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RESEARCH PAPER

Effects of Yellow Sticky Trap and Chemical Insecticides for the Management of Leaf Beetle and Whitefly on French bean

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ABSTRACT

A field experiment was conducted to evaluate the effectiveness of yellow sticky trap and chemical insecticides for the management of leaf beetle and whitefly on French bean during December 2017 to January 2018. Results revealed that the lowest incidence of leaf beetle (0.70) was recorded in plot treated with Nitro 505EC @ 1 ml/L of water (T_2) and the highest incidence of leaf beetle (1.46 to 2.28) was found in untreated control plot (T_7). The percent reduction of leaf beetle over untreated control was higher (63.73%) in the treatment T_2. The lowest percent infested plants per square meter (0.67%) was recorded in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) while the highest percent infested plants per square meter (100.00%) were recorded from untreated control plots (T_7) on 15 January 2018. After 10 days of 1st and 2nd application of treatment, the lowest percent leaflet damage per 5 plants (20.98% and 24.80%, respectively) was recorded in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) followed by T_4 (Bioneem plus 1 EC @ 1 ml/L of water) treated plot (24.17% and 34.45%, respectively) while the highest percent leaflet damage (100.00%) was recorded from untreated control plot (T_7). No leaflet area damage was observed in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) and the lowest percent leaflet area damage (8.67%) was observed in plot treated with T_4 and the highest percent leaflet area damage (11.33% to 26.67%) was recorded from untreated control plots (T_7) on 26 December 2017, 5 and 15 January 2018. Considering the mean number of whitefly of all the periods, the lowest incidence of whitefly (0.79) was recorded in T_4 treated plot and highest incidence (3.27) was in untreated control plots (T_7).The percent reduction of whitefly over untreated control was highest (75.84%) in the treatment T_4. In conclusion, Nitro 505 EC @ 1 ml/L of water was found to be the most effective for chemical control of leaf beetle and Bioneem plus 1 EC @ 1 ml/L of water was the most effective for chemical control of whitefly on French bean.

Key words: French bean, leaf beetle, whitefly, yellow sticky trap, insecticides

Introduction

The common bean or French bean (*Phaseolus vulgaris* L.) is an important food and cash crop in Africa. It is also known 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. Despite its importance, common bean yields in parts of Africa have dropped in the last ten years by as much as 50 percent. This decline is attributed to low soil fertility, poor crop management, diseases and high incidences of insect pests. Key among the major insect pests of beans are the stem maggot (*Ophiomyia* spp), and the black bean aphid (*Aphis fabae*) accounting for yield losses ranging from 8 to 100% and 37 to 90%, respectively (Ochilo and Nyamasyo, 2011), In Bangladesh, bean leaf beetle and whitefly has become serious threat to French bean cultivation in Sylhet and Chittagong regions. 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. Bean leaf beetle is also a very efficient vector of Bean pod mottle virus, a widespread virus of soybean in the south and southeastern United States with recent expansion into the north central region of the country (Hadi *et al.*, 2012). There are more than 1500 species of whitefly

(Lohr and Michalik, 1995). They 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. To overcome the insect pest problems of beans, insecticides were and are still used. Pesticides including cypermethrin, carbaryl and karate are useful and have shown efficacy on controlling the pest (Kapeya et al., 2005). Use of conventional insecticides for pest management is the most frequently used method to suppress insect pests of French beans in Kenya (Wambua, 2004; Pest Control products Board, 2014). Some of the commonly used insecticides to control thrips, aphids and whiteflies include synthetic pyrethrins, carbamates, neonicotinoids and benzourea based insecticides (Kasina, 2003; Misheck, 2011; Pest Control products Board, 2014).

The control of aphids, jassid and whitefly in Bangladesh is principally carried out by the conventional use of insecticides. 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). Synthetic pesticides are reported to be effective, reliable against a wide range of insect pests, quick acting and easy tested for new insect pests. In spite of the usefulness and effectiveness, synthetic pesticide have limited distribution in rural areas, often adultered or applied at inappropriate application rate due to illiteracy, poor labeling or use of old, expired products and lead to rapid evolution of pesticide resistance (Stuart, 2003). It is also difficult to emphasize the effectiveness of particular synthetic insecticides out of many commercially available ones against a certain insect pest. These chemicals should be applied at appropriate dose and at right time against the target pests. For controlling the pests successfully and to save biological agents, judicious application of insecticides is very essential. Considering the facts, the present study was undertaken to evaluate yellow sticky trap and chemical insecticides that are affordable to find out suitable control tactics against leaf beetle and whitefly of French bean.

Materials and Methods

A field experiment was conducted for the management of leaf beetle and whitefly of French bean during December 2017 to January 2018 at Regional Horticulture Research Centre, Shibpur, Narsingdi. Variety BARI Jharsheem-2 was used as study material. There were seven treatments including untreated control viz., T_1 = Yellow sticky trap, T_2 = Nitro 505 EC @ 1 ml/L of water, T_3 = Voliam Flexi 300SC @ 0.5 ml/L of water, T_4 = Bioneem plus 1 EC @ 1 ml/L of water, T_5 = Admire 200SL @ 0.5 ml/L of water, T_6 = Tafgor 40EC @ 2 ml/L of water and T_7 = untreated control. The seeds of French bean were collected from Pulse research Centre, BARI, Joydebpur, Gazipur. Insecticides were procured from the local market. 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 having 1 m space between the blocks and each block was again sub-divided into 7 plots (4x 3m plots) as treatment plots having space 0.5 m between plots. The seeds were sown on 15 November 2017 in plots in double rows with 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 plants were treated with insecticides using Knapsack sprayer and spray materials were applied uniformly for complete coverage of each plant. Precaution was taken to avoid any drift of the spray mixture to the adjacent plot during spraying.
Data on various parameters were taken from 5 randomly selected plants from each plot. Populations of leaf beetle and whitefly were recorded at 10 days intervals. The number of infested and healthy plants per meter square was counted from each plot. The number of infested and healthy of leaves was counted from 5 randomly selected plants and the per cent leaf area damaged by leaf beetle was measured by eye estimation. The percent plant or leaf infestation per sq. meter was determined using the following formula:

$$\% \text{ P/L infestation} = \frac{\text{Number of infested P/L}}{\text{Total number of P/L}} \times 100$$

Where, P/L means plant or leaves

Post treatment data on the number of leaf beetle and whitefly were recorded 1 day after spraying.

$$\% \text{ Insect infestation reduction over control} = \frac{C - T}{C} \times 100$$

Where, C: Mean value of control; T: mean value of the treatment

Data were analyzed statistically using WASP software and means were separated by CD (Critical difference) values.

Results and Discussion

Effect of different treatments on the incidence of leaf beetle

Different treatments had a significant effect on the incidence of leaf beetle on French bean (Table 1). Incidence of leaf beetle in different treatments indicated ranged from 0.70 to 1.88 compared to 1.46 to 2.28 in untreated control. The lowest incidence of leaf beetle ($0.70/m^2$) on different dates of observations was recorded in the plot treated with Nitro 505EC @ 1 ml/L of water (T_2) which was statistically identical to

Bioneem plus 1 EC @ 1 ml/L of water (T_4) treated plot (0.70) followed by T_3 (Voliam Flexi 300SC @ 0.5 ml/L of water) treated plot (0.88 to 1.46). The highest incidence of leaf beetle (1.46 to 2.28) was found in untreated control plot (T_7) which was statistically similar to T_1 (Yellow sticky trap) on 16 and 26 December but significantly different from all other treatments. Considering the mean number of leaf beetle/m^2 of all the periods, the lowest incidence of leaf beetle was recorded in T_2 (0.70) which was statistically identical to T_4 (0.70) which were followed by T_3 (1.19), T_6 (1.31) and T_5 (1.32). The percent reduction of leaf beetle over untreated control was higher (63.73%) in the treatment T_2 which was identical to T_4 (Table 1).

Percentage of plant infestation per square meter by leaf beetle

Figure 1 reveals the percentage of plant infestation per square meter by leaf beetle after application of different treatments at various dates of observations. On 16 and 26 December 2017, 100 % infested plants were observed in all the treated plots which were damaged prior to treatment application. On 5 January 2018, the lowest percent infested plants was recorded in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) followed by T_4 while the highest percent infested plants were recorded from untreated control plots (T_7) followed by yellow sticky trap (T_1) stetted plot, T_5, T_6 and T_3 treated plots. On 15 January 2018, no new infestation was observed in Nitro 505 EC @ 1 ml/L of water (T_2) treated plot and the lowest percent infested plants was recorded in plot treated with Bioneem plus 1 EC @ 1 ml/L of water (T4) followed by T3 (Voliam Flexi 300SC @ 0.5 ml/L of water) while the highest percent infested plants were recorded from untreated control plots (T_7) followed by yellow sticky trap (T_1) stetted plot, T_5, and T_6 treated plots.

Table 1. Effect of different treatments on the incidence of leaf beetle on various dates of observations

Treatments	Mean number of leaf beetle on				Mean	Reduction over untreated control (%)
	16.12.2017	26.12.2017	05.01.2018	15.01.2018		
T_1	1.46a	1.58a	1.77b	1.88b	1.68b	12.95
T_2	0.70b	0.70c	0.70d	0.70d	0.70d	63.73
T_3	0.88b	1.05b	1.35c	1.46c	1.19c	38.34
T_4	0.70b	0.70c	0.70d	0.70d	0.70d	63.73
T_5	1.05ab	1.18b	1.46c	1.58c	1.32c	31.61
T_6	0.99ab	1.23b	1.46c	1.56c	1.31c	32.12
T_7	1.46a	1.77a	2.20a	2.28a	1.93a	-
CD (5 %)	0.506	0.324	0.293	0.264	0.219	
CV (%)	27.52	15.84	12.16	10.32	11.45	

Means followed by a common letter are not significantly different by CD values (P=0.05)
T_1 = Yellow sticky trap, T_2 = Nitro 505EC @ 1 ml/L of water, T_3 = Voliam Flexi 300SC @ 0.5 ml/L of water, T_4 = Bioneem plus 1 EC @ 1 ml/L of water, T_5 = Admire 200SL @ 0.5 ml/L of water, T_6 = Tafgor 40EC @ 2 ml/L of water and T_7 = untreated control.

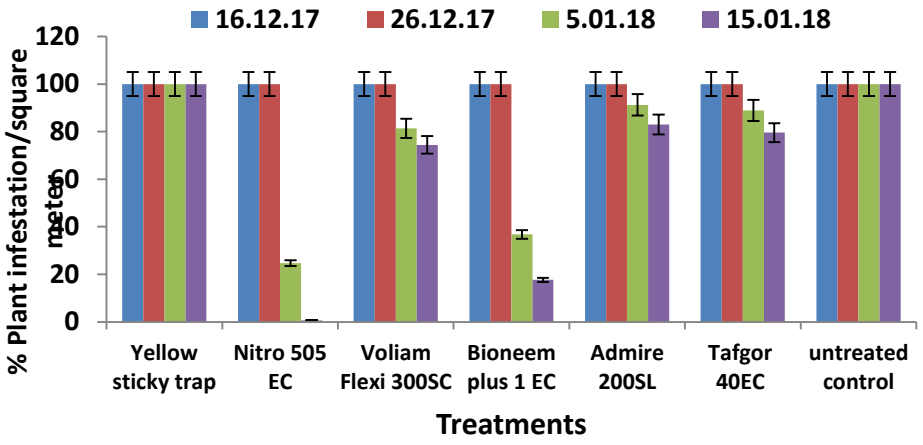

Figure 1. Percentage of plant infestation per square meter by leaf beetle after application of treatments

Percentage of leaflet damage by leaf beetle

The percentage of leaflet damage per 5 plants by leaf beetle after 10 days of 1st and 2nd application of treatments is presented in Fig. 2. After 10 days of 1st application of treatment, the lowest percent leaflet damage per 5 plants was recorded in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) followed by T_4 (Bioneem plus 1 EC @ 1 ml/L of water) treated plot

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while the highest percent leaflet damage was recorded from untreated control plot (T_7) followed by T_5, T_6, T_1 and T_3 treated plots. Similar trends were also observed after 10 days of 2nd application of treatment.

Leaflet area damage per leaf by leaf beetle

Figure 3 reveals the percentage of leaflet area damage per leaf by leaf beetle after application of treatments. On 16 December 2017, all treatments including untreated control had lowest percent leaflet area damage by leaf beetle at initial stage of infestation and treatment application. On 26 December 2017, no leaflet area damage was observed in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) and the lowest percent leaflet area damage was found in plot treated with Voliam Flexi 300SC @ 0.5 ml/L of water (T_3) followed by T_4 (Bioneem plus 1 EC @ 1 ml/L of water) treated plot. The highest percent leaflet area damage was observed in untreated control plot followed by T_1, T_5 and T_6. On 5 January 2018, no leaflet area damage was observed in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) and the lowest percent leaflet area damage was observed in plot treated with T_4 followed by T3 and T5 while the highest percent leaflet area damage was recorded from untreated control plots (T_7) followed by yellow sticky trap (T_1) stetted plot and T_6. Similar trends of leaflet area damage as 5 January were also observed on 15 January 2018.

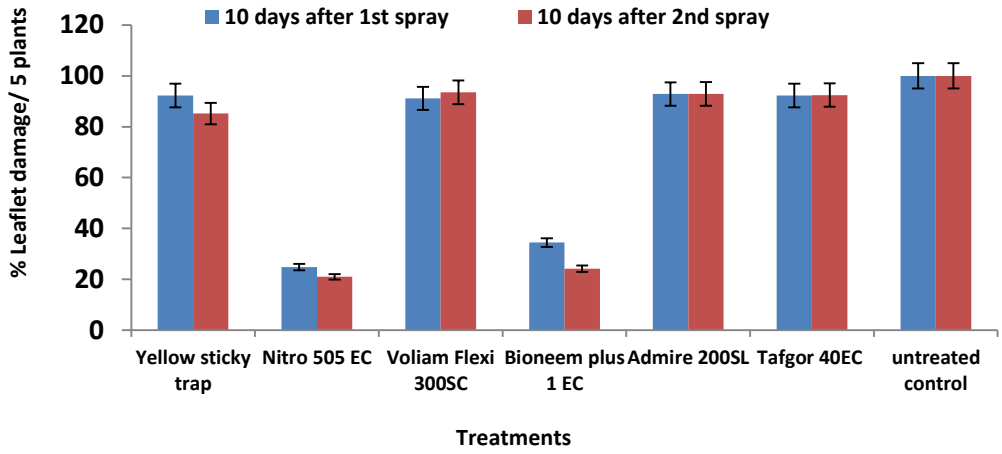

Figure 2. Percentage of leaflet damage per 5 plants by leaf beetle at 10 days after 1st and 2nd application of treatments

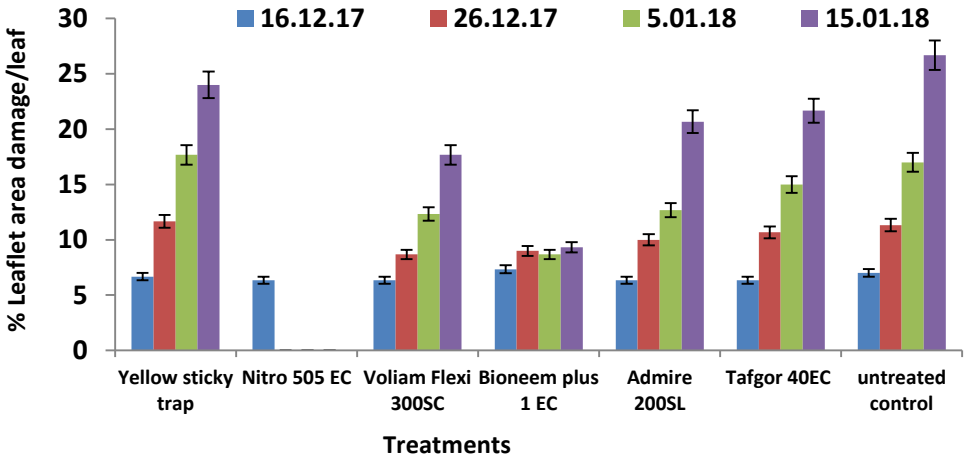

Figure 3. Percentage of leaflet area damage per leaf by leaf beetle after application of treatments

Effect of different treatments on the incidence of whitefly

Incidence of whitefly in the experimental field of French bean had significantly influenced due to different treatment application on various dates of observations except on 16 December 2017 in this period no significant difference was found among treatments (Table 2). On 26 December 2017, the lowest number of whitefly (0.70) was recorded in plot treated with Bioneem plus 1 EC @ 1 ml/L of water (T_4) followed by T_6 (1.05) and T_2 (1.35) while the highest number of whitefly (2.97) was recorded in untreated control plot (T_7) followed by T_1 (2.11), T_3 (1.86) and T_5 (1.68). On 5 January 2018, the lowest incidence of whitefly was observed in plot treated with Nitro 505 EC @ 1 ml/L of water (T_2) which was statistically identical to T_4 and T_6 followed by T_5, T_3 and T_1 while the highest incidence (3.66) was recorded in untreated control plot (T_7). Similar trends of incidence were also observed among different treatments on 15 January 2018. Considering the mean number of whitefly of all the periods, the lowest incidence of whitefly was recorded in T_4 (0.79) followed by T_6 (0.95) and T_2 (1.03). The percent reduction of whitefly over untreated control was highest (75.84%) in the treatment T_4 which was followed by T_6 (70.95%) and T_2 (68.50%) (Table 2).

The efficacy of different treatments of this experiment are in conformity with the reports of Wambua (2004) and Pest Control Products Board (2014) where they reported that use of conventional insecticides is the most frequently used method to suppress insect pests of french beans in Kenya. Roy et al. (2014) conducted an experiment to study the efficacy of some insecticides against whitefly and aphid insect pests of French bean. They found that Chlorpyriphos 20EC @ 3 ml/l of water performed best to suppress the whitefly and aphid of French bean followed by Foratap 50SP @ 3g/l of water. They also reported that lowest infested fruits, highest total healthy fruit yield and highest gross return were obtained by the application of Chlorpyriphos. Variations in the incidence by number and in terms of percent reduction of whitefly over control as influenced by different treatment application has also similarity with the findings of Raja (2005) and Eapen (1994). The use of yellow sticky trap had no significant effect on the population reduction of whitefly on French bean. This result is in agreement with the findings of Yaobin et al (2012) who reported that the yellow traps did not have a significant impact on the population dynamics of adult and immature potato whiteflies.

From the findings of the present study it may be concluded that Nitro 505 EC @ 1 ml/L of water was found the most effective for chemical control of leaf beetle and Bioneem plus 1 EC @ 1 ml/L of water was the most effective for chemical control of whitefly on French bean.

Table 2. Effect of different treatments on the incidence of whitefly on various dates of observations

Treatments	Mean number of whitefly on				Mean	Reduction over untreated control (%)
	16.12.2017	26.12.2017	05.01.2018	15.01.2018		
T_1	1.46	2.11b	1.94b	1.46c	1.75b	46.48
T_2	1.35	1.35de	0.70c	0.70d	1.03bcd	68.50
T_3	1.35	1.86bc	1.86b	1.56c	1.66bc	49.24
T_4	1.05	0.70f	0.70c	0.70d	0.79d	75.84
T_5	1.56	1.68cd	1.77b	1.86b	1.72bc	47.40
T_6	1.35	1.05ef	0.70c	0.70d	0.95cd	70.95
T_7	1.84	2.97a	3.66a	4.60a	3.27a	-
CD (5 %)	NS	0.376	0.350	0.272	0.790	
CV (%)	19.55	12.59	12.16	9.31	33.60	

Means followed by a common letter are not significantly different by CD values (P=0.05)

T_1 = Yellow sticky trap, T_2 = Nitro 505 EC @ 1 ml/L of water, T_3 = Voliam Flexi 300SC @ 0.5 ml/L of water, T_4 = Bioneem plus 1 EC @ 1 ml/L of water, T_5 = Admire 200SL @ 0.5 ml/L of water, T_6 = Tafgor 40EC @ 2 ml/L of water and T_7 = untreated control.

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