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Short communication

Biorational approaches for management of aphid (*Hyadaphis coriandri* Das) on fennel

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ABSTRACT

A field experiment was conducted for two years on management of aphid (*Hydaphis coriandri* Das) on fennel through application of biorational products based on entomopathogenic fungi, release of predators, plant products alone and in combination of entomopathogenic fungi and insecticidal check. The maximum protection against aphis on crop and seed yield was recorded in insecticidal check Deltamethrin 0.003%. However, alone application of *Verticillium lacanii*, applied as aqueous suspension along with Tween 80, 0.02% + 0.2% vegetable oil (108 spores/ml), neem oil-2% and sulphur extract of *karanj*-1% gave good control of aphids and yield of seed fennel at harvest. The application of entomopathogen in combination with neem oil showed reduced impact on aphid control and yield than alone application of either product as treatments. Among the biorational approaches applied, maximum increase in yield (46.5%) over control was recorded in treatment containing 2% neem oil followed by sulphur extract of *karanj*.

Key words: Fennel, entomopathogens, coccinella, botanicals, seed yield.

Fennel (*Foeniculum vulgare* Mill.) is an important seed spice belonging to family Apiaceae and is native of Southern Europe and Mediterranean area In India, fennel is mainly grown in the states of Gujarat and Rajasthan (Meena *et al.*, 7) and to some extent in U.P., Karnataka, A.P., Punjab, M.P., Bihar, Haryana, and J&K as a winter season crop covering a total area of about 74,149 ha with an annual production of 1,14,277 metric tonnes during the year 2008-09. Aphids are the major pest of fennel crop causes heavy yield loss in unprotected crops. In fennel *Hyadaphis coriandri* Das is main aphid species in India. Pesticide residues in seed spices is a major concern, since it is high value crop having large export market and regulation of pesticide residues an important non tariff barrier in trade in spice. The application of different fungal entomopathogenic and botanicals proved effective to control sucking pests especially aphids on different crops. The present study on biological control of fennel aphid is based on application of various fungal entomopathogens, botanicals alone and in combination of each other, release of predator to attain effective management at field level.

The biorational management of fennel aphid was conducted at field experiment centre of NRC on Seed Spices, Ajmer during, 2009-10 and 2011-12. Fennel variety Ajmer Fennel-1 was selected for the study and the crop was sown on 15th October having plot size of 5 m x 5 m with row and plant distance of 45 and 20 cm, respectively. All recommended agronomical and nutritional intervention was allowed to raise good crop. During 2010-11 field experiments were not conducted because aphids population on fennel crop was very low. All the treatments were applied as foliar application and were given thrice on the crop at ten days intervals after aphid colonization of minimum of 50 aphids per umblet. The treatments include entomofungal pathogen *Beauveria bassiana*, *Metarhizium anisopliae* and *Verticillium lacanii* applied as aqueous suspension along with Tween 80, 0.02% + 0.2% vegetable oil (108 spores/ ml). Botanicals like Neem oil -2%, Allyl-iso-thiocynate -1% and sulphur compound of *karanj* extract-1%. Neem (*Azadirachta indica*) oil was based on cold press extraction method and obtained from local market. Allyl-iso-thiocynate was extracted from mustard seed (*Brassica camprestris*) and sulphur compound of *karanj* isolated from its seed through the process of seed grinding at less than 7% moisture and then further isolation of compound through heat separation method in alkaline water. Liquid soap (Labolene-Ran Chem, Mumbai, India) at a dose of 5 ml/l was added to spray tank as a wetting and emulsifying agent. Release of predator *Coccinella septempunctata* L. @ 4000 grubs or adults /acre, insecticide check-Deltamethrin 0.003% and absolute control.

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Population of aphids in different treatments was recorded seven days after application of different treatments. Total number of aphids/floret/plant recorded on ten randomanly selected plants, thus average population of aphids per treatment was worked out. Seed yield in each treatment was also recorded after harvest and calculated on per hectare basis. The experiment was laid out in RBD design and replicated thrice. All the data were analyzed using SAS 9.2 software.

The average number of aphids population recorded after the different treatments on fennel crop showed that all the treatments significantly reduces the aphids number and increases yield of seed than control (Tables 1 & 2). The impact of different treatments on aphids population was more sharpen in second application than first one. The population after third spray was drastically reduced due to heavy predation of coccinellids which shifted from other seed spice crop of experimental farm and was predated completely in first year of experiments before collection of data. Among individual application of entomofungal pathogens, *V. lecanii* gave the maximum protection on crop as average reduction of aphids population was more in comparison to other entomofungal pathogen in which average of only 17.8 aphids/floret was recorded for the period of two years. It proved better at all observation except population after 1st spray during first year. Application of *M. anisopliae* (21.4 aphids/floret) was found next after *V. lecanii* for efficacy against aphids. Efficacy of *M. anisopliae* and *B. bassiana* were found statistically at par against the control of aphids population. In case of mix application of entomofungal pathogen with botanical (neem oil), showed less effective than alone of either product for total numbers of aphids reduction and seed yield at harvest. Among the Mix application, *neem* oil with *V. lecanii* gave better performance (22.08 aphids/floret) than other combinations at all stages of application during both of year. *M. anisophilae* with neem oil also gave good result and was at par with *V. lecanii*. Use of all botanicals proved more effective than any other treatments except insecticide application. Neem oil was given maximum protection and seed yield for both the years as average aphids population were only 15.82 aphids/floret and seed yield was 12.60q/ha obtained. Allyl-iso-thiocynate and sulphur compound of *karanj* extract proved at par for aphids control at field but yield was found higher than sulphur compound of *karanj* extract. The release of coccinella proved non significant in control of aphids population and yield of fennel seed. Overall insecticide deltamethrin 0.003% gave maximum protection against aphids infestation and higher crop yield.

Table 1. Effect of different safe control treatments on population reduction of aphids.

Treatment	Aphids population/ plant after Ist spray		Av. of Ist spray	Aphids population/ plant after IInd spray		Av. of IInd spray	Aphids popln./ plant after IIIrd spray		Av. of IIIrd Spray	Av. Popln. of all spray
	2009-10	2010-11		2009-10	2010-11		2009-10	2010-11		
T1: *B. bassiana*	42.8^{cd}	61.2^{de}	52^{d}	8.1^{b}	38.4^{ab}	23.25^{ab}	0	0.90^{a}	0.90^{a}	25.38^{bc}
T2: *M. anisopliae*	32.3^{b}	44.6^{c}	38.45^{bc}	13.3^{d}	36.8^{ab}	25.05^{ab}	0	0.80^{a}	0.80^{a}	21.43^{bc}
T3: *V. lacanii*	34.3^{bc}	36.2^{abc}	35.25^{bc}	8.5^{b}	26.40^{ab}	17.45^{a}	0	0.60^{a}	0.60^{a}	17.77^{ab}
T4: 2% Neem oil	32.1^{b}	72.3^{e}	52.23^{d}	11.1^{c}	57.20^{b}	34.15^{b}	0	2.10^{abc}	2.10^{abc}	29.48^{c}
T5: (T1 + T4)	37.8^{bcd}	51.0^{cd}	44.4^{cd}	11.7^{cd}	35.50^{ab}	$23.6a^{b}$	0	3.20^{bc}	3.20^{bc}	23.73^{bc}
T6: (T2 + T4)	32.4^{b}	49.5^{cd}	40.95^{bcd}	8.4^{b}	33.80^{ab}	21.1^{ab}	0	4.20^{c}	4.20^{c}	22.08^{bc}
T7: (T3 + T4)	34.6^{bc}	28.6^{ab}	31.6^{b}	9.5^{b}	19.80^{a}	14.65^{a}	0	1.20^{ab}	$1.20a^{b}$	15.82^{ab}
T8: Release of coccinella	34.3^{bc}	42.5^{bc}	38.4^{bc}	$12.^{cd}$	33.20^{ab}	22.2^{ab}	0	1.30^{ab}	1.30^{ab}	20.77^{bc}
T9: Allyl iso thiocyanate	30.5^{b}	46.0^{c}	38.25^{bc}	11.2^{c}	27.50^{ab}	19.35^{ab}	0	1.20^{ab}	1.20^{ab}	19.60^{bc}
T10: 1% sulphur extract of *karanj*	144.4^{d}	250.5^{f}	197.45^{e}	11.4^{c}	170.00^{c}	90.7^{c}	0	33.80^{d}	33.80^{d}	107.32^{d}
T11: Insecticide check	15.7^{a}	25.6^{a}	20.65^{a}	3.7^{a}	14.50^{a}	9.1^{a}	0	0.30^{a}	0.30^{a}	10.02^{a}
T12: Control	216.3^{e}	287.4^{g}	251.85^{f}	32.6^{e}	744.40^{d}	388.5^{d}	0	47.40^{e}	47.40^{e}	229.25^{e}

Mean separation with in column by Duncan's multiple range test at <0.05 using SAS 9.2 software

Table 2. Effect of different treatments on seed yield of fennel

S. No.		Average yield (q/ha)	Yield in comparison to insecticide check (%)	increase in yield over control (%)
1	*B. bassiana*	11.0^{cde}	73.82	27.9
2	*M. anisopliae*	11.7^{bcd}	78.52	36.0
3	*V. lacanii*	11.0^{cde}	73.82	27.9
4	2% neem oil	12.6^{b}	84.56	46.5
5	(T1 + T4)	9.9^{ef}	64.4	15.1
6	(T2 + T4)	9.9^{ef}	64.4	15.1
7	(T3 + T4)	10.6^{def}	71.1	12.2
8	Release of *Coccinella*	9.5^{fg}	63.7	10.4
9	Allyl iso thio cyanate	12.1^{bc}	81.2	40.6
10	1% sulphur extract of *karanj*	12.3^{b}	82.5	43.0
11	Insecticide-Check	14.9^{a}	100.00	73.2
12	Control	8.6^{g}	57.7	-

Mean separation with in column by Duncan's multiple range test at <0.05 using SAS 9.2 software

The average yield of fennel at harvest was recorded maximum in insecticide check (14.9 q/ha). In case of entomopathogen avareage yield was recorded highest in *M. anisopliae,* however, *M. anisopliae* gave higher yield in first year and *V. lecanii* in second years. Among botanicals highest yield of 12.6 q/ha was recorded in neem oil - 2% which was only next to insecticidal check. Other botanicals were also at par with neem oil. Mixes application of entomopathogen applied with *neem* oil gave lower yield than alone application of either products as treatment. In comparison to insecticide check neem oil gave 84.5% and sulphur compound of Karanj extract gave 82.5% of yield. Naik and Shekharappa (5) reported that different formulation of *B. bassiana, M. anisopliae* and *V. lecanii* at 1 x 10^8 conidia per g against okra aphid at laboratory condition gave superior control of aphids by all fungi. Among various formulations of three different fungi, *V. lecanii* oil based formulation showed complete mortality at 10 day after treatment. El-Wakil *et al*. (2) found application of neem formulation (Neem Azal-T/S) and diatomaceous earth in combination given superior control of *M. persicae* on artichoke plants. Uses of rape seed oil and Azadirachtin on pepper crop gives >92 and >93 per cent efficacy against aphids *M. persicae* and *Brevicoryne brassicae*, respectively Peric *et al*. (6).Yankova *et al*. (7) found 80 per cent control of aphids M. persicae in green house condition through application of mineral oil Akarzin-0.4%, essential oil of eucalyptus and turpentine at 1.0%. Application of *Metarhizium anisopliae*, isolate MA 126 and of *Vercillium lecanii*, isolate 615 showed superior control of aphid *M. persicae* in green house condition.(Lin and Liu, 3). Cabral (1 suggested that presence of both 4th instars larva and adult of lady bird beetle could increase the efficiency on field pest suppression of aphids species.

On the basis of above finding it is concluded that use of botanicals and entomopathogen significantly managed the aphids population on crop and increase the yield. In the treatments of 2% neem oil and 1% sulphur extract of *karanj* gave 84.5 and 82.5% of yield, respectively in comparison to insecticide check. Among the biorational approaches applied, maximum increase in yield (46.5%) over control was recorded in treatment containing 2% neem oil followed by sulphur extract of *karanj*.

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