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Bio-Efficacy of different Biopesticides Evaluated against Aphids Infesting Coriander

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A B S T R A C T

A field experiment was conducted at Anand Agricultural University, Anand during *Rabi* season 2019-20 to assess the bio-efficacy of various biopesticides against aphids infesting coriander. Of the nine biopesticides evaluated against aphids infesting coriander, application of tobacco decoction was found the most effective followed by ginger rhizome extract and garlic bulb extract with coriander seed yield of 449, 437, and 420 kg/ha, respectively.

Introduction

Coriander (*Coriandrum sativum* L.) is very important spice and it is mainly a crop of tropics and sub-tropics and the crop is the native of Mediterranean region near east region. India is the largest producer, consumer and exporter of coriander in the world. It is extensively grown in the arid to semi-arid regions of India. Andhra Pradesh, Assam, Madhya Pradesh, Odisha, Rajsthan, Uttar Pradesh and West bengal are the major coriander producing states of India covering an area of about 0.628 million ha with the production of 0.75 million tonnes (Anon., 2019a). Rajasthan and Gujarat states have emerged as seed spice bowl and together contribute more than 80 per cent of the total coriander production in the country. Gujarat, covering an area of about 86.175 thousand ha with production of 129150 MT production (Anon., 2019b). Insect-pests are one of the major limiting factor for higher production of good quality coriander leaves as well as seeds. These include: aphid, *Hyadaphis coriandri* (Das.), *Bemisia tabaci* (Genn), *Agonoscelis nubile* (Fab.), *Spodoptera exigua* (Hub.), *Myzus persicae* (Sulzer), *Thrips tabaci*

(Lindeman) and the mite, *Petrobia latens* (Muller) (Jain and Yadava, 1988). Among the insect-pests infesting coriander, the aphid, *Hyadaphis coriandri* (Das.) has been reported as a regular and major pest in Rajasthan and other parts of the country (Hameed *et al.,* 1975; Jain, 1984). Aphids cause both the quantitative and qualitative loss in the seed yield and deteriorate the green leaves by sucking cell sap. Moreover, it exudes copious quantity of honey dew, which favour the growth of sooty mould and results into retarded growth of the plant. In case of severe infestation the growing points and flower stalks wither and dry up and at flowering and fruiting stage, the seeds are not formed and if they are formed, they are shriveled and of poor quality. Both the nymphs and adults cause qualitative and quantitative losses to seed yield by sucking cell sap from inflorescences/umbels. Biopesticides have an essential role in IPM because it can be used along with other strategies for sustainable insect-pest management. They cause regularly a considerable mortality of varied insect pests in many parts of the world and thus, constitute an efficient and extremely important natural control factor (Steinhaus, 1949). The safety of biopesticides towards humans, the environment and non-target organisms is an important criteria and offers a safer alternative for application in IPM over continuously evolving chemical insecticides.

Materials and Methods

For evaluation of various insecticides against aphid infesting coriander an experiment was conducted under field conditions at B. A. College of Agriculture, Anand Agricultural University, Anand during 2019-20. The experiment was laid out in Random Blocked Design with ten treatments *viz.*, neem oil 1%, neem seed kernel extract 5%, garlic bulb extract 5%, ginger rhizome extract 5%, tobacco decoction 2%, kalmegh extract 10%, indranama fruit extract 5%, cow urine 2%, Asafoetida + Ajawain + turmeric2% and control (no spray) along with three replications with a view to evaluate bio-efficacy of various biopesticides against aphids infesting coriander. The first spray of respective biopesticides was given on appearance of aphid and second spray was given after 10 days of first spray for recording observations, 5 plants were randomly selected from each plot and 3 shoots each of 5 cm was selected randomly from each plant and count the number of aphids and also count their natural enemies. The observations were recorded before first spray as well as 3,5,7 and 10 days after each spray. The seed yield was also recorded. The data obtained were analyzed by following standard statistical technique (Steel and Torrie, 1980).On the basis of coriander seed yield harvested from various treatments under study, the avoidable losses due to aphids was calculated with the help of formula described by Khosla(1977).

$$\text{Avoidable losses (\%)} = \frac{\text{Yield of treatment which gave the highest yield} - \text{Yield of respective treatment}}{\text{Yield of treatment which gave the highest yield}} \times 100$$

Results and Discussion

The population of aphids was homogenous before spray in all the treatments as treatments did not differ significantly. All the evaluated biopesticdes were significantly superior to control up to 10 days of spray.

First spray

The analysis of data on aphid population/5 cm shoot of plant at 3rd DAS revealed that the all the treatments were found non-significant but the aphid population decreased as compared to the before spray observations. At the 5th DAS,

the treatment of tobacco decoction 2 per cent recorded that lowest aphid population (25.40/5 cm shoot) and proved to be the most effective and remained par with ginger rhizome extract (GRE) 5%. The maximum aphid population was recorded in the treatment of indranama fruit extract (IFE) 5% with the population of 47.38 aphids/ 5 cm shoot and it was at par with the kalmegh (KE) extract 10% but they were also found at par with control but significantly superior.

While, the others treatment like the neem oil 1%, NSKE 5%, Garlic bulb extract (GBE) 5%, cow urine 2% and asafoetida + ajwain + turmeric (AsAjT) 2% were mediocre in their effectiveness against the aphid population but recorded aphid population significantly lower than that of the control. The order of efficacy of biopesticides in comparison to control based on aphid population/5 cm shoot (given in bracket after each treatment) was : Tobacco decoction 2% (25.40) > ginger rhizome extract 5% (25.91) > garlic bulb extract 5% (36.10) > neem oil 1% (35.34) > NSKE 5% (36.95) > asafoetida + ajwain + turmeric 2% (37.69) > cow urine 2% (46.69) > kalmegh extract 10% (46.97) > indranama fruit extract 5% (47.38) > control (56.65).

At the seven days after first spray, aphid population slightly decreased due to the increasing effect of biopesticides and all the treatment were significantly superior over control. Similar trend in efficacy as per the 5th DAS was found in the 7th day as well wherein, the treatment of tobacco decoction 2% recorded the least (22.82/ 5 cm shoot) aphid population which was at par with the treatment of GRE 5% (23.11/5 cm shoot).

Whereas, the minimum control of the aphid population (48.92/5 cm shoot of plant) was observed in the indranama fruit extract with the concentration of the 5% and it was also at par with the treatment of the cow urine 2% and kalmegh extract 10%. More or less similar effect of treatments was observed at the 10th DAS.

The pooled over period data of population of aphid showed that the highest control in aphid's population was achieved in two treatment *viz.*, tobacco decoction 2% and GRE 5%. After that, the treatments of GBE 5%, neem oil 1%, NSKE 5%, AsAjT 2% and cow urine 2% stood next in their efficacy and were at par with each other. And the least effective treatments were indranama fruit extract 5% and kalmegh extract 10% but were recorded significantly superior over control.

Second spray

Three days after the second spray of the biopesticide, minimum aphid population was found in the plots treated with the tobacco decoction 2% at observed the population of aphid at 5 cm shoots were 22.34 aphids as per the Table 2. Which was at par with the treatment of GRE 5% and the population of aphid was 22.82 /5 cm shoot of plant. After that GBE 5% was found moderately effective with the population of 33.48 aphids/5 cm shoot and at par with neem oil 1% (33.37/5 cm shoot). Where the less control of population found in which plots with the treated by the kalmegh extract 10% and indranama fruit extract 10%. At 5th DAS after the second spray of the biopesticides, the tobacco decoction 2% with population of 12.17aphid /5 cm shoot of plant found most effectively treatment and it was at par with the treatment of GRE 5% and aphid's population was registered as 13.78/5 cm shoot of plant.

Whereas, the highest population was found in the treatments of the kalmegh extract and indranama fruit extract with the population of aphid as 30.63 and 30.97/ 5 cm of shoot. More or less similar results were observed at seven days after second spray.

Table.1 Bio-efficacy of biopesticides against aphids infesting coriander after first spray

Tr. No.	Treatments	Conc. (%)	Before spray	No. of aphids/5 cm shoots at indicated days after spray				
				3	5	7	10	Pooled over periods
T1	Neem oil (*Azadirachta indica* L.)	01	7.54 (56.35)	6.81 (45.87)	6.07b (36.34)	5.86c (28.22)	5.36c (28.22)	6.03c (35.86)
T2	Neem seed kernel extract	05	7.46 (55.15)	6.67 (43.98)	6.12b (36.95)	5.84c (33.60)	5.39c (28.55)	6.01c (35.62)
T3	Garlic bulb extracts (*Allium sativum* L.)	05	7.37 (53.81)	6.59 (42.92)	6.05b (36.10)	5.81c (33.25)	5.35c (28.12)	5.95c (34.90)
T4	Ginger rhizome extracts (*Zingiber officinale Roscoe)*	05	7.59 (57.10)	6.78 (45.46)	5.14c (25.91)	4.86d (23.11)	4.33d (18.24)	5.28d (27.37)
T5	Tobacco decoction	02	7.44 (54.85)	6.65 (43.72)	5.09c (25.40)	4.83d (22.82)	4.16d (16.80)	5.18d (26.33)
T6	Kalmegh extracts (*Andrographis paniculata* Wall)	10	7.45 (55.00)	6.84 (46.28)	6.89ab (46.97)	6.87b (46.69)	6.72b (44.65)	6.83b (46.14)
T7	Indranama fruit extracts (*Citrullus colocynthis* L.)	05	7.59 (57.10)	6.83 (46.14)	6.92ab (47.38)	7.03b (48.92)	6.77b (45.33)	6.88b (46.83)
T8	Cow urine	02	7.55 (56.50)	6.84 (46.28)	6.87ab (46.69)	6.27bc (38.81)	6.10bc (36.71)	6.52bc (42.01)
T9	Asafoetida + Ajawain + turmeric(AsAjT)	02	7.46 (55.15)	6.78 (45.46)	6.18b (37.69)	5.91c (34.42)	5.77c (32.79)	6.16c (37.44)
T10	Control		7.55 (56.50)	7.58 (56.95)	7.56a (56.65)	7.95a (62.70)	7.73a (59.25)	7.70a (58.59)
S.Em.±T		-	0.35	0.36	0.26	0.27	0.28	0.20
P		-						0.09
T x P		-						0.29
F test (T)		-	NS	NS	Sig.	Sig.	Sig.	Sig.
C.V. %		-	8.99	9.05	8.48	8.20	8.31	8.09

Note : Figures in parentheses are retransformed values and those outside are √x +0.5 transformed values. Treatment mean(s) with the letter(s) in common are not significant by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance. Significant parameters and its interactions: T, P and T X P.

Table.2 Bioefficacy of biopesticides against aphids infesting coriander after second spray

Tr. No.	Treatments	Conc. (%)	No. of aphids/5 cm shoots at indicated days after spray					Pooled over periods and sprays
			3	5	7	10	Pooled	
T1	Neem oil (*Azadirachta indica* L.)	01	5.82d (33.37)	4.77c (22.25)	4.41d (18.94)	3.89cd (14.63)	4.72cd (21.77)	5.37d (28.33)
T2	Neem seed kernel extract	05	5.86b (33.83)	4.75c (22.06)	4.65d (21.12)	4.20cd (17.14)	4.86cd (23.11)	5.43d (29.98)
T3	Garlic bulb extracts (*Allium sativum* L.)	05	5.83d (33.48)	4.74c (21.96)	4.29d (17.90)	3.68d (13.04)	4.64d (21.02)	5.29d (27.48)
T4	Ginger rhizome extracts (*Zingiber officinale Roscoe)*	05	4.83e (22.82)	3.78d (13.78)	3.03e (8.68)	2.27e (4.65)	3.48e (11.61)	4.38e (18.68)
T5	Tobacco decoction	02	4.78e (22.34)	3.56d (12.17)	2.69e (6.73)	1.8e (2.74)	3.23e (9.99)	4.21e (17.22)
T6	Kalmegh extracts (*Andrographis paniculata* Wall)	10	6.60b (43.06)	5.58b (30.63)	5.71b (32.10)	4.99b (24.40)	5.73b (32.33)	6.28b (38.93)
T7	Indranama fruit extracts (*Citrullus colocynthis* L.)	05	6.70b (44.39)	5.61b (30.97)	5.78b (32.90)	5.01b (24.60)	5.77b (32.79)	6.33b (39.56)
T8	Cow urine	02	6.00b (35.05)	4.91bc (23.60)	5.19bc (26.43)	4.46bc (19.39)	5.14c (25.91)	5.83c (33.48)
T9	Asafoetida + Ajawain + turmeric	02	5.84bc (33.60)	4.81bc (22.63)	4.69cd (21.49)	4.34bcd (18.33)	4.92cd (23.70)	5.74cd (32.44)
T10	Control	-	7.56a (56.65)	7.38a (53.96)	7.35a (53.52)	7.36a (53.66)	7.42a (54.55)	7.56a (56.65)
S.Em.±T		-	0.31	0.25	0.31	0.23	0.14	0.10
P		-					0.08	6.50
T x P		-					0.27	0.20
F test (T)		-	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C.V. %		-	8.61	8.53	11.25	9.62	9.58	8.59

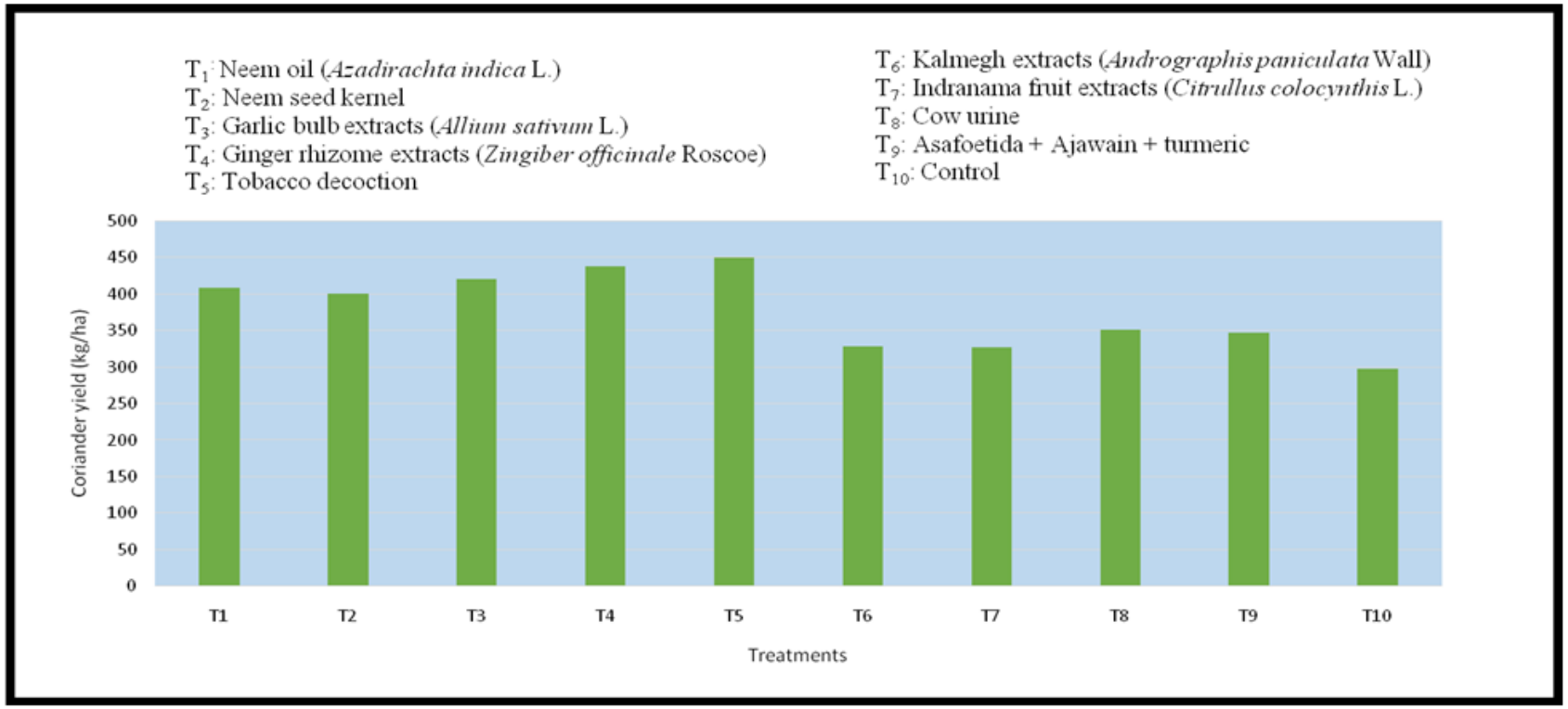
Note : 1. Figures in parentheses are retransformed values and those outside are √x +0.5 transformed values. 2. Treatment mean(s) with the letter(s) in common are not significant by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance. 3. Significant parameters and its interactions: T, P and T X P. Where, T = Treatment and P = Period.

Table.3 Effect of various biopesticides on coriander yield

Tr. No.	Treatments	Conc. (%)	Yield (kg/ha)	Increase in yield over control (%)	Avoidable losses (%)
T_1	Neem oil (*Azadirachta indica* L.)	1	408cd	37.37	9.13
T_2	Neem seed kernel extract	05	400cd	34.65	10.91
T_3	Garlic bulb extracts (*Allium sativum* L.)	5	420bc	41.41	6.45
T_4	Ginger rhizome extracts (*Zingiber officinale Roscoe)*	5	437ab	47.13	2.67
T_5	Tobacco decoction	2	449a	51.17	0.00
T_6	Kalmegh extracts (*Andrographis paniculata* Wall)	10	328d	10.43	26.94
T_7	Indranama fruit extracts (*Citrullus colocynthis* L.)	5	327d	10.10	27.17
T_8	Cow urine	2	350d	17.84	22.04
T_9	Asafoetida + Ajawain + turmeric	2	346d	16.49	22.93
T_{10}	Control	-	297e		33.85
S. Em. ±			56.66	-	-
F test (T)			Sig.	-	-
C. V. (%)			12.35	-	-

Note: Treatment mean with letter(s) in common are non-significant by DNMRT at 5% level of significance

Fig.1 Effect of different biopesticides on yield of coriander



Population of aphids after tenth day of second spray of the biopesticides, the lowest population was found in the treatments of tobacco decoction 2% (9.99 aphids/5 cm shoot) and GRE 5% (11.61 aphids/5 cm shoot). Among the evaluated treatments, the highest population of aphid was found in the treatment of kalmegh extract 10% and the indranama fruit extract treatment 5%. The treatments, GBE 5%, neem oil 1%, NSKE 5% and AsAjT 2% were found comparatively less effective against aphid population infesting coriander. Pooled over periods (Table 2) data of second spray asserted that the treatment of tobacco decoction 2% (9.99 aphid/5 cm shoot) and GRE 5% (11.61 aphid/5 cm shoot) were found highly effective in checking the population of aphid infesting coriander. Whereas, the treatments of GBE 5% (21.02 aphid/5 cm shoot) and neem oil 1% (21.77 aphid/5 cm shoot) moderately effective and it was at par with the treatments of the NSKE 5% (23.11 aphid/5 cm shoot), cow urine 2% (25.91 aphid/5 cm shoot) and AsAjT 2% (23.70 aphid/5 cm shoot). And the treatment of kalmegh extract and indranama fruit extract less effectively in the control of the aphid population in coriander.

Over all pooled

Pooled over spray data (Table 2) revealed that tobacco decoction 2% (17.22/5 cm shoot) was found the significantly superior than all the evaluated biopesticides except GRE 5% (18.68/5 cm shoot). Also GBE 5% (27.48/5 cm shoot), neem oil 1% (28.33/5 cm shoot) and NSKE 5% (29.98/5 cm shoot) treated plots revealed significantly lower incidence of aphids compared to the remaining treatments, while the plots treated with IFE 5% recorded the maximum (39.56/5 cm shoot) aphid population and it was at par with kalmegh extract 10% (38.93/5cm shoot). From the above result, it can be deduced that tobacco decoction 2%, GRE 5% and GBE 5% were more effective in reducing aphid population in present investigation. However, neem oil 1%, NSKE 5% and AsAjT 2% were found mediocre in their effectiveness against the aphid in coriander. Whereas, the cow urine 2%, kalmegh extract 10% and indranama fruit extract 5% were found least effective in the reducing of aphid population.

According to Noonari *et al.,* (2016) studied on efficacy of bio-pesticides for management of sucking insect pests of cotton and they found that highest per cent reduction of thrips in NSKE, neem oil, tobacco and hing (asafoetida) when in condition of jassid neem oil, hing, and tobacco and in whitefly reduction per cent revealed that hing, neem oil and tobacco.

Megersa (2016) evaluated botanicals extract for control of pea aphid at Ethiopia and reveled that garlic and neem was found superior on aphid under laboratory condition as compared to the ended seed (*Phytolacca dodecandra*). Pradhan *et al.,* (2018) reviewed the cow urine effect on crop production and according to them cow urine works on management of sucking insect pest of any crop but it only works well when it used in high concentration. Thus, present findings are more or less tally with the reports of previous researchers.

Effect on Coriander Yield

The coriander seed yield data recorded in various biopesticide treatments as well as in control during study are presented here in Table 3.

Maximum coriander seed yield (471 kg/ha) was recorded from the plots treated with the tobacco 2% (449 kg/ha) which was at par with GRE 5% (437 kg/ha). Among the biopesticides, the lowest yield was recorded from the plots treated with indranama fruit

extract 5% (327 kg/ha) which was at par with kalmegh extract 10% (328 kg/ha). Increase in yield over control of coriander seed yield was worked out in different bio-pesticidal treatments which indicated that maximum (51.17%) increase in yield found from plots treated with tobacco decoction 2% followed by GRE 5% (47.13%).

While among the tested biopesticides, minimum increase in yields over control (10.10) was found from plots treated with indranama 5% (10.10%) followed by the kalmegh extract 10% (10.43). Concisely, tobacco decoction 2% and GRE 5% recorded higher yield of coriander seed compared to the rest of treatments.

Earlier researchers have not compared these biopesticides against aphid infesting coriander; therefore, present findings could not be discussed with the earlier reports. The GRE 5% (2.67%) recorded lowest avoidable losses followed by GBE 5% (6.45%). The avoidable losses were 9.13, 10.91, 22.04, 22.93 and 26.94 per cent in neem oil 1%, NSKE 5%, cow urine 2% and AsAjT 2%, respectively. The highest losses was recorded in the control treatment (33.85%).

Among the nine biopesticides evaluated against aphidin coriander, application of tobacco decoction 2 per cent was found the most effective followed GRE 5 per cent, GBE 5 per cent and neem oil 1 per cent with coriander seed yield 449, 437, 420 and 408 kg/ha, respectively.

While the plots treated with NSKE 5 percent and AsAjT2 per cent treatments exhibited significant efficacy and yield (400 and 346 kg/ha). The treatments of indranama fruit extract 5 per cent and kalmegh extract 10 per cent were found least effective against aphids with coriander yield 327 and 328 kg/ha, respectively.

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