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Unravelling Whitefly Population Dynamics and Management of Yellow Mosaic Disease in Mungbean

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ABSTRACT

Background: Yellow mosaic disease (YMD), continues to be a major production constraint in mungbean, especially under changing climatic conditions. Vector population dynamics, weather variability and sowing time play a decisive role in YMD epidemic development. The investigation aimed to elucidate the impact of fluctuations in whitefly population, interacting weather parameters and variation in sowing dates on YMD incidence and seed yield and management of the disease through chemical approach.

Methods: A field experiment was conducted during summer 2022-23 at MARS, Dharwad using susceptible mungbean variety DGGV 2 in randomized complete block design with three replications. The management experiment was laid out in randomized complete block design during summer 2023 and 2024 with 10 treatments and 3 replications. Weather data was recorded weekly and whitefly population was monitored on selected trifoliate leaves of five plants per replication. YMD incidence was assessed from 25 DAS across four sowing dates (30 Jan, 8 Feb, 14 Feb, 23 Feb). Correlation and regression analyses using SPSS and R were used to determine the influence of weather variables on whitefly dynamics and disease incidence.

Result: Whitefly population peaked (6.60/three leaves) in the 14th SMW under hot, dry conditions. Rainfall negatively influenced whitefly abundance (r = -0.807), while maximum temperature showed a positive association (r = 0.665). Early sowing on 30th January resulted in the lowest YMD incidence (13.85%) and highest yield (575.56 kg/ha), whereas delayed sowings recorded higher disease and lower yields. Seed treatment with Imidacloprid 60 FS 5 ml/ kg of seeds followed by foliar spray with Thiamethaxom 25% WG 0.3 g/L at 25 days after sowing reduced the yellow disease incidence and severity. Hence early sowing aligned with low vector activity and prophylactic spray of chemicals results in effective management of the disease.

Key words: Management, Mungbean, Whitefly, Yellow mosaic disease.

INTRODUCTION

Mungbean [*Vigna radiata* (L.) R. Wilczek] is a self-pollinated short-duration legume crop, ranked as the third most important pulse in India after chickpea and pigeonpea (Barigal *et al*., 2024). It is native to India and cultivated across East and Southeast Asia (Kumar *et al*., 2014). Mungbean is known for its nitrogen-fixing ability, thereby enhancing soil fertility and contributing to the sustainable agriculture (Kumar *et al*., 2025). It offers several health benefits such as improving digestion and providing potential protection against diabetes, heart disease and cancer as it is rich in phytoestrogens (Amruta *et al*., 2024). Despite India being the largest producer of mungbean, there is a gap in the productivity, due to various abiotic and biotic stresses, including pathogens like fungi, bacteria, viruses and nematodes (Vidyashree *et al*., 2024). Viral infections pose major threats with common diseases including Yellow Mosaic Disease (YMD), Mungbean Leaf Curl Disease (MLCD), leaf crinkle, mosaic mottle disease and bud necrosis (Amruta *et al*., 2023).

YMD caused by the *Mungbean yellow mosaic virus* (MYMV) was first reported at Indian Agricultural Research Institute (IARI), New Delhi (Nariani, 1960) and it is one of the major constraints in pulse production (Chowdary *et al*., 2021). The disease is characterized by scattered yellow spots on young leaves evolving into a mosaic pattern leading to complete yellowing, drying and withering of leaves. The diminished photosynthetic efficiency due to

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leaf yellowing subsequently leading to reduced pod size and number manifests as a severe yield penalty (Rohit *et al*., 2023). This viral pathogen is transmitted by whitefly, *Bemisia tabaci*, in a continuous and circulative manner (Madhumitha *et al*., 2021; Swati *et al.,* 2021). Notably, the population dynamics of the whitefly and therefore the intensity and spread of YMD are strongly influenced by weather variables such as temperature, relative humidity, rainfall and sunlight availability. These climatic factors govern seasonal disease outbreaks and cause significant year to year variability in epidemic development (Verma *et al*., 2023).

The temporal and spatial dynamics of YMD epidemics exhibit considerable variation across regions, seasons and changing environmental conditions. Hence, there is a dire need to generate location specific information to understand the influence of weather variables on disease incidence, progress and spread. This helps to derive epidemiological base essential for strengthening outbreak prediction and guiding timely, effective management strategies in mungbean production. Chemical management of Yellow Mosaic Disease (YMD) primarily revolves around the effective control of its vector, the whitefly (*Bemisia tabaci*), as no chemical treatment can cure plants directly by targeting the virus. YMD spreads rapidly when whitefly populations build up under favourable environmental conditions, making timely vector suppression critical for preventing both primary infection and secondary spread within the field (Jain *et al.,* 2025). Hence, the use of insecticides that have a direct and quick action on whiteflies is essential in reducing virus transmission. Although YMD in mungbean has been widely studied, research integrating weather variables with whitefly dynamics and disease progression at a location specific level is limited. The lack of validated, climate based forecasting models and weather informed chemical vector management remains a key gap in achieving precise and sustainable YMD control. Under this context, the present study was aimed to investigate the epidemic dynamics of YMD in relation to prevailing weather factors to devise forecasting models and to formulate effective chemical strategies for sustainable disease management in mungbean.

MATERIALS AND METHODS

During Summer season of 2022-23, a field experiment was conducted at the Main Agricultural Research Station (MARS), Dharwad, with the highly susceptible mungbean variety, DGGV 2 in randomised complete block design with three replications. The crop was raised with a spacing of 30 × 10 cm in 100 m^2 plot following the standard agronomic practices without any disease management interventions. Weather parameters, including minimum and maximum temperature, rainfall, relative humidity and number of rainy days were recorded on daily basis and aggregated into weekly intervals for statistical analysis. Whitefly population was recorded on three trifoliate leaves of five randomly selected plants at three different positions (top, middle and lower) in each replication. The YMD incidence was recorded from 25th day after sowing.

$$\text{Mean no. of whitefly per plant} = \frac{n_1 + n_2 + n_3 + n_4 + n_5}{5}$$

Where,

N= Number of whitefly per plant numbered 1 to 5.

To study the effect of sowing dates on YMD incidence, temporal dynamics was created with four different dates of sowing *viz.,* 30th January, 8th February, 14th February and 23rd February 2023 assigned as T_1, T_2, T_3 and T_4 respectively with three replications. The disease incidence (%) was recorded at weekly interval from its onset to crop maturity using the standard formula (Wheeler, 1969):

Disease incidence (%) =

$$\frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

The management experiment was conducted during the summer seasons of 2022 and 2023 (22nd January) using a randomized complete block design (RCBD) with ten treatments, each having a plot size of 8.1 m^2 and replicated thrice. Seed treatment with Imidacloprid 60 FS at 5 ml/kg of seed and the installation of yellow sticky traps (25/ha) were uniformly applied to treatments 1 to 9. The efficacy of different insecticide formulations applied using knapsack sprayer against the whitefly vector was evaluated across these treatments. The treatment details are as follows:

T1: Foliar spray of Fipronil 5% SC at 1.0 ml/L at 25 days after sowing.
T2: Foliar spray of Thiamethoxam 25% WG at 0.3 g/L at 25 days after sowing.
T3: Foliar spray of Diafenthiuron 50 WP at 1.0 g/L at 25 days after sowing.
T4: Foliar spray of Thiacloprid 240 SC at 0.5 ml/L at 25 days after sowing.
T5: Foliar spray of Flubendiamide 39.35% SC at 0.3 ml/L at 25 days after sowing.
T6: Foliar spray of Flubendiamide 24% + Thiacloprid 24% SC at 0.4 ml/L at 25 days after sowing.
T7: Foliar spray of Spiromesifen 240 SC at 1.0 ml/L at 25 days after sowing.
T8: Foliar spray of Pyriproxyfen 10% EC at 1.0 ml/L at 25 days after sowing.
T9: Only seed treatment; no foliar spray.
T10: No seed treatment and no foliar spray.

Yellow mosaic disease (YMD) incidence and severity were assessed weekly on five randomly selected plants per plot. Disease severity (%) was assessed using Wheeler's (1969) formula with the 0-9 rating scale of Mayee and Datar (1986).

Per cent disease severity =

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

The statistical analysis was carried out using SPSS and R softwares to explore the relationship between weather parameters and whitefly population. Treatment means were compared through analysis of variance (ANOVA) to determine the significance of differences among insecticide formulations. Per cent disease incidence values were arcsine transformed prior to analysis to normalize variance. Pearson correlation coefficients were derived to evaluate the linear associations between weather variables and whitefly abundance. A multiple regression model was developed to assess the combined effects of environmental factors.

RESULTS AND DISCUSSION

In the epidemiological investigation of Yellow mosaic disease, weather factors had significant impact on whitefly population dynamics. The peak whitefly population of 44.00 per plant was observed during 14th Standard Meteorological Week (SMW) corresponding to 35.9°C (Max.) and 18.6°C (Min.) temperatures with no recorded rainfall and moderate relative humidity (56.0%). The lowest whitefly population (8.00/plant) was recorded during 16th SMW, with 33.6°C (Max.) and 19.1°C (min.) temperatures and 24.0 mm rainfall over two days. Whitefly numbers dropped to 21.33 and 8.00 during 15th and 16th SMW, coinciding with increased rainfall of 6.0 mm and 24.0 mm, respectively (Table 1).

Statistical analysis revealed a significant negative correlation between whitefly populations and rainfall (r = -0.807), while a positive correlation was noticed with maximum temperature (r = 0.665). No significant correlations were found for relative humidity and minimum temperature (Fig 1). Regression analysis, further confirmed these relationships, showing a negative association with mean relative humidity (-0.057) and rainfall (-0.087), whereas positive association was noticed from minimum temperature (0.059) and maximum temperature (0.960) (Table 2). The multiple regression equation was derived as:

$$Y = -26.262 + 0.960 X_1 + 0.059 X_2 - 0.087 X_3 - 0.057 X_4$$

Where,

Y- Whitefly population.

X_1- Maximum temperature.

X_2- Minimum temperature.

X_3- Rainfall.

X_4- Relative humidity.

Table 1: Influence of weather parameters on population of whiteflies at weekly intervals during summer, 2022-23.

Weekly intervals	Standard meteorological week	Whitefly number per plant	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	No of rainy days	Mean RH (%)
20-02-2023	9	26.67	33.5	15.3	0.0	0	49.0
27-02-2023	10	30.67	33.9	16.6	0.0	0	45.0
06-03-2023	11	34.67	34.6	19.0	0.0	0	46.0
13-03-2023	12	38.00	35.0	17.6	0.0	0	61.0
20-03-2023	13	41.33	35.3	17.9	0.0	0	57.0
27-03-2023	14	44.00	35.9	18.6	0.0	0	56.0
3-04-2023	15	21.33	34.3	17.3	6.0	1	65.0
10-04-2023	16	8.00	33.6	19.1	24.0	2	69.0
17-04-2023	17	34.00	35.0	18.8	0.0	0	67.0
24-04-2023	18	24.67	35.6	18.3	0.0	0	63.0

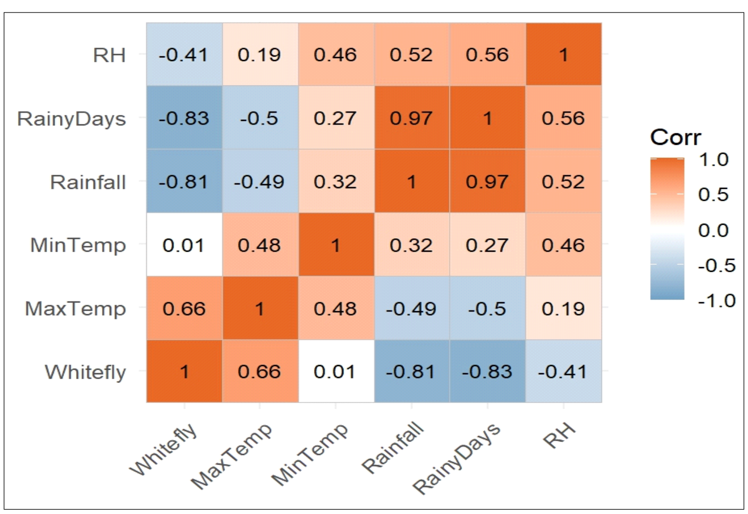

Fig 1: Heatmap depicting the correlation between weather parameters and whitefly population.

The results of the study showed that the higher temperatures facilitate the expansion of whitefly numbers, resulting in a greater transmission rate of YMD. On the other hand, a reduction in the whitefly population was noted during rainy period, indicating that such weather conditions may function as a natural control mechanism by dislodging and removing whiteflies, thereby decreasing the numbers. Under the prevailing agro-climatic conditions, relative humidity and minimum temperature may have remained within ranges that neither restricted nor enhanced whitefly survival and virus transmission. Consequently, their effects were likely overshadowed by more influential variables such as maximum temperature, sunshine hours and sowing time, which more directly govern vector population build-up and crop susceptibility. These findings are in agreement with previous reported results wherein maximum temperature and minimum temperature showed positive correlations with whitefly population (r = 0.505 and r = 0.150) (Patil *et al*., 2021). According to the earlier findings (Meti *et al*., 2018), the populations of whiteflies fluctuated in response to environmental conditions, reaching a maximum of 1456/trap in the 50th SMW under 29.7°C max temperature, 16.7°C min temperature and 8.2 mm rainfall, while the lowest number (16-20/trap) occurred in the 39-40th SMWs with cooler temperatures and higher rainfall. Similarly, a significant positive relationship was observed between the whitefly population and higher temperature coupled with bright sunshine hours, whereas evening relative humidity and rainfall were found to have a significant negative correlation (Verma *et al*., 2023). Thus, it could be concluded that the incidence of MYMV disease and the associated vector population escalated with higher temperatures and increased relative humidity (Khan *et al*., 2018).

Among the various sowing dates assessed, T1 (6th SMW) exhibited the lowest YMD incidence of 13.85 per cent, followed by T2 (7th SMW) with an incidence of 20.07 per cent. The data indicated a progressive increase in disease incidence with delayed sowing dates, resulting in high YMD incidence of 78.15 per cent and 60.58 per cent in T4 (9th SMW) and T3 (8th SMW) respectively (Table 3).

The distribution and variability of Yellow Mosaic Disease (YMD) incidence across different sowing windows was illustrated by using violin plot. Early sowing treatments (T1 and T2) exhibited narrow, symmetrical violin shapes signifying a concentrated distribution of low disease incidence with limited variability, indicative of stable and favourable conditions for disease escape or suppression. Conversely, later sowing dates (T3 and T4) revealed broader and more irregular violins, reflecting not only elevated YMD incidence but also substantial variability among successive disease assessment intervals. This pattern underscored a strong temporal influence on disease dynamics, where delayed sowing created conditions more conducive for disease development and spread (Fig 2).

Sowing date had a significant impact on seed yield too. There was a reduction in yield with delayed sowings. The optimal yield was recorded at earliest sowing time *i.e.* during 6th SMW, while delayed sowings showed decline in yield with higher incidence of yellow mosaic disease (YMD). Specifically, the first sowing on January 30th had lowest

Table 2: Correlation analysis of the interplay between whitefly abundance and environmental weather variables.

Pearson correlation	Whitefly number	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Relative humidity (%)
Whitefly number	1				
Maximum temperature (°C)	0.665*	1			
Minimum temperature (°C)	0.007	0.482	1		
Rainfall (mm)	-0.807**	-0.489	0.324	1	
Relative humidity (%)	-0.410	0.192	0.465	0.522	1

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Table 3: Influence of sowing dates on incidence of YMD and seed yield (kg/ha).

Treatment no.	Sowing dates	SMW	Per cent disease incidence				Seed yield (q/ha)
			36 DAS	43 DAS	50 DAS	57 DAS	
T1	30th January	6	4.50 (12.25)*	8.95 (17.41)	9.56 (18.01)	13.85 (21.85)	5.75
T2	8th February	7	5.86 (14.01)	13.65 (21.68)	15.85 (23.46)	20.07 (26.62)	3.76
T3	14th February	8	7.56 (15.96)	25.35 (30.23)	45.68 (42.52)	60.58 (51.11)	3.00
T4	23rd February	9	10.35 (18.77)	35.84 (36.77)	58.65 (49.98)	78.15 (62.13)	2.50
	S.Em. ±		0.06	0.10	0.14	0.15	0.15
	CD at 5%		0.19	0.38	0.45	0.46	0.52

SMW: Standard meterological week.

*Figures in the parenthesis indicate arc sine transformed values.

YMD incidence and highest yield of 5.75 quintals per ha, while February 23rd sowing recorded highest YMD incidence and reduced yield of 2.50 quintals per ha.

A strong negative correlation (r = -0.86) between Yellow Mosaic Disease (YMD) incidence and seed yield across different sowing dates was visualized by a scatter plot with regression line. As YMD incidence increased, seed yield showed a corresponding decline. Early sowing treatments (T1 and T2) with lower disease incidence recorded higher seed yields, while delayed sowing dates (T3 and T4) experienced high disease pressure, resulting into significant reduction in yield levels (Fig 3).

Higher YMD incidence leads to extensive chlorosis and mosaic symptoms, which reduce photosynthetic efficiency, disrupt assimilate translocation and limit pod development. Early sowing likely enabled crop escape from peak whitefly activity, resulting in lower virus transmission and healthier canopy development, thereby sustaining higher yields. In contrast, delayed sowing exposed plants to favourable conditions for whitefly proliferation, increasing YMD infection at early growth stages and causing substantial yield losses. This inverse relationship highlights the detrimental impact of YMD on yield and reinforces the importance of ideal sowing window as one of the strategies to overcome disease induced yield losses.

This trend may be attributed to increasing temperatures associated with late sowing dates, which can elevate whitefly population and facilitate the spread of disease. These results align with the findings of previous report (Meghashree, 2017), which showed that sowing mungbean on June 6th led (Check) to the lowest YMD incidence of 4.85 per cent. As sowing dates were progress, by each week a clear upward trend in disease incidence was noticed with a peak YMD incidence of 15.15 per cent for plots sown on July 11th. A study (Mahalakshmi *et al*., 2014) corroborated these findings, indicating that the lowest YMD incidence (4.85%) occurred on June 6th. Furthermore, the sowing on February 15th and March 1st resulted in lower YMD infections, while April 1st sowing led to significant yield reductions due to high MYMV infection (Rashid *et al*., 2013).

Under management trail, there was significant difference between the treatments. Seed treatment with Imidachloprid at 5 ml/kg of seeds followed by foliar spray with Thiamethaxom 25% WG 0.3 g/L at 25 days after sowing (T2) was statistically superior with the lower mean disease incidence and mean disease severity of 16.87% and 11.5%

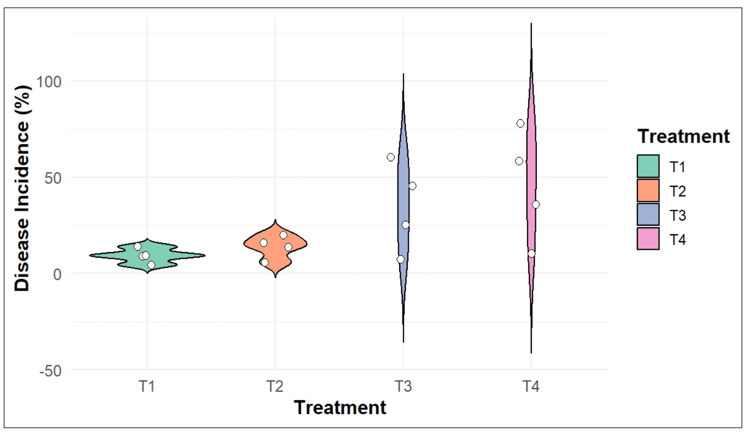

Fig 2: Progress of yellow mosaic disease incidence under different sowing dates.

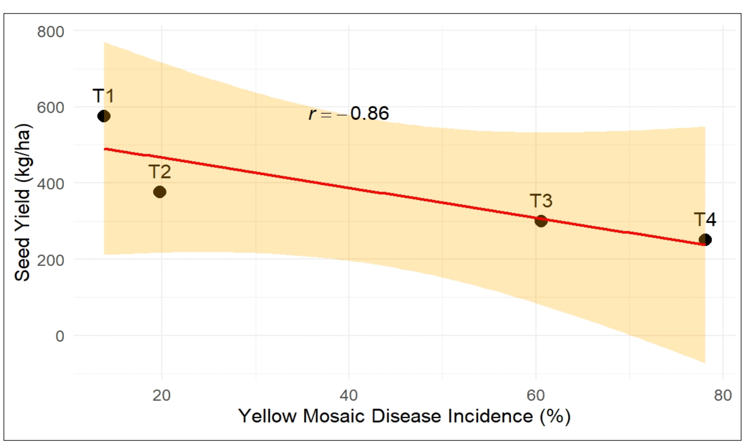

Fig 3: Effect of yellow mosaic disease on seed yield of mungbean at different sowing dates.

respectively with elevated yield of 6.98 q/ha. It was followed by T3 treatment (Seed treatment with Imidachloprid at 5 ml/kg of seeds followed by foliar spray with Diafenthiuron 50 WP 1.0 g/L at 25 days after sowing) which resulted in lower disease incidence and disease severity of 18.67% and 14.38% respectively. Consequently there was increase in yield (6.56 q/ha) when compared to other treatments, whereas T10 treatment showed highest disease incidence and disease severity (73.10% and 54.78%) with lower yield of 3.46 q/ha (Table 4).

The management trial revealed significant differences among the treatments with respect to disease suppression, yield enhancement and economic returns (Table 4). Seed treatment with imidacloprid (5 mL kg^{-1} of seed) followed by a foliar spray of thiamethoxam 25% WG (0.3 g L^{-1}) at 25 DAS (T2) was significantly superior in reducing disease pressure, recording the lowest mean disease incidence (16.87%) and mean disease severity (11.50%). This effective disease suppression was reflected in an elevated yield of 6.98 q ha^{-1}, which was the highest among all treatments. The next best treatment was T3, comprising seed treatment with imidacloprid (5 mL kg^{-1}) followed by a foliar application of diafenthiuron 50 WP (1.0 g L^{-1}) at 25 DAS, which resulted in comparatively lower disease incidence (18.67%) and disease severity (14.38%), with a corresponding yield increase to 6.56 q ha^{-1}. In contrast, the untreated control (T10) recorded the highest disease incidence (73.10%) and disease severity (54.78%), resulting in the lowest yield (3.46 q ha^{-1}), emphasizing the substantial benefits of seed treatment based integrated chemical approaches in managing the disease.

Economic analysis further substantiated the biological effectiveness of the treatments. T2 recorded the highest net returns (₹ 19,582 ha^{-1}) and the highest benefit-cost ratio (1.76), emphasizing its economic viability. This was followed by T3, which produced net returns of ₹ 15,138 ha^{-1} with a B:C ratio of 1.55. In contrast, T10 resulted in a monetary loss (₹ -2,532 ha^{-1}) and the poorest B:C ratio (0.90), clearly indicating the economic risks associated with unprotected cultivation.

Integrating seed treatment with targeted foliar insecticidal applications plays a vital role in minimizing disease impact and enhancing productivity in susceptible cultivars. The superior performance of T2 can be attributed to the systemic and long-lasting activity of neonicotinoids, which effectively suppress vector populations during the early stages when plants are most vulnerable. By reducing initial inoculum pressure and limiting secondary spread, imidacloprid-thiamethoxam integration ensures lower disease incidence and severity, consistent with previous findings on vector-borne diseases in pulses (Jayappa *et al*., 2017; Vishal *et al*., 2024). Treatments T2 and T3 both demonstrated the efficacy of systemic (imidacloprid, thiamethoxam) and contact-vapour action insecticides (diafenthiuron) in interrupting disease transmission cycles. Their ability to provide uniform plant protection likely contributed to the higher yields recorded in these treatments.

Table 4: Evaluation of insecticide-based management strategies against yellow mosaic disease in greengram (Pooled mean of summer 2022 and 2023).

Treatment details	Disease incidence (%)	Disease severity (%)	Seed yield q/ha	Gross returns (Rs/ha)	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
FS of Fipronil 5% SC 1.0 ml/L at 25 days	40.47 (39.53)*	35.16 (36.39)	4.32	28058	25800	2258	1.09
FS of Thiamethaxom 25% WG 0.3 g/L at 25 days	16.87 (24.27)	11.5 (19.83)	6.98	45392	25810	19582	1.76
FS of Diafenthiuron 50 WP 1.0 g/L at 25 days	18.67 (25.61)	14.38 (22.29)	6.56	42618	27480	15138	1.55
FS of Thiacloprid 240 SC 0.5 ml/L at 25 days	36.12 (36.96)	31.22 (33.99)	4.75	30853	26245	4608	1.18
FS of Flubendiamide 39.35% SC 0.3 ml/ L at 25 days	29.06 (32.64)	24.09 (29.41)	5.70	37028	28555	8473	1.30
FS of Flubendiamide 24% + Thiacloprid 24% SC 0.4 ml/L at 25 days	25.2 (30.15)	20.09 (26.65)	6.04	39260	26659	12601	1.47
FS of Spiromesifen 240 SC 1.0 ml/L at 25 days	37.44 (37.74)	32.15 (34.56)	4.62	30030	28180	1850	1.07
FS of Pyriproxyfen 10% EC 1.0 ml/L at 25 days	34.8 (36.17)	30.89 (33.78)	5.15	33475	26080	7395	1.28
Only seed treatment- No FS	73.1 (58.79)	54.86 (47.82)	4.06	26368	25330	1038	1.04
No seed treatment- No foliar spray	81.67 (64.69)	58.6 (49.98)	3.46	22468	25000	-2532	0.90
SEm±	1.362	0.973	0.150	-	-	-	-
CD (5%)	4.047	2.890	0.448	-	-	-	-
CV (%)	6.107	5.035	5.016	-	-	-	-

*Figures in the parenthesis indicate arc sine transformed values.

It was corroborated with the earlier study conducted by Swapna and Prema (2025) where, it was reported that seed treatment with Imidacloprid 600 FS @ 5 ml/kg of seeds, followed by foliar spray (pyriproxifen 5% + difenthuron 25% SE) @ 2 ml/l resulted in lowest YMD incidence of 13.42, 17.55, 20.80 and 24.78 per cent at 30 DAS, 45 DAS, 60 DAS and 90 DAS (physiological maturity), respectively. This trend aligns with established epidemiological principles that emphasize early intervention as essential for managing rapidly spreading vector-borne diseases.

The study dissected the impact of environmental factors, sowing time and vector targeted insectides in the management of Yellow Mosaic Disease (YMD) in mungbean. A strong positive correlation between whitefly population and maximum temperature, coupled with a negative correlation with rainfall, infers that warm and dry conditions favour the vector proliferation and subsequent disease spread. Early sowing effectively minimized both whitefly abundance and YMD incidence, resulting in higher yield, whereas delayed sowing exposed the crop to intensified disease pressure and hence led to severe yield loss. Such information helps in strategic formulation of crop production practices especially the sowing window as a sustainable measure in minimising the threats of yellow mosaic disease. The findings of chemical management approach reaffirm that prophylactic seed treatment combined with timely systemic foliar sprays forms a reliable, economically viable strategy for managing vector transmitted diseases in mungbean. Future research may focus on integrating these economically favourable chemical based strategies with biological agents, resistant varieties and cultural management practices to develop sustainable, holistic IPM modules suitable for diverse agro-climatic zones to enhance mungbean production and further support India's vision of *Atmanirbharata* in pulses in order to ensure nutritional food security to the country.

CONCLUSION

Sowing date and prevailing environmental conditions significantly influenced whitefly dynamics and mungbean yellow mosaic disease epidemiology. Second fortnight of January sowing resulted in significantly lower whitefly population build-up which further drastically reduced the disease incidence. There is a progressive increase in the both whitefly population and disease incidence after Febraury second fortnight sowing. Higher temperature above 35°C coupled with no rainfall favoured the vector activity and high disease incidence. Seed treatment with Imidachloprid 60FS @ 5 ml/kg seeds and foliar spray with Thiamethoxam 25 WG @ 0.3 g/L found very effective control measure which proved economically viable strategy for managing yellow mosaic disease in mungbean.

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Disclaimers

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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