Management of Mungbean Yellow Mosaic Virus (MYMV) disease using chemical insecticides and bio-pesticides

Abstract

Field trials were conducted during 2018-19 and 2019-20 crop seasons to evaluate the efficacy of insecticides and bio-pesticides for the management of Mungbean Yellow Mosaic Virus (MYMV) disease, which is naturally spread by vector whitefly (*Bemisia tabaci*). The mean of two-year data showed that the, lowest disease incidence and the least number of whiteflies were recorded in Imidacloprid (17.8% SL) treated plots. Fifteen days after the 1st spray and 2nd spray of the Imidacloprid (17.8% SL), recorded 17.09% & 18.15% disease incidence, respectively, as compared to control 47.45%. As well as imidacloprid treated plot documented the least number of whiteflies 3.10/plant five days after 1st spray and 3.32/plant five days after 2nd spray as compared to control 7.57 and 7.60 respectively. It also offers maximum reduction of whiteflies 61.75% which consequently resulted in higher grain yield (9.10 q/ha). In bio-pesticides, *Beauveria bassiana* @ 0.5% and Neem Oil @ 3ml/lit, were found to be moderately effective in managing the disease incidence and the population of whiteflies, 22.82 and 25.11 per cent disease incidence recorded at 15 days after first spray and 25.32 and 26.73 per cent at 15 days after second spray.

Keywords: Imidacloprid, *Beauveria bassiana*, Bio-pesticide, Neem and Mungbean

Introduction

Mungbean or green gram (*Vigna radiata* L.) is important pulse crop in India. It is cultivated in tropical and sub-tropical regions of the world. In India it is cultivated throughout the year in an area 4.07 mha and its production is 1.90 mt in year 2017-18 [13]. The highest acreage under the crop and its production are in the States of Rajasthan, MP, Maharashtra and followed by Bihar. The major constraints in the production of mungbean is biotic stress factors like infection with pathogenic fungi, bacteria and viruses. Among which Mungbean yellow mosaic virus (MYMV) is the major constraint in the production of the crop. The disease is spread in nature through the whitefly vector, *Bemisia tabaci* in a persistent (circulative) manner, and by inoculation with sap, this virus disease is responsible for up to 85% or more crop losses in green gram. [2]. Nymphs and adults of *Bemisia tabaci* acquires the virus from diseased leaves and spread the virus to the healthy plants. Higher incidences occur in regions where the temperature ranges between 31 to 35°C with a relative humidity of around 70 percent [16]. These conditions favour disease development and multiplication of the whitefly vector, *Bemisia tabaci* [2,11,12]. *Bemisia tabaci* has potential to develop resistance against different insecticides have been reported by Toscano [18]. Golmohammadi [6] assessed efficacy of imidacloprid was 73.42 ± 3.41 against *B. tabaci* nymphs at 7 days after treatment in Yazd province of Iran. Insecticides are hazardous to the environment. These imposed environmental threats and dangerous for humans and other animals. Imidacloprid 17.8 SL @ 50 g a.i./ha, was found superior against whiteflies [4], it has a mixed reputation regarding its safety to natural enemies of pests [9]. Bio-pesticides is alternate way to restrict the pest resurgence and resistance development due to continuous spread of insecticides. Different bio-pesticides to evaluate their efficacy against this noxious pest.

Biopesticides like *Beauveria bassiana, V. lecanii,* neem, pongam oil exerted potential effect in managing whitefly population in cotton and tomato [5]. Present work, in concern of restrict the natural spread of MYMV disease through the whitefly vector by newer insecticides and biopesticides, were evaluated under prevailing agro-climatic conditions of Jharkhand state.

Material and Method

The experiment was conducted at Holy Cross Krishi Vigyan Kendra (KVK), Hazaribag Demonstration Farm. Field trials were conducted during the years, 2018-2019 and 2019-2020. Field trials were laid out during *Kharif*, 2018-19 and 2019-20 crop seasons in Randomized Block Design, nine chemical insecticides and bio-pesticides as treatments were replicated three times. The variety (SML668) were sown in plots of 3×1.5 m^2 with spacing of 30×10cm^2. For seed priming treatment seeds were overnight pre-soaked in the Pesticide/Bio-agent/Chemical before sowing. The treatments were as follows:

Table 1: List of Chemical and bio-pesticides

S.No.	Trade Name	Chemical name	Dosage
1	Dupont Tm Rekord TM	Acetamiprid	1.5 ml/lit
2	A-One	Imidacloprid	0.25 ml/lit
3	Rogor Plus	Dimethoate	1.5 ml/l
4	Success	Spinosad	0.25%
5	Maxtara	Thiomethoxam	0.5g/lit
6	Daman	*Beauveria bassiana*	0.5 %
7	Vertifire-L	*Verticillium lecani*	0.25ml/l
8	Neem Baan	Neem Oil	3ml/lit
9	Control	-	-

Spraying of insecticides was undertaken at intervals of 25 and 40 days after sowing (DAS) similar worked done by Jayappa et al [10]. The per cent yellow mosaic virus disease incidence was recorded by counting the number of plants infected with the disease at 15 days after 1st spray subsequently 15 days after 2nd spray and the total number of plants in the plot and converted to per cent incidence. The samples were taken to the laboratory and using stereo zoom microscope the live population of nymphs and adults were counted. Data of whitefly population was recorded before and after spraying and taken at 20 DAS, 30 DAS followed by 45 DAS, further disease incidence was recorded at 15 days after 1st spray and 15 days after 2nd spray. The data thus obtained was subjected to ANOVA after using proper transformations. Data were statistically analysed using OPSTAT. Mean value were calculated and compared using F-test at 5% level of significance.

$$\text{Percent disease incidence} = \frac{\text{Number of infected plants in a row}}{\text{Total number of plants in a row}} \text{x } 100$$

Per cent reduction over control was calculated by using formula:

$$\text{Per cent reduction over control} = \frac{\text{No. of whiteflies in control} - \text{No. of whiteflies in treatment}}{\text{No. of whiteflies in control}} \text{x } 100$$

Result and discussion:

Effect of chemical on incidence of MYMV and grain yield of *V. radiata* during, 2018-19 and 2019-20

Results obtained have been presented in Tables 2 and 3, and also depicted in Figure 1 and 2. Out of nine different treatments, two sprays of A-One (Imidacloprid 17.8% SL) on 25 and 40 days after sowing (DAS) were recorded highly efficacious and best for the management of the disease. Mean of two-year data revealed that foliar spray application of Imidacloprid 17.8 SL @ 0.5/lit (T_2) on 25 DAS and 40 DAS recorded higher grain yield (9.10q/ha), lowest disease incidence of MYMV 17.09% and 18.15% respectively, and highest disease reduction over control (61.75%). This treatment was followed by Spinosad 2.5% SC @ 0.5ml/lit (T_4) which recorded disease incidence of MYMV on 25 DAS and 40 DAS 19.32% and 20.18% respectively, disease reduction over control of 57.48%; and grain yield of 8.58q/ha, table 3, figure 2. Mean of two-year data showed lowest disease incidence and least number of whiteflies was recorded in Imidacloprid treated plots 3.10 and 3.32 per plant at 30 DAS and 45 DAS respectively table 2, figure 1. Effectiveness of Imidacloprid 17.8% SL for the management of whitefly and MYMV disease, as it is having nicotinic acetylcholine receptor agonists. Imidacloprid 17.8 SL @ 50 g a.i./ha, was found superior against whiteflies [4]. Similar results have been reported by other workers under different agro-climatic situations (Hossain et al. [7]; Akram & Naimuddin [1]; Jayappa et al. [10]; Islam et al. [8]; Reang et al. [14]).

Effect of bio-pesticide on the incidence of MYMV and grain yield of *V. radiata* during, 2018-19 and 2019-20

Mean of two-year data revealed that foliar spray application of bio-pesticides, *Beauveria bassiana* 2 % WP @ 1.5g/lit (T_6) sprayed plot recorded disease incidence of MYMV 22.82% and 25.11 on 25 DAS and 40 DAS respectively, disease reduction over control of 47.10% and grain yield of 6.80q/ha followed by Neem Baan (Azadiractin 0.15%w/w 1500ppm) (T_8) were found to be moderately effective in managing the disease and whiteflies population recording, 22.82 and 25.11 per cent incidence (T_7) sprayed plot on 25 DAS and 40 DAS respectively, disease reduction over control (43.59%) and grain yield (6.37/ha), table 3, fig. 2. Two sprays of Daman (*Beauveria bassiana*) reduce whitefly counts of 4.19 and 4.32 per plant at 30 DAS and 45 DAS respectively, table 2, figure 1. Efficacies of bio-pesticides in the management of whitefly-borne MYMV, it acts as insect antifeeding and affect fecundity of insects, the azadirachtin-based product can also act as an insect growth regulator by blocking the synthesis and release of moulting hormones leading to incomplete moulting of immature insects. Similar results have also been reported by El Shafie [3], Sharma et al. [15], Sujatha & Bharpoda [17], Reang et al. [14] reported that among the five plant origin products with different doses tested as spray application, Neem Baan (Neem Oil) @ 0.2% showed lowest incidence (10.49%) and severity (9.58%).

Conclusion

Comprehensive analysis of two year's data showed that combination of seed priming/ treatment with A-One (Imidacloprid) 17.8 SL @ 3ml/kg and two foliar sprays of A-One (Imidacloprid) 17.8 SL @ 0.5/lit (T_1) sprayed on 25 DAS and 40 DAS recorded lowest disease incidence of MYMV 15.37% and 17.90%, respectively. Two sprays of Daman *(Beauveria bassiana)* (2% WP@ 1.5 g/L) and *Azadirachtin* oil (0.2%) were efficacious in the management of whitefly vector population build-up.

Table-2: Population of whitefly, *B.tabaci* after the application of chemicals and bio-pesticides which transmitted MYMV in *V. radiata* during 2018-19 & 2019- 20

Treatment		No. of Vector								
		20 (DAS)			30 (DAS)			45 (DAS)		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
1	Dupont Tm Rekord TM (Acetamiprid 20% SP) @0.5g/lit	21.69 (4.71) *	20.20 (4.54)	20.94	4.15 (2.15)	3.73 (2.06)	3.94	4.57 (2.25)	4.17 (2.14)	4.37
2	A-One (Imidaclorpid 17.8% SL) @0.5ml/lit	18.46 (4.35)	17.80 (4.27)	18.13	3.27 (1.94)	2.93 (1.85)	3.10	3.55 (2.01)	3.10 (1.89)	3.32
3	Rogor Plus (Dimethoate 30 % EC) @1.5ml/lit	20.99 (4.63)	19.10 (4.40)	20.04	3.88 (2.09)	3.54 (2.01)	3.71	4.11 (2.15)	4.04 (2.13)	4.07
4	Success (spinosad 2.5 % SC) @0.5 ml/lit	19.21 (4.43)	18.51 (4.36)	18.86	3.31 (1.95)	3.18 (1.91)	3.24	3.75 (2.06)	3.35 (1.96)	3.55
5	Maxtara (Thamethoxam 25% WG) @ 0.5g/lit	22.44 (4.77)	22.78 (4.81)	22.61	4.97 (2.32)	4.31 (2.19)	4.64	5.27 (2.40)	4.67 (2.27)	4.97
6	Daman (Beauveria bassiana 2 % WP) @ 1.5g/lit	23.15 (4.86)	23.81 (4.93)	23.48	4.33 (2.19)	4.06 (2.13)	4.19	4.53 (2.24)	4.11 (2.15)	4.32
7	Vertifire-L (Verticillium lecani 1% WP, CFUI $1X10^8$) @ 1.5 g/lit	25.59 (5.09)	24.59 (5.00)	25.09	6.77 (2.69)	6.09 (2.57)	6.43	6.99 (2.73)	6.59 (2.66)	6.79
8	Neem Baan (Azadiractin 0.15%W/W 1500 ppm) @ 0.2%	24.77 (5.02)	23.77 (4.92)	24.27	6.31 (2.61)	5.95 (2.54)	6.13	6.81 (2.70)	6.01 (2.55)	6.41
9	Control	27.77 (5.30)	28.10 (5.35)	27.93	7.38 (2.80)	7.76 (2.87)	7.57	7.32 (2.78)	7.89 (2.90)	7.60
	SEm±	0.21	0.20	0.205	0.12	0.08	0.1	0.10	0.09	0.09
	CD 5%	0.64	0.61	0.62	0.35	3.73	2.04	0.31	0.28	0.29
	CV %	7.65	7.39	7.52	8.74	7.93	5.83	7.47	7.13	7.3

** Figures in parentheses are square root transformed values*

Table-3: Effect of Chemicals and bio-pesticides on *B. tabaci* which transmitted MYMV in *V. radiata* during, 2018-19 & 2019- 20

Treatments (Brand names of Pesticides)		15 Days after 1st Spray			15 Days after 2nd Spray			% Reduction over control			Yield (q/ha)		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
1	Dupont Tm Rekord TM (Acetamiprid 20% SP) @0.5g/lit	23.06 (28.61)*	22.04 (27.88)	22.55	24.76 (29.75)	23.21 (28.68)	23.98	48.90	50.03	49.46	7.35	7.62	7.48
2	A-One (Imidaclorpid 17.8% SL) @0.5ml/lit	17.55 (24.65)	16.63 (24.05)	17.09	18.70 (25.53)	17.60 (24.76)	18.15	61.41	62.10	61.75	9.04	9.16	9.10
3	Rogor Plus (Dimethoate 30 % EC) @1.5ml/lit	20.75 (27.03)	19.09 (25.86)	19.92	21.51 (27.48)	20.92 (27.21)	21.21	55.61	54.96	55.28	8.13	8.54	8.33
4	Success (spinosad 2.5 % SC) @0.5 ml/lit	19.75 (26.26)	18.90 (25.70)	19.32	20.88 (27.15)	19.48 (26.15)	20.18	56.91	58.06	57.48	8.37	8.80	8.58
5	Maxtara (Thamethoxam 25% WG) @ 0.5g/lit	22.33 (28.15)	21.01 (27.70)	21.67	25.58 (30.36)	22.59 (28.33)	24.08	47.21	51.36	49.28	7.04	7.92	7.48
6	Daman (Beauveria bassiana 2 % WP) @ 1.5g/lit	24.24 (29.49)	21.41 (27.17)	22.82	26.41 (30.91)	23.82 (29.21)	25.11	45.50	48.71	47.10	6.15	7.46	6.80
7	Vertifire-L (Verticillium lecani 1% WP, CFUI $1X10^8$) @ 1.5 g/lit	28.75 (32.42)	25.78 (30.45)	27.26	28.87 (32.46)	26.25 (30.70)	27.56	40.42	43.48	41.95	4.51	5.44	4.97
8	Neem Baan (Azadiractin 0.15%W/W 1500 ppm) @ 0.2%	25.87 (30.48)	24.36 (29.56)	25.11	27.60 (31.65)	25.94 (30.59)	26.77	43.04	44.15	43.59	6.03	6.72	6.37
9	Control	47.88 (43.78)	47.11 (43.34)	47.49	48.46 (44.11)	46.45 (42.96)	47.45	-	-		3.49	4.23	3.86

	SEm±	1.69	1.86	1.77	1.65	1.47	1.56				0.51	0.52	0.51
	CD 5%	5.06	5.56	5.31	4.95	4.41	4.68				1.54	1.56	1.55
	CV %	9.71	11.07	10.39	9.21	8.54	8.87				6.03	6.08	6.05

*****_Figures in parantheses are angular transformed values_, 1st Spray were taken at 25 and 2nd Spray 40 days after sowing.

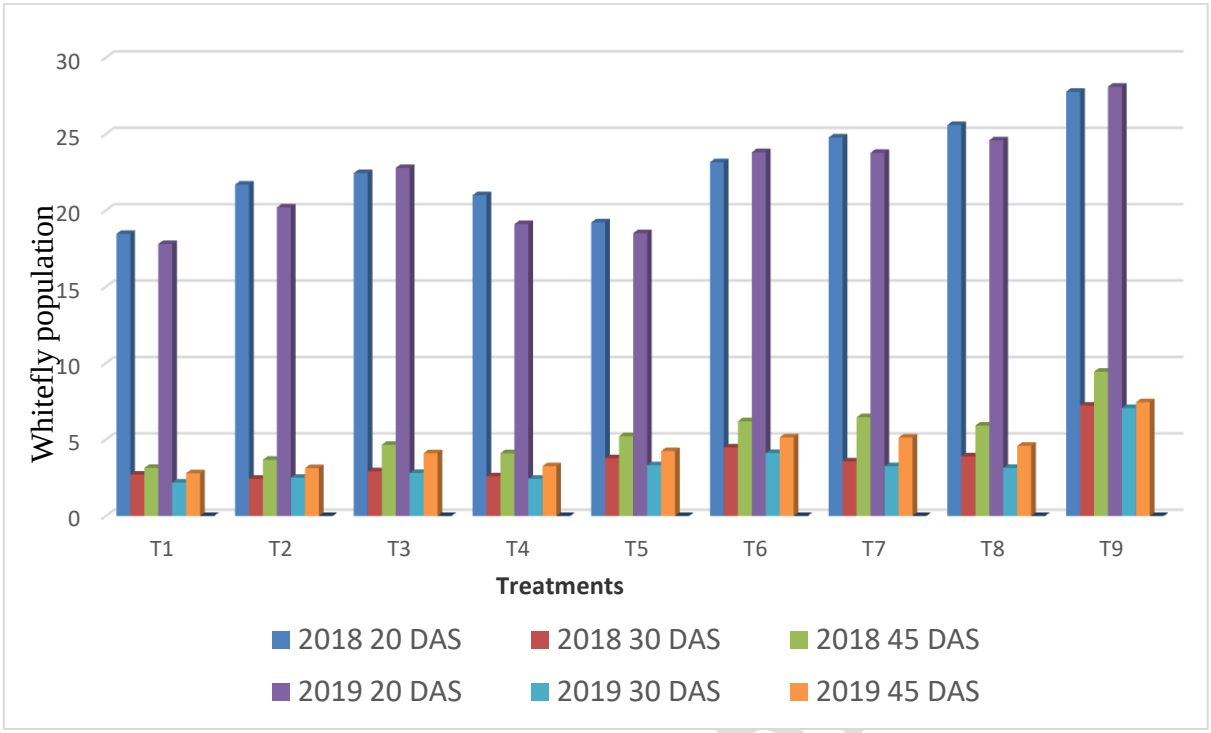

Fig. 1: Population of whitefly, *B. tabaci* in Chemicals and bio-pesticides on management of transmitted MYMV in *V. radiata* during 2018-19 & 2019- 20

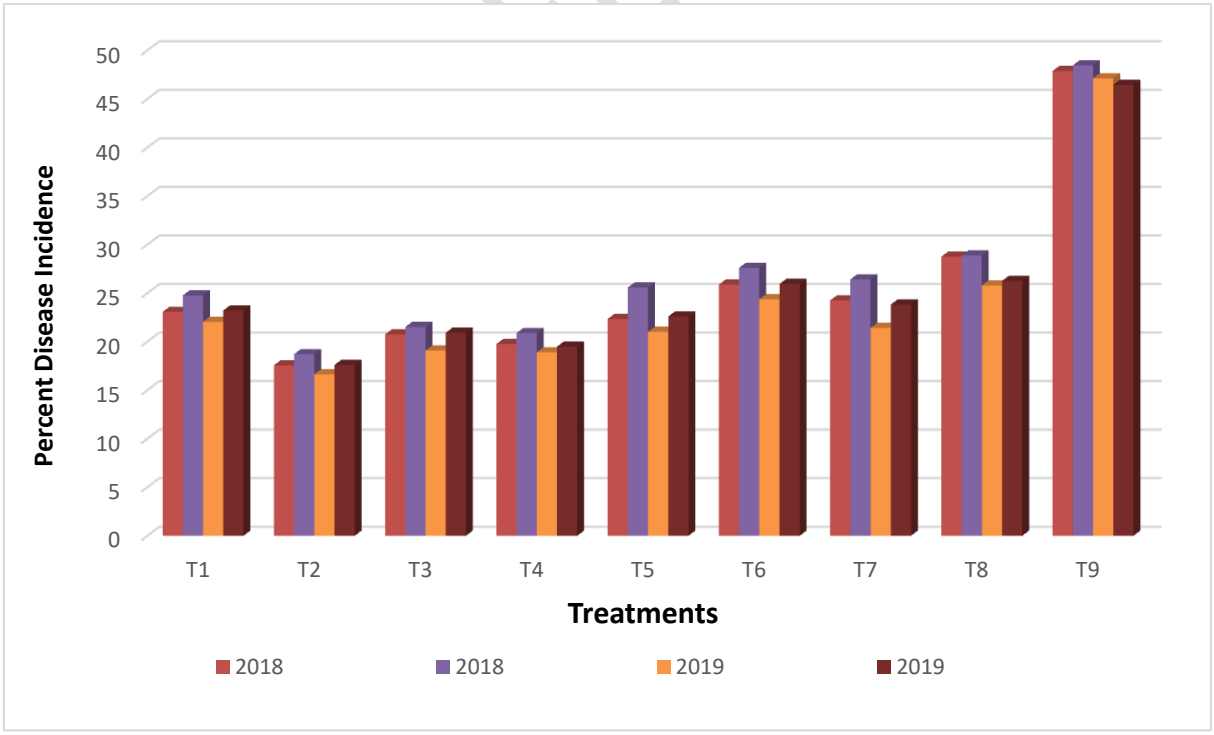

Fig. 2: Effect of Chemicals and bio-pesticides on management of whitefly, *B. tabaci* transmitted MYMV in *V. radiata* during 2018-19 & 2019- 20

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