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Population dynamics of coriander aphid and occurrence of their natural enemies in organic coriander

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Abstract

The infestation of coriander aphid initiated from third week of December, 2020 and continued up to the first week of March, 2021 with ranged from 5.00 to 66.0 aphid/plant and reached to its peak in the first week of February, 2021 with mean population of 66.0 aphid per plant. The population of coriander aphid showed with mean atmospheric temperature and sunshine hours were significant positive correlation. The abundance of predatory coccinellid beetles and spiders population observed in the fourth week of December, 2020 and reached its peak in the first week of February, 2021 (4.00 coccinellids/plant) and last week of January, 2021 (5.75 spiders/plant), respectively. The mean atmospheric temperature and sunshine hours had a significant positive correlation, whereas the mean per cent mean relative humidity had a significant negative correlation with the population of coccinellid beetles but abiotic factors were showed non-significant with the population of spiders. The coccinellid beetles and spiders population had a significant positive correlation with the mean population of coriander aphid ($r = 0.704$ and $r = 0.580$, respectively).

Keywords: Coriander, aphid, natural enemies, organic farming, population dynamics

Introduction

India is the largest producer as well as consumer of spices with commercial cultivation undertaken on 27 spices besides the herbal spices. The leading spice producing states in India are the Andhra Pradesh, Karnataka, Kerala, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal. Spices are mostly used as flavoring agent in a number of foodstuffs like curries, bakery products, pickles, processed meat, beverages, liqueurs etc. They are endowed with tremendous functional properties and medicinal values provide great health benefits and immunity (Paswan *et al.*, 2021) [16]. The coriander growing and producing districts of Rajasthan are Baran, Jhalawar, Kota, Chittorgarh, Bundi, Ajmer, Jodhpur, Jaisalmer, Bhilwara, Jaipur, and Sikar. (Kalra, 2007; Swami *et al.* 2018) [2, 19].

Population and incidence of insect pests depends upon different factors like as different crop growth stages, presence of natural enemies, and climatic conditions on different days. The correlation and interaction between natural enemies, pest activity, and meteorological measures helps in predicate the derive models that in turn of forecast the pest incidence in area or field. In reduction of the aphid population coccinellid predators also play a significant role (Kumari and Yadav, 2005) [5].

Coriander is susceptible to insect pests and short duration cash crop. For higher yield and quality production of coriander Insect and pests are one of the important limiting measures. Coriander has been found to infesting by aphid *Hyadaphis coriandri* (Das), white fly (*Bemisia tabaci*) (Gennadius), green peach aphid (*Myzus persicae*) (Sulzer), mite (*Petrobia latens*) (Muller) and thrips (*Thrips tabaci*) (Lindeman) cropget infested with highly number of insect pests which damage the crop right from germination of seed to till maturity of the crop (Swami *et al.*, 2018) [19]. The coriander aphid reported as major regular pest among them, initiation of their infestation during early growth stages (15 to 25 days after seed germination). Aphid infestation starts on coriander at during flowering to full vegetative stage and become more severe till seed formation. In the absence of control measures, incurred 40-50% yield loss. Aphid remains active throughout the reproductive phase of coriander till maturity of seeds. Due to infestation of aphid, a considerable yield and quality loss to the growers as well as consumers. (Meena and Meena, 2020) [9].

The insect pests viz., *Hyadaphis coriandri* (Das) by sucking cell sap of plant cause severe damage to the plant from tender shoots to umbels (as they prefer tender parts for feeding and breeding). Later they feeds on the sap from developing seeds. In addition to direct damage, promotes development of sooty mould. The substances called honey dew excreted by the insect that interferes with the photosynthesis of the plant. Nymphs and adults of aphid both by sucking cell sap caused quantitative and qualitative loss to coriander seeds and yield from flowering to till full maturation of the crop during the (mainly February to March) crop season. The attack of insect pests majorly depends upon climatic conditions (Swami *et al.*, 2018) [19]. Aphid cause a different diseases like vector of viral diseases like mosaic of cowpea as well coriander yellowing and mosaic on papaya and different other crops. If management and control strategies are not applied on economic threshold level, it caused 40 to 50 per cent yield loss. (Meena *et al.* 2016) [16].

Materials and Methods

A field trial was carried out at Agronomy Farm, RCA, Udaipur. The seeds of coriander variety RKD-18 were sown with 40 cm row to row and 40 cm plant to plant distance in uniformly sized plots measuring 4 m x 4 m (16 m²). Six such plots were maintained pesticides-free to allow natural infestation and thus recorded the Seasonal incidence of major insect pests complex were recorded on 5 randomly selected and tagged plants from each plot.

Sampling and observations

- The counting of aphid's population 10 cm twigs per plant were taken on 5 randomly selected and tagged plants in each plot.
- The associated natural enemies like coccinellids, predatory bugs, syrphid flies and spiders were recorded by the visual count technique from the same plants randomly.
- Observations were taken on a weekly basis during early hours of the day.

The following statistical analysis was made towards estimating the species incidence and abundance: Formula for simple correlation (Pearson, 1920) [17]:

$$\text{Where } r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n} \right] \left[\sum Y^2 - \frac{(\sum Y)^2}{n} \right]}}$$

r_{xy} = Simple correlation coefficient

X = Variable *i.e.*, abiotic components (Average temperature and relative humidity rainfall and sunshine hours)

Y = Variable *i.e.*, mean number of insect pests

N = Number of paired observations

The correlation coefficient (r) values will be subjected to the test of significance using t-test

$$t = \frac{r}{\sqrt{1-r^2}} \times \sqrt{n-2} \sim t_{n-2, d.f.}$$

Where,

r = Correlation coefficient value n-2 = Degrees of freedom

$t_{(n-2)}$ D.F. = t table value for n-2 degrees of freedom.

Results and Discussion

Population dynamics of coriander aphid in coriander

During the crop season, the incidence of coriander aphid was started form third week of December, 2020 and continued till the first week of March, 2021. The peak population of coriander aphid was recorded in first week of February, 2021 (66.0 aphid/plant) with the the mean atmospheric temperature (16.40 °C), mean relative humidity (49.90 per cent) and sunshine (8.60 hours) were recorded. The mean atmospheric temperature and sunshine hours had a significant positive correlation with the population of coriander aphid and also mean relative humidity had a significant negative correlation with coriander aphid (Table 1 and Fig. 1).

According to available literature, there are many insect pests which are causing damage to the coriander crop. Meena *et al.* (2017) [10] reported 15 species of insect pests from semi-arid region of Rajasthan on coriander. Among the different pests, aphid, *H. coriandri* is a major insect pest and responsible for reduction in crop yield and quality of seed (Jain and Yadav, 1989; Upadhyay *et al.* 1996) [11]. The heavy infestation of aphid on coriander occurred between December to March and causes the loss of more than 50 per cent of yield in unprotected (Jain and Yadav 1989) [11]. The coriander aphid, *H. coriandri* has been reported to be the main aphid species in India infesting coriander and causes about 19 per cent losses (Meena *et al.* 2011) [13]. The present findings are in accordance with that of Kant, *et al.* (2019) [14] reported that the activity period of coriander aphid from month of December to March in the crop season. Meena *et al.* (2009) [8] reported that the peak period of *H. coriandri* in the first week of February with mean population of aphid were 584.16 per 3-plants total and report in parallel to the above outcome peak period of *H. coriandri* in the month of February by Pareek *et al.*, 2013 and Swami *et al.*, 2018 [19]. Kanjiya *et al.* 2018 [3] and Choudhary *et al.* 2020 recorded that the peak activity of *H. coriandri* in the crop of fennel in the month of February.

The present findings are in accordance to our studies that recorded maximum aphid population on coriander crop during February month. Aphid population and maximum temperature exhibit positive significant correlation and also recorded by Puri *et al.* (2017) [18] and Swami *et al.* (2018) [19] that the mean atmospheric temperature was showed positive significant correlation with aphid population. The more or less same results were obtained by Kumari and Yadav, 2006 [6] and Meena *et al.* (2009) [8] reported that the mean atmospheric temperature was showed positive significant, while the mean relative humidity exhibited significant negative correlation with aphid population.

Occurrence of natural enemies of coriander aphid

The occurrence of coccinellid beetles and spiders population appeared in the fourth week of December, 2020 and reached to the maximum in the first week of February, 2021 and last week of January, 2021, respectively and that time mean atmospheric temperature (16.40 °C), mean relative humidity (49.90 per cent), sunshine hours (8.60 hours) and mean population of coriander aphid (66.0 per plant) they were recorded.

The mean atmospheric temperature and sunshine hours had a significant positive correlation; whereas, the mean per cent mean relative humidity had a significant negative correlation with the population of coccinellid beetles but abiotic factors were showed non-significant with the population of spiders.

The coccinellid beetles and spiders population had a significant positive correlation with the mean population of coriander aphid ($r = 0.704$ and $r = 0.580$, respectively) (Table 2 and Fig. 2).

During the crop season we are observed the predatory coccinellid beetles and spiders have been found preying aphid, *H. coriandri*. The present findings are in conformity with those of Lekha (2002) [7] observed that both the grubs and adults of *C. septempunctata* feed on the aphid *H. coriandri* infesting coriander crop. The occurrence of predator *C. septempunctata* coincided with the population of aphid and Kant *et al.* (2019) [4] reported that the growth of beetle population increase with the population development of aphids on crop and reached its peak in 13th standard week with the average population of both year were 3.7 beetle per plant. The predatory activity of the coccinellids also began in the second week of January, and during January to February their population ranged from 0.5 to 15 beetles per 3-plant. The

adult coccinellids had a significant positive correlation with atmosphere temperature; whereas, with relative humidity the correlation was significantly negative. (Meena *et al.* 2009) [8] Earlier, a number of workers have reported that the peak activity of aphid coccinellid with the peak infestation of aphid. The correlation metrix studies between the aphid, *H. coriandri* and the coccinellids predator depicted significant positive correlation (Swami *et al.* 2018) [19]. Meena *et al.* (2002) [12] also reported that the coriander aphid, *H. coriandri* was showed positive significant correlation with predator coccinellid population. Higher population of coccinellids was observed during last week of January to third week of March and showed significantly highly correlated with aphid population in funnel crop (Kanjiya *et al.* 2018) [3] but Meena *et al.* (2009) [8] reported that the relationship between the aphids and grubs of the coccinellids also showed a significant negative correlation.

Table 1: Population dynamics of the aphid in coriander under organic farming in *rabi* season during 2020-21

Dates of Observations	Weather parameters			Mean population (No's) of aphid /plant
	Mean Atm. temp. (°C)	Mean RH (%)	Sunshine (hours)	
20-12-2020	15.40	63.00	4.80	5.00
27-12-2020	15.20	58.90	8.30	20.00
03-01-2021	13.00	54.90	7.10	25.60
10-01-2021	16.90	72.40	3.20	40.40
17-01-2021	15.90	62.30	6.10	45.00
24-01-2021	17.70	60.90	8.30	54.40
31-01-2021	12.90	52.60	8.70	59.60
07-02-2021	16.40	49.90	8.60	66.00
14-02-2021	16.80	49.20	8.30	40.60
21-02-2021	18.40	47.70	8.70	35.20
28-02-2021	20.90	43.10	9.60	25.60
07-03-2021	21.70	39.80	9.60	15.40
Seasonal mean	16.77	54.56	7.61	36.07
Coefficient of correlation (r) b/w aphid and mean Atm. Temp.				0.660*
Coefficient of correlation (r) b/w aphid and mean Relative humidity				-0.638*
Coefficient of correlation (r) b/w aphid and Sunshine				0.589*

* Significant at 5 per cent level of significance

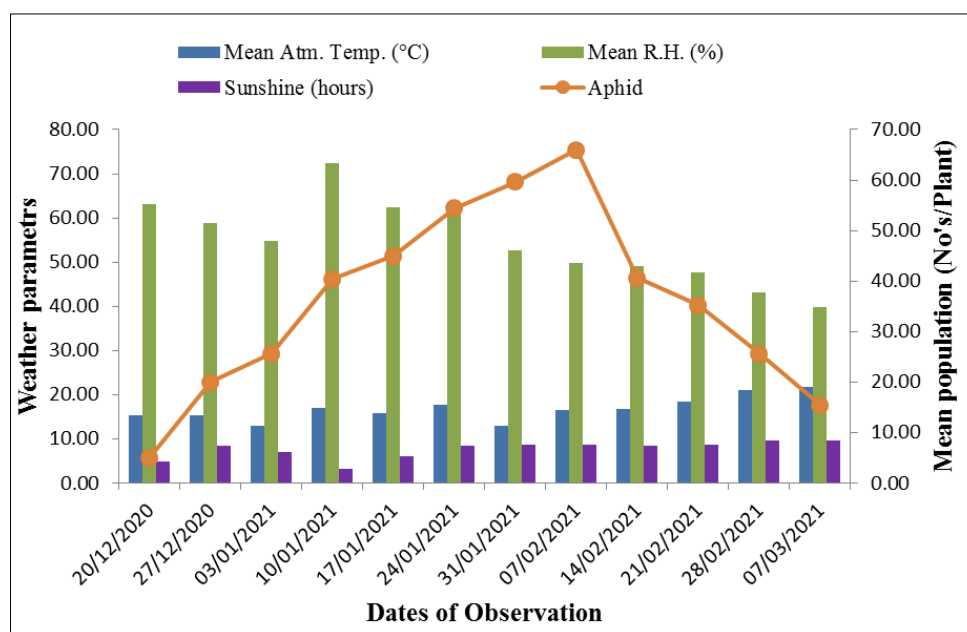
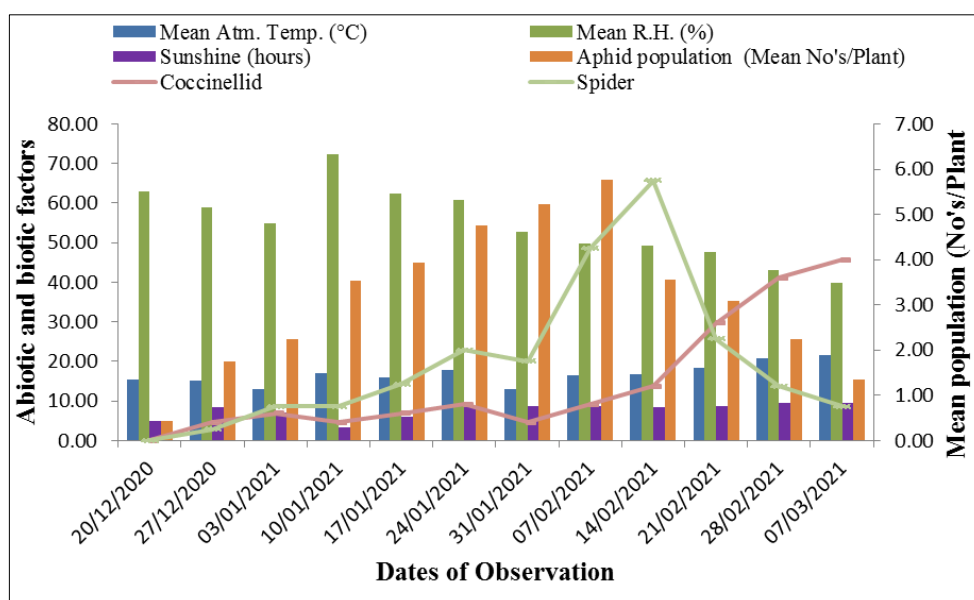


Fig 1: Population dynamics of the aphid in coriander under organic farming in *rabi* season during 2020-21.

Table 2: Occurrence of natural enemies in coriander under organic farming in *rabi* season during 2020-21

Dates of Observations	Abiotic and biotic factors				Mean population (No's) /plant	
	Mean Atm. temp. (°C)	Mean RH (%)	Sunshine (hours)	Mean population (No's) of aphid /plant	Coccinellids	Spiders
20-12-2020	15.40	63.00	4.80	5.00	0.00	0.00
27-12-2020	15.20	58.90	8.30	20.00	0.60	0.25
03-01-2021	13.00	54.90	7.10	25.60	0.40	0.75
10-01-2021	16.90	72.40	3.20	40.40	0.80	0.75
17-01-2021	15.90	62.30	6.10	45.00	0.80	1.25
24-01-2021	17.70	60.90	8.30	54.40	2.60	2.00
31-01-2021	12.90	52.60	8.70	59.60	3.60	5.75
07-02-2021	16.40	49.90	8.60	66.00	4.00	4.25
14-02-2021	16.80	49.20	8.30	40.60	1.20	1.75
21-02-2021	18.40	47.70	8.70	35.20	0.60	2.25
28-02-2021	20.90	43.10	9.60	25.60	0.40	1.20
07-03-2021	21.70	39.80	9.60	15.40	0.40	0.75
Seasonal mean	16.77	54.56	7.61	36.07	1.28	1.75
Coefficient of correlation (r) for natural enemies population and Atm. Temperature					0.868*	0.037
Coefficient of correlation (r) for natural enemies population and Relative humidity					-0.799*	-0.329
Coefficient of correlation (r) for natural enemies population and Sunshine					0.615*	0.340
Coefficient of correlation (r) for aphid and natural enemies					0.704*	0.580*

* Significant at 5 per cent level of significance

**Fig 2:** Occurrence of natural enemies in coriander under organic farming in *rabi* season during 2020-21

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