Bio-efficacy of different insecticides evaluated against aphids infesting coriander

KN Patel, RK Thumar, AR Mohapatra, DJ Parmar and P Pandey

DOI: https://doi.org/10.22271/chemi.2021.v9.i1ao.11671

Abstract
A field experiment was conducted at Anand Agricultural University, Anand during Rabi season 2019-20 to assess the bio-efficacy of various insecticides against aphids infesting coriander. Of the nine evaluated insecticides tolfenpyrad 15 EC, flonicamid 50 WG and afidopyropen 5 DC were found the most effective in reducing the incidence of aphids infesting coriander. However, thimethoxam 25 WG, flupyridifurone 200 SL, dinotefuran 20 SG and sulfoxaflor 21.8 SC were found moderate in their effectiveness. Maximum coriander seed yield was recorded from the plots treated with tolfenpyrad 15 EC (1441 kg/ha) which was at par with flonicamid 50 WG (1400 kg/ha) and afidopyropen 5 DC (1391 kg/ha).

Keywords: Coriander, aphids, insecticides, flupyridifurone, afidopyropen

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, Rajasthan, 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) [1]. 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) [2]. 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.), Mycus persicae (Sulzer), Thrips tabaci (Lindeman) and mite, Petrobia latens (Muller) (Jain and Yadava, 1988) [3]. 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) [1, 4]. 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.

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., dimethoate 30 EC, sulfoxaflor 21.8 SC, flonicamid 50 WG, flupyridifurone 200 SL, dinotefuran 20 SG, pymetrozine 50 WG, afidopyropen 5 DC, thiamethoxam 25 WG, tolfenpyrad 15 EC and control (No. spray) along with three replications with a view to evaluate bio-efficacy of various insecticides against aphids infesting coriander. The first spray of respective insecticides was given on appearance of aphids and second spray was given after 15 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 1, 3, 5, 7, 10 and 15 days after each spray. The seed yield was also recorded. The data obtained were analyzed by following standard statistical technique (Steel and Torrie, 1980) [6]. 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) [9].

Results and Discussion
The population of aphids was homogenous before spray in all the treatments as treatments did not differ significantly. All the evaluated insecticides were significantly superior to control up to 15 days of spray.

First spray

The lowest (19.21/5 cm shoot) population of aphids were recorded from plots treated with tolfenpyrad 15 EC which was at par with flonicamid 50WG (19.75/5 cm shoot) and afidopyropen 5 DC (20.20/5 cm shoot) at one day after first spray (Table 1). These three insecticides were found to be significantly superior to the remaining treatments. Among the evaluated insecticides, the highest (46.69/5 cm shoot) population of aphids was observed in plots treated with pymetrozine 50 WG and it was at par with dimethoate 30 EC (42.79/5 cm shoot). Similarly, Population of aphid showed analogous trend at three days after spray and it was noticed to be the minimum (15.74/5 cm shoot) from plots treated with tolfenpyrad 15 EC which was at par with flonicamid (16.39/5 cm shoot) and afidopyropen (17.39/5 cm shoot) after five days of spray. Whereas, the treatment of thiamethoxam 25 WG (25.81/5 cm shoot) was at par with flupyradifurone 200 SL (25.51/5 cm shoot) and dinotefuran 20 SG (26.64/5 cm shoot) significantly affected the pest population. Among the evaluated insecticides, the maximum population of aphids was found in the plot treated with pymetrozine 50 WG (35.74/5 cm shoot) and it was at par with sulfoxaflor (26.43/5 cm shoot) and dimethoate 30 EC (35.38/5 cm shoot). More or less undistinguishable results were obtained at seven days after first spray.

Likewise, ten days after spray, tolfenpyrad 15 EC (14.47/5 cm shoot), flonicamid 50WG (14.55/5 cm shoot) and afidopyropen 5 DC (16.88/5 cm shoot) were most effective and at par with each other while, thiamethoxam 25 WG (25.00/5 cm shoot), flupyradifurone 200 SL (24.20/5 cm shoot), dinotefuran 20 SG (24.30/5 cm shoot) and sulfoxaflor 21.8 SC (24.40/5 cm shoot) also exhibited significant efficacy. The treatments pymetrozine 50 WG (34.19/5 cm shoot) and dimethoate 30 EC (31.30/5 cm shoot) were found the least effective. Again, fifteen days after first spray, tolfenpyrad showed the lowest (15.38/5 cm shoot) population of aphids and it was at par with flonicamid 50 WG (16.39/5 cm shoot) and afidopyropen 5 DC (18.53/5 cm shoot). Among the tested insecticides, thiamethoxam (27.46/5 cm shoot), flupyradifurone 200 SL (27.51/5 cm shoot), dinotefuran 20 SG (27.66/5 cm shoot) revealed significantly lower population of aphid in coriander. The plots treated with pymetrozine recorded the maximum (39.28/5 cm shoot) population of aphids and it was at par with dimethoate (34.78/5 cm shoot).

However, the insecticidal treatments, thiamethoxam, flupyradifurone, dinotefuran and sulfoxaflor were also effective and registered aphid population as 25.40, 25.61, 26.22 and 26.74 aphis/5 cm shoot, respectively. The plot treated with pymetrozine recorded the highest (35.74/5 cm shoot) population of aphids and it was at par with dimethoate (34.78/5 cm shoot).

Second spray

One day after second spray (Table 2), tolenpyrad (10.19/5 cm shoot), flonicamid (11.47/5 cm shoot) and afidopyropen (20.02/5 cm shoot) were effective in reducing the population of aphid infesting coriander. While, thiamethoxam (19.84/5 cm shoot), flupyradifurone (20.11/5 cm shoot) and dinotefuran (19.57/5 cm shoot) also significantly reduced the pest population. Maximum population of aphid (29.80/5 cm shoot) was recorded from the plots treated with pymetrozine and it was at par with sulfoxaflor (20.20/5 cm shoot) and dimethoate (27.90/5 cm shoot). Population of aphids were noticed the lowest (9.93/5 cm shoot) in plots treated with tolenpyrad which was at par with flonicamid (10.06/5 cm shoot) and afidopyropen (10.06/5 cm shoot) after three days of spray. Whereas, thiamethoxam (17.99/5 cm shoot), flupyradifurone (18.16/5 cm shoot) and dinotefuran (17.73/5 cm shoot) also revealed significantly lower activity of aphids. Among the evaluated insecticides, the highest (27.90/5 cm shoot) population of aphids was recorded from the plots treated with pymetrozine and it was at par with dimethoate (26.54/5 cm shoot). Comparatively similar results were observed at five and seven days after second spray.

The lowest (5.30/5 cm shoot) population of aphids was registered in plots treated with tolenpyrad and it was at par with flonicamid (6.62/5 cm shoot) and afidopyropen (6.89/5 cm shoot) at ten days after second spray. These three insecticides were found to be significantly superior to rest of the insecticides. The plots treated with thiamethoxam (12.53/5 cm shoot), flupyradifurone (12.67/5 cm shoot) and dinotefuran (12.82/5 cm shot) also recorded significantly lower population of aphid. Amidst the evaluated insecticides, the maximum (19.93/5 cm shoot) population of aphids were recorded from plots treated with pymetrozine. More or less, same trend in efficacy of treatments observed at fifteen days after second spray. The data (Table 2) on pooled over periods of second spray indicated that the lowest (4.69/5 cm shoot) population of aphid was recorded from plots with the treatment of tolenpyrad which was at par with flonicamid (5.35/5 cm shoot) and afidopyropen (5.50/5 cm shoot). Thiamethoxam (10.06/5 cm shoot), flupyradifurone (10.19/5 cm shoot), dinotefuran (10.12/5 cm shoot) and sulfoxaflor (10.39/5 cm shoot) were next effective and remained at par with each other and recording lower count of aphids. While, the plots treated with pymetrozine recorded the highest (15.26/5 cm shoot) population of aphids and it was at par with dimethoate (15.18/5 cm shoot).
Overall pooled
Pooled over sprays results (Table 2) revealed that tolfenpyrad (7.62/5 cm shoot) was found significantly superior among all the evaluated insecticides except thionamid (8.32/5 cm shoot) and afidopyropen (8.44/5 cm shoot). thiamethoxam (15.10/5 cm shoot), flupyradifurone (15.18/5 cm shoot), dinetofuran (15.02/5 cm shoot) and sulfloxafur (15.58/5 cm shoot) were the next effective treatments. The plots treated with pymetrozine recorded the maximum (23.21/5 cm shoot) population of aphids and it was at par with dimethoate (22.15/5 cm shoot).

Thus, from the above outcome, it can be deduced that the treatments of tolfenpyrad, flonicamid and afidopyropen were found to be more effective on the basis of aphids incidence. Whereas, thiamethoxam, flupyradifurone, dinetofuran and sulfloxafur were mediocre in their effectiveness. However, pymetrozine and dimethoate were found less effective in reducing the incidence of aphids infesting coriander.

**Effect on coriander seed yield**
The yield of coriander seed from various insecticidal treatments were recorded along with the control treatment and data are presented in Table 3. Maximum (1441 kg/ha) coriander seed yield was recorded from plots treated with tolfenpyrad which was at par with thionamid (1400 kg/ha) and afidopyropen (1391 kg/ha). While, thiamethoxam (1199 kg/ha), flupyradifurone (1183 kg/ha) and dinetofuran (1170 kg/ha) were found average in yield performance. Among tested insecticides, the lowest (927 kg/ha) coriander seed yield was recorded from pymetrozine and it was at par with dimethoate (954 kg/ha). Increase in yield over control in coriander was worked out for different insecticidal treatments and indicated that maximum (84.98%) increase in yield over control was found from plots treated with tolfenpyrad, followed by flonicamid (79.71%) and afidopyropen (78.56%). Plots treated with thiamethoxam (53.91%), flupyradifurone (51.86%) and dinetofuran (50.19%) provided with average increase in the yield. Whereas, among the tested insecticides, minimum (18.99%) increase in yield was found from plots treated with pymetrozine followed by dimethoate (22.46%). Overall, it revealed tolfenpyrad, flonicamid, afidopyropen, thiamethoxam, flupyradifurone and dinetofuran recorded relatively higher seed yield in coriander than the remaining tested treatments.

The flonicamid 50 WG (2.84%) recorded lowest avoidable losses followed by afidopyropen 5 DC (3.46%). The avoidable losses were 16.79, 17.90, 18.80, 21.37, 33.79 and 35.66 per cent in thiamethoxam 0.01%, flupyradifurone 0.05%, dinetofuran 0.008%, sulfloxafur 0.0218%, dimethoate 0.03% and pymetrozine 0.015%, respectively. The highest losses was recorded in the control treatment (45.94%).

Hirpara (2017) [7] found that thiamethoxam 0.01 per cent (1101 kg/ha), and flonicamid 0.015 per cent (1035 kg/ha) gave significantly higher yield over the control of coriander. Ghadage (2009) [8] studied the two applications of nine different insecticidal treatments against aphid of coriander and revealed that the treatments with dimethoate 0.03% was proved to be the most effective. Flupyradifurone, tolfenpyrad and afidopyropen being new insecticides, their effectiveness could not be compared with the past researchers.

| Tr. No. | Treatments | Conc. (%) | Before spray | No. of aphids/5 cm shoot at indicated days after spray | Pooled over periods |
|---------|------------|-----------|--------------|------------------------------------------------------|---------------------|
| T1      | Dimethoate 30 EC | 0.03  | 7.58 (56.95) | 6.58b (42.79) | 5.90c (35.38) | 5.52b (29.97) | 5.39b (28.55) | 5.64c (31.30) | 6.26b (38.89) | 5.94b (34.78) |
| T2      | Sulfoxaflor 21.8 SC | 0.0218  | 7.49 (55.60) | 6.03bc (35.86) | 5.19bc (26.43) | 4.85bc (23.02) | 4.70cd (21.59) | 4.99bc (24.40) | 5.54bc (30.43) | 5.22c (26.74) |
| T3      | Flonicamid 50 WG | 0.015  | 7.41 (54.40) | 4.50d (19.75) | 4.11d (16.39) | 3.87d (14.47) | 3.40a (11.06) | 3.88d (14.55) | 4.10d (16.39) | 3.98d (15.34) |
| T4      | Flupyradifurone 200 SL | 0.05 | 7.65 (58.02) | 5.87e (33.95) | 5.10e (25.51) | 4.78 (22.34) | 4.66 (21.21) | 4.97c (20.24) | 5.28c (27.51) | 5.11c (25.61) |
| T5      | Dinetofuran 20 SG | 0.008  | 7.50 (55.75) | 6.05bc (36.10) | 5.21bc (26.64) | 4.81c (22.63) | 4.70cd (21.59) | 4.98c (24.30) | 5.29c (27.66) | 5.17c (26.22) |
| T6      | Pymetrozine 50 WG | 0.015  | 7.50 (55.75) | 6.87b (46.69) | 6.02b (35.74) | 5.63b (31.19) | 5.41b (28.76) | 5.89b (34.19) | 6.28b (39.28) | 6.02b (35.74) |
| T7      | Afidopyropen 5 DC | 0.01 | 7.63 (57.71) | 4.55d (20.20) | 4.23d (17.39) | 4.01d (15.58) | 3.48e (11.61) | 4.17d (16.88) | 4.34d (18.53) | 2.19d (4.29) |
| T8      | Thiamethoxam 25 WG | 0.01 | 7.50 (55.75) | 5.67c (31.64) | 5.13c (25.81) | 4.77c (22.25) | 4.68d (21.40) | 5.00c (25.00) | 5.28bc (27.46) | 5.09c (25.40) |
| T9      | Tolfenpyrad 15 EC | 0.0225 | 7.52 (56.05) | 4.44d (19.21) | 4.03d (15.74) | 3.70d (13.19) | 3.38e (10.92) | 3.87d (14.47) | 3.96d (15.38) | 3.90d (14.71) |
| T10     | Control | - | 7.50 (55.75) | 7.94a (62.54) | 8.01a (63.66) | 8.10a (65.11) | 8.13a (65.59) | 8.17a (66.24) | 8.25a (67.56) | 8.10a (65.11) |

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 2: Bio-efficacy of insecticides against aphids infesting coriander after second spray

| Tr. No. | Treatments          | Conc. (%) | 1       | 3       | 5       | 7       | 10      | 15      | Pooled over periods | Pooled over periods and sprays |
|---------|---------------------|-----------|---------|---------|---------|---------|---------|---------|---------------------|-------------------------------|
| T1      | Dimethoate 30 EC    | 0.03      | 5.33bc  | 5.20bc  | 4.95bc  | 4.70bc  | 4.41bc  | 3.96b   | 4.76b              | (22.15)                      | 5.35b                           |
| T2      | Sulfoxaflor 21.8 SC | 0.0218    | 4.55cd  | 4.36cd  | 4.15cd  | 3.96cd  | 3.74bc  | 3.30c   | 4.01c              | (15.58)                      | 4.61c                           |
| T3      | Flonicamid 50 WG    | 0.015     | 3.46e   | 3.25e   | 3.12e   | 2.91e   | 2.67d   | 2.42d   | 2.97d              | (8.32)                       | 3.47d                           |
| T4      | Flupyrdifurone 200 SL | 0.05     | 4.54d   | 4.32d   | 4.11d   | 3.92cd  | 3.63c   | 3.27c   | 3.96c              | (15.18)                      | 4.54c                           |
| T5      | Dinotefuran 20 SG   | 0.008     | 4.48d   | 4.27d   | 4.09d   | 3.88d   | 3.65c   | 3.26c   | 3.94c              | (15.02)                      | 4.55c                           |
| T6      | Pymetrozine 50 WG   | 0.015     | 5.51b   | 5.33b   | 5.07b   | 4.80b   | 4.52b   | 3.97b   | 4.87b              | (23.21)                      | 5.44b                           |
| T7      | Afidopyropen 5 DC   | 0.01      | 4.53c   | 3.25e   | 3.11e   | 2.93c   | 2.72d   | 2.45d   | 2.99d              | (8.44)                       | 3.94d                           |
| T8      | Thiomethoxam 25 WG  | 0.01      | 4.51c   | 4.30d   | 4.12d   | 3.92cd  | 3.61c   | 3.25c   | 3.95c              | (15.10)                      | 4.52c                           |
| T9      | Tolfenpyrad 15 EC   | 0.0225    | 3.27e   | 3.23e   | 3.07e   | 2.85e   | 2.41d   | 2.28d   | 2.85d              | (7.62)                       | 3.37d                           |
| T10     | Control             |           | 9.97a   | 9.66a   | 9.41a   | 8.43a   | 7.61a   | 6.19a   | 8.54a              | (72.43)                      | 8.32a                           |

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 3: Effect of various insecticides on coriander yield

| Tr. No. | Treatments          | Yield (kg/ha) | Increase in yield over control (%) | Avoidable losses (%) |
|---------|---------------------|---------------|-----------------------------------|---------------------|
| T1      | Dimethoate 30 EC    | 954c          | 22.46                             | 33.79               |
| T2      | Sulfoxaflor 21.8 SC | 1133bc        | 45.44                             | 21.37               |
| T3      | Flonicamid 50 WG    | 1400a         | 79.71                             | 19.90               |
| T4      | Flupyrdifurone 200 SL | 1183b       | 50.19                             | 18.80               |
| T5      | Dinotefuran 20 SG   | 1170b         | 71.01                             | 17.90               |
| T6      | Pymetrozine 50 WG   | 927c          | 61.99                             | 18.80               |
| T7      | Afidopyropen 5 DC   | 1591a         | 88.99                             | 39.66               |
| T8      | Thiomethoxam 25 WG  | 1199b         | 99.99                             | 49.66               |
| T9      | Tolfenpyrad 15 EC   | 1441a         | 111.11                            | 49.66               |
| T10     | Control             | 779d          | -                                 | 45.94               |

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

Fig 1: Effect of different insecticides on seed yield of coriander
Conclusion
Of the nine chemicals evaluated tolfenpyrad 15 EC, flonicamid 50 WG and afidopyropen 5 DC were found more effective on the basis of population of aphids, whereas thimethoxam 25 WG, flupyradifuron 200 SL and dinotefuran 20 SG were mediocre in their effectiveness. However, pymetrozine 50 WG, dimethoate 30 EC and sulfoxaflor 21.8 SC were found less effective in reducing the incidence of aphids infesting coriander. The coriander seed yield recorded from treatments viz., tolfenpyrad, flonicamid, afidopyropen, thimethoxam, flupyradifuron, dinotefuran, sulfoxaflor, dimethoate and pymetrozine were 1441, 1400, 1391, 1199, 1183, 1170, 1133, 954 and 927 kg/ha, respectively.

References
1. Anonymous. Ministry of Agriculture & Farmers Welfare 2019a.
2. Anonymous Director of horticulture department of Gujarat, India 2019b.
3. Jain PC, Yadava CPS. Relative susceptibility of coriander to brown wheat mite. Indian Journal of Applied Entomology 1988;3:5-10.
4. Jain PC. Incidence of pests and their control on coriander (Coriandrum sativum L.). Ph.D. thesis, Sukhadia University, Udaipur, Rajasthan 1984.
5. Hameed SF, Sud VK, Giamzo SP. New records of aphids from Kulu and Lahoul valley (Himachal Pradesh). Indian Journal of Entomology 1975;37:203-205.
6. Steel RGD, Torrie JH. Principle and procedures of statistics. Second Edition, Mcgraw Hill Book Company, Inc., New York 1980.
7. Hirapara JR. Bionomics, seasonal insecticide and chemical control of aphid, Hyadaphis coriandri (Das) on coriander M.Sc. thesis, Junagadh Agricultural University, Junagadh, Gujarat 2017.
8. Ghadage SM. Seasonal incidence, varietal screening, yield losses and chemical control of pest complex of coriander. M.Sc. thesis, Junagadh Agriculture University, Junagadh, Gujarat 2009.
9. Khosla RK. Techniques for assessment of losses due to pests and disease of rice. Indian Journal of Agricultural Science 1977;47(4):171-174.