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Research Article

MANAGEMENT OF YELLOW MOSAIC DISEASE OF SOYBEAN

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Abstract: To work out the sustainable management of yellow mosaic disease, field experiments were conducted. All the treatments were found to be significantly superior over control, but the plots receiving spray of Imidachloprid (0.3%) at vegetative stage and Azadirachtin (2%) after flowering had minimum PDI least number of whiteflies per plant and maximum grain yield. This was followed by Dimethoate at vegetative stage and Azadirachtin after flowering. One PGPR Bacillus subtilis was also evaluated as seed treatment and also in combination with azadirachtin spray. The purpose was to reduce dependency on harmful synthetic insecticides and also to develop a suitable control strategy for organic farming of soybean.

Keywords: Yellow mosaic disease, Soybean, whitefly, Begomovirus

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Introduction

Soybean (*Glycine max L.* Merrill) is energy rich oil seed and grain legume crop. It is a highly valuable crop in agriculture, which provides high quality plant protein and vegetable oils. It has undergone extensive cultivation from temperate to tropical and subtropical regions. YMD of soybean incited by a whitefly transmitted begomovirus causes considerable loss in yield and it is one of the main constraints in increasing the productivity of this crop [1]. YMD is most destructive and has become a major limiting factor for soybean growing areas of Rajasthan. It is widely distributed in all the pulse growing states of India affecting several legume crops [7]. Yellow mosaic viruses infect major leguminous species greengram, blackgram, cowpea, pigeonpea and soybean, causing annual loss of yield about $300 million [9] and are of the main constraints in increasing the productivity of these crops. The virus is mainly transmitted by whitefly, *Bemisia tabaci* Genn. Keeping these factors in view, this investigation on different management practices for vector control was undertaken.

Materials and Methods

A field experiment was conducted at Rajasthan college of Agriculture, MPUAT, Udaipur during *Kharif* 2011-12 & 2012-13 with eight treatments and three replications. The size of each plot was 3 x 2 m^2 with an inter row spacing of 15 x 30 cm. A susceptible variety JS-335 was used. The treatments included two sprays of insecticides imidachloprid or dimethoate, one botanical (Azadirachtin 1500 ppm) individually, and also in combination of fungicide and botanical (insecticide at vegetative stage and Azadirachtin after flowering) one PGPR (Bacillus spp.) as seed treatment and PGPR as seed treatment in combination with Azadichractin as spray. Spray of insecticide was given at 45 days and 60 days after sowing. Observations for disease severity on standard 0-9 scale and number of plants in each score were recorded 15 days after first spray and 15 days after second spray and percent disease index (PDI), percent efficacy of disease control (PEDC) were calculated. The whitefly population was counted from 10 randomly selected plants from each treatment at early hours of the day. Leaves from top, middle and lower part of each plant were sampled.

Results and Discussion

The pooled data of both year *i.e*. 2011-12 and 2012-13 showed that all the treatments were found to be significantly superior over control at ($P< 0.05$). Plots receiving spray of Imidachloprid at vegetative stage and Azadirachtin after flowering had minimum PDI 16.45, PEDC 61.06 at 15 d after first spray; and PDI 16.0% after 15 d of second spray, PEDC 65.98 percent. This was followed by Dimethoate at vegetative stage and Azadirachtin after flowering where PDI 19.5%, 53.76 PEDC after first spray, 20.3% PDI and PEDC 57.01 after second spray. Next to follow was Imidachloprid spray where PDI was 16.75%, PEDC 60.30 after first spray, 25.05% PDI and 46.94 PEDC after second spray and Dimethoate with PDI 20.35%, PEDC 51.86 after first spray, 27.05% PDI and PEDC 42.64 after second spray. Azadirachtin sprays resulted in 24.8% PDI, 41.22 PEDC after first spray, 29.5% PDI and PEDC 37.12 after second spray. Plots with PGPR seed treatment and Azadichractin spray had 24.6% PDI, 41.48 PEDC after first spray, 28.25% PDI and 39.99 PEDC after second spray, followed by PGPR seed treatment with 37.1% PDI, 11.80 PEDC after first spray, 33.9% PDI and 28.11 PEDC after second spray. The untreated control plots showed the highest YMD (PDI 42.15% after first spray and 47.1 after second spray. (Table 1). The evaluation of different management components against the YMD insect vector, *B. tabaci* during this study evidenced that 5 days after the first spray as well as the second spray of the treatment (T_5) comprising imidachloprid at the vegetative stage and azadirachtin after flowering resulted in significantly maximum reduction of the population of the vector being 61. 38 and 51.50 percent, respectively during 2011-12; however, 5 days after the second spray dimethoate at vegetative stage and azadirachtin after flowering had an equal efficacy with 46.62 percent population reduction that was statistically at par. Among the components evaluated, PGPR as seed treatment (5g /kg) showed the minimum reduction (27.41 and 31.47%) in the vector population 5 days after both the first and second sprays, respectively. The other treatments varied in their response towards reduction in the vector population after the first and second sprays. These management components when evaluated the next year in 2012-13 showed that

Table-1 Management of yellow mosaic disease during 2011-12 and 2012-13

Tr. No.	Management component	PDI 15 days after first spray*			Percent efficacy of disease control (PEDC) 15 days after first spray*			PDI 15 days after second spray			Percent efficacy of disease control (PEDC) 15 days after second spray		
		2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
T_1	Imidachlopridspray (0.3%)	15.20 (22.95)	18.30 (25.33)	16.75 (26.37)	61.94 (51.91)	58.67 (49.99)	60.30 (50.95)	22.4 (28.25)	27.70 (31.75)	25.05 (30.00)	50.43 (45.25)	43.45 (41.24)	46.94 (43.24)
T_2	Dimethoate (0.3%)	17.60 (24.77)	23.10 (29.80)	20.35 (28.04)	55.89 (48.41)	47.83 (43.76)	51.86 (46.08)	24.8 (29.86)	29.30 (32.77)	27.05 (31.32)	45.11 (42.19)	40.18 (39.33)	42.64 (40.76)
T_3	Azadirachtin (Neem based formulation)2%	23.0 (28.65)	26.60 (31.04)	24.80 (29.85)	42.55 (40.71)	39.89 (39.15)	41.22 (39.93)	29.8 (33.08)	29.20 (32.70)	29.50 (32.89)	33.94 (35.59)	40.29 (39.83)	37.12 (37.49)
T_4	PGPR as seed treatment (5g/kg)	36.20 (36.99)	38.0 (38.06)	37.10 (37.52)	9.40 (17.34)	14.20 (22.10)	11.80 (19.72)	31.0 (33.83)	36.8 (37.34)	33.90 (35.59)	31.37 (34.05)	24.85 (29.88)	28.11 (31.97)
T_5	Imidachloprid (0.3%) at vegetative stage and Azadirachtin (2%)after flowering	14.90 (2270)	18.00 (25.09)	16.45 (21.36)	62.75 (52.39)	59.36 (50.40)	61.06 (51.40)	15.20 (22.94)	16.80 (24.19)	16.00 (23.57)	66.31 (54.53)	65.65 (54.13)	65.98 (54.33)
T_6	Dimethoate (0.3%) at vegetative stage and Azadirachtin (2%) after flowering	16.60 (24.03)	22.50 (28.31)	19.55 (24.10)	58.38 (49.84)	49.14 (44.51)	53.76 (47.17)	18.00 (25.10)	22.60 (28.38)	20.30 (26.74)	60.16 (50.86)	53.86 (47.22)	57.01 (49.04)
T_7	PGPR as seed treatment plus Azadichractin (2%) as spray	24.20 (29.47)	25.0 (29.99)	24.60 (29.73)	39.39 (38.86)	43.57 (41.30)	41.48 (40.08)	26.20 (30.79)	30.30 (33.40)	28.25 (32.09)	41.93 (40.35)	38.05 (38.07)	39.99 (39.21)
T_8	Untreated control	40.00 (39.23)	44.30 (41.73)	42.15 (40.48)	0.00	0.00	0.00	45.20 (42.24)	49.00 (44.43)	47.10 (43.34)	0.00	0.00	0.00
SEm±		0.69	0.47	0.26	1.65	0.92	0.94	0.41	0.45	0.30	0.77	0.77	0.55
CD at 5%		2.09	1.42	0.77	4.99	2.78	2.73	1.24	1.35	0.88	2.35	2.35	0.59

Figures in parenthesis are angular transformed values * Sprays were given at 45 days and 60 days after sowing

Table-2 Effect of different management components on whitefly population infesting soybean during 2011-12 and 2012-13

Tr. No.	Vector Management Components	Population Reduction (%) in 2011-12				Population Reduction (%) in 2012-13			
		I-spray 45 DAP		II-spray 60 DAP		I-spray 45 DAP		II-spray 60 DAP	
		PTP	5 DAS	PTP	5 DAS	PTP	5 DAS	PTP	5 DAS
T1	Imidachloprid spray (0.3%)	4.10	52.45d (62.85)	3.00	39.44abc (40.36)	4.20	48.73de (56.49)	2.90	50.34d (59.26)
T2	Dimethoate (0.3%)	4.25	50.14c (58.92)	3.10	37.74ab (37.46)	4.25	46.71d (52.98)	2.80	46.63c (52.84)
T3	Azadirachtin (Neem based formulation) - (0.2%)	4.30	40.88b (42.83)	3.20	35.14a (33.12)	4.20	37.78c (37.53)	2.95	44.09ab (48.41)
T4	PGPR as seed treatment (5g /kg)	4.27	27.41a (21.19)	4.60	31.27a (26.94)	4.40	24.98a (17.83)	3.65	41.60a (44.07)
T5	Imidachloprid(0.3%) at vegetative stage and Azadirachtin (2%) after flowering	3.90	61.38f (77.05)	2.25	51.50de (61.24)	3.40	59.19g (73.76)	2.40	61.05f (76.56)
T6	Dimethoate (0.3%)at vegetative stage and Azadirachtin 2% after flowering	4.00	56.35e (69.29)	2.60	46.62d (52.82)	3.97	56.66f (69.79)	2.75	54.50e (66.27)
T7	PGPR as seed treatment plus Azadichractin2 % as spray	4.20	28.58a (22.88)	4.50	32.94a (29.56)	4.30	32.23b (28.44)	4.00	42.72a (46.02)
T8	Untreated control	4.15		4.32		4.12		3.20	
S. Em. ±		0.068	0.74	0.074	1.69	0.097	0.74	0.068	0.72
C. D. (p = 0.05)		0.209	2.27	0.228	5.20	0.301	2.28	0.210	2.22

PTP = Pre-treatment population data as mean numbers of whitefly per trifoliate. DAP = Days after planting; DAS = Days after spray
Figures in parentheses are retransformed percent values

the treatments (T5) comprising imidachloprid at vegetative stage and azadirachtin after flowering significantly caused the maximum reduction (59.19 and 61.05%) in the population of the vector (*B. tabaci*) as observed 5 days after the first and second sprays, respectively. Similar to the effect recorded in the previous year, PGPR as seed treatment (5g /kg) showed the minimum reduction (24.98 and 41.60%) in the vector population 5 days after both the first and second sprays, respectively (Table 2). All the treatments were found to be significantly superior over control, but the plots receiving spray of Imidachloprid at vegetative stage and Azadirachtin after flowering had minimum PDI least number of whiteflies per plant and maximum grain yield. This was followed by Dimethoate at vegetative stage and Azadirachtin after flowering. Several insecticides have been recommended for control of white fly [2, 4]. One PGPR Bacillus subtilis was also evaluated as seed treatment and also in combination with azadirachtin spray. The purpose was to avoid / reduce dependency on harmful synthetic insecticides and also to develop a suitable control strategy for organic farming of soybean. PGPR are known to induce resistance in the host plant-virus interactions, like tomato mottle virus [6] *Banana bunchy top virus* [5] and Cucumber mosaic virus (CMV) associated with viral satellite RNAs [3]. Azadirachtin, a neem-based botanical is known to have insecticidal properties and its use for disease and pest suppression is well documented [4,8]

Conclusion

The studies showed crop could be protected from heavy loss due to spray of Imidachloprid at vegetative stage and Azadirachtin after flowering and hence proved the superiority of sprays in controlling whitefly vector over all other management practices which had minimum PDI, least number of whiteflies per plant.

Application of research: Study help in sustainable management of Yellow Mosaic disease and also reduce dependency of harmful synthetic pesticides

Research Category: Plant virology

Abbreviations:

PDI: Percent disease index, PEDC: Percent efficacy of disease control, YMD: Yellow mosaic disease

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