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RESEARCH PAPER

Field efficacy of commercial botanicals and bioagents against yellow mosaic disease of mungbean

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Abstract: Yellow Mosaic Disease (YMD) caused by *Mungbean yellow mosaic virus* (MYMV) is of key importance especially in South and Southeast Asia. Yield loss due to MYMV ranges from 10- 100 per cent and may even kill the infected plant at vegetative stage. Hence attempt was made to evaluate botanicals and bioagents against MYMV. The experiment was laid out using Randomized Complete Block Design with 11 treatments replicated thrice, Among the different commercial botanicals evaluated for MYMV management, seed treatment with crude neem oil @ 5 ml/kg of seeds followed by foliar spray with multineem (Azadirichtin 0.03%) @ 10 ml/l showed least disease incidence of 7.66 per cent and disease severity of 6.55 per cent with higher seed yield of 7.00 q/ha and Benefit : Cost ratio of 2.57, which was next to standard check treatment (T_{11}). Highest per cent disease incidence of 75.83 per cent and disease severity of 35.85 per cent was observed in treatment with no seed treatment and no spray, which exhibited least seed yield of 2.85 q/ha and B:C ratio of 1.03. Hence commercial neem formulations can be used as effective and eco-friendly option for MYMV management.

Key words: Azadirichtin, Botanicals, Bioagents, Disease incidence, Yield loss

Introduction

Greengram, scientifically known as *Vigna radiata* (L.) is a vital pulse crop that has its origin in India and is primarily cultivated in East Asia and Southeast Asia. It ranks as the third most important self-pollinated, short-duration crop for grain production in India, following chickpea and pigeonpea (Markam *et al*., 2018). Due to its superior nutritional quality, it is often referred to as the "Queen of pulses." Greengram is cultivated in about five m. ha in India with production of three million tonnes and productivity of 601 kg/ha in India. Maharashtra has largest area of greengram followed by Rajasthan, Andhra Pradesh, Karnataka but Maharashtra ranks first in productivity which is followed by Andhra Pradesh, Bihar and Tamil Nadu. In Karnataka it is cultivated in an area of four lakh hectare with production of 1.0 lakh million tonnes and productivity of 346 kg/ha (Anon, 2022).

Disease outbreaks are increasing and threatening food security of the world under changing climatic scenario. Major viral diseases *viz.*, Mungbean Yellow Mosaic Disease, Mungbean Leaf Curl Disease, Leaf Crinkle, Mosaic Mottle Disease and Bud Necrosis in greengram are also threatening food security. Yellow Mosaic Disease is most devastating disease especially in South Asian countries (Mogali *et al*., 2021). MYMV was first reported on greengram by Nariani T. K during 1960 at Indian Agricultural Research Institute (IARI), New Delhi. The symptoms are noticed as small scattered chlorotic specks on the tender leaves which further turn into a mosaic pattern and proceeds with complete yellowing, drying and withering of leaves. Infected plants will bear few flowers and pods. Pods contain some immature and deformed seeds, reducing yield both qualitatively and quantitatively (Balol *et al*., 2023). In severe cases, different plant parts also turn completely yellow. Yellowing of the leaves reduces the photosynthesis efficiency which finally reflects severe yield penalty (Malathi and John, 2009). This disease primarily spreads by the sucking pest *Bemisia tabaci* in a circulative, non-propagative manner but not through seed, soil or mechanically.

Yellow Mosaic Disease (YMD) in pulses is mainly caused by four different viruses namely MYMV, *Dolichos Yellow Mosaic Virus* (DoYMV), MYMIV and *Horsegram Yellow Mosaic Virus* (HgYMV), collectively known as Yellow Mosaic Viruses (YMVs) (Qazi *et al*., 2007; Malathi and John, 2009; Naimuddin *et al*., 2016). The legume-infecting bipartite viruses are also called as legumo viruses (Briddon *et al*., 2010), depending on their genetic characteristics. MYMV results in significant yield loss under severe incidence. The economic losses due to this virus accounts up to 85 per cent in greengram, which is spreading faster towards newer areas (Karthikeyan *et al,* 2014).The management of MYMV involves various strategies, including controlling the vector population through chemical, biological measures and also by utilizing resistant cultivars. Recent studies have shown that certain plant extracts such as neem have antiviral activity and may offer a promising alternative for managing MYMV without harming human health or the environment. Neem (*Azadirachta indica*) is native tree to India that has been used in traditional medicine for centuries. Its extracts contain a complex mixture of bioactive compounds, including azadirachtin, which attributes for its insecticidal properties and nimbin, which shows antiviral activity against a wide number of viruses.Thus keeping in view the importance of MYMV disease and the losses caused, the present study was conducted on the field efficacy of commercial botanicals and bioagents against Yellow Mosaic Disease of Mungbean.

Material and methods

The study was conducted during summer 2023, at Main Agricultural Research Station, University of Agricultural Sciences Dharwad. The experiment was laid out in RCBD with 11 treatments and 3 replications. Seed treatment was done with crude neem oil at 5 ml/kg of seeds which was common for all the treatments except treatments 10 and 11 and boarder row of sorghum was common for all treatments. Different commercial formulations of neem, chilli garlic extract, pongamia oil, salicyclic acid, *Lecanicillium lecani* (Table. 1) were used and control treatment was without any protection and chemical treatment was with protection by chemical insecticides. Observations on per cent disease incidence, per cent disease severity and Coefficient of disease index (CODEX) were recorded on weekly basis and calculated using following formulas given by Wheeler (1969), Singh *et al*. (1988) and Datar and Mayee (1982), respectively. Total seed yield was assessed by bulking the seeds from each plant and weighing them using an electrical balance. The yield was computed in q/ha.

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

$$\text{Percent disease severity} = \frac{\text{Sum of all disease ratings}}{\text{Total number of plants observed} \times \text{maximum disease grade}} \times 100$$

$$\text{CODEX} = \frac{\text{Per cent disease incidence} \times \text{Per cent disease severity}}{100}$$

Results and discussion

Maximum disease incidence of 75.83 per cent was observed in control treatment (T_{10}), whereas least disease incidence of 6.16 per cent was recorded in standard check -T_{11} [Seed treatment with Imidachloprid 600 FS 5 ml/kg of seeds and spray with Thiamethoxam 25% WG 0.3g/l] which was best in comparison with other treatments, followed by T_1 [Seed treatment with crude neem oil @ 5 ml/kg of seeds coupled by spray with multineem (Azadirichtin 300 ppm) @ 10ml/l], which had disease incidence of 7.66 per cent. Whereas T_3 treatment showed disease incidence of 12.00 per cent which was statistically on par with T_6 treatment which exhibited disease incidence of 13.00 per cent. Similarly, the maximum disease severity of 35.85 per cent and CODEX of 27.19 were observed in control treatment (T_{10}) and the least disease severity of 5.15 per cent and CODEX of 0.32 were recorded in standard check (T_{11}) followed by T_1 which performed better with 6.55 per cent disease severity and CODEX of 0.50. Whereas T_3 treatment expressed disease severity of 9.31 per cent and CODEX of 1.12 which was statistically on par with T_6 treatment with disease severity of 10.35 per cent and CODEX of 1.35. (Plate.1 and Fig. 1)

The standard check (T_{11}) produced the highest yield of 7.45 q/ha, resulting in gross returns of 57,737 ₹ /ha, net return of 36,728 ₹ /ha and Benefit : Cost ratio of 2.75 which was followed by T_1 with yield of 7.0 q/ha, gross returns of 54,250 ₹ /ha, net returns of 33,175 ₹ /ha and B:C ratio of 2.57. T_3 and T_6 treatments were on par in terms of yield and B:C ratios. Conversely, the control treatment (T_{10}) had the lowest yield at 2.85 q/ha, with gross returns of 22,101.85 ₹ /ha, net returns of 277 ₹ /ha and B:C ratio of 1.03 (Table 1). The effectiveness of multineem can likely be attributed to the presence of azadirachtin, which serves multiple roles as an antifeedant, repellent and stomach poison for whiteflies, which are the primary vectors of the MYMV. This result underscores the potential of commercial neem formulations like multineem as efficient and eco-friendly alternatives to conventional pesticide use, which can have significant adverse environmental impacts.The research findings are consistent with results of Verma *et al*. (2022), demonstrating the efficacy

Plate.1. Efficacy of crude neem oil seed treatment and multi neem foliar spray in comparison with control treatment.

Plate1

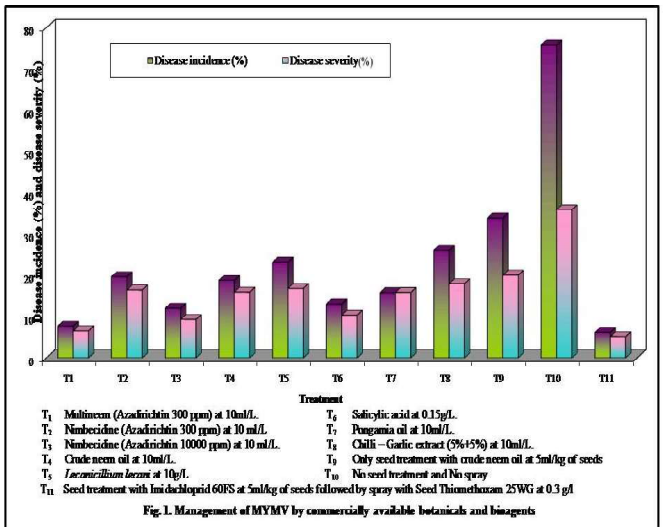

Fig. 1. Management of MYMV by commercially available botanicals and bioagents

Table 1. Efficacy of commercial botanicals and bioagents for management of MYMV

No	Treatments	Disease incidence (%)	Disease severity (%)	CODEX	Seed yield q/ha	Gross returns (₹ /ha)	Cost of cultivation (₹ /ha)	Net returns (₹ /ha)	B:C Ratio
T_1	Multineem (Azadirichtin 300 ppm) @ 10ml/l	7.66 (16.06)*	6.55 (15.65)*	0.50	7.00	54250.00	21075.25	33175.00	2.57
T_2	Nimbecidine (Azadirichtin 300 ppm) @ 10 ml/l	19.67 (26.32)	16.32 (23.82)	3.21	3.08	23881.48	20925.50	2956.25	1.14
T_3	Nimbecidine (Azadirichtin 10000 ppm) @ 10 ml/l	12.00 (20.26)	9.31 (17.76)	1.12	6.98	54163.89	21150.12	33014.50	2.56
T_4	Crude neem oil @ 10ml/l	18.75 (25.65)	15.82 (23.43)	2.97	3.11	24154.17	20825.32	3066.75	1.16
T_5	*Lecanicillium lecani* @ 10g/l	23.16 (28.76)	16.70 (24.12)	3.87	3.02	23430.83	21825.45	2383.50	1.12
T_6	Salicylic acid @ 0.15g/l	13.00 (21.13)	10.35 (18.77)	1.35	4.81	37314.81	21250.25	16065.00	1.76
T_7	Pongamia oil @ 10ml/l	15.71 (23.35)	15.73 (23.37)	2.47	3.66	28416.67	21375.00	7042.35	1.33
T_8	Chilli – Garlic extract (5%+5%) @ 10ml/l	26.08 (30.70)	17.91 (25.04)	4.67	3.00	22675.93	21925.75	2229.45	1.09
T_9	Only seed treatment with crude neem oil @5ml/kg of seeds	33.83 (35.56)	20.04 (26.59)	6.78	2.92	22707.50	20365.25	1851.25	1.07
T_{10}	Control (No seed treatment and No spray).	75.83 (65.55)	35.85 (36.78)	27.19	2.85	22101.85	20325.50	0277.00	1.03
T_{11}	Standard Check (Seed treatment with Imidachloprid 60 FS @ 5ml/kg of seeds followed by spray with Seed Thiomethoxam 25WG @ 0.3 g/l)	6.16 (14.37)	5.15 (13.45)	0.32	7.45	57737.50	21010.75	36728.00	2.75
	S E m ±	1.04	0.36		1.08				
	C. D at 5%	3.07	1.89		3.51				

of biorational treatments such as salicylic acid, sarpagandha leaves extract and neem oil in managing MYMV disease in mungbean. Salicylic acid at 150 mg/l used as seed priming and foliar spray, resulted in the highest yield (5.45 q/ha), lowest disease incidence (32.75%) and maximum disease control (57.27%). Similar results were reported by Mehra *et al*. (2018), emphasizing the effectiveness of nimbecidine @ 300 ppm (5 ml/l) for MYMV management.

Conclusion

The results of present study revealed that crude neem oil as seed treatment combined with multineem spray was found most effective in reducing disease incidence, severity and resulted in higher seed yields and economic benefits. In order to optimize yield with good profit, the obtained result emphasizes the usage of commercial neem formulations like multineem as a effective and eco-friendly alternative to pesticide usage.

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