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Efficacy of Biopesticides and Botanicals Against Fennel Aphid

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ABSTRACT

A field experiment on the relative efficacy of botanical and biopesticides against aphid *Hyadaphis coriandri* (Das) on fennel was conducted in 2021-22. The results revealed that azadirachtin 0.03 EC proved most effective, followed by NSKE (5%) and Neem oil (1%), whereas, *Metarhizium anisopliae* 1.15 WP, *Beauveria bassiana* 1.15 WP and *Leacanicillium lecani* 1.15 WP were proved least effective. The treatment of Karanj oil (1%) and karanj seed extracts (5%) were found moderately effective against aphid.

Keywords: Hyadaphis coriandri , fennel, biopesticides, azadirachtin, Karanj oil, karanj seed extracts

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INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.; chromosome number 2n=22) is an herbaceous biennial or perennial plant belongs to family Apiaceae. It is originated from Southern Europe and Mediterranean region. It is commonly known as '*Variali*' in Gujarati, whereas 'Saunf' in Hindi and considered as an important seed spices crop (Kanjiya *et al*., 2018). It is mainly grows in *Rabi* season. In India, it cultivates commercially for various uses. Being an important seed spice, it is growing mainly in the states of Gujarat, Rajasthan, Uttar Pradesh, Karnataka, Bihar, Maharashtra, Punjab, Tamil Nadu, Haryana and Madhya Pradesh (Meena *et al*., 2020). In 2019-20 total area under the crop in India is about 83 thousand hectares with production of 140 thousand metric tonnes with productivity of 1687 kg/ ha (Anonymous, 2020a). In Rajasthan, The area of 30.67 thousand hectares with an annual production of 35.29 thousand metric tonnes and productivity 1150.33 kg/ ha. during 2019-20 (Anonymous, 2020b). The low productivity of fennel has been attributed to various abiotic and biotic factors. Insect-pests are major biotic constraints in achieving potential fennel production. The crop was infested by different species of insect pests *viz*; Jassids, *Empoasca kerri* (Das), thrips (*Thrips tabaci*, and *Thrips flavus* schrank), whitefly, *Bemisia tabaci* Genn., aphids (*Hyadaphis coriandri* Das and *Aphis gossypii* Glover) and some bugs cause damage by sucking the cell sap of plants. *Chalcid* wasp, *Systole albipennis* Walker, cutworms, *Agrotis* sp., lepidopteran caterpillars and grasshopper, *Acrida* sp., are another types of pests damage on fennel during winter season crop under semi-arid conditions of Rajasthan (Meena *et al*., 2020).

Among the insect pests of fennel, aphid, *H. coriandri* was reported to be regular in Rajasthan and other parts of the country. Mittal and Butani (1989) recorded the losses of fennel seeds caused by aphid up to 903 kg/ ha, which means 50 per cent of the crop losses in Gujarat and it is considered as a major or key pest of fennel which poses a threat to seed spices under Gujarat condition. The aphid population fluctuates in different month of crop growth period and can be controlled by application of foliar spray timely before emergence of severe infestation of aphid. The use of botanicals and biopesticides for management of aphid is a part of this work for effective management of this pest and avoiding harmful effect to the predators.

MATERIALS AND METHODS

The field experiment was laid out in a randomized block design (RBD) with nine treatments and replicated thrice. The fennel variety RF-205 recommended for this region was used and the plot size was 2.0 m x 2.25 m, keeping row to row and plant to plant spacing of 45 cm and 20 cm, respectively. The crop was sown on 30th October 2021. The treatments included were azadirachtin 0.03 EC , NSKE (5%), Neem oil (1%), *Metarhizium anisopliae* 1.15 WP, *Beauveria bassiana* 1.15 WP and *Leacanicillium lecani* 1.15 WP, Karanj oil (1%), karanj seed extracts (5%) and untreated control. To prepare 5% NSKE and KSE, coarse powder of 30 kg seeds of neem and karanj were tied in a muslin cloth separately and immersed in 50 l of water overnight and the complete extract was separated by squeezing the cloth containing the crushed seeds. The cloth containing the crushed seed was again dipped in 50 l of water and squeezed again. In this way 100 l of solution was obtained, and to this 500 l of water was added to prepare 5% solution. Before using the solution, 200 gm khadi soap was added and

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the fresh material was used. Two foliar sprays of all the botanical and biopesticides were given at an interval of 15 days, with spraying done using knapsack sprayer. First spray was done when the pest incidence crossed ETL and second was done at 15 days interval. The aphids on three inflorescence/ umbels from each tagged plants were counted. Pretreatment count was recorded one day before the application of botanical and biopesticides, and post treatment data after 3, 7, 10 and 15 days. Similar observations were made after the second application. The data obtained were used to estimate the % reduction in incidence following Henderson and Tilton, 1955. The data were statistically analysed by transforming the % reduction into angular transformation values. To determine the most effective and economical treatment, the net profit and benefit cost ratio was worked out by taking the expenditure on the individual botanical and biopesticidal treatment and the corresponding yield into account.

RESULTS AND DISCUSSION

The data as given in Table 1 indicate that azadirachtin 0.03EC proved to be the most effective insecticidal treatment against aphid *H. coriandri* (48.79 and 51.70% reduction after three days in first and second insecticidal application, respectively); these were at par with NSKE 5% and Neem oil 1%. The treatments tested in the present study were not evaluated earlier against aphid on fennel. Hence, the efficacy of these treatments tested on other relevant crops discussed to support the present findings. The results are in conformity with that of Choudhary *et al.*, (2015) found that the azadirachtin 1500 ppm was most effective against aphid on coriander. Sarvaiya *et al.*, (2018) reported that the azadirachtin (0.0006%) and Neem oil (0.3%) were most effective in

Table 1: Efficacy of botanicals and biopesticides against aphid, Hyadaphis coriandri (Das) during Rabi, 2021-22.

S. No.	Treatments	Dose/ conc. (%)	Mean per cent reduction of aphid population days after									
			First spray					Second spray				
			Three	Seven	Ten	Fifteen	Mean	Three	Seven	Ten	Fifteen	Mean
1	*Beauveria bassiana* 1.15 WP	1g/l	30.71 (33.65)	38.25 (38.20)	30.46 (33.50)	15.67 (23.32)	28.77 (32.44)	37.19 (37.58)	44.49 (41.84)	32.53 (34.77)	17.33 (24.60)	32.89 (34.99)
2	*Lecanicillium lecanii* 1.15 WP	1g/l	28.26 (32.11)	37.90 (38.00)	29.20 (32.71)	14.58 (22.45)	27.49 (31.62)	36.16 (36.97)	41.38 (40.04)	31.92 (34.40)	16.43 (23.91)	31.47 (34.13)
3	*Metarhizium anisopliae*1.15 WP	1g/l	33.83 (35.57)	39.48 (38.93)	31.10 (33.90)	18.48 (25.46)	30.72 (33.66)	39.63 (39.01)	45.62 (42.49)	34.16 (35.77)	19.10 (25.91)	34.63 (36.05)
4	NSKE 5.0 %	5%	56.32 (48.63)	52.11 (46.21)	41.49 (40.10)	38.97 (38.63)	47.22 (43.41)	58.20 (49.72)	54.96 (47.85)	49.67 (44.81)	40.54 (39.55)	50.84 (45.48)
5	Neem oil 1.0 %	1%	51.34 (45.77)	50.21 (45.12)	42.25 (40.54)	35.23 (36.41)	44.76 (41.99)	54.41 (47.53)	51.33 (45.76)	47.39 (43.50)	39.29 (38.82)	48.11 (43.91)
6	Azadirachtin 0.03 EC	5ml/l	57.10 (49.08)	53.84 (47.20)	42.96 (40.95)	41.27 (39.97)	48.79 (44.31)	58.96 (50.16)	55.62 (48.23)	50.27 (45.15)	41.96 (40.37)	51.70 (45.98)
7	Karanj seed extract 5.0 %	5%	43.53 (41.28)	41.60 (40.16)	34.33 (35.87)	22.46 (28.29)	35.48 (36.56)	46.22 (42.83)	46.06 (42.74)	38.26 (38.21)	23.48 (28.98)	38.51 (38.35)
8	Karanj oil 1.0 %	1%	45.47 (42.40)	43.37 (41.19)	38.08 (38.10)	26.92 (31.25)	38.46 (38.33)	49.96 (44.98)	47.29 (43.45)	39.56 (38.97)	27.54 (31.65)	41.09 (39.87)
9	Untreated control		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	S.Em.+		0.57	0.67	0.54	0.33	0.52	0.67	0.77	0.58	0.35	0.59
	CD (p=0.05)		1.72	2.01	1.60	0.99	1.57	2.00	2.30	1.74	1.06	1.77

Figures in the parentheses are angular transformed values

suppressing the aphid population on fenugreek. Meena *et al.,* (2018) reported that the maximum reduction in aphid population on coriander was recorded in the plots treated with organic salt (bio-product) (5ml/l) followed by karmel extract (10ml/1). The present findings are also in agreement with Choudhary *et al.,* (2015) who found Neem oil (1%) and NSKE (2%) were moderately effective in the control of aphid on coriander crop. The treatments *viz.*, Karanj oil (1%) and KSE (5%) were found moderately effective against aphid on fennel crop. The present findings are in conformity with those of Kant *et al.,* (2011) who reported Karanj seed powder extract (5%) gave maximum protection against seed midge and recorded less than three per cent seed damage. Kant *et al.,* (2013) reported that the treatments viz., Karanj oil (1%) and KSE (5%) proved moderately effective against aphid and seed midge. The treatments viz., *L. lecani* 1.15 WP followed by *B. bassiana* 1.15 WP and *M. anisoplise* 1.15 WP were found least effective against aphid. The results are partially in agreement with the findings of Selvaraj *et al.* (2012), Selvaraj and Kaushik (2014) who reported that *B. bassiana* can be used as potential biocontrol agent against *H. coriandri* on coriander and *A. craccivora* on fenugreek. Jasim and Mohammed (2019) reported that *Verticillium lecanii* and *Isaria fumosorosea* were effective against *M. persicae* on cucumber partially support the present findings. Table 2 reveals that the maximum net profit of Rs. 42150 was obtained with azadirachtin 0.03 EC followed by NSKE 5% (Rs.33737) and Neem oil 1% (Rs. 32590). The minimum net profit of Rs.18995 was observed in plots treated with *L. lecanii* 1.15 WP followed by *B bassiana* 1.15 WP (Rs. 20408), *M. anisopliae* 1.15 WP (Rs. 21822), Karanj oil (Rs. 24998) and KSE (Rs. 25891). The maximum benefit cost ratio of 8.49 was recorded in the treatment of azadirachtin 0.03 EC. The higher benefit cost ratio of 8.15, 7.83, 7.62, and 7.09 was obtained in the treatment of *M. anisopliae* 1.15 WP, Neem oil (1%) *B. bassiana* 1.15 WP and *L. lecani* 1.15 WP. The minimum benefit cost ratio of 3.55 was obtained in the treatment of Karanj oil (1%) followed by KSE (5%) and NSKE (5%) were 5.58 and 5.78, respectively. Bana *et al.,* (2011) found lowest benefit cost ratio was obtained in the treatments of azadirachtin 20 EC (1.21) and NSKE (1.68). Nema Ram (2014) found maximum net profit was recorded in the plots treated with NSKE (5%). Whereas, the maximum benefit cost ratio was recorded in the treatment of NSKE (5%) against seed midge on fennel. Sarvaiya *et al.,* (2018) who obtained maximum realization in the treatment of azadirachtin and maximum ICBR was registerd in Neem oil.

Effect of treatments on the seed yield of fennel

The data presented in table 3 revealed that all the plots treated with biopesticides and botanicals gave significantly higher seed yield over untreated control (7.00 q ha^{-1}). The highest seed yield of 12.00 q ha^{-1} was obtained in the plots treated with azadirachtin 0.03 EC followed by NSKE 5% (11.20 q ha^{-1}), however only azadirachtin and NSKE were found at par with each other. The minimum seed yield was obtained in the plots treated with *Leacanicillium lecani* 1.15 WP (9.30 q ha^{-1}) followed by *Beauveria bassiana* 1.15 WP (9.45 q ha^{-1}), *Metarhizium anisopliae* 1.15 WP (9.60 q ha^{-1}) and KSE 5% (10.24 q ha^{-1}) and

Table 2: Economics of botanicals and biopesticides applied against H. coriandri of fennel during Rabi, 2021-22.

S. No.	Treatments	Dose/ conc. (%)	Yield (q ha^{-1})	Increase in yield over control (q ha^{-1})	Return of increase yield (`ha $^{-1}$)	Total cost of expenditure ()**	Net profit (`ha $^{-1}$)	B:C
1	*Beauveria bassiana* 1.15 WP	1g/l	9.45	2.45	23086	2678	20408	7.62
2	*Lecanicillium lecanii* 1.15 WP	1g/l	9.30	2.30	21673	2678	18995	7.09
3	*Metarhizium anisopliae*1.15 WP	1g/l	9.60	2.60	24500	2678	21822	8.15
4	NSKE 5 %	5%	11.20	4.20	39577	5840	33737	5.78
5	Neem oil 1 %	1%	10.90	3.90	36750	4160	32590	7.83
6	Azadirachtin 0.03 EC	5ml/l	12.00	5.00	47115	4965	42150	8.49
7	Karanj seed extract 5 %	5%	10.24	3.24	30531	4640	25891	5.58
8	Karanj oil 1 %	1%	10.40	3.40	32038	7040	24998	3.55
9	Untreated control		7.00	0.00	0	0	0	0.00

* Cost of fennel seed at current season was ` 9423 /ha ** It includes cost of treatments and labour charges

these were differed non significant with each other. The treatment of Neem oil (1%) and Karanj oil (1%), gave seed yield of 10.90 and 10.40 q ha^{-1}, respectively and statistically at par with each other.

Table 3: Effect of biopesticides and botanicals on seed yield of fennel during Rabi , 2021-22.

S.No.	Treatments	Dose/ conc. (%)	Seeds yield (q/ha)
1	*Beauveria bassiana* 1.15 WP	1g/l	9.45
2	*Lecanicillium lecanii* 1.15 WP	1g/l	9.30
3	*Metarhizium anisopliae*1.15 WP	1g/l	9.60
4	NSKE 5 %	5%	11.20
5	Neem oil 1 %	1%	10.90
6	Azadirachtin 0.03 EC	5ml/l	12.00
7	Karanj seed extract 5 %	5%	10.24
8	Karanj oil 1 %	1%	10.40
9	Untreated control		7.00
	S.Em.+		0.31
	CD (p=0.05)		0.93

CONCLUSIONS

The study showed that using azadirachtin 0.03 EC resulted in the lowest total and percentage of avoidable losses, as well as the highest benefit-cost ratio. These results indicate that this biopesticide is effective in reducing aphid presence in fennel fields while maintaining economic viability.

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CONFLICT OF INTEREST

All the author both individually and collectively, affirms that they do not possess any conflicts of interest either directly or indirectly related to the research being reported in the publication.

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