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MANAGEMENT OF SUCKING PESTS AND MUNGBEAN YELLOW MOSAIC VIRUS DISEASE IN BLACKGRAM DURING SUMMER SEASON

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ABSTRACT

The field experiment was conducted during summer, 2020 and 2021at Agricultural Research Station, Bidar on management of sucking pests and Mungbean Yellow Mosaic Virus disease in blackgram by using seed treatment followed by spraying of different insecticides. The results showed that the seed treatment with Imidacloprid 60 FS @ 10 ml/kg or Thiamethoxam 35 FS@ 7.5 ml/kg recorded less thrips and whitefly population up to 25 days after sowing compared to untreated control which recorded highest population of thrips and whiteflies. Hence, the YMV disease incidence upto 30 DAS was also less in seed treated plots than untreated control. Further, the treatment where in seed treatment followed by spraying of Flonicamid 50 WG @ 0.3g/L or Dinotefuran 20 SG @0.3 g/L or Thiamethoxam 25 WG @ 0.2g/L was found effective in further management of the sucking pests and also MYMV incidence throughout the cropping period.

Key words : Sucking pests, Mungbean Yellow Mosaic Virus disease, Seed treatment, Blackgram.

Introduction

Blackgram [*Vigna mungo* (L.) Hepper] is an important pulse crop in India. It is a short duration, self-pollinated and diploid grain legume (Gupta and Gopalakrishna, 2008). Among the pulses grown in India, blackgram is third most important pulse crop both in acreage and production. It is a drought tolerant, grown twice in a year and fits well in Indian crop rotation program. In India, it is grown over an area of 4.49 million ha with an annual production of 2.93 million tonnes (Anonymous, 2017). 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. Though blackgram is grown in large area, the productivity was low due to various biotic and abiotic stresses. The main reasons for low yield are the susceptibility of the crop to insects, weeds and diseases caused by fungus, virus and bacteria.

Among the several factors responsible for such poor yield, undoubtedly, insect infestation is considered as one of the most important factor. In India about 18 species of insect pests damage the blackgram (Singh and Singh, 1977). The annual yield loss due to insect pests has been estimated to 30 per cent in urdbean and mung bean (Hamad and Dubey, 1983). In blackgram, the avoidable loss in yield due to insect pest was recorded to be 34.7 per cent (Saxena, 1983). During summer season sucking insect pests (aphid, jassids, white leaf hopper and whitefly) are of the major importance (Islam *et al*., 2008). These insect pests not only reduce the vigour of the plant by sucking the sap but transmit diseases and affect photosynthesis as well (Sachan *et al*., 1994).

Apart from insect pests, blackgram crop suffers from various diseases caused by fungus, virus and bacteria. Among the diseases, yellow mosaic disease (YMD) caused by yellow mosaic viruses (YMVs) is of key importance especially in South and Southeast Asia. MYMV is a single standard DNA containing virus belongs to the genus Begomovirus of the family Geminivirideae. In India, Nariani (1960) first reported MYMV from the fields of mungbean in Indian Agricultural Research Institute (IARI), New Delhi during 1950s. YMD spread to the mungbean crop through whitefly (*Bemisia* *tabaci* Gennadius) an insect vector for YMVs (Selvi *et al*., 2006). The virus enters the phloem cells of the host through the whitefly proboscis and the viral aggregates appear in the host cell nuclei roughly two days before the symptom appearance (Thongmeearkom *et al*., 1981). The visible symptoms appear as scattered yellow-color spots on the young leaves, which later turns into a yellow mosaic pattern and ultimately results in complete yellowing, drying and withering of leaves. The pods on the infected mungbean plant become smaller in size, yellowing of the leaves decreases the photosynthetic efficiency which ultimately manifested as severe yield loss (Malathi and John, 2009). The overall crop yield loss may range between 10 and 100%, depending on the mungbean genotype and stage of crop infection (Singh, 1980a; Bashir *et al*., 2005). Many farmers are growing blackgram crop during summer after harvesting paddy, pigeonpea and Bt cotton cotton in Tungabhadra and Upper Krishna project command areas, but yield levels were very low due to the incidence of YMV disease during the summer season. Hence there is a need for YMV disease resistant varieties and also management practices for managing YMV disease. So far there is no control measures directly aimed at virus management, Hence, the management of vector is the only available method. With this background, the present study was conducted with the main objective to identify the best treatment in the management of the MYMV of blackgram by managing the vectors.

Materials and Methods

Management of whiteflies, thrips and YMV disease during summer season

The field experiment was laid out at ARS, Bidar for the management of whiteflies and thrips and YMD disease during summer (2020 and 2021) season. The trial was laid in Randomized block design with 13 treatments replicated twice. Blackgram Var, TAU-1 was sown at 30 cm × 10cm spacing and all the recommended package of practices was followed to raise the crop, except plant protection measures. The details of the treatments were given in the table. The seed treatment followed by two foliar sprays were take up at 20 DAS and 35 DAS.

The observations on population of whiteflies and thrips were recorded at ten days intervals from germination to crop maturity stage by randomly selecting 10 plants from each plot. The population of the whiteflies and thrips per top three leaves of the plant was recorded during morning hours. The data was subjected for square root transformation and statistical analysis.

The observation on YMV diseases was done at 30 and 60 DAS and worked out the Per cent Disease incidence (PDI) using the formula as given below.

$$\text{Per cent disease incidence (PDI)} = \frac{\text{Total number of yellow mosaic disease infected plants}}{\text{Total number of observed plants}} \times 100$$

The seed yield was recorded plot wise at the time of harvest and converted to hectare basis and subjected for statistical analysis.

Treatment details

T_1: Imidacloprid 60 FS @ 10 ml/Kg

T_2: Thiamethoxam 35 FS@ 7.5 ml/Kg

T_3:T_1 + Thiamethoxam 25 WG @ 0.2g/L

T_4: T_1 + Flonicamid 50 WG @ 0.3g/L

T_5: T_1 + Neem oil (3000 ppm) @ 5ml/L

T_6: T_1 + Dinotefuran 20 SG @0.3 g/L

T_7: T_1 + Dimethoate 30 EC@ 2ml/L

T_8: LT_2 +Thiamethoxam 25 WG @ 0.2g/L

T_9: T_2 + Dinotefuran 20 SG @0.3 g/

T_{10}: T_2 + Flonicamid 50 WG @ 0.3g/L

T_{11}: T_2 + Neem oil (3000 ppm) @ 5ml/L

T_{12}: T_2 + Dimethoate 30 EC@ 2ml/L

T_{13}: Untreated Control

Results and Discussion

Management of whiteflies, thrips and YMV disease during summer season

The results of the experiment on management of whiteflies, thrips and YMV disease of blackgram carried out at Agricultural Research Station, Bidar for two consecutive summer seasons (2020 and 2021) was pooled and presented in the Tables 1 and 2.

Whitefly population : The whitefly population at 10DAS ranged from 0.68 to 1.60 whiteflies per top three leaves and showed no significant difference among the treatments. At 20 DAS, the lowest whiteflies population was recorded in T_4 treatment followed by T_1 treatment with 2.60 and 2.60 whiteflies per top three leaves respectively and there was no significant difference among them. These two treatments were followed by T_6, T_{10} and T_9 treatments with 2.80, 2.85 and 2.90 whiteflies per top three leaves respectively. However, the highest whitefly population was recorded in untreated control with 5.25 whiteflies per top three leaves. At 30 DAS, the plot which received spray of different pesticides recorded less whitefly population compared to T_1, T_2 where only seed treatment was done and untreated control. Among the all the treatments T_4 and T_6 recorded

Table 1 : Efficacy of different treatments on whitefly population and MYMV disease incidence in blackgram during summer 2020 and 2021.

Treatments	Population of whiteflies/top three leaves							PDI (30DAS)	PDI (60DAS)
	10DAS	20DAS	30DAS	40DAS	50DAS	60DAS	Mean		
T_1: Imidacloprid 60 FS @ 10 ml/Kg	0.73(1.31)	2.60(1.90)	6.80(2.79)	3.73(2.17)	5.88(2.62)	5.00(2.45)	4.12(2.21)	3.93(11.42)	22.13(28.01)
T_2: Thiamethoxam 35 FS@ 7.5 ml/Kg	1.03(1.42)	2.95(1.99)	8.20(3.03)	3.88(2.21)	7.28(2.88)	6.40(2.72)	4.95(2.37)	4.75(12.58)	22.98(28.61)
T_3:T_1 + Thiamethoxam 25 WG @ 0.2g/L	1.08(1.44)	2.95(1.99)	4.35(2.31)	1.63(1.62)	3.43(2.11)	2.30(1.82)	2.62(1.88)	4.04(11.58)	15.15(22.88)
T_4: T_1 + Flonicamid 50 WG @ 0.3g/L	0.68(1.29)	2.60(1.89)	3.60(2.14)	1.28(1.51)	2.68(1.92)	2.05(1.75)	2.15(1.75)	3.95(11.46)	10.33(18.71)
T_5: T_1 + Neem oil (3000 ppm) @ 5ml/L	1.18(1.45)	3.20(2.05)	5.00(2.43)	2.18(1.78)	3.98(2.23)	3.10(2.03)	3.10(1.99)	4.33(11.85)	20.56(26.93)
T_6: T_1 + Dinotefuran 20 SG @0.3 g/L	0.93(1.39)	2.80(1.95)	4.05(2.25)	1.58(1.60)	3.13(2.03)	2.20(1.79)	2.45(1.83)	3.96(11.47)	11.98(20.22)
T_7: T_1 + Dimethoate 30 EC@ 2ml/L	1.03(1.42)	3.15(2.04)	4.80(2.41)	2.03(1.74)	3.88(2.21)	2.55(1.89)	2.90(1.95)	4.43(12.13)	17.30(24.55)
T_8: LT_2 +Thiamethoxam 25 WG @ 0.2g/L	1.08(1.44)	3.10(2.02)	4.65(2.16)	1.88(1.70)	3.73(2.18)	2.40(1.85)	2.80(1.89)	4.95(12.85)	15.40(23.07)
T_9, T_2 + Dinotefuran 20 SG @ 0.3 g	0.88(1.37)	2.85(1.96)	4.10(2.25)	1.80(1.67)	3.18(2.04)	2.33(1.83)	2.52(1.85)	4.45(12.15)	13.35(21.40)
T_{10}: T_2 + Flonicamid 50 WG @ 0.3g/L	0.93(1.38)	2.90(1.97)	4.15(2.27)	1.80(1.67)	3.23(2.06)	2.45(1.86)	2.58(1.87)	4.89(12.76)	12.75(20.89)
T_{11}: T_2 + Neem oil (3000 ppm) @ 5ml/L	1.18(1.47)	3.20(2.05)	5.75(2.60)	3.08(2.01)	4.43(2.31)	3.55(2.13)	3.53(2.10)	5.01(12.92)	21.30(27.46)
T_{12}: T_2 + Dimethoate 30 EC@ 2ml/L	0.88(1.37)	3.30(2.07)	4.25(2.29)	3.18(2.04)	3.33(2.08)	2.70(1.93)	2.94(1.96)	4.48(12.19)	17.95(25.05)
T_{13}: Untreated Control	1.60(1.61)	5.25(2.50)	9.03(3.17)	10.43(3.38)	10.28(3.36)	8.25(3.05)	7.47(2.84)	11.13(19.44)	26.94(31.18)
SEm±	0.10	0.12	0.10	0.11	0.11	0.11	0.11	0.64	0.75
CD(0.05)	0.30	0.38	0.32	0.34	0.34	0.35	0.34	1.97	2.31

DAS: Days after sowing; PDI: Percent Disease Index; Figures in the parentheses are square root transformed values $\sqrt{(x+1)}$.

lowest whitefly population of 3.60 and 4.05 whitefly per top three leaves respectively. These two treatments were followed by T_{10} and T_9 treatments with 4.10 and 4.15 whiteflies per top three leaves, respectively. The untreated plot recorded highest whitefly population of 9.03 whiteflies per top three leaves. At 40, 50, 60 DAS the same trend was followed with respect to the whitefly population. However, the treatment, which received second spray recorded less whitefly population compared to unsprayed treatments.

YMV disease incidence : The per cent disease incidence was observed at 30 and 60 days after sowing and the results are presented in Table 1. The YMV incidence at 30 DAS ranged from 3.93 to 11.13 percent among the treatments. The lowest per cent disease incidence was noticed in T_4, T_6 and T_{10} treatments with 3.93, 3.95 and 3.96 per cent disease incidence respectively and there was no significant difference among them. These three treatments were followed by T_9 and T_3 treatments with 4.04 and 4.33 per cent disease incidence respectively. The highest per cent disease incidence was noticed in untreated control with 11.13 per cent disease incidence. At 60 DAS, the YMV disease incidence increased and ranged from 10.33 to 26.94 per cent. Among all the treatments with respect to the efficacy same trend was followed as that of 30 DAS.

Thrips population : The population of thrips at 10DAS ranged from 1.43 to 2.04 thrips per top three leaves and showed no significant difference among the treatments. At 20 DAS the lowest thrips population was recorded in T_4 treatment followed by T_1 treatment with 2.45 and 2.50 thrips per top three leaves respectively and there was no significant difference among them. These two treatments were followed by T_6, T_9 and T_{10} treatments with 2.55, 2.65 and 2.65 thrips per top three leaves, respectively. However, the highest thrips population was recorded in untreated control with 5.23 thrips per top three leaves. At 30 DAS, the plot which received spray of different pesticides recorded less thrips population compared to T_1, T_2 where only seed treatment was done and untreated control. Among the all the treatments T_4 and T_6 recorded lowest thrips population of 3.33 and 3.78 thrips per top three leaves respectively. These two treatments were followed by T_{10} and T_9 treatments with 3.83 and 3.88 thrips per top three leaves respectively. The untreated plot recorded highest thrips population of 8.30 thrips per top three leaves. At 40, 50, 60 DAS the same trend

Table 2 : Efficacy of different treatments on thrips population and yield of blackgram during summer 2020 and 2021.

Treatments	Population of thrips /top three leaves							Yield (Q/ha)
	10DAS	20DAS	30DAS	40DAS	50DAS	60DAS	Mean	
T_1: Imidacloprid 60 FS @ 10 ml/Kg	1.53(1.59)	2.50(1.87)	6.78(2.79)	4.60(2.37)	7.45(2.91)	6.25(2.69)	4.85(2.37)	4.74
T_2: Thiamethoxam 35 FS@ 7.5 ml/Kg	1.78(1.67)	3.30(2.07)	8.18(3.03)	5.90(2.63)	8.65(3.11)	7.65(2.94)	5.91(2.57)	4.30
T_3:T_1 + Thiamethoxam 25 WG @ 0.2g/L	1.58(1.61)	2.70(1.92)	3.98(2.23)	1.95(1.72)	3.80(2.19)	2.80(1.95)	2.80(1.94)	6.04
T_4: T_1 + Flonicamid 50 WG @ 0.3g/L	1.53(1.59)	2.65(1.91)	3.33(2.08)	1.30(1.52)	2.25(1.80)	1.70(1.64)	2.13(1.76)	6.71
T_5: T_1 + Neem oil (3000 ppm) @ 5ml/L	1.85(1.69)	3.85(2.20)	4.73(2.38)	2.35(1.82)	4.33(2.31)	3.30(2.05)	3.40(2.07)	5.36
T_6: T_1 + Dinotefuran 20 SG @0.3 g/L	1.43(1.55)	2.55(1.88)	3.78(2.19)	1.65(1.63)	3.00(2.00)	2.00(1.73)	2.40(1.83)	6.48
T_7: T_1 + Dimethoate 30 EC@ 2ml/L	1.80(1.67)	3.53(2.13)	4.38(2.32)	2.00(1.74)	3.98(2.23)	2.95(1.99)	3.10(2.01)	5.69
T_8: LT_2 +Thiamethoxam 25 WG @ 0.2g/L	1.75(1.66)	3.45(2.11)	4.08(2.23)	1.85(1.69)	3.68(2.16)	2.65(1.91)	2.91(1.96)	5.93
T_9: T_2 + Dinotefuran 20 SG @0.3 g	1.53(1.59)	2.65(1.91)	3.88(2.21)	1.75(1.66)	3.45(2.11)	2.45(1.86)	2.62(1.89)	6.27
T_{10}: T_2 + Flonicamid 50 WG @ 0.3g/L	1.48(1.57)	2.45(1.84)	3.83(2.19)	1.80(1.68)	3.45(2.11)	2.45(1.86)	2.58(1.87)	6.19
T_{11}: T_2 + Neem oil (3000 ppm) @ 5ml/L	1.85(1.69)	3.60(2.14)	5.18(2.48)	2.55(1.88)	4.78(2.40)	3.75(2.18)	3.62(2.13)	5.33
T_{12}: T_2 + Dimethoate 30 EC@ 2ml/L	1.83(1.68)	3.45(2.11)	4.53(2.35)	2.15(1.78)	4.08(2.26)	3.05(2.00)	3.18(2.03)	5.53
T_{13}: Untreated Control	2.04(1.74)	5.23(2.49)	8.30(3.05)	9.65(3.24)	11.08(3.48)	8.13(3.02)	7.40(2.84)	3.14
SEm±	0.09	0.12	0.12	0.08	0.10	0.11	0.11	0.43
CD (0.05)	0.29	0.37	0.38	0.26	0.32	0.34	0.33	1.33

DAS: Days after sowing; Figures in the parentheses are square root transformed values $\sqrt{(x+1)}$.

was followed with respect to the thrips population. However, the treatment received second spray recorded less thrips population compared to unsprayed treatments (Table 2).

Grain yield : The highest blackgram yield was recorded in T_4 and T_6 treatments with 6.71 and 6.48 q/ha grain yield, respectively. These two treatments were followed by T_{10} and T_9 treatments with grain yield of 6.27 and 6.19 q/ha, respectively. The lowest grain yield was recorded in untreated control with 3.14 q/ha.

In the present study the plots where the seed treatment with Imidacloprid 60 FS @ 10 ml/Kg or Thiamethoxam 35 FS@ 7.5 ml/Kg was done recorded less thrips and whitefly population up to 25 days after sowing compared to untreated control which recorded highest population of thrips and whiteflies. Hence, the YMV disease incidence upto 30 DAS was also less in seed treated plots than untreated control. The present findings are agreed with Archana *et al.* (2018) and Jayappa *et al.* (2017), where they have revealed that seed treatment with imidacloprid contributed to relatively lowest populations of whitefly. Corresponding results were reported by Rhadika *et al*. (2018), lowest population of whiteflies were recorded in seed treatment with thiamethoxam @ 3 g/kg with 2.40 whiteflies and was on par with seed treatment of imidacloprid @ 5 g/kg with 2.60 whiteflies per six leaves. Further, Shobharani *et al.* (2019) reported that seeds treated with imidacloprid 60 FS @ 10 ml/kg seeds or thiamethoxam 30 FS @ 5.7 ml/ Kg of seeds sown when there is sufficient moisture in the soil was found most effective in managing the early season sucking pests of black gram up to 30-35 DAS. Seed treatment with imidacloprid 600 FS @ 10ml/kg seed significantly recorded lowest population of whitefly, leafhopper and thrips with highest gross and net returns (Anusha *et al.*, 2016).

The population of whiteflies, thrips and MYMV disease incidence gradually increased as the crop growth progressed. The treatments where two sprays of different insecticides were give including seed treatment recorded lowest population of whiteflies, thrips and MYMV incidence compared to only seed treated plots or the untreated control plots. These findings are in accordance with Shobharani *et al.* (2019), who reported that plots where seeds treated with imidacloprid 60 FS or thiamethoxam 30 FS protected the blackgram crop from early season sucking pests 30-35 DAS. Further, in order to manage spread of MYMV incidence by vector there is a need of plant protection measures either by insecticides or plant products or bio-agents. During the present study seed treatment followed by spraying of Flonicamid 50 WG @ 0.3g/L or Dinotefuran 20 SG @0.3 g/L or Thiamethoxam 25 WG @ 0.2g/L were found effective in further b managing the sucking pests and MYMV incidence throughout the cropping period. These findings are in line with Kasi Rao *et al.* (2021), where seed treatment with imidacloprid 600 FS @ 5.0ml/kg and 2 sprays of flonicamid @ 0.4g/l protected the blackgram from whiteflies and MYMV incidence. Swathi (2018) reported that flonicamid 50 WG @ 0.0325% was very effective against the population of whitefly by recording 72.19 per cent reduction and lowest per cent disease incidence (17.66%) in rice fallow balckgram. Mahalakshmi *et al*. (2015) reported that Thiamethoxam 25 WG @ 0.2 g l^{-1} was effective in recording the lowest per cent population of whitefly (45.15) and 30.38 per cent YMV disease incidence in blackgram.

Imidacloprid (0.05%) and thiamethoxam (0.025%) were found to be most effective against whitefly and thrips resulting in highest reduction of population in soybean, greengram, urdbean clusterbean (Iqbal *et al*., 2013; Ahirwar *et al*., 2016 and Singh *et al*., 2016) at Varnasi, Junagadh and other locations. Razaq *et al.* (2005) also observed minimum number of whiteflies (5.39 whiteflies/leaf) in plots treated with diafenthiuron, acetamiprid (5.85 whiteflies / leaf) and imidacloprid (6.03 whiteflies/leaf) at 24 hours after application of insecticides. Venkateshalu and Mahesh Math (2017) also reported that dinotefuran 20% SG @ 30 g *a.i.* can be used for the effective management of sucking pests and for realizing higher okra fruit yield.

From the present study, it was clearly evident that, though the newer insecticide molecules with novel modes of action were able to control the whiteflies very effectively, they could not able to protect the crop absolutely from the incidence of YMV. Hence, the management of YMV should be done through integrated approach, rather than relying upon chemical insecticides completely.

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