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Evaluation of integrated pest managment components for the management of shoot fly, shoot bug and aphid in rabi sorghum

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Abstract: A field trial was conducted at the Regional Agricultural Research Station, Bijapur during post rainy seasons of 2006-07 and 2007-08 to find out eco-friendly management tactics for the suppression of shoot fly, shoot bug and aphid in rabi sorghum. The results revealed that, four treatments *viz.,* intercropping of chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed, seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of NSKE @ 5% at 45 days after emergence of crop (DAE), seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of endosulfan @ 0.07% at 45 DAE and seed treatment with thiamethoxam 70 WS @ 3 g/kg seed alone were effective in reducing the shoot fly, shoot bug and aphid incidence and thereby harnessed higher sorghum grain equivalent yield, fodder yield and net returns. Intercropping of sorghum with chickpea (2:2 row proportions) was not a good option from point of insect pest suppression and higher returns.

Key words: Sorghum, shoot fly, aphid, shoot bug, thiamethoxam, intercropping, chickpea

Introduction

Sorghum is vulnerable to over 150 insect species from sowing to the final crop harvest (Sharma, 1985). In this region three insect pests namely, shoot fly, shoot bug and aphids are the important regular pests. The sorghum shoot fly, *Atherigona soccata* Rondani (Diptera: Muscidae) causes severe damage in the early stage and lasts up to four weeks causing severe reduction in plant population. Maximum yield losses of 75.6 per cent in grain and 68.6 per cent in fodder have been reported by Pawar *et al.* (1984). Its incidence is greater in late sown crop in rainy and post rainy seasons in India. Several workers have tried different insecticides for this pest (Shivpuje and Thombare, 1983; Patil *et al*., 1992; Panchabhavi and Kotikal, 1992). Sorghum aphid, Melanaphis sacchari (Zehntner) is distributed in Asia, Africa and Americas. It prefers to feed on the under surface of older leaves, resulting in premature drying of leaves, non-filling of grains and deterioration of fodder quality. Spraying or dusting of several insecticides are being recommended for its control. The shoot bug, *Peregrinus maidis* (Ashmead) previously considered to be of minor importance, but now with the introduction of new sorghum genotypes of different maturity periods in certain parts of Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu has become a serious pest. The shoot bug is a major hurdle in rabi sorghum production by causing dual problem of direct loss by sucking the sap and indirect damage by transmitting sorghum stripe virus disease. Hence, it comes in the way of harvesting potential yield of grain and fodder. Managing the pest in established sorghum ecosystem through chemical spraying has several limitations. Farmers are unable to go for spraying due to increased cost of production of sorghum and also phytotoxic effect of these insecticides on foliage. Hence, different IPM components were evaluated in comparison with farmer's practice for the management of shoot fly, shoot bug and aphid in rabi sorghum.

Material and methods

A field trial was conducted at the Regional Agricultural Research Station, Bijapur, Karnataka, India during two consecutive rabi seasons of 2006-07 and 2007-08 under rainfed conditions in a randomized block design replicated thrice with seven treatments including farmer's practice (Table 1). The commercial sorghum variety CSV 216R was planted by dibbling the seeds at a spacing of 60 x 15 cm in a plot size of 3.6 x 5.0 m, each having six rows of 5.0 m length. For intercropping treatment in T_2 and T_3, paired rows of sorghum having 45 cm within pairs and 90 cm between pairs was followed where in two rows of chickpea (variety- A 1) were sown between sorghum pairs with 30 cm row spacing in such away that six rows of sorghum and four rows of chickpea were accommodated. In the case farmer's practice seed hardening was done i.e., the seeds were soaked in water for 8 hours, dried in shade and used for sowing. The thinning of sorghum plants was done a week after emergence of the crop. For the treatments involving seed treatment, sorghum seeds were treated with test insecticide using 1% acacia gum followed by shade drying for three hours before sowing. The total number of plants and number of plants showing deadheart symptoms were recorded in each treatment on 28th day after emergence of the crop. The percentage of deadhearts caused by shoot fly was worked out and subjected to angular transformations before analysis. The shoot bug population was counted on randomly selected five plants in each treatment at 50 days after sowing. The aphid incidence was recorded and per cent aphid index was worked out by following the methods of Balikai and Lingappa (2002) when the aphid incidence was at its peak during January second week (80 days after sowing). The data were subjected to angular transformations before statistical analysis. Later, grain yield (of sorghum and chickpea) and fodder yields were recorded, converted to quintals per hectare. Sorghum grain equivalent yield was also worked out. The data were analyzed statistically.

Results and discussion

The results of the study are consistent over two years of experimentation and hence the pooled results over two years have been discussed. Two years pooled results revealed that the treatments *viz.,* T_3 (intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed), T_4 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of NSKE @ 5% at 45 DAE), T_5 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of endosulfan @ 0.07% at 45 DAE) and T_1 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed) recorded 4.3, 4.6, 4.6 and 4.7 per cent deadhearts due to shoot fly; 11.8, 13.2, 12.1 and 12.6 per cent aphid index and were on par with each other. These four treatments were significantly superior over rest of the treatments [T_2 (Intercropping with chickpea (2:2)), T_6 (Seed hardening (Farmers practice) and T_7 (Untreated check)] (Table 1). Karibasavaraja *et al*. (2005) also reported that, the seed treatment with thiamethoxam 70 WS @ 5 and 4 g a.i./kg seeds were very effective in reducing shoot fly incidence even under high pest population. The results of the present study are in conformity with the findings of Balikai (2003) who reported 4.5 per cent shoot fly deadhearts with thiamethoxam 70 WS @ 4 g/kg seeds. Similarly, the results of study conducted by Katole *et al*. (2003) also support the present findings.

The lowest shoot bug population of 9.2/ 5 plants was recorded in T_5 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of endosulfan @ 0.07% at 45 DAE) followed by T_4 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of NSKE @ 5% at 45 DAE) with 13.1shoot bugs/ 5 plants and were on par with each other. The next best treatments were T_3 (intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed) and T_1 (Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed) with 17.5 and 18.3 shoot bugs/ 5 plants. The rest of the treatments [T_2 (Intercropping with chickpea (2:2)), T_6 (Seed hardening (Farmers practice) and T_7 (Untreated check)] were significantly inferior to above treatments. The results of the present study are in conformity with the findings of Anaji and Balikai (2007), Vijaykumar (2004) and Bheemanna *et al.* (2003) with respect to efficacy of thiamethoxam 70 WS against shoot bug. The treatment T_2 (Intercropping with chickpea (2:2)) alone did not suppress any of the pests i.e., shoot fly, aphid or shoot bug population and the chickpea seed cost was an additional cost in this intercropping treatments, thus resulting in no net profit. However, in treatment T_3 (intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed), there was a better control of shoot fly, shoot bug and aphid which resulted in net profit of Rs. 3996/ha (Table 2).

The treatments *viz.,* T_5, T_4, T_1 and T_3 recorded higher fodder yield of 3.87, 3.84, 3.64 and 3.45 t/ha, respectively. Similarly the treatments *viz.,* T_5, T_4, T_1 and T_3 recoded sorghum grain equivalent yield of 23.29, 22.64, 22.42 and 21.69 q/ha, respectively with increased returns of Rs. 7260, 6480, 6216 and 5340/ha, respectively; thus harnessing net profit of Rs. 6954, 6098, 6072 and 3996/ha, respectively (Table 2). These results corroborate

Table 1. Efficacy of different integrated pest management components against sorghum shoot fly, aphid and shoot bug

Tr. No.	Treatments	Shoot fly DH (%) at 28 DAE			% Aphid index at 80 DAS			Shoot bug population/ 5 plants at 50 DAS		
		2006-07	2007-08	Mean	2006-07	2007-08	Mean	2006-07	2007-08	Mean
T_1	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed	4.8 (12.7)	4.6 (12.4)	4.7 (12.5)	11.3 (16.6)	13.9 (21.9)	12.6 (19.3)	21.7	14.80	18.3
T_2	Intercropping with chickpea (2:2)	35.0 (36.3)	31.2 (34.0)	33.1 (35.2)	55.4 (48.1)	58.7 (50.0)	57.0 (49.1)	66.7	47.43	57.1
T_3	Intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed	4.2 (11.8)	4.3 (11.9)	4.3 (11.8)	10.3 (18.7)	13.2 (21.3)	11.8 (20.0)	20.5	14.47	17.5
T_4	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of NSKE @ 5% at 45 DAE	4.7 (12.5)	4.5 (12.2)	4.6 (12.3)	12.4 (20.7)	14.1 (22.1)	13.2 (21.4)	15.4	10.87	13.1
T_5	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of endosulfan @ 0.07% at 45 DAE	4.5 (12.3)	4.7 (12.5)	4.6 (12.4)	11.7 (19.9)	12.4 (20.6)	12.1 (20.2)	10.2	8.23	9.2
T_6	Seed hardening (Farmers practice)	34.7 (36.1)	30.8 (33.8)*	32.8 (34.9)	54.3 (47.5)	58.5 (49.9)	58.2 (48.7)	68.3	48.17	58.2
T_7	Untreated check	35.8 (36.8)	31.1 (33.9)	33.5 (70.7)	55.8 (48.3)	58.5 (49.9)	57.2 (49.1)	69.2	49.00	59.1
	S.Em.±	0.7	0.6	0.7	1.2	0.5	0.9	2.1	0.96	1.7
	C.D. (5%)	2.3	1.8	2.0	3.6	1.7	2.8	6.5	2.97	5.2

Figures in the parentheses are arcsine transformed values; DH- Deadhearts; DAE- Days after emergence; DAS- Days after sowing

with the findings of previous workers with respect to thiamethoxam (Vijatakumar, 2004, Bheemanna *et al*., 2003 and Anaji and Balikai ,2007. The results of the present study are in conformity with the findings of Balikai (2003) who reported highest grain yield of 32.1q/ha with thiamethoxam 70 WS @ 4 g/ kg seeds. Similarly, the results of study conducted by Katole *et al.* (2003) also support the present findings.

Thus, it can be concluded that either seed treatment with thiamethoxam 70 WS @ 3 g/kg seed alone or in addition to seed treatment one spray with endosulfan @ 0.07 per cent or NSKE @ 5 per cent at 45 days after crop emergence (looking to shoot bug or aphid incidence) could be recommended for the effective management of all the three major pests of sorghum including shoot fly, shoot bug and aphids. The intercropping with chickpea is not a profitable option.

Table 2. Effect of different integrated pest management components on fodder and sorghum grain equivalent yield and their cost economics

Tr. No.	Treatments	Fodder yield (t/ha)			Sorghum grain equivalent yield (q/ha)			Returns from increased yield (Rs/ha)	Extra cost including protection (Rs./ha)	Net profit (Rs./ha)
		2006-07	2007-08	Mean	2006-07	2007-08	Mean			
T_1	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed	4.16	3.13	3.64	24.70	20.10	22.42	6216	144	6072
T_2	Intercropping with chickpea (2:2)	3.14	2.53	2.84	18.50	15.98	17.24	0.00	1200	-1200
T_3	Intercropping with chickpea (2:2) + seed treatment with thiamethoxam 70 WS @ 3 g/kg seed	3.85	3.05	3.45	24.30	19.01	21.69	5340	1344	3996
T_4	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of NSKE @ 5% at 45 DAE	4.25	3.43	3.84	24.80	20.47	22.64	6480	382	6098
T_5	Seed treatment with thiamethoxam 70 WS @ 3 g/kg seed + spray of endosulfan @ 0.07% at 45 DAE	4.29	3.44	3.87	25.10	21.47	23.29	7260	306	6954
T_6	Seed hardening (Farmers practice)	3.43	2.84	3.14	19.10	15.57	17.34	120	0.00	120
T_7	Untreated check	3.42	2.71	3.07	19.00	15.47	17.24	-	-	-
	S.Em.±	0.09	0.08	0.08	0.81	0.71	0.77	-	-	-
	C.D. (5%)	0.29	0.25	0.26	2.50	2.19	2.31	-	-	-

DAE- Days after emergence; DAS- Days after sowing

Market Rates: Sorghum grains- Rs. 1200 /q; Chickpea seeds- Rs. 1800/q

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