Efficacy of biopesticides against whiteflies and jassids of soybean

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ABSTRACT

Tested biopesticides were significantly superior over untreated check on 1 and 3-days after spray, but did not show any significant effect on the sap sucking pest population 7-days after spray. Of the biopesticides tested, *A. indica* seed kernel extract (5%) was most effective against whiteflies and jassids 1 and 3 days after the first and second sprays; however, after the third spray, the treatment schedule comprising *A. indica* oil followed by SL-NPV and later by *A. indica* seed kernel extract caused maximum reduction of jassids population. The treatment comprising *A. indica* leaf extract (10%) proved to be least effective against jassids and whiteflies. *A. indica* seed kernel extract (5%) was significantly more effective in causing the maximum population reduction of whiteflies and jassids after the three sprayings and *A. indica* oil (1%) application was the next in order of efficacy.

Keywords: Soybean, Biopesticides, Sprays, Population, Insect pests.

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INTRODUCTION

Soybean is a major oilseed crop in India and is grown in the states of Madhya Pradesh, Maharashtra, Karnataka, Uttar Pradesh, Rajasthan, Tamil Nadu, Andhra Pradesh and Uttarakhand. About 275 insect species have been recorded infesting soybean in India; among these, defoliators and sap–sucking insects are the major constraints to soybean production (Raju *et al*., 2013). Chemical pesticides played an important role in green revolution through which we realized higher yields. The use of synthetic insecticides in crop protection programmes around the world has resulted in disturbances of the environment, pest resurgence, pest resistance to pesticides and lethal effect to non target organisms in the agro-ecosystems in addition to direct toxicity to users. Therefore, it has now become necessary to search for alternative means of pest control, which can minimize the use of synthetic pesticides. Botanical pesticides are an important alternative to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellency, antifeedance and insect growth regulatory activities against pests of agricultural importance (Prakash and Rao, 1986; Prakash *et al*., 1989). In fact botanical pesticides have been in use in Indian agriculture for over a century to minimize losses caused by pests and diseases (Prakash *et al*., 1990, 1997; Parmar and Dev Kumar, 1993). Neem byproducts control gypsy moths, leaf miners, sweet potato whiteflies, western flower thrips, loopers, caterpillars and mealy bugs as well as some of the plant diseases, including certain mildews and rusts (Dubey *et al*., 2011). They are locally available, relatively cheap, biodegradable and easy to handle which enable to minimize input cost of management for insect pests of soybean and maintain the ecosystem balance. As agriculture is gradually shifting towards organic farming, they have much better scope in pest management tactics.

MATERIALS AND METHODS

The investigations were carried out at the Instructional Farm of Rajasthan College of Agriculture, MPUAT, Udaipur for two successive crop seasons, *kharif* 2015 and

2016. Udaipur is located at 23.4°N Longitude and 75°E Latitude at an elevation of 579.5 MSL in the state of Rajasthan. The commonly recommended bio-pesticides were evaluated for their efficacy against whiteflies and jassids of soybean during the two successive crop seasons of kharif 2015 and 2016. The trial was laid out with 5 treatments replicated four times in uniformly sized plots measuring 4m x 3m in Randomized Block Design; in all there were 20 plots. Soybean variety JS-335 was sown in July in the two successive years 2015 and 2016; the row to row and plant to plant spacing for soybean were 30 cm and 10 cm, respectively. The treatment included: T_1-untreated control; T_2-*Azadirachta indica* oil (1%); T_3-*Azadirachta indica* seed kernel extract (5%); T_4-*Azadirachta indica* leaf extract (10%); T_5- *A. indica* oil + SL-NPV + *A. indica* seed kernel extract.

***Azadirachta indica* seed kernel extract**

Fifty grams of powdered seeds of neem kept in muslin cloth was soaked overnight in one litre of water, later squeezed through muslin cloth and the extract collected was diluted as per requirement and used for spraying.

***Azadirachta indica* leaf extract**

For five litres of water, one kg of green neem leaf was required. The leaves were soaked overnight in water; the next day, they were ground wet and the extract filtered for use and diluted to the required concentration (Nandagopal and Ghewande, 2014)

Observations

The population reduction of sap sucking insect pests was estimated using the Henderson and Tilton (1955) method. Observations were recorded one day before and 1, 3 and 7 days after biopesticide application.

$$\text{Population reduction } (\%) = \left[1 - \frac{T_a \times C_b}{T_b \times C_a}\right] \times 100$$

Where,

Ta = Number of insects in treatment after spray

Tb = Number of insects in treatment before spray

Ca = Number of insects in untreated check after spray

Cb = Number of insects in untreated check before spray

RESULTS

Whiteflies-First spray

The incidence of whiteflies given in Table 1 and 2 reveal that the mean pre-treatment population per plant varied from 5.50 to 5.75 in 2015 and 1.05 to 1.10 in 2016. One and three days after spray, the maximum mean reduction in population of whiteflies was 24.34 and 50.37 per cent during 2015 and 86.22 and 94.69 per cent during 2016, respectively, as recorded for *A. indica* seed kernel extract, that was significantly superior to the other biopesticides; whereas, the minimum reduction of 8.20 and 25.45 per cent in 2015 and 30.41 and 30.85 per cent in 2016 was recorded in the treatment with *A. indica* leaf extract.

Second spray

Before the second spray the mean pre-treatment population of whiteflies did not vary significantly among different treatments and ranged from 6.85 to 7.30 and 1.15 to 1.95 during 2015 and 2016 respectively. One and three days after spray, the maximum reduction in whiteflies population was 52.48 and 62.38 in first year and 52.16 and 84.90 per cent in the second year respectively for *A. indica* seed kernel extract. The minimum reduction of 13.30 and 20.27 per cent during 2015 and 14.28 and 37.58 per cent during 2016 was recorded for *A. indica* leaf extract treatment.

Third spray

Before the third spray, whiteflies mean population per plant varied from 5.30 to 5.45 and 6.05 to 6.10 during 2015 and 2016 respectively. One and three days after spray, the maximum reduction in the population of whiteflies was 60.85 and 56.89 per cent in 2015 and 29.87 and 47.73 per cent in 2016 respectively, as recorded in the treatment schedule *A. indica* oil as first spray, followed by Sl-NPV against tobacco caterpillar and then by *A. indica* seed kernel extract. The treatment of *A. indica* leaf extract was least effective with 15.82 and 28.36 per cent in 2015 and 7.43 and 14.19 per cent reduction in 2016, one and three days after spray.

Table 1. Efficacy of biopesticides against whiteflies infesting soybean during *kharif*, 2015

Treatments	Mean whiteflies population reduction (%)											
	1st Spray				2nd Spray				3rd Spray			
	PTP*	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS
T_1	5.75	00.00	00.00	00.00	7.30	00.00	00.00	00.00	5.45	00.00	00.00	00.00
T_2	5.70	25.33	37.69	35.16	7.10	31.07	28.46	38.68	5.35	34.90	34.37	33.62
T_3	5.50	29.56	45.21	37.85	6.85	46.42	52.17	45.38	5.30	36.64	42.21	39.21
T_4	5.60	16.64	30.30	24.69	7.20	21.39	26.76	30.59	5.40	23.44	32.18	25.21
T_5	5.60	22.41	35.26	31.29	7.20	23.79	28.47	33.97	5.40	51.27	48.96	38.20
S. Em. ±		1.18	1.54	NS		2.55	3.06	NS		2.75	1.81	NS
CD (P=0.05)		3.79	4.94			8.14	9.80			8.79	5.79	

Legend: T_1 Untreated control; T_2 *A. indica* oil (1%); T_3 *A. indica* seed kernel extract (5%); T_4 *A. indica* leaf extract (10%); T_5 *A. indica* oil + SL-NPV+ *A. indica* seed kernel extract; *Pre-treatment population= PTP (Mean/plant); DAS= Days after spray, NS=Non-significant

Table 2. Efficacy of biopesticides against whiteflies infesting soybean during *kharif*, 2016

Treatment	Mean whiteflies population reduction (%)											
	1st spray				2nd spray				3rd spray			
	PTP*	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS
T_1	1.10	00.00	00.00	00.00	1.95	00.00	00.00	00.00	6.10	00.00	00.00	00.00
T_2	1.05	48.09	51.25	45.92	1.50	41.95	53.77	36.69	6.05	19.62	27.19	19.97
T_3	1.10	68.21	76.68	50.82	1.15	46.24	67.13	35.45	6.05	26.71	36.97	26.60
T_4	1.10	33.47	33.74	29.67	1.55	22.20	37.81	22.68	6.10	15.82	22.13	16.23
T_5	1.10	47.76	49.76	49.78	1.45	34.10	56.12	39.48	6.10	33.13	43.70	29.60
S. Em. ±		3.46	3.74	NS		1.86	2.69	NS		1.93	1.64	NS
CD (P=0.05)		11.06	12.05			5.95	8.59			6.16	5.23	

T_1 Untreated control; T_2 *A. indica* oil (1%); T_3 *A. indica* seed kernel extract (5%); T_4 *A. indica* leaf extract (10%); T_5 *A. indica* oil + SL-NPV+ *A. indica* seed kernel extract; *Pre-treatment population= PTP (Mean/plant); DAS= Days after spray, NS=Non-significant

Jassids-First spray

The mean pre-treatment population of jassids per plant varied from 9.50 to 11.05 in 2015 and 1.50 to 1.70 mean/plant in 2016. One and three days after spray, the maximum mean reduction in population of jassids was 57.22 and 75.83 per cent during 2015 and 43.78 and 93.09 per cent during 2016 respectively, as recorded for *A. indica* seed kernel extract that was significantly superior to the other bio-pesticides; whereas, the minimum reduction of 22.17 and 44.79 per cent in 2015 and 14.97 and 59.86 per cent in 2016 was recorded in the treatment with *A. indica* leaf extract.

Second spray

The second spray was applied for the management of the tobacco caterpillar in both the years; however, the efficacy against jassids was also observed. Before the second spray the mean pre-treatment population of jassids

per plant did not vary significantly among different treatments and ranged from 4.25 to 5.80 and 1.60 to 1.65 during 2015 and 2016 respectively. One and three days after spray, the maximum reduction in jassids population 63.73 and 45.64 per cent in first year and 81.26 and 93.20 per cent in the second year respectively was recorded for the treatment comprising *A. indica* seed kernel extract. The minimum reduction of 33.92 and 12.23 per cent during 2015 was recorded in the treatment schedule *A. indica* oil as first spray, followed by Sl-NPV against tobacco caterpillar and then by *A. indica* seed kernel extract; while, 30.40 and 32.37 per cent during 2016 was recorded for *A. indica* leaf extract treatment.

Third spray

Before the third spray the mean jassids population per plant varied from 6.45 to 6.80 and 2.15 to 2.20 during 2015 and 2016 respectively. One and three days after spray, the maximum reduction in the population of jassids was recorded in the treatment schedule *A. indica* oil as first spray, followed by Sl-NPV against tobacco caterpillar and then by *A. indica* seed kernel extract. The treatment of *A. indica* leaf extract was least effective with 8.32 and 21 71 in 2015 and 22.11 and 25.68 per cent reduction in 2016, one and three days after spray. The data are presented in Tables 3 and 4.

Table 3. Efficacy of biopesticides against jassids infesting soybean during *kharif*, 2015

Treatments	Mean jassids population reduction (%)											
	1st spray				2nd spray				3rd spray			
	PTP*	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS
T_1	11.05	00.00	00.00	00.00	5.80	00.00	00.00	00.00	6.80	00.00	00.00	00.00
T_2	10.65	29.25	46.55	30.15	4.95	42.76	27.68	36.91	6.60	19.14	30.57	27.78
T_3	9.50	47.42	60.55	35.92	4.25	52.97	42.50	32.78	6.50	32.58	42.02	37.13
T_4	10.70	28.09	42.01	28.68	4.90	37.31	22.29	29.43	6.75	16.77	27.77	22.45
T_5	10.60	29.05	46.45	29.65	4.80	35.62	20.47	25.25	6.45	37.94	45.02	39.29
S. Em. ±		2.34	2.03	NS		1.31	1.32	NS		2.29	2.13	NS
CD (P=0.05)		7.48	6.51			4.20	4.21			7.33	6.82	

T_1 Untreated control, T_2 *A. indica* oil (1%), T_3 *A. indica* seed kernel extract (5%); T_4 *A. indica* leaf extract (10%); T_5 *A. indica* oil + SL-NPV + *A. indica* seed kernel extract; *Pre-treatment population= PTP (Mean/plant); DAS= Days after spray, NS=Non-significant.

Table 4. Efficacy of biopesticides against jassids infesting soybean during *kharif*, 2016

Treatments	Mean jassids population reduction (%)											
	1st Spray				2nd Spray				3rd Spray			
	PTP*	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS	PTP	1st DAS	3rd DAS	7th DAS
T_1	1.70	00.00	00.00	00.00	1.65	00.00	00.00	00.00	2.20	00.00	00.00	00.00
T_2	1.50	33.91	56.44	41.07	1.65	44.04	50.83	41.83	2.20	36.18	41.74	36.74
T_3	1.50	41.43	74.76	46.44	1.60	64.35	74.89	46.89	2.15	44.64	46.40	41.93
T_4	1.60	22.76	50.69	41.19	1.65	33.46	34.68	30.56	2.20	28.05	30.45	32.27
T_5	1.50	26.74	56.47	42.33	1.60	47.16	50.35	42.35	2.15	46.33	51.49	46.63
S. Em. ±		1.87	2.42	NS		2.84	3.56	NS		2.07	2.25	NS
CD (P=0.05)		5.97	7.74			9.10	11.38			6.63	7.19	

T_1 Untreated control; T_2 *A. indica* oil (1%); T_3 *A. indica* seed kernel extract (5%); T_4 *A. indica* leaf extract (10%); T_5 *A. indica* oil + SL-NPV+ *A. indica* seed kernel extract; *Pre-treatment population= PTP (Mean/plant); DAS= Days after spray, NS=Non-significant

DISCUSSION **05**

The overall efficacy of the biopesticides evaluated after three sprays indicated that *A. indica* seed kernel extract was significantly most effective in causing the maximum population reduction of whiteflies and jassids 1 and 3 days after the first, second and third sprays; while, *A. indica* oil application was the next in order of efficacy. The treatment with *A. indica* leaf extract was least effective against jassids and whiteflies on soybean. Likewise, among the different treatment schedules, the schedule comprising *A. indica* oil as first spray, followed by SL-NPV against tobacco caterpillar as the second spray, then followed by *A. indica* seed kernel extract as third spray was most effective against whiteflies and jassids during both the years of study.

Botanical insecticides have proven to be more environments friendly. Neem is one plant source of botanical pesticide that can be used for pest control. Based on the content of active ingredient, neem seeds and leaves contain azadirachtin as the main active compound, meliantriol, salanin and nimbin, which are secondary metabolites from the neem tree (Ascher, 1993; Mordue and Blackwell, 1993), that are concentrated more in the seed and the bark (Vietmeyer, 1992). The active compounds of neem tree do not kill pests quickly, but they negatively affect feeding, growth, reproduction power, molting process, disrupt mating, and sexual communication; decrease egg hatchability; and inhibit formation of chitin (Schmutterer and Singh, 1995). These active compounds of neem are reported to effect approximately 400 insects (Howatt, 1994). Neem products like neem seed kernel extract (5%) are effective in managing the population of whiteflies in mungbean (Hussain *et al*., 2001). Lal and Jat (2015) observed that three days after spray application, the lowest whiteflies population was noted in NSKE (5%) sprayed plots. At seven days after spray, NSKE (5%) and triazophos (0.04%) were the most effective in keeping the whiteflies incidence and yellow mosaic virus infection low. Triazophos and NSKE did not help in managing the whiteflies population at low levels up to 10-days after spray application.

The superiority of NSKE (5%) and neem leaf extract (10%) against pests of Indian bean noticed in the present study conforms to the report of Ramasubramanian and Babu (1991). Neem leaf extract (Patel, 1998) and NSKE (Desai, 2000) have shown promising results against *Aphis craccivora* on cowpea. Dalwadi *et al*. (2008) reported the treatments of NSKE (5%) and NLE (10%) were significantly promising in suppressing the leafhopper, *Empoasca kerri* population over other botanical insecticides. Plots treated with Gronim (1%) and NFLE (10%) also showed reduction of leafhopper population in appreciable number. Plots sprayed with NSKE yielded maximum (2913.81 kg/ha) green pods followed by NLE (2681.11 kg/ha) and Gronim (2543.21kg/ha) and these three treatments were significantly superior to rest of the treatments evaluated. Chandrasekharan and Balasubramanian (2002) reported that acephate 75 SP @ 0.075 per cent and TNAU neem oil (C) 60 EC at 3.0% were significantly superior by recording higher percentage of reduction in aphid population and yellow mosaic virus (YMV) incidence due to whiteflies and also with grain yield recording 8.5 and 7.4 q/ha respectively.

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