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Management of yellow mosaic virus disease using insecticides and biopesticides in mungbean

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Abstract
The field experiments were conducted during *Kharif* 2014 and 2015 at Agricultural Research Farm, Banaras Hindu University, Varanasi, U.P. to determine the effectiveness of some insecticides and biopesticides against Mung bean yellow mosaic virus (MYMV) in Mung bean. The results revealed that lowest incidence of MYMV disease was recorded from T_2-Imidacloprid 50 g a.i./ha followed by T_5-Acetamiprid 20 g a.i./ha, T_4-Fipronil 100 g a.i./ha and maximum from T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L. The maximum percent protection of MYMV over control was recorded from T_2-Imidacloprid 50 g a.i./ha (83.55%) followed by T_5-Acetamiprid 20 g a.i./ha (75.04%), T_4-Fipronil 100 g a.i./ha (65.09%) and minimum in T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (9.79%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (14.50%).

Keywords: MYMV, insecticides, biopesticides, Mung bean

1. Introduction
Green gram or mungbean, *Vigna radiata* (L.) Wilczek is a major legume crop grown widely in the South and Southeast Asia, mostly on small-scale family-owned farms. It is native to India-Burma region of South-East Asia. This low input, short duration crop is prized for its seeds, which are high in protein, easily digested, and consumed as food. It is an important source of dietary protein, especially in Indian subcontinent where consumption of animal protein is very low. Since mungbean is grown mainly in the tropical climates, insect pests play an important role in the economic production of the crop [13]. India is the largest producer of green gram and account 3.83 million tones of the world production and covers 1.60 million ha of the world acreage with average productivity 418 kg/ha [1]. The major producing states in India are Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, Orissa, Bihar, Tamil Nadu, Madhya Pradesh and Uttar Pradesh accounting for about 70 percent of total production [1].
The yellow mosaic disease of mungbean is caused by mungbean yellow mosaic begomovirus (MYMV). This disease is important, serious, destructive, wide spread and inflicts heavy loss annually. It was first identified in India in 1955 and is naturally transmitted by whitefly (*Bemisia tabaci* Genn.), but not by mechanical inoculation or by seed [8]. Yellow mosaic disease incidence has been reported as high as 100 percent in susceptible cultivars in farmers' fields. Together in black gram, mung bean and soybean, YMD has been reported to cause an annual yield loss of about US $ 300 million [2, 14, 15]. Various approaches used to control YMD include chemical sprays [5], cultural practices [7, 9], entomopathogenic fungus [10], antibiotics, seed priming [11] and botanicals [12]. Since, YMD is spread by whitefly; its spread can be reduced by controlling the whitefly population. Hence, the present study was aimed at the management of yellow mosaic disease through controlling its vector using insecticides and biopesticides.

2. Materials and Methods
The Present study was conducted during *Kharif* season of 2014 and 2015 at Agricultural Research Farm, Banaras Hindu University, Varanasi, U.P. to test the efficacy of some insecticides and biopesticides viz., T_1–Spinosad 60g a.i./ha (Conserve 45% SC), T_2–Imidacloprid 50g a.i./ha (Confidor 17.8% SL), T_3–Emamectin benzoate 8g a.i./ha (Proclaim 5% SG), T_4–Fipronil 100g a.i./ha (Regent 5% SC), T_5–Acetamiprid 20g a.i./ha (Aceta 20% SP), T_6–*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (Pacer), T_7–*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (Beau Shakti), T_8–*Verticillium lecanii* (1×10^8 Spores/g) 5g/L

(Mealikil) and T_9–NSKE 5% with T_{10}–Control for management of Mungbean Yellow Mosaic Virus disease in Mung bean. The green gram variety HUM 12 was grown in 30cm×10cm spacing in a randomized block design with three replications. The crop was grown under recommended agronomic practices, except plant protection measures. Two sprays of insecticides and biopesticides were done. Spraying was done by using pre-calibrated ASPEE foot sprayer with cone type nozzle. The concentration of insecticides required, on the basis of active ingredient, the desired amount of each insecticide was measured by an electronic balance and micro pipette and subsequently mixed with water (600 L/ha).

MYMV disease incidence was recorded at 60 days after sowing. In each plot, the total numbers of healthy plants, as well as virus-infected plants, were counted separately and the percentage of the infection was calculated. Effect of different insecticides on the incidence of MYMV disease was calculated in terms of Percent protection over control using the following formula.

$$\text{Percent MYMV disease incidence} = \frac{\text{Total number of infested plants}}{\text{Total number of plants}} \times 100$$

$$\text{Percent Protection} = \frac{\text{MYMV disease incidence in control} - \text{MYMV disease incidence in treatment}}{\text{MYMV disease incidence in control}} \times 100$$

3. Results and Discussion

3.1 Effect of insecticides and biopesticides on MYMV disease incidence

The results pertaining the effect of insecticides and biopesticides on incidence of MYMV during *Kharif* 2014 was recorded and presented in Table 1 revealed that minimum MYMV incidence was recorded form T_2-Imidacloprid 50 g a.i./ha (3.52%) followed by T_5-Acetamiprid 20 g a.i./ha (5.33%), T_4-Fipronil 100 g a.i./ha (7.46%) and maximum from T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (19.48%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (18.49%).

The similar trend was observed during *Kharif* 2015 (Table 1) and data indicated that lowest MYMV incidence was recorded form T_2-Imidacloprid 50 g a.i./ha (2.36%) followed by T_5-Acetamiprid 20 g a.i./ha (4.07%), T_4-Fipronil 100 g a.i./ha (7.23%) and highest from T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (18.26%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (16.59%).

The pooled data of both the years indicated that lowest MYMV incidence was recorded in T_2-Imidacloprid 50 g a.i./ha (2.94%) followed by T_5-Acetamiprid 20 g a.i./ha (4.70%), T_4-Fipronil 100 g a.i./ha (7.35%) and highest from T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (18.87%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (17.54%) (Table 1).

3.2 Percent protection in MYMV incidence over control

The data of percent protection of MYMV incidence over control during *Kharif* 2014 (Table 1) indicated that maximum percent protection against MYMV was recorded in T_2-Imidacloprid 50 g a.i./ha (83.55%) followed by T_5-Acetamiprid 20 g a.i./ha (75.04%), T_4-Fipronil 100 g a.i./ha (65.09%) and minimum in T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (9.79%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (14.50%).

The data of percent protection of MYMV incidence over control during *Kharif* 2015 (Table 1) depicted that highest percent protection was observed from T_2-Imidacloprid 50 g a.i./ha (88.34%) followed by T_5-Acetamiprid 20 g a.i./ha (79.96%), T_4-Fipronil 100 g a.i./ha (64.39%) and lowest in T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (10.28%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (18.48%).

The pooled data of both the year of experimentation showed that maximum percent protection was found in T_2-Imidacloprid 50 g a.i./ha (85.95%) followed by T_5-Acetamiprid 20 g a.i./ha (77.50%), T_4-Fipronil 100 g a.i./ha (64.74%), and lowest in T_6-*Metarhizium anisopliae* (1×10^8 Spores/g) 5 g/L (10.04%) followed by T_7-*Beauveria bassiana* (2×10^8 Spores/mL) 2.5 mL/L (16.49%) (Table 1).

Yellow mosaic virus incidence was less in diafenthiuron 50 WP @ 600 g/ha, imidacloprid 70 WG @ 75 g/ha and thiamethoxam 25 WG @ 100 g/ha treatments; compared to the untreated control [4]. Another reports show that insecticides are effective in reducing Yellow Mosaic Virus disease incidence [3, 6].

Table 1: Bioefficacy of certain insecticides and biopesticides against Mungbean Yellow Mosaic Virus disease incidence

Tr. No.	Treatments	Dose	MYMV disease incidence (%)			Percent Protection Over Control		
			2014	2015	Pooled	2014	2015	Pooled
T_1	Spinosad	60g a.i./ha	13.31 (21.39)	10.30 (18.72)	11.80 (20.09)	38.39 (38.29)	49.39 (44.65)	43.89 (41.49)
T_2	Imidacloprid	50g a.i./ha	3.52 (10.81)	2.36 (8.84)	2.94 (9.87)	83.55 (66.07)	88.34 (70.04)	85.95 (67.98)
T_3	Emamectin benzoate	8g a.i./ha	14.49 (22.37)	11.72 (20.02)	13.10 (21.22)	32.53 (34.78)	42.49 (40.68)	37.51 (37.77)
T_4	Fipronil	100g a.i./ha	7.46 (15.85)	7.23 (15.60)	7.35 (15.73)	65.09 (53.78)	64.39 (53.36)	64.74 (53.57)
T_5	Acetamiprid	20g a.i./ha	5.33 (13.35)	4.07 (11.63)	4.70 (12.52)	75.04 (60.03)	79.96 (63.40)	77.50 (61.68)
T_6	*Metarhizium anisopliae* (1×10^8 Spores/g)	5 g/L	19.48 (26.19)	18.26 (25.30)	18.87 (25.75)	9.79 (18.23)	10.28 (18.70)	10.04 (18.47)
T_7	*Beauveria bassiana* (2×10^8 Spores/mL)	2.5 mL/L	18.49 (25.47)	16.59 (24.04)	17.54 (24.76)	14.50 (22.38)	18.48 (25.46)	16.49 (23.96)
T_8	*Verticillium lecanii* (1×10^8 Spores/g)	5g/L.	16.97 (24.33)	14.54 (22.42)	15.76 (23.39)	21.34 (27.51)	28.55 (32.30)	24.94 (29.96)

T_9	NSKE	5%	15.56 (23.23)	12.99 (21.13)	14.28 (22.20)	28.27 (32.12)	36.18 (36.98)	32.23 (34.59)
T_{10}	Control (Water Spray)	-	21.62 (27.71)	20.36 (26.82)	20.99 (27.27)	-	-	-
SEm±			0.69	0.42	0.47	1.82	1.04	1.10
CD (P =0.05)			2.04	1.26	1.38	5.40	3.09	3.26

Figures in the parenthesis are Arcsine transformed values

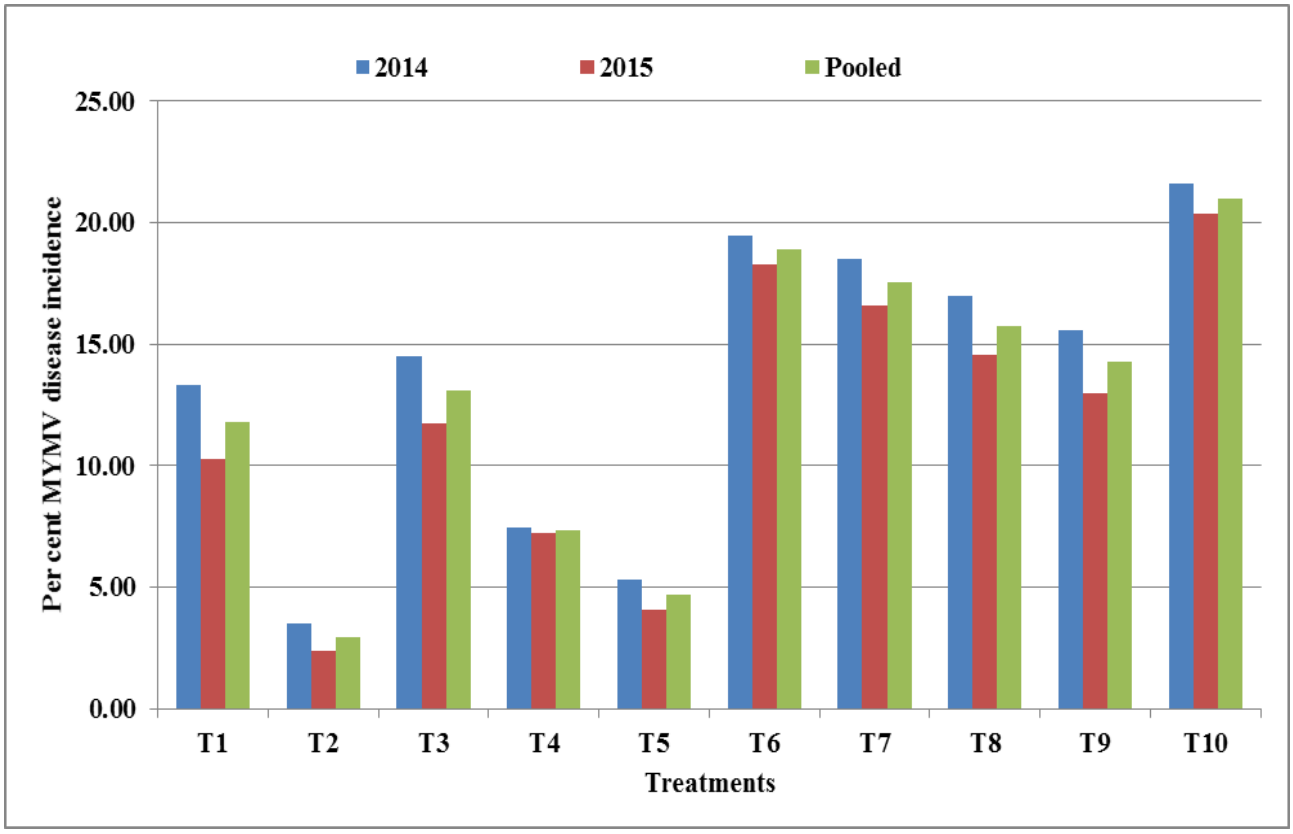

Fig 1: Effect of certain insecticides and biopesticides on the incidence of MYMV disease

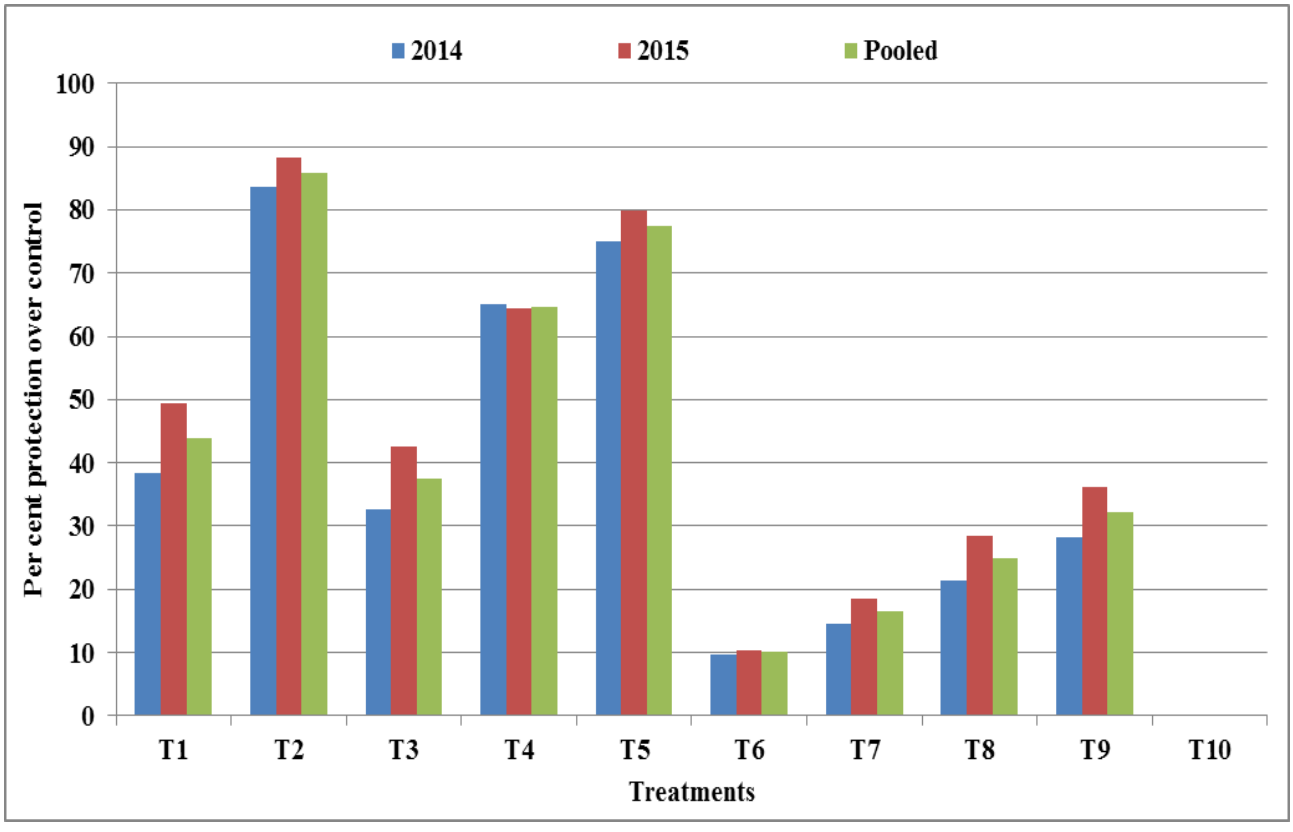

Fig 2: Effect of certain insecticides and biopesticides on the percent protection of incidence of MYMV disease

4. Conclusion

There was a significant impact of insecticides and biopesticides on the incidence of MYMV disease. This may be utilized for the management MYMV disease. Farmers may use Imidacloprid and Acetamiprid for the management of MYMV as a first line of defence.

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