



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(4): 460-464

© 2018 JEZS

Received: 18-05-2018

Accepted: 21-06-2018

Dinesh Swami

Department of Entomology,
S.K.N. College of Agriculture,
Jobner, Jaipur, Rajasthan, India

BL Jat

Department of Entomology,
S.K.N. College of Agriculture,
Jobner, Jaipur, Rajasthan, India

SK Dotasara

Department of Entomology,
S.K.N. College of Agriculture,
Jobner, Jaipur, Rajasthan, India

Population dynamics of insect pests of coriander and their correlation with biotic and abiotic factors

Dinesh Swami, BL Jat and SK Dotasara

Abstract

Population dynamics of insect pests of coriander and their correlation with biotic and abiotic factors were studied in the department of Entomology, S.K.N. College of Agriculture, Jobner (Sri Karan Narendra agricultural University, Jobner) during two consecutive years *i.e.*, *rabi*, 2015-16 and 2016-17. The coriander crop has been found to be infested by aphid, *Hyadaphis coriandri* (Das), whitefly, *Bemisia tabaci* (Gennadius), thrips, *Thrips tabaci* (Lindeman) and mite, *Petrobia latens* (Muller), among these, the coriander aphid was reported as a regular and major pest. The infestation of aphid was started from second week of January on early and third week of January on normal and late maturing varieties and peaked in the fourth week of February on all three varieties in both the years. The peak activity of aphid on all three varieties was observed at 30.1-32.7 °C maximum and 9.7-12.1 °C minimum temperature with average relative humidity between 51.0-54.5 percent during both the years. The maximum temperature had significant effect on aphid population, whereas, minimum temperature, average relative humidity and rainfall had non-significant effect. Among the natural enemies, coccinellids predator have been found preying aphid, *H. coriandri* on the coriander crop in both the years. The peak activity of coccinellids coincided with the peak infestation of aphid. The correlation matrix studies between the aphid, *H. coriandri* and the coccinellids predator depicted significant positive correlation in both the years. The maximum and minimum temperatures, average relative humidity and rainfall had non-significant effect on the coccinellid predators.

Keywords: Coccinellids, coriander, *Hyadaphis coriandri* (Das), population dynamics

1. Introduction

Coriander, *Coriandrum sativum* (Linn.) is one of the important seed spice winter season crop belongs to family Apiaceae (Umbelliferae), native of Mediterranean region. It is commonly known as “*Dhaniya*” and grown both for green vegetable as well as for seed purpose. India is the largest producer, consumer and exporter of coriander in the world. Coriander crop is extensively grown in the arid to semi-arid regions of India, covering an area of about 0.624 million ha with the production of 0.673 million tonnes ^[1]. Insect pests are one of the major limiting factors for higher and quality production of coriander. The insect pests *viz.*, *Hyadaphis coriandri* (Das), *Bemisia tabaci* (Genn.), *Thrips tabaci* (Linn.) and *Petrobia latens* (Muller) have been found infesting coriander crop. Among the various insect pests, the coriander aphid, *H. coriandri* has been reported as a regular and major pest of coriander in Rajasthan and other parts of the country. Both the nymphs and adults of aphid cause qualitative and quantitative losses to seed yields by sucking cell sap from inflorescences/umbels during February-March ^[2-5]. It is well known that attack of insect pests depends upon climatic conditions, crop growth stage and presence of natural enemies at a particular time. The interaction between pest activity and biotic and abiotic factors help in deriving predicative models that in turn forecast the pest incidence. Coccinellid predators, *Coccinella septempunctata* (Linn.) and *Menochilus sexmaculatus* (Fab.) play a significant role in reduction of the aphid population ^[6-7]. Substantial losses due to insect pests, which have not been fully investigated, could be prevented at minimum cost and without hazards to men and environment. Such an approach envisages the necessity to understand the ecological background while considering the entire spectrum of control methodology. Complete details of abiotic and biotic factors of environment of the pest require full investigations.

Correspondence

Dinesh Swami

Department of Entomology,
S.K.N. College of Agriculture,
Jobner, Jaipur, Rajasthan, India

2. Materials and Methods

To study the population dynamics of insect pests of coriander and their correlation with biotic and abiotic factors, three varieties *viz.*, early (RCr-436), normal (RCr-475) and late maturing (RCr-728) were used. All the varieties were sown in five plots separately and allow natural infestation of insect pests. The crop was sown on 30th October and 2nd November, during two consecutive seasons *i. e.*, *Rabi*, 2015-16 and *Rabi*, 2016-17 respectively. The plot size was 3.0 x 2.0 m² with row to row and plant to plant distance of 30 cm and 10 cm, respectively. The observation on insect pests and their predatory fauna were recorded on the crop at weekly interval after one week of germination to till harvesting the crop in early morning hours on five randomly selected and tagged plants in each plot. For recording the observations of aphid and their predators were counted on whole plant in early stage of the crop and later on the population of aphid was counted on three inflorescence/ umbels from each tagged plants. The population of mite and thrips were recorded by tapping them on the white paper sheet, whereas, in case of whitefly by counting nymph and adults. The population data of the aphids as well as the natural enemies were correlated and regression equation computed wherever the r-value were significant.

3. Results and Discussion

1. Population of insect pests and coccinellids predators:

It was observed that insect species belonging to different taxonomic order appeared at different stages of crop growth. Among them, coriander aphid, *Hyadaphis coriandri* (Das) was found the major pest attacking the crop. The whitefly, *Bemisia tabaci* (Genn.), thrips, *Thrips tabaci* (Lindeman) and mite, *Petrobia latens* (Muller) were recorded in very low numbers, hence, were recognized as minor pests. The present result are in agreement with [8-11] who reported coriander aphid, *H. coriandri* as a major pest and whitefly, *B. tabaci*, thrips, *T. tabaci* and mite, *P. latens* as minor pests.

The incidence of aphid started from second week of January on early and third week of January on normal and late maturing varieties and peaked in fourth week of February on all three varieties in both the years. The findings of [12-17] support the present findings. During the studies, it was observed that the infestation of coriander aphid started when the maximum temperature ranged between 20.8 °C-28.1 °C on early (RCr-436) and 19.2 °C-22.0 °C on normal (RCr-475) and late (RCr-728) maturing varieties, and minimum temperature ranged between 4.7 °C-6.3 °C on early (RCr-436) and 2.1 °C-4.4 °C on normal (RCr-475) and late (RCr-728) maturing varieties and average relative humidity during this period varied between 48.5-60.5 percent for early (RCr-436) and 55.5-62.5 percent for normal (RCr-475) and late (RCr-728) maturing varieties of coriander during both the years. The peak activity of aphid on all three varieties was observed at 30.1-32.7 °C maximum and 9.7-12.1 °C minimum temperature with average relative humidity between 51.0-54.5 percent during both the years. These findings confirm with the statements given by the earlier workers that the most of the insects are poikilothermic in nature; therefore, abiotic factors played an important role in their distribution and abundance [18-9].

The quantitative survey during *Rabi*, 2015-16 and *Rabi*, 2016-17 revealed that the coccinellid predatory species, *viz.*, *Coccinella septempunctata* (Linn.), *Menochilus sexmaculatus* (Fab.) and *Adonia variegata* (Geoge) have been found

preying aphid, *H. coriandri* on the coriander crop in both the years. Out of the three, *C. septempunctata* was reported to be dominant one. During *Rabi*, 2015-16, the population of coccinellids predator (both beetles and grubs) appeared in the second week of January (0.2/ five plants), third week of January (0.4/ five plants) and fourth week of January (2.2/ five plants) and reached to maximum in the last week of February *i.e.*, 14.2, 14.6 and 15.6 coccinellids per five plants on early (RCr-436), normal (RCr-475) and late (RCr-728) maturing varieties of coriander, respectively, when maximum and minimum temperatures were 30.1 °C and 12.1 °C and average relative humidity was 54.5 percent. During *Rabi*, 2016-17, the population of coccinellids predator (both beetles and grubs) appeared in the second week of January (0.4/ five plants), third week of January (0.4/ five plants) and fourth week of January (1.2/ five plants) and reached to maximum in the fourth week of February *i.e.*, 17.6, 18.2 and 18.6 coccinellids per five plants on early (RCr-436), normal (RCr-475) and late (RCr-728) maturing varieties, respectively, when maximum and minimum temperatures were 32.7 °C and 9.7 °C and average relative humidity was 51.0 percent.

2. Correlation coefficient of aphid and coccinellids predator with abiotic factors:

With a view to provide a sound base for the management of insect pests of coriander a quantitative estimation of population build up of coriander aphid, *H. coriandri* was carried out in relation to biotic as well abiotic factors, like temperature, relative humidity and rainfall under the prevailing agroclimatic conditions. The maximum and minimum temperature, average relative humidity and rainfall had non-significant effect on the aphid population $r=0.309, 0.027, -0.438$ and -0.198 , respectively on early (RCr-436), $r=0.298, 0.037, -0.428$ and -0.211 , respectively on normal (RCr-475) and $r=0.312, 0.029, -0.424$ and -0.207 , respectively on late (RCr-728) maturing variety of coriander during 2015-16. The same trend has been noticed during *Rabi*, 2016-17 except maximum temperature which showed significant positive correlation with aphid population, $r =0.746, 0.732$ and 0.752 on early (RCr-436), normal (RCr-475) and late (RCr-728) maturing varieties of coriander, respectively [20-23]. reported that the maximum temperature had positive significant effect, whereas, minimum temperature, average relative humidity and rainfall had non-significant effect on the aphid population, support the present findings.

The significant positive correlation was found between aphid, *H. coriandri* population and coccinellid predators, $r= 0.974, 0.902$ and 0.929) during first year (*Rabi*, 2015-16) and $r= 0.978, 0.958$ and 0.946 during second year (*Rabi*, 2016-17) for early (RCr-436), normal (RCr-475) and late (RCr-728) maturing varieties of coriander, respectively. The present findings are corroborate with that of [24-28] who observed that the *C. septempunctata* as a major predator of aphid, *H. coriandri* on coriander crop and significant positive correlation between coccinellids and aphid population.

The maximum and minimum temperatures, average relative humidity and rainfall had non-significant effect on the coccinellid predators. These observations are in partial agreement with the findings of [29-34] who reported that the maximum and minimum temperatures, average relative humidity and rainfall had non-significant effect on the coccinellid predators.

Table 1: Population dynamics of coriander aphid, *Hyadaphis coriandri* (Das) on early, normal and late maturing varieties of coriander during Rabi, 2015-16

SMW	Date of observation	*Mean number of aphid/ five plants			Meteorological observations			
					Temperature (°C)		Average relative humidity (%)	Total rainfall (mm)
		RCr-436	RCr-475	RCr-728	Maximum	Minimum		
2	14.01.2016	2.4	0.0	0.0	20.8	04.7	60.5	0.0
3	21.01.2016	4.0	5.4	8.4	19.2	04.4	62.5	4.6
4	28.01.2016	21.0	24.0	29.0	20.4	04.1	59.5	0.0
5	04.02.2016	140.6	142.2	146.6	24.0	09.5	64.5	1.0
6	11.02.2016	146.8	150.8	152.8	26.7	10.3	55.0	0.0
7	18.02.2016	261.0	263.0	266.0	22.3	03.2	54.0	0.0
8	25.02.2016	284.8	287.8	298.8	30.1	12.1	54.5	1.5
9	04.03.2016	66.6	70.6	74.6	29.2	15.2	59.5	0.0
10	11.03.2016	22.0	24.2	26.4	28.6	12.1	52.0	0.0
11	18.03.2016	0.0	0.0	0.0	32.5	12.7	48.0	0.0

*Average of five replications

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

SMW-Standard Meteorological Weeks

Table 2: Population dynamics of coriander aphid, *Hyadaphis coriandri* (Das) on early, normal and late maturing varieties of coriander during Rabi, 2016-17

SMW	Date of observation	*Mean number of aphid/ five plants			Meteorological observations			
					Temperature (°C)		Average relative humidity (%)	Total rainfall (mm)
		RCr-436	RCr-475	RCr-728	Maximum	Minimum		
2	13.01.2017	1.4	0.0	0.0	28.1	6.3	48.5	0.0
3	20.01.2017	7.2	2.0	4.0	22.0	2.1	55.5	0.0
4	27.01.2017	17.0	19.0	22.4	27.9	6.2	48.0	0.0
5	03.02.2017	153.6	155.8	158.8	25.4	6.8	46.0	0.0
6	10.02.2017	176.2	181.4	183.6	31.3	9.9	43.0	0.0
7	17.02.2017	292.4	298.8	302.6	34.4	12.4	42.0	0.0
8	24.02.2017	308.8	314.2	320.6	32.7	9.7	51.0	0.0
9	03.03.2017	72.4	76.8	80.4	30.7	12.3	56.0	1.5
10	10.03.2017	28.0	32.4	40.8	27.8	11.9	58.5	4.5
11	17.03.2017	0.0	0.0	0.0	32.8	14.9	47.0	0.0

* Average of five replications

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

SMW-Standard Meteorological Weeks

Table 3: Population of Coccinellid predators on early, normal and late maturing varieties of coriander during Rabi, 2015-16

SMW	Date of observation	*Mean number of Coccinellids/ five plants			Meteorological observations			
					Temperature (°C)		Average relative humidity (%)	Total rainfall (mm)
		RCr-436	RCr-475	RCr-728	Maximum	Minimum		
2	14.01.2016	0.2	0.0	0.0	20.8	04.7	60.5	0.0
3	21.01.2016	0.4	0.4	0.0	19.2	04.4	62.5	4.6
4	28.01.2016	2.0	1.8	2.2	20.4	04.1	59.5	0.0
5	04.02.2016	4.6	4.6	4.8	24.0	09.5	64.5	1.0
6	11.02.2016	5.0	5.4	5.8	26.7	10.3	55.0	0.0
7	18.02.2016	9.8	10.4	10.6	22.3	03.2	54.0	0.0
8	25.02.2016	14.2	14.6	15.6	30.1	12.1	54.5	1.5
9	04.03.2016	3.8	4.6	4.8	29.2	15.2	59.5	0.0
10	11.03.2016	0.2	0.4	0.6	28.6	12.1	52.0	0.0
11	18.03.2016	0.0	0.0	0.2	32.5	12.7	48.0	0.0

*Average of five replications

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

SMW-Standard Meteorological Weeks

Table 4: Population of Coccinellid predators on early, normal and late maturing varieties of coriander during *Rabi*, 2016-17

SMW	Date of observation	*Mean number of Coccinellids/ five plants			Meteorological observations			
					Temperature (°C)		Average relative humidity (%)	Total rainfall (mm)
					Maximum	Minimum		
2	13.01.2017	0.4	0.0	0.0	28.1	6.3	48.5	0.0
3	20.01.2017	0.4	0.4	0.0	22.0	2.1	55.5	0.0
4	27.01.2017	1.0	1.0	1.2	27.9	6.2	48.0	0.0
5	03.02.2017	4.8	5.2	5.6	25.4	6.8	46.0	0.0
6	10.02.2017	7.8	8.2	8.6	31.3	9.9	43.0	0.0
7	17.02.2017	12.4	12.8	13.6	34.4	12.4	42.0	0.0
8	24.02.2017	17.6	18.2	18.6	32.7	9.7	51.0	0.0
9	03.03.2017	4.8	5.0	5.6	30.7	12.3	56.0	1.5
10	10.03.2017	0.6	0.8	1.6	27.8	11.9	58.5	4.5
11	17.03.2017	0.0	0.0	0.8	32.8	14.9	47.0	0.0

*Average of five replications

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

SMW-Standard Meteorological Weeks

Table 5: Correlation coefficient (r) between the population of coriander aphid, *Hyadaphis coriandri* (Das) and abiotic, biotic factors during *Rabi*, 2015-16 and 2016-17

S. No	Abiotic and biotic factors	Coriander aphid					
		RCr-436		RCr-475		RCr-728	
		2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
A	Abiotic factors						
1	Temperature °C						
	a. Maximum	0.309	0.746*	0.298	0.732*	0.312	0.752*
	b. Minimum	0.027	0.412	0.037	0.398	0.029	0.422
2	Av. relative humidity (%)	-0.438	-0.628	-0.428	-0.625	-0.424	-0.628
3	Total rainfall (mm)	-0.198	-0.455	-0.211	-0.462	-0.207	-0.460
B	Biotic factor						
	Coccinellid predators	0.974*	0.978*	0.902*	0.958*	0.929*	0.946*

*Significant at 5 percent level of significance

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

Table 6: Correlation coefficient(r) between coccinellid predators and abiotic factors during *Rabi*, 2015-16 and 2016-17

S. No	Abiotic factors	Coccinellid Predators					
		RCr-436		RCr-475		RCr-728	
		2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
1	Temperature (°C)						
	a. Maximum	0.369	0.771*	0.539	0.792*	0.343	0.763*
	b. Minimum	0.084	0.421	0.078	0.493	0.098	0.456
2	Av. relative humidity (%)	-0.409	-0.494	-0.441	-0.552*	-0.472	-0.484
3	Total rainfall (mm)	-0.160	-0.417	-0.166	-0.463	-0.169	-0.398

*Significant at 5 percent level of significance

RCr-436 early, RCr-475 normal and RCr-728 late maturing varieties of coriander

4. References

- Anonymous. Vital Agriculture Statistics, 2015-16, Directorate of Agriculture, Rajasthan (Statistics cell), Jaipur, 2016.
- Lekha. Management of *Hyadaphis coriandri* (Das) on coriander (*Coriandrum sativum* Linn.). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2002.
- Bana JK. Management of insect-pests of coriander, *Coriandrum sativum* (L.) with special reference to aphid, *Hyadaphis coriandri* (Das). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2007.
- Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology. 2013; 27(1):21-26.
- Meena NK, Lal G, Meena RS, Harisha CB, Meena SR. Pest scenario of coriander (*Coriandrum sativum* L.) and population dynamics in semi-arid region of Rajasthan. International Journal of Tropical Agriculture. 2017; 35(4):779-783.
- Bana JK. Management of insect-pests of coriander, *Coriandrum sativum* (L.) with special reference to aphid, *Hyadaphis coriandri* (Das). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2007.
- Kalra VK. Population dynamics of various predators associated with coriander aphid, *Hyadaphis coriandri* (Das). Journal of Biological Control. 2011; 2:77-79.
- Lekha. Management of *Hyadaphis coriandri* (Das) on coriander (*Coriandrum sativum* Linn.). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2002.
- Meena NK, Lal G, Meena RS, Harisha CB, Meena SR. Pest scenario of coriander (*Coriandrum sativum* L.) and population dynamics in semi-arid region of Rajasthan. International Journal of Tropical Agriculture. 2017;

- 35(4):779-783.
10. Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology. 2013; 27(1):21-26.
 11. Meena NK, Lal G, Meena RS, Harisha CB, Meena SR. Pest scenario of coriander (*Coriandrum sativum* L.) and population dynamics in semi-arid region of Rajasthan. International Journal of Tropical Agriculture. 2017; 35(4):779-783.
 12. Nayar KK, Ananthakrishna TN, David BV. General and Applied Entomology, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1982, 537.
 13. Jain PC. Incidence of pests and their control on coriander (*Coriandrum sativum* Linn.) A thesis submitted for Ph.D. (Ag.) to Sukhadia University, Udaipur, 1984.
 14. Mittal VP, Butani PG. Evaluation of some insecticides against coriander aphid, *Hyadaphis coriandri* (Das). First National Seminar on Seed Spices, Jaipur (Raj), 1989, 41-42.
 15. Meena PC. Incidence and management of insect pest of coriander (*Coriandrum sativum* L.). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 1999.
 16. Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology, 2013; 27(1):21-26.
 17. Puri R, Malik VS, Sharma SS, Tehlan SK. Screening of coriander varieties/ germplasm and evaluation of insecticides against coriander aphid, *Hyadaphis coriandri* (Bodenheimer and Swirski). Annals of Biology, 2017a; 32(1):59-62.
 18. Singh G, Saini BS. Seasonal activity and control of red spider mite, *Tetranychus telarius* (L.) in Punjab. Science and Culture. 1971; 37:339-341.
 19. Gupta SK, Dhooria MS, Sindhu AS. Seasonal abundance of *Tetranychus telarius* (Linn.) on castor in Punjab. Oil Seed Journal. 1976; 6:16-18.
 20. Jain PC, Yadav CPS. Pest complex of coriander and seasonal incidence of coriander aphid, *Hyadaphis coriandri* (Das) in relation to insect predators. Indian Journal of Applied Entomology, 1988a; 2:35-41.
 21. Kumari S, Yadav RP. Effect of weather on population dynamics of *Hyadaphis coriandri* (Das) (Homoptere; Aphididae) in coriander eco-system under late sown condition. Journal of Applied Zoological Researches, 2006; 17:51-53.
 22. Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology. 2013; 27(1):21-26.
 23. Puri, Rinku, Anuradha. Correlation between the Incidence of coriander aphids (*Hyadaphis Coriandri* Das), their natural Enemies (coccinellids) and abiotic factors of the environment. Chemical Science Review and Letters. 2017b; 6(23):1745-1749.
 24. Omkar, Shefali S, James BE, Srivastava S. Prey Preference of a lady beetle, *Coccinella septempunctata* (Linn.). Journal of Advanced Zoology. 1997; 18:96-97.
 25. Lekha. Management of *Hyadaphis coriandri* (Das) on coriander (*Coriandrum sativum* Linn.). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2002.
 26. Meena DK, Swaminathan R, Bhati KK, Jain HK. Population dynamics of the coriander aphid and its coccinellid predators. Indian Journal of Applied Entomology. 2009; 23(1):66-69.
 27. Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology. 2013; 27(1):21-26.
 28. Puri, Rinku, Anuradha. Correlation between the Incidence of coriander aphids (*Hyadaphis Coriandri* Das), their natural Enemies (coccinellids) and abiotic factors of the environment. Chemical Science Review and Letters. 2017b; 6(23):1745-1749.
 29. Lekha. Management of *Hyadaphis coriandri* (Das) on coriander (*Coriandrum sativum* Linn.). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2002.
 30. Bana JK. Management of insect-pests of coriander, *Coriandrum sativum* (L.) with special reference to aphid, *Hyadaphis coriandri* (Das). A thesis submitted for M.Sc. (Ag.) to Rajasthan Agricultural University, Bikaner, 2007.
 31. Meena DK, Swaminathan R, Bhati KK, Jain HK. Population dynamics of the coriander aphid and its coccinellid predators. Indian Journal of Applied Entomology. 2009; 23(1):66-69.
 32. Pareek RK, Sharma A, Kumawat KC. Seasonal abundance of insect pests and their major natural enemies in coriander, *Coriander sativum* (Linn.). Indian Journal of Applied Entomology. 2013; 27(1):21-26.
 33. Puri, Rinku, Anuradha. Correlation between the Incidence of coriander aphids (*Hyadaphis Coriandri* Das), their natural Enemies (coccinellids) and abiotic factors of the environment. Chemical Science Review and Letters. 2017b; 6(23):1745-1749.