The highly susceptible variety to jassid was BARI Jarsheem-3.

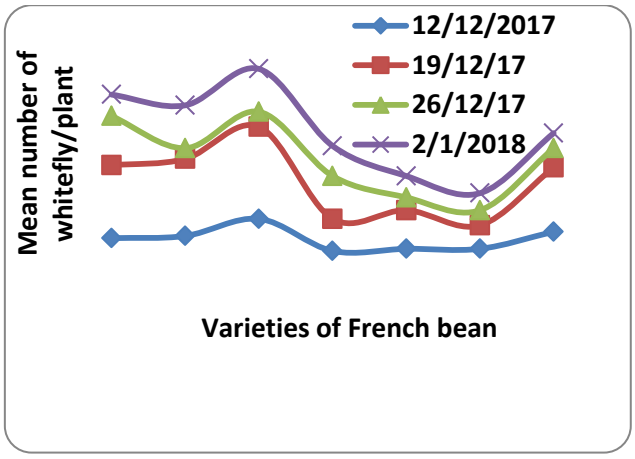

Figure 1. Mean number of whiteflies/plant on various dates of observations among different varieties of French bean

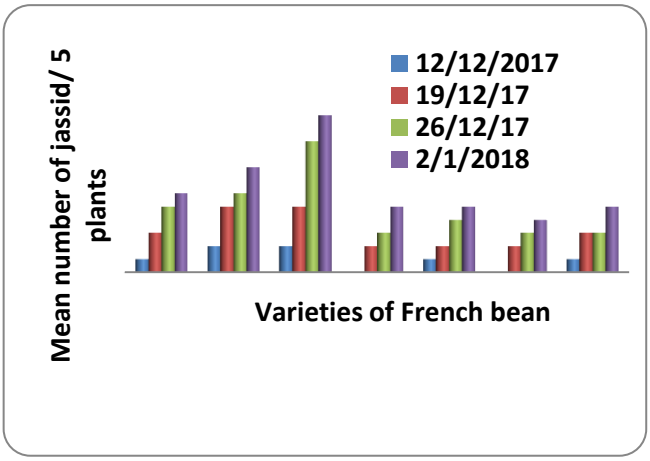

Figure 2. Mean number of jassid/ 5 plant on various dates of observations among different varieties of French bean

Mean number of leaf beetle plant^{-5} on various dates of observations

Figure 3 reveals that all Sylhet local varieties of French bean had lowest number (1.50 to 2.00 plant^{-5}) of leaf beetles plants^{-5} compared to high yielding varieties indicating least susceptible or tolerant to leaf beetle. Among high yielding varieties, BARI Jarsheem-1 and BARI Jarsheem-2 had lowest number of leaf beetle plants^{-5} (3.75 plant^{-5}) indicating less susceptible to leaf beetle compared to BARI Jarsheem-3 (4.75 plant^{-5}) on various dates of observations.

Percentage of infested plants per square meter by leaf beetle

Percentage of infested plants per square meter by leaf beetle on various dates of observations among different varieties of French bean is presented in Figure 4. On 5 December 2017, all varieties had lowest per cent infested plants m^{-2} due to initial stage of leaf beetle attack and lowest number of leaf beetle. On 12 December 2017, Sylhet local 1 variety (0%) had lowest per cent infested plants/m^2 followed by Sylhet local 2 (2.13%), 3 (2.32%) and 4 (2.33%). Among high yielding varieties, lowest per cent infested plants was recoreded on BARI Jarsheem-1 (1.79%) followed by BARI Jarsheem-2 (2.17%) and BARI Jarsheem-3 (2.56%). On 19 December 2017, the percentage of infested plants/m^2 ranged from 90-100% in all varieties except Sylhet local 4 which had the lowest (89.80%). The per cent infestation was increased with increasing plant age or growing period of plant due to taking no plant protection measures.

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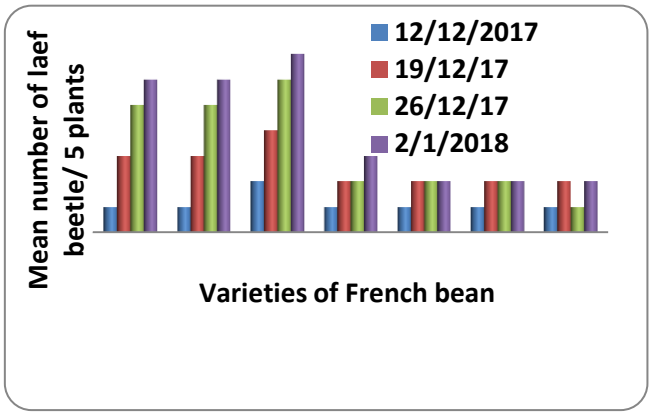

Figure 3. Mean number of leaf beetle/ 5 plant on various dates of observations among different varieties of French bean

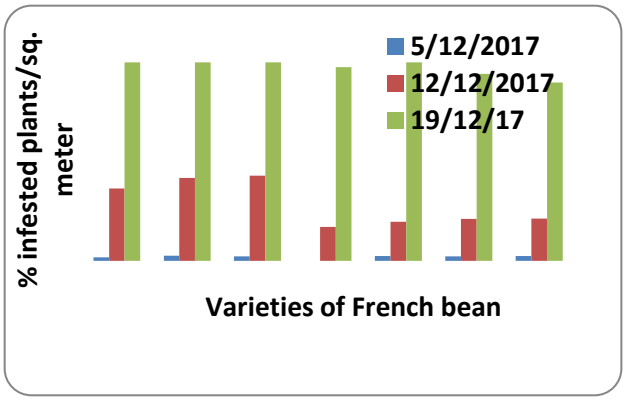

Figure 4. Percenatge of infested plants per square meter by leaf beetle on various dates of observations among different varieties of French bean

Percentage of infested leaflets per plant by leaf or flea beetle

Figure 5 revealed percentage of infested leaflets per plant by flea beetle on different dates of observation among different varieties of french bean. On 12 December 2017, the lowest per cent infested leaflets plant^{-1} was recorded on Sylhet local 4 (31.58%) followed by Sylhet local 2 (38.89%), 3 (38.89%) and 1 (42.12%) while the highest per cent infested leaflet was on BARI Jarsheem-1 (65.00%) followed by BARI Jarsheem-2 and BARI Jarsheem-3 (57.89%). On 19 December 2017, all varieties had 95-100 % infested leaflets/plant. In case of 26th December 2017 and 2nd January 2018, all local and high yielding varieties had 100 per cent infested leaflets plant^{-1}.

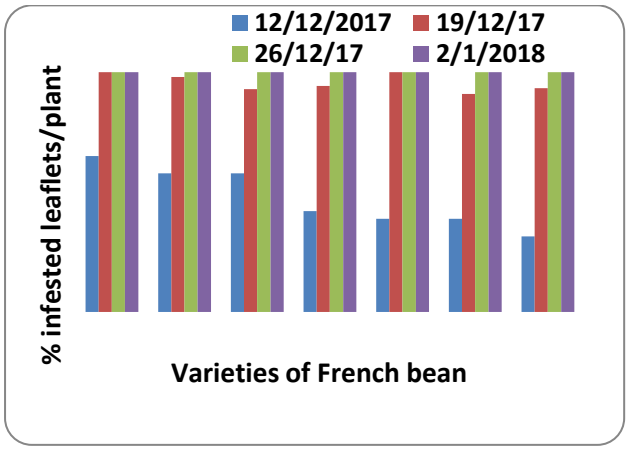

Figure 5. Percentage of infested leaflets per plant by flea beetle on different dates of observation among different varieties of french bean

Yield of different varieties of French bean

Figure 6 revealed that the highest yield per hectare was obtained from variety BARI Jarsheem-2 (1.51 ton ha^{-1}) followed by BARI Jarsheem-1 (1.44 ton ha^{-1}) while the lowest yield ha^{-1} was obtained from Sylhet local 1 (0.19 ton ha^{-1}) followed by Sylhet local 3 (0.22 ton ha^{-1}), 4 (0.23 ton ha^{-1}), 2 (0.31 ton ha^{-1})and BARI Jarsheem-3 (0.42 ton ha^{-1}). On the basis of yield performance, BARI Jarsheem-2 variety of French bean was the best and BARI Jarsheem-1 was better compared to BARI Jarsheem-3.

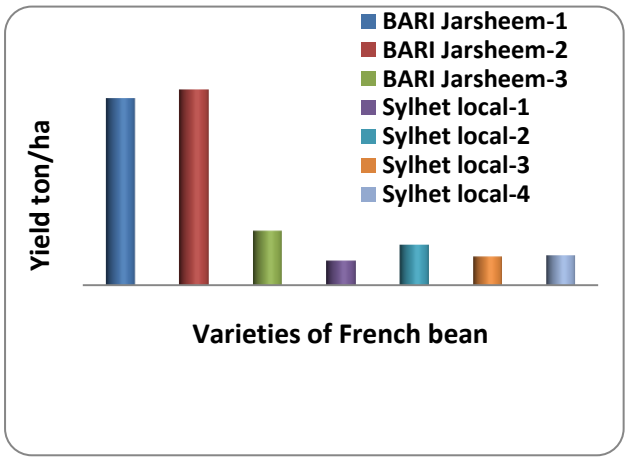

Figure 6. Yield of different varieties of French bean

There was a limited published research articles related to screening of French bean against insect pests. The findings of the present study indicated that no variety was found to free from insect infestation. The severity of infestation by leaf beetle, whitefly, jassid were in agreement with findings described by other authors. Jakhar and Chaudhary (2013) reported that out of ten genotypes screened, R-79 found resistant against aphid, whitefly and thrips, genotypes VL-1 and R-76 showed resistant against leafhoppers and aphid, respectively. Adult bean leaf beetles prefer to eat tender young plant tissue. They feed primarily on the undersides of leaves, creating round, 1/8 inch diameter holes. High populations of adults can defoliate the first true leaves and kill young seedlings. Extensive feeding can reduce the vigor and yields of bean plants. High larval infestation (19 larvae/plant) may reduce the leaf and pod nitrogen content (Lundgren and Riedell, 2008). Adults feed on the above ground parts of the plant such as cotyledons, leaves and pods. Beetles feeding may commence at the leaflet edge or in the middle of the leaflet producing round holes in the tissues between leaf

veins. Whiteflies typically feed on the underside of the leaves. They feed on the sap of plant tissues and are responsible for the transmission of viruses. It only takes a few of these insect vectors to spread the virus. The genus *Bemisia* is important in transmission of crop diseases particularly the bean dwarf mosaic and bean golden mosaic diseases. The severity of the pest infestation depends on location and planting. Richardson (2012) evaluated four green bean varieties for pest and disease tolerance at the Gladstone Road Agricultural Centre and found significant differences among the three surviving varieties with respect to the total number of pods per plant, weight of pods per plant and pod length with proper pest and disease management. One of the varieties succumbed to pest and disease problems. Tolerance to leafhopper feeding damage was considered the pre-dominant mechanism of resistance until oviposition antixenosis was observed in a number of improved lines of beans (Kornegay et al. 1986).

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