MANAGEMENT OF YELLOW MOSAIC DISEASE IN SOYBEAN

Abstract

Soybean (*Glycine max* L.) is a highly esteemed crop due to its remarkable protein content of 40 per cent and high-quality oil content of 20 per cent. However, the area and the production of this crop is slightly decelerated due to various reasons and the incidents of pests and diseases are some of them.~~its production potential is consistently hindered by various pests and diseases.~~ Of particular concern is yellow mosaic disease, caused by the mungbean yellow mosaic virus (MYMV) and mungbean yellow mosaic India virus, which are transmitted by the whitefly (*Bemisiatabaci*), posing a significant threat to soybean cultivation worldwide. In the wake of the above, an effort has been made ~~A study was conducted~~ at the Agricultural Research Station (ARS) in Bidar, India, during the summer of 2024 to manage yellow mosaic disease by controlling its vectors. All treatments were found to be significantly superior to the control. Among them, seed treatment with imidacloprid 600 FS and two foliar sprays of flonicamide 50 WG at 0.03 per cent at 20 and 35 days after sowing were found to be the most effective compared to other treatments.

Key words; *Soybean***,** *Mungbean yellow mosaic virus, Mungbean yellow mosaic India virus, Bemisiatabaci, Flonicamide.*

Introduction

Soybean is known as a wonder crop/miracle crop due to its high protein and oil content of 40 and 20 per cent respectively. Soybean is cultivated in countries like USA, Brazil, Argentina and China, which altogether produce 90 to 95 per cent of world soybean as compared to 2.5 per cent share of India (Anon., 2023a). It is cultivated in an area of 136.03 million hectares with an annual production of 369.72 million tonnes ~~with~~ anda productivity of

2720 kg/ha(Anon., 2023a). In India, it occupies an area of 13.00 million hectares with production of 12.04 million tonnes and India occupies an area of 13.00 million hectares with a production of 12.04 million tonnes and productivity of 930 kg ha^{-1} (Anon., 2023b), which is much lower than the global average. Madhya Pradesh, Maharashtra and Rajasthan are the three largest soybean growing states accounting for nearly 95 per cent of the total area. The low productivity of soybean is attributed mainly tobiotic bioticand abiotic stresses. Among the biotic stresses the virus diseases are posing a serious threat to production *viz*., yellow mosaic virus (YMV), soybean mosaic virus (SMV), peanut bud necrosis virus (PBNV), bean pea mottle virus(BPMV), soybean crinkle leaf geminivirusGemini virus, cowpea mild mottle carla virus (CMMV) are the major virus diseases of soybean in India (Lal *et al*., 2005). Among these virus diseasethese virus diseases, The two major viruses that cause yellow mosaic disease (YMD) in legumes are Mungbean yellow mosaic virus (MYMV) and Mungbean yellow mosaic India virus (MYMIV)yellow mosiac disease which is caused by majorly two viruses i.e. mungbean yellow mosaic India virus and mungbean yellow mosaic virus (Bhattacharyya *et al*., 1999). The MYMIV and MYMV are transmitted by whitefly (*Bemisia*tabaci) in a persistent manner (Nair and Wilson, 1969). The present investigation was conducted to manage the yellow mosaic disease by managing the whiteflies through chemical insecticides

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Material and methods

The experiment was carried out during the *summer* 2024 at the Agriculture Research Station (ARS), Bidarin a randomized block design with nine treatments including control in three replications with a 30 x 10 cm spacing. The trial was laid with different treatment and their combination in the field under natural epiphytotic conditions. Recommended agronomic practices were followed. The plots were irrigated during moisture stress and at critical growth stages weeding was done manually twice, the first weeding was done at 15 days after sowing and the second one at 30 days after sowing. Yellow sticky traps were installed in all the treatments except control for the monitoring of whiteflies. A susceptible variety JS-335 was used for the management of the disease. The treatments included the seed treatment with Imidacloprid 600 FS at 5 ml/kg seeds except for the control treatment. Two sprays of the insecticides and botanicals were taken at 20 DAS and 35 DAS. The number of whiteflies on the top three trifoliate leaves per plant from each of five randomly selected plants in each treatment was counted visually and whitefly populations were recorded after two days of spraying. ~~Each treatment, observation on per cent disease incidence was recorded at the vegetative stage, floweringstage and pod filling stagesand observation on yield per plot was recorded during harvesting of the crop and the data was analyzed statistically.~~Observations on percentage disease incidence were recorded at the vegetative, flowering, and pod-filling stages. Yield per plot was noted during crop harvesting, and the data was analyzed with the help of suitable statistical tools and techniques.

Results and Discussion

~~The study evaluated disease incidence, vector population and yield for each treatment.~~The study assessed the incidence of disease, the population of vectors, and the yield for each treatment.~~The maximum whitefly population was seen in control plot (T9) with average population of 8.3 per plant followed by treatment including only seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky traps with an average whitefly population of 7.3 per plant.~~The highest population of whiteflies was observed in the control plot (T9), which had an average of 8.3 whiteflies per plant. This was followed by the treatment that involved only seed treatment with imidacloprid 600 FS at a concentration of 5 ml per kg of seed, resulting in an average whitefly population of 7.3 per plant when using yellow sticky traps. The minimum whitefly population was observed in treatment (T4)Seed treatment with imidacloprid 600 FS at 5ml/kg seed followed by yellow sticky trap followed by foliar sprayof spray offlonicamide 50 WG at 0.03 per cent with mean whitefly population was 3.0 per plant (Table 1.& Plate 1.).

The disease incidence varied from treatment to treatment and maximum disease incidence was seen in control (T9) with 93.01 per cent disease incidence which is followed by seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap (T1) with 59.93 per cent disease incidence and least disease incidence was observed in seed treatment by imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of flonicamide 50 WG at 0.03 per cent (T4) with disease incidence of 26 per cent.The incidence of disease varied across different treatments. The highest disease incidence was observed in the control group (T9), which recorded 93.01%. This was followed by the seed treatment with imidacloprid 600 FS at a concentration of 5 ml/kg of seed, resulting in a disease incidence of 59.93%. The lowest disease incidence was noted with the same seed treatment using imidacloprid 600 FS at 5 ml/kg, in combination with yellow sticky traps and a foliar spray of flonicamide 50 WG at 0.03%. This treatment resulted in a disease incidence of 26%.

The maximum yield was recorded in treatment involving seed treatment by imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of flonicamide 50 WG at 0.03 per cent after sowing with a mean yield of 15.07 q/ha followed by treatment (T8) which includes imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trapfollowed by foliar spray of afidopyropen 50 g/l DC at 0.2 per cent with a mean yield of 13.8 q/ha and minimum yield was recorded in control plot with a mean yield of 3.24 q/ha.

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Seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of flonicamide50 WG at 0.03 per cent (T4) had shown minimum disease incidence of 26 per cent, least mean whitefly population (3.0 whiteflies/plant) and recorded significantly maximum yield of 15.07 q/ha which was on par with seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of afidopyropen 50 g/l DC at 0.2 per cent (T8) with disease incidence of 29 per cent, mean whitefly population of 3.3 whiteflies per plant and yield of 13.8 q/ha, remaining treatments were found to be on par with each other except seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of azadirachtin 1500 ppm at 0.2 per cent. Whereas in the control plot highest disease incidence of 93.01 per cent, with maximum whitefly population (8.3 per plant) and the lowest yield of 3.24 q/ha was recorded (Table 1., Fig. 1.& Fig. 2.).

~~The benefit cost ratio of treatment was calculated and it ranged from 0.5-1.96 seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of flonicamide 50 WG at 0.03 per cent (T4) had shown as the best treatment with B:C ratio of 1.96 and next best treatment was found to be seed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trap followed by foliar spray of afidopyropen 50 g/l DC at 0.2 per cent (T8) with a benefit-cost ratio of 1.79. The lowest recorded B: C of 0.5 observed in the control plot.~~ The benefit-cost ratio for the treatment was assessed and it varied between 0.5 and 1.96. The most effective treatment was found to be the seed treatment with imidacloprid 600 FS at 5 ml/kg, followed by the yellow sticky trap and then a foliar spray of flonicamide 50 WG at a concentration of 0.03 percent (T4), which resulted in a B:C ratio of 1.96. The second most effective treatment was the seed treatment with imidacloprid 600 FS at 5 ml/kg, followed by the yellow sticky trap and a foliar spray of afidopyropen 50 g/l DC at a concentration of 0.2 percent (T8), which had a benefit-cost ratio of 1.79. The control plot registered the lowest benefit-cost ratio of 0.5.

Similar findings were reported by Rao *et al*. (2021), who observed that seed treatment with thiamethoxam (5.0 g/kg) followed by two sprays of acetamiprid (4%) + fipronil (4%) (2.0 ml/l) resulted in the lowest mean incidence of mungbean yellow mosaic virus (MYMV), with incidence of 3.75 per cent and 4.84 per cent during the *kharif* and *rabi* seasons, respectively. Additionally, this treatment also led to a reduction in the whitefly population of 4.14 and 2.95 per plant during the same periods. In comparison, seed treatment with imidacloprid 600 FS (5.0 ml/kg) and two sprays of flonicamid (0.2 ml/l) were also effective but not as superior in controlling MYMV incidence and whitefly populations.

Flonicamide 50 WG operates as a systemic insecticide with a distinct mode of action that targets the nervous systems of insects. This insecticide is a selective antagonist of nicotinic acetylcholine receptors (nAChRs) in insects, disrupting normal neurotransmission (Gordon, 2020). Specifically, flonicamide interferes with acetylcholine binding to these receptors, significantly inhibiting feeding behavior. Insects that ingest flonicamide cease feeding within a few hours, which limits the damage they can inflict on crops (Smith and Brown, 2019). Prolonged exposure to flonicamide impairs the insect's ability to maintain essential physiological functions, resulting in eventual death (Johnson, 2018). A notable feature of flonicamide is its high selectivity for insects, which minimizes its impact on non-target organisms such as humans, animals and beneficial insects. This selectivity arises from the specific interaction with insect nAChRs, which differ from those found in mammals. Consequently, flonicamide 50 WG is effectively utilized in agriculture to control pests including aphids, whiteflies and thrips, owing to its efficacy and low toxicity to non-target species.

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Management of disease completely by any single approach is not possible,therefore integrating different approaches like the use of resistant cultivars, seed treatment, standard agronomic practices, use of biological methods, use of botanicals, vector control and chemical management, management can be done effectively.The management of disease cannot be effectively achieved through a single approach. Therefore, integrating various strategies is essential. These strategies include the use of resistant cultivars, seed treatment, standard agronomic practices, biological methods, botanical interventions, vector control, and chemical management. This multifaceted approach can lead to more effective disease management. As far as concerned about whitefly population and incidence of disease, it was found that By interpreting the whitefly population and disease incidence, it was confirmed thatseed treatment with imidacloprid 600 FS at 5 ml/kg seed followed by yellow sticky trapfollowed byand foliar spray of flonicamide 50 WG at 0.03 per cent gave efficient results.

Conclusion

On the basis of the results above and the references used, it can be concluded that, The most effective treatment was seed treatment with imidacloprid 600 FS at 5 ml/kg, followed by yellow sticky traps and a foliar spray of flonicamide 50 WG at 0.03 per cent. This combination resulted in the lowest disease incidence (26%), the lowest mean whiteflyThe most effective approach to tackling the issue involved treating seeds with imidacloprid 600 FS at a rate of 5 ml per kilogram. Following this initial treatment, yellow sticky traps were employed to capture the whiteflies, complemented by a foliar spray of flonicamide 50 WG at a concentration of 0.03 percent. This comprehensive strategy yielded remarkable results, achieving the lowest disease incidence at just 26% while also significantly reducing the mean whitefly population.

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Table 1. Management of Yellow mosaic disease in soybean during *Summer* 2024 at ARS Bidar

Tr. No.	Treatment details	No. of Whitefly/ plant (No.)	Disease incidence (%)	Yield (q ha^{-1})	Total cost (Rs.)	Gross returns (Rs.)	Net profit (Rs.)	B:C
T_1	Seed treatment with imidacloprid 600 FS @ 5ml/kg seed followed by yellow sticky trap	7.3	59.93 (50.58) *	7.70	42986	43890	904	1.02
T_2	T_1followed by FS of azadirachtin1500 ppm @ 0.2 at 20 DAS and 35 DAS	6.0	52.00 (46.15)	8.50	43626	48450	4824	1.11
T_3	T_1 followed by FS of fipronil 5 SC @ 0.1 at 20 DAS and 35 DAS	4.3	34.00 (37.64)	11.80	43766	67260	23494	1.54
T_4	T_1 followed by FS of flonicamide50 WG @ 0.03 at 20 DAS and 35 DAS	3.0	26.00 (30.64)	15.07	43836	85842	42006	1.96
T_5	T_1followed by FS of dimethoate 30EC @ 0.20 at 20 DAS and 35 DAS	4.6	38.00 (38.06)	11.27	43586	64182	20596	1.47
T_6	T_1 followed by FS of acephate 95 SG @ 0.1 at 20 DAS and 35 DAS	4.3	40.33 (39.42)	11.09	43292	63156	19864	1.46
T_7	T_1 followed by FS of difenthiron 50 WP @ 0.1 at 20 DAS and 35 DAS	4.0	41.33 (40.01)	11.45	43906	65208	21302	1.49
T_8	T_1followed by FS of afidopyropen 50 g/l DC @ 0.2 at 20 DAS and 35 DAS	3.3	29.00 (35.21)	13.80	43998	78660	34662	1.79
T_9	Control	8.3	93.01 (72.84)	3.24	37986	18981	-19005	0.50
	S.Em±	0.68	2.47	0.37				
	CD at 5	2.03	7.41	1.11				
	CV	23.38	9.31	6.12				

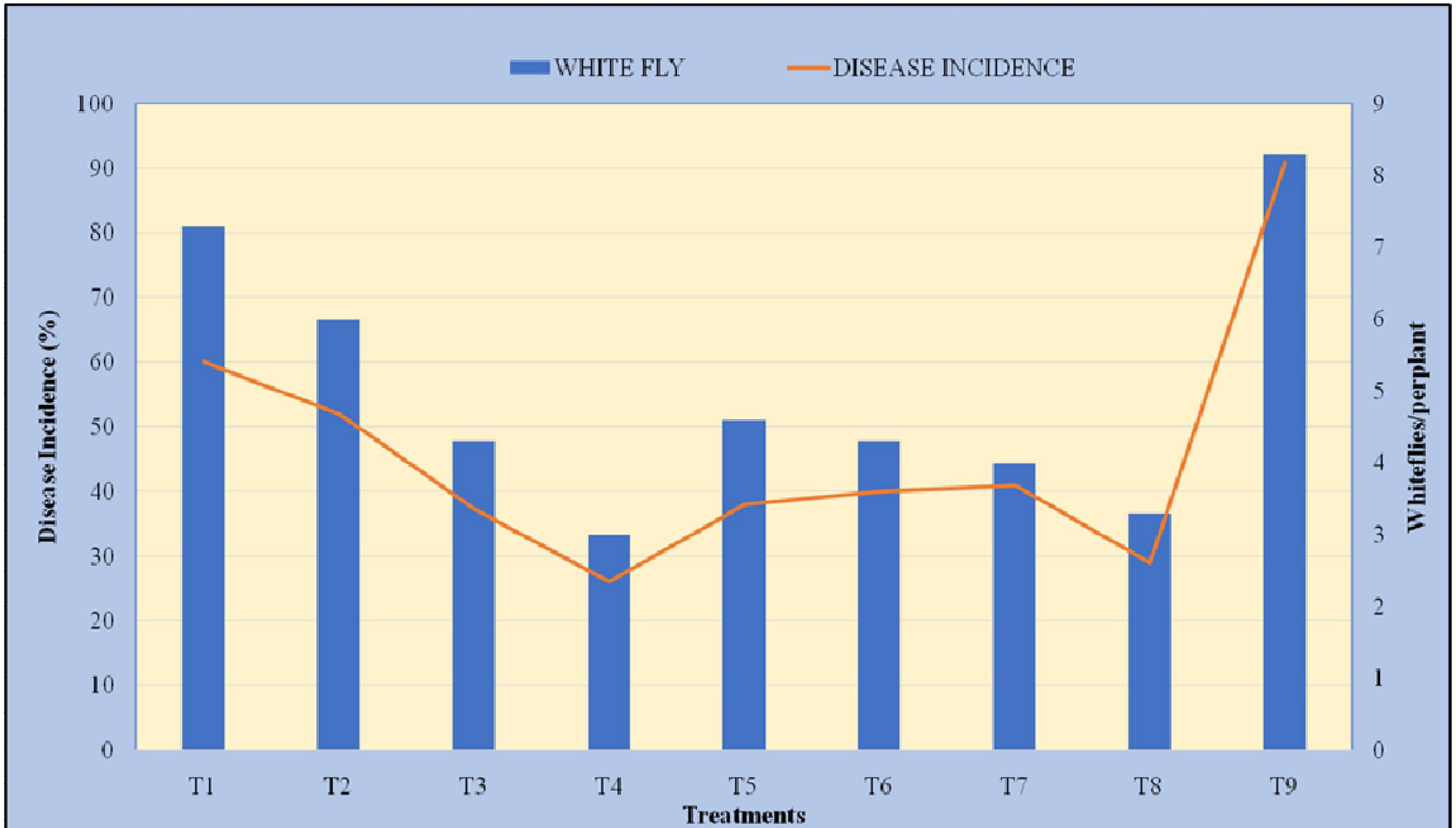

Fig. 1. Effect of different treatments on whitefly population and YMD incidence in soybean during *summer*, 2024 at ARS, Bidar

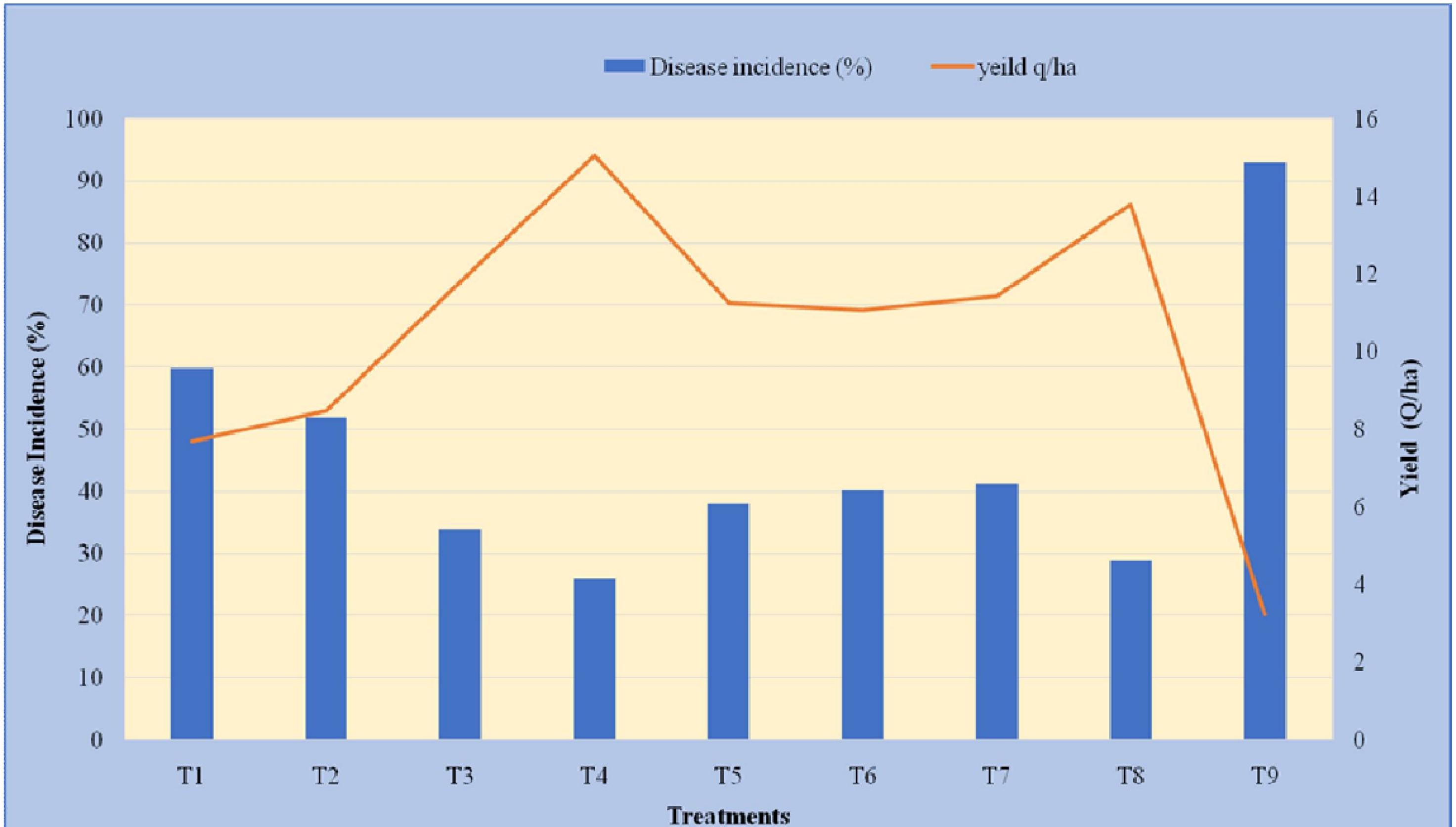

Fig. 2. Effect of different treatments on YMD incidence and yield in soybean during *summer,* 2024 at ARS, Bidar

Seed treatment with imidacloprid 600FS at 5ml/kg

Control

T1 + Foliar spray of flonicamide 50 WG at 0.03% at 20 DAS and 35 DAS

T1 + Foliar spray of afidopyropen 50 g/l DC at 0.2% at 20 DAS and 35 DAS

Plate 1. Management of yellow mosaic disease in soybean