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Management of yellow mosaic disease (YMD) of blackgram (*Vigna mungo* L.) in Southern dry zone of Karnataka

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Abstract
The field experiment was conducted on management of YMD by using different combination of insecticides and neem based pesticides during *Kharif* 2017. Among the treatments imposed, seed treatment with imidachloprid 600 FS @ 5.0 ml/ kg and 2 sprays of Imidacloprid 17.8 SL (@ 0.5 ml/l, 30 and 45 DAS had significantly less YMD incidence (13.33%) and whitefly population (1.86/ plant). Spraying with imidachloprid 17.8 SL @ 0.5 ml/l (3 sprays at 15, 30 and 45 DAS) was also found effective in the management of YMD (18.73%) and its vector (3.13/plant). Further it was observed that seed treatment with Imidacloprid 600 FS and two sprays of Imidacloprid 17.8 SL) observed higher growth and seed yield compared to other treatments employed. The maximum percent incidence (26.98%) and whitefly population (6.86/plant) was recorded in control.

Keywords: Blackgram, Imidacloprid, management, yellow mosaic disease, Karnataka

1. Introduction
Blackgram (*Vigna mungo* L.) popularly known as urdbean in India is an important short duration and self-pollinating legume [5, 12]. It is rich in all nutrients, which includes proteins (25-26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins [7]. Therefore, blackgram is the affordable source of protein for the vegetarians [3]. It is one of the most highly prized pulse crops, cultivated in almost all parts of India. It is the second important pulse crop of India in terms of area and production next to pigeonpea. India is the world's largest producer of uradbean and is being grown in about 32.46 lakh ha with a production of 19.59 lakh tonnes and productivity of 604 kg/ha [1]. Major blackgram growing states are Andhra Pradesh, Bihar, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. In Karnataka, blackgram is cultivated in an area of 0.7 lakh ha with a production of 0.21 lakh tonnes and productivity of 300 kg/ha [1]. The main reason for low productivity is the susceptibility of the crop to insects, weeds and diseases caused by fungus, virus and bacteria. Among these, the viruses are the most important group of plant pathogens affecting the production of the crop. They cause severe diseases and economic losses in blackgram and reducing seed yield and quality [11]. Plant viral diseases cause serious economic losses in many pulse crops by reducing seed yield and quality [14]. Among the various viral diseases, the yellow mosaic disease caused by *Mungbean yellow mosaic virus* (MYMV) is the most serious disease and major bottle neck for the production of blackgram. This disease is popularly known as *"Yellow plague of kharif pulses"* is currently spread over different agriculture zones of India including southern dry zone of Karnataka. It was given special attention because of severity and ability to cause huge yield loss depending upon the variety and stage of the crop [10, 13]. Even though, strategies for management of YMD caused by MYMV include planting resistant varieties, vector management, management of alternate hosts of viruses and modifying the cultural practices of the crop are not effective in managing the disease remarkably. Therefore, there is need to develop a better management practices. In this context, the present study was taken on different aspects of integrated management of YMD by using different chemicals and neem based pesticides.

2. Materials and Methods
2.1 Experimental design and treatments
A field experiment was conducted during early *kharif* 2017 at College of Agriculture, V. C. Farm, Mandya for the management of YMD in blackgram.

The experiment was replicated three times in a plot size of 525 m^2, spacing 30 cm x 10 cm in randomized complete block design (RCBD). The experiment included seven treatments out of which four systemic insecticides and one botanical insecticide were used. Rashmi was used as susceptible check in the present study. The details of spray schedule and treatment details are:

T_1: Acetamiprid 20 SP@0.25g/l (3 sprays at 15, 30 and 45 DAS).
T_2: Imidachloprid 17.8 SL @ 0.5 ml/l (3 sprays at 15, 30 and 45 DAS).
T_3: Triazophos 40 EC @1.5 ml/l (3 sprays at 15, 30 and 45 DAS).
T_4: Seed treatment with Imidachloprid 600 FS @ 5.0 ml/ kg and 2 sprays of Imidacloprid 17.8 SL @ 0.5 ml/l, 30 and 45 DAS).
T_5: Azadirachtin 1000ppm @ 5.0 ml/l (3 sprays at 15, 30 and 45 DAS).
T_6: Thiamethoxam 25 WG @ 0.3 g/l (3 sprays at 15, 30 and 45 DAS).
T_7: Control (without insecticide application).

2.2 Percent disease incidence and Vector population

Disease incidence (%) was calculated by counting the number of plants infected and total number of plants in an experimental plot (for each treatment)

$$Percent\ disease\ incidence\ (PDI) = \frac{Number\ of\ infected\ plants\ in\ a\ plot}{Total\ number\ of\ plants\ in\ plot} X100$$

Pre-spraying counts of the vector (Whitefly) were made one day before spray were recorded in each treatment at 15, 30, 45, 60 and 75 DAS by random collection of 25 plants in each treatment.

2.3 Growth and yield parameters

Randomly five plants from each treatment were collected (at harvesting stage) for assessing plant growth and yield parameters. The effect of YMD on plant height, yield parameters and yield per ha was recorded and average data obtained from sample plants was analyzed statistically.

2.4 Statistical analysis

The experimental data was analyzed by using Two-way ANOVA with CD at 5%. Experimental design used was Randomized complete block design.

3. Results and Discussion

Total 20 fields were visited during the Kharif 2016-17. None of the field observed was found free from the YMD. Common pattern of disease incidence and spread of YMD was observed during the survey. Around 25-50% YMD incidence was recorded under field conditions in different taluks of Mandya and Chamarajanagar districts (Fig.1 a&b). In this context different management treatments were designed to reduce incidence of YMD and its insect vector, whitefly population under field conditions. The results were tabulated as shown in Table 1 and Table 2.

3.1 Percent disease incidence and whitefly population

The results indicated that all the treatments were found comparatively effective in reducing disease incidence and whitefly population than untreated control. The observations of seven treatments revealed that, when no sprays were given, the percent disease incidence varied from 9.33 to 42.33% (Table.1). Among the treatments imposed, Seed treatment with imidachloprid 600 FS @ 5.0 ml/ kg and 2 sprays of imidacloprid 17.8 SL (@ 0.5 ml/l, 30 and 45 DAS) had significantly lowest mean YMD incidence (13.33 %). The systemic effect of imidacloprid on the insect vector at initial stages might be the reason for low disease incidence [17]. Highest mean disease incidence was observed with the treatment involving Triazophos 40 EC (@1.5 ml/l, 3 sprays at 15, 30 and 45 DAS) and azadirachtin 1000 ppm (@ 5.0 ml/l, 3 sprays at 15, 30 and 45 DAS). Our results are agreed with Malathi and John (2008) and Sethuraman *et al*. (2001) where they have reported that seed treatment and spaying with imidacloprid contributed to relatively low disease incidence of YMV on mungbean [8, 15]. Similarly, Jayappa it was observed that Seed treatment with imidacloprid @ 5 ml/kg of seeds and two spray of imidacloprid @ 0.5 ml/l recorded significantly lowest mean disease incidence [6].

The data on number of whiteflies per 3 leaves at 15, 30, 45, 60 and 75 DAS revealed that the lowest mean whitefly population (1.86) was recorded in seed treatment with imidachloprid 600 FS @ 5.0 ml/ kg and 2 sprays of imidacloprid 17.8 SL (@ 0.5 ml/l, 30 and 45 DAS). Highest whitefly population (4.86) was recorded triazophos 40 EC (1.5 ml/lt), 3 sprays at 15, 30 and 45 DAS treated plot. Number of whitefly population was less in the treatment with imidacloprid seed treatment and two sprays. Since, the chemical was systemic in nature, the insecticide could be effective in the plant up to 45 days after sowing. Hence, there was a lesser whitefly population recorded. Imidacloprid seed treatment at a higher dose (15g/ kg) effectively checked whitefly population up to 60 days by controlling the spread of the disease [9]. The application of the insecticide imidachloprid having a great impact in controlling the insect vector whitefly, which resulted in significantly less infestation of YMV in the plants under treatment [4].

3.2 Growth and yield parameters

The effect of YMD caused by MYMV on various growth and yield parameters *viz.*, plant height, pods per plant, pod length, pod weight, number seeds per pod, seed yield per plant and yield/ha in different treatments were recorded (Table 2). It is evident from the results that the treatments which recorded least percent disease incidence and whitefly population have shown a significant positive impact on all the growth and yield parameters evaluated.

There was no significant difference observed between various treatments with respect to plant height, pod length and number of seeds per pod. The plant height, pod length and number of seeds per pod varied from 33.52 to 40.82 cm, 4.62 to 5.79 cm and 3.97 to 5.23 respectively. Whereas, the significant difference was recorded between treatments with regard to number of pods per plant (33.13 to 44.92), pod weight (17.46 to 24.38 cm), seed yield (15.50 to 21.24 g) and (5.33 to 11.04 q). However in the present investigation, seed treatment with imidacloprid 600 FS and two sprays of imidacloprid 17.8 SL) observed higher growth and seed yield followed by imidacloprid 17.8 SL (0.5ml/lt), 3 sprays) compared to other treatments. These treatments were indirectly contributed for lower incidence of disease. Further, it was observed that, the virus infection at a later stage had no profound effect on the yield and pod size. The systemic insecticides were attributed to greater residual activity, high level of protection, and quick knock down effect on viruliferous vectors compared to botanicals [2] and cultural practices that act indirectly by delaying disease appearance,

enhancing growth and by inducing resistance [16]. The application of insecticide imidacloprid significantly influenced pod and seed development plants untreated plants [4]. Similarly, seed treatment and spraying with imidacloprid at different intervals during crop growth was found effective in reducing the incidence of YMD and its vector [6].

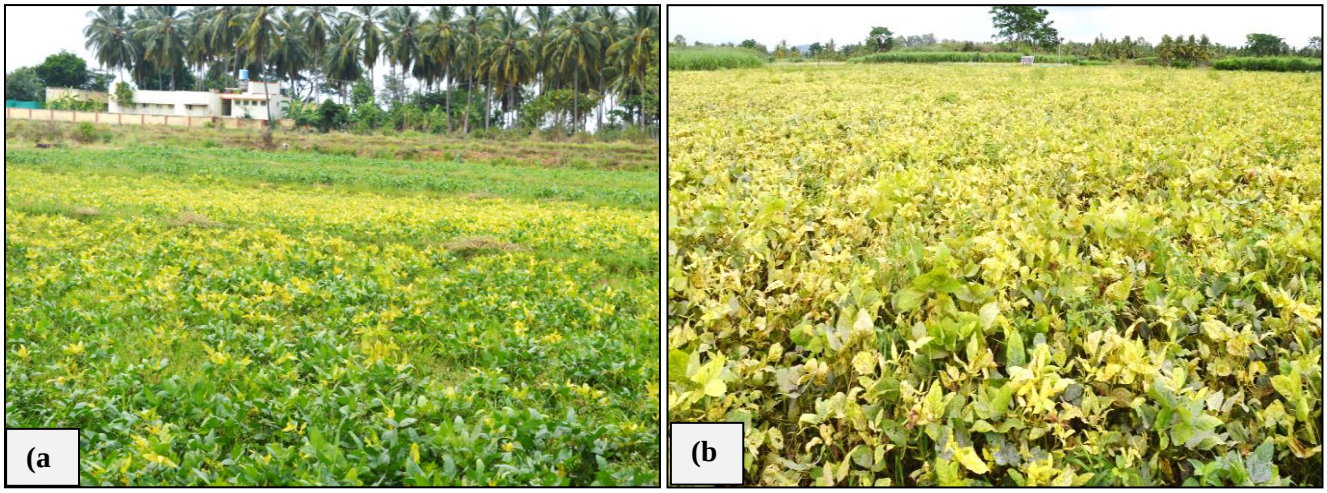

Fig 1: Blackgram fields infected with yellow mosaic disease in Mandya (a) and Chamarajanagr (b) districts of Southern dry zone Karnataka

Table 1: Effect of different treatments on whitefly population and percent disease incidence on yellow mosaic virus of blackgram

Treatment	15 DAS		30 DAS		45 DAS		60 DAS		75 DAS		Mean	
	WF	DI (%)	WF	DI (%)	WF	DI (%)	WF	DI (%)	WF	DI (%)	WF	DI (%)
T1	0.33 (0.91)	2.67 (1.78)	1.67 (1.47)	9.33 (3.14)	4.67 (2.27)	21.67 (4.71)	8.67 (3.03)	25.00 (5.05)	8.33 (2.97)	33.50 (5.83)	4.73	18.43
T2	0.67 (1.08)	4.67 (2.27)	2.67 (1.78)	11.00 (3.39)	3.67 (2.04)	24.67 (5.02)	2.33 (1.68)	25.67 (5.12)	6.33 (2.61)	27.67 (5.31)	3.13	18.73
T3	0.33 (0.91)	7.33 (2.80)	2.67 (1.78)	13.00 (3.67)	6.33 (2.61)	26.67 (5.21)	7.33 (2.80)	29.00 (5.43)	7.67 (2.86)	34.33 (5.90)	4.86	22.06
T4	0.00 (0.71)	1.67 (1.47)	0.67 (1.08)	5.33 (2.41)	3.67 (2.04)	15.33 (3.98)	2.33 (1.68)	20.67 (4.60)	2.67 (1.78)	23.67 (4.92)	1.86	13.33
T5	0.67 (1.08)	2.67 (1.78)	3.33 (1.96)	8.00 (2.92)	4.33 (2.20)	26.00 (5.15)	7.67 (2.86)	34.67 (5.93)	7.67 (2.86)	37.00 (6.12)	4.73	21.66
T6	0.67 (1.08)	1.67 (1.47)	2.67 (1.78)	11.33 (3.44)	5.33 (2.42)	23.67 (4.92)	6.67 (2.68)	28.00 (5.34)	8.67 (3.03)	30.54 (5.57)	4.80	19.04
T7	1.67 (1.47)	9.33 (3.14)	5.33 (2.42)	16.67 (4.14)	7.67 (2.86)	29.57 (5.48)	9.33 (3.14)	37.00 (6.12)	12.33 (3.58)	42.33 (6.54)	6.86	26.98
SE m±	0.03	0.21	0.22	0.92	0.46	1.15	0.28	1.79	0.48	2.15	----	---
CD @ 5%	0.11	0.67	0.69	2.89	1.45	3.61	0.88	5.59	1.50	6.72		
CV	10.61	8.71	14.21	15.07	15.90	8.38	7.57	10.88	10.92	11.42		

T1:Acetamiprid 20 SP (0.25gm/lt), 3 sprays at 15, 30 and 45 DAS; T2:Imidacloprid 17.8 SL (0.5ml/lt), 3 sprays at 15, 30 and 45 DAS T3: Triazophos 40 EC (1.5ml/lt), 3 sprays at 15, 30 and 45 DAS; T4:Seed treatment with Imidacloprid 600 FS (5ml/kg seed) and 2 sprays of Imidacloprid 17.8 SL (0.5 ml/lt) at 30 and 45 DAS; T5:Azadirachtin 1000ppm (5ml/lt), 3 sprays at 15, 30 and 45 DAS; T6:Thiamethoxam 25 WG (0.3gm/lt), 3 sprays at 15, 30 and 45 DAS; T7:Untreated control (Without insecticide application)
DAS = days after sowing; Figures in the parenthesis indicate root transformed values; WF = whitefly population; DI = disease incidence

Table 2: Effect of different treatments on the growth and yield parameters of blackgram

Treatment	Plant Height (cm)	No. of Pods/ Plant	Pod Length (cm)	No. of Seeds/ Pod	Pod weight (g)	Seed yield (g) / Plant	Seed yield (q/ha)
T1	35.25	40.57	5.44	4.58	19.55	19.62	7.87
T2	40.82	43.20	4.95	4.55	22.00	21.08	9.75
T3	35.52	39.42	4.83	4.07	23.52	18.52	7.02
T4	39.12	44.92	5.79	5.23	24.38	21.24	11.04
T5	33.53	37.40	5.00	4.40	18.29	16.63	6.00
T6	38.45	38.93	5.12	4.37	18.93	18.59	7.41
T7	33.52	33.13	4.62	3.97	17.46	15.50	5.33
S.E m±	NS	2.19	NS	NS	1.56	1.21	0.47
CD @ 5%		6.84			4.87	3.49	1.47
CV %		9.60			13.15	10.35	10.56

T1:Acetamiprid 20 SP (0.25gm/lt), 3 sprays at 15, 30 and 45 DAS; T2:Imidacloprid 17.8 SL (0.5ml/lt), 3 sprays at 15, 30 and 45 DAS T3: Triazophos 40 EC (1.5ml/lt), 3 sprays at 15, 30 and 45 DAS; T4:Seed treatment with Imidacloprid 600 FS (5ml/kg seed) and 2 sprays of Imidacloprid 17.8 SL (0.5 ml/lt) at 30 and 45 DAS; T5:Azadirachtin 1000ppm (5ml/lt), 3 sprays at 15, 30 and 45 DAS; T6:Thiamethoxam 25 WG (0.3gm/lt), 3 sprays at 15, 30 and 45 DAS; T7:Untreated control (Without insecticide application)
DAS = days after sowing; Figures in the parenthesis indicate root transformed values; WF = whitefly population; DI = disease incidence

4. Conclusion

The application of systemic insecticide, imadicloprid contributed more seed yield compared with control by reducing whitefly population and YMD incidence. Our results showed that seed treated with imidacloprid @ 5 ml/kg seeds followed by two sprays of imidacloprid @ 0.5 ml/l could be effectively used for the management of YMD and its vector, whitefly in blackgram.

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