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Population Dynamics of Insect Pests of Coriander and their Correlation with Biotic and Abiotic Factors

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ABSTRACT: Field investigations during *rabi* 2022–23 and 2023–24 revealed the population dynamics of insect-pests and their natural predator on coriander. Among insect pests, coriander aphid (*Hyadaphis coriandri* Das) was recorded as the major pest, while whitefly (*Bemisia tabaci* Genn.), thrips (*Thrips tabaci* Lindeman) and mite (*Petrobia latens* Muller) occurred in low numbers and were identified as minor pests. Aphid infestation initiated from the second to third week of January and peaked in late February, coinciding with maximum temperatures of 23.2–24.5°C, minimum 3.5–4.9°C, and relative humidity 55.0–55.5%. Aphid population showed significant positive correlation with maximum temperature and coccinellid predator (*Coccinella septempunctata* Linn.) abundance, but negative correlation with relative humidity. The predator appeared in late January and peaked in February (14.2–15.8 beetles/5 plants). Coccinellid population showed positive correlation with temperature and non-significant response to relative humidity. Thus, *C. septempunctata* was the key biological control agent of *H. coriandri* in coriander ecosystems.

Keywords: *Hyadaphis coriandri*, coccinellid, Coriander, population dynamics, correlation.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an important seed spice crop belonging to the family Apiaceae, and is commonly known as cilantro, Chinese parsley, or dhania. It is native to Italy and is widely cultivated in India, Russia, Central Europe, Asia Minor, Romania, Mexico, Morocco, and the USA (Pruthi, 1976). The stems, leaves, and seeds possess a pleasant aromatic fragrance. The fresh leaves and tender stems of young plants are used in preparing chutneys and sauces, while the dried fruits are extensively used as a condiment in curry powder, pickling spices, and various seasonings (Butani, 1984). India is the world's largest producer, consumer, and exporter of coriander. The crop is predominantly grown in the arid and semi-arid regions of the country, covering about 5.28 lakh hectares with a production of approximately 7.0 lakh tonnes (Anonymous, 2022–23a).

Rajasthan and Gujarat have emerged as the seed spice hubs of India, together accounting for over 80% of the country's total coriander production. In Rajasthan, coriander is mainly cultivated in the districts of Jhalawar, Baran, Kota, Chittorgarh, Bundi, Jaisalmer, Bhilwara, Jodhpur, Jaipur, Sikar, and Ajmer. The state cultivates coriander over an area of about 0.60 lakh hectares, producing approximately 0.89 lakh tonnes annually, with a productivity of 1,488 kg/ha (Anonymous, 2022–23b).

Insect pests are one of the main constraints to achieving higher yields and better quality in coriander production. Species such as *Hyadaphis coriandri* (Das), *Bemisia tabaci* (Genn.), *Thrips tabaci* (Linn.), and *Petrobia latens* (Muller) have been observed attacking coriander crops. The aphid, *Hyadaphis coriandri* and seed midge, *Systole albipennis* have been recorded as major insect pests of coriander crops. Of these, the coriander aphid, *H. coriandri*, is considered a persistent and major pest in Rajasthan and other regions of India. Both nymphs and adults damage the crop by sucking sap from inflorescences or umbels during February–March, leading to both qualitative and quantitative losses in seed yield (Lekha, 2002; Bana, 2007; Pareek *et al.*, 2013; Meena *et al*., 2017; Dalal *et al.*, 2024). It is well established that pest outbreaks are influenced by factors such as climate, crop growth stage, and the presence of natural enemies at specific times. Understanding the interaction between pest activity and both biotic and abiotic factors allows the development of predictive models for forecasting pest incidence. Ladybird beetles like *Coccinella septempunctata* (Linn.) and *Menochilus sexmaculatus* (Fab.) are important predators that help reduce aphid populations (Bana, 2007; Kalra, 2011). Significant yield losses caused by insect pests, many of

which are not yet fully studied, could be prevented at low cost and without harm to humans or the environment. This approach highlights the need to consider ecological aspects while applying a complete range of pest control strategies. For this, detailed investigations into the pest's environmental biotic and abiotic factors are essential.

MATERIAL AND METHODS

The present study was carried out at the Agronomy Farm and Laboratory, Department of Entomology and Biochemistry, S.K.N. College of Agriculture, Jobner (Sri Karan Narendra Agricultural University, Jobner) during two consecutive *Rabi* seasons, 2022–23 and 2023–24. The experiment was arranged in a randomized block design with three replications. For assessing aphid incidence, the coriander variety Rcr-728 was sown on 29th October in *Rabi* 2022–23 and on 1st November in *Rabi* 2023–24, maintaining a spacing of 30 cm × 10 cm. All recommended agronomic practices, except plant protection measures, were followed to raise the crop. The variety was cultivated in a separate plot measuring 3.0 m × 2.0 m². In each plot, five plants were randomly selected and tagged for recording aphid populations. Observations were taken weekly in the morning, starting from germination until crop maturity. No insecticides were applied in the plots during the entire crop season. In the early crop stage, aphid counts were recorded on the whole plant, while in later stages, counts were taken from three umbels per tagged plant. Similarly, the population of coccinellids was recorded from five randomly selected and tagged plants per plot at weekly intervals, counting individuals on the whole plant. The average number of natural enemies per plant was then calculated from these observations.

RESULTS AND DISCUSSION

A. 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 results are in agreement with (Lekha, 2002; Pareek *et al*., 2013; Meena *et al*., 2017; Meena *et al*., 2009), 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 and third week of January in both the years.and peaked in third week of February in both the years.The findings of (Pareek *et al*., 2013; Nayar *et al.*, 1982; Jain, 1984; Mittal and Butani 1989; Meena, 1999) support the present findings. During the studies, it was observed that the infestation of coriander aphid started when the maximum temperature ranged between 23.2°C-24.5°C, and minimum temperature ranged between 3.5°C-4.9°C. While average relative humidity during this period varied between 55.0-55.5 per cent (Table 1 & 2). The minimum temperature showed non-significant effect on the aphid population r=0.443 and positive significant correlation (r = 0.637) with maximum temperature. The negative significant correlation with relative humidity (r = -0.646) during *Rabi* 2022-23 (Table 3). The maximum, minimum temperature and average relative humidity, showed positive significant effect on the aphid, r=0.255, 0.584 and 0.208, during *Rabi*, 2023-24 (Table 3). Aphid showed positive significant correlation (r= 0.967 and 0.694) with coccinellid during both the years (Table 3). The present findings are corroborated with that of Omkar *et al*. (1997); Lekha (2002); Meena *et al.* (2009); Pareek *et al.* (2013); Swami *et al*. (2018); Dalal *et al.* (2024) who observed that the *C. septempunctata* as a major predator of aphid, *H. coriandri* on coriander crop and had significant positive correlation with aphid population.

The quantitative survey during *Rabi*, 2022-23 and 2023-24 revealed that the coccinellid predator, *viz.*, *Coccinella septempunctata* (Linn.), have been found preying aphid, *H. coriandri* on the coriander crop in both the years. During *Rabi* season of 2022-23, the population of coccinellids predator (both beetles and grubs) appeared in the fourth week of January (2.40/five plants), and reached to maximum in the last week of February *i.e.*, 14.2, coccinellids per five plants when maximum and minimum temperatures were 31.9°C and 9.8°C and average relative humidity was 49.0 per cent. During *Rabi* season of 2023-24, the population of coccinellids predator (both beetles and grubs) appeared in the fourth week of January (0.4/ five plants), and reached to maximum in the fourth week of February *i.e.*, 15.8, coccinellids per five plants when maximum and minimum temperatures were 26.4°C and 11.6°C and average relative humidity was 70.0 per cent (Table 1 & 2). The maximum and minimum temperature showed non-significant positive effect on the coccinellid predators, r=0.538, 0.391, respectively and relative humidity showed non-significant negative correlation (r = -0.458) during *Rabi*, 2022-23 (Table 3). The correlation between population of coccinellid predators with maximum and minimum temperature were positive correlation (r = 0.608 and r = 0.838 respectively) and relative humidity had non-significant effect (r = 0.100) during *Rabi* 2023-24(Table 3). These results are in partial agreement with the findings of Lekha (2002); Bana (2007); Meena *et al.* (2009); Pareek *et al.* (2013); Swami *et al.* (2018); Dalal *et al.* (2024) who reported that the maximum and minimum temperatures, average relative humidity and rainfall had non-significant effect on the coccinellid predators.

Table 1: Seasonal incidence of aphid, *Hyadaphis coriandri* (Das) on coriander and their natural enemies in relation to meteorological parameters in *Rabi*, 2022-23.

SMW	Abiotic Factors			Population /five plants	
	Maximum	Minimum	RH	Aphid	coccinellid
2	24.5	4.9	55	0.80	0.00
3	20.1	-0.5	55	2.20	0.00
4	21.3	3.6	61	12.60	2.40
5	22.0	5.2	69	28.20	5.00
6	26.9	6.9	56	135.40	5.60
7	28.4	5.8	51	167.80	8.40
8	31.9	9.8	49	314.60	14.20
9	32.1	12.0	49	244.20	11.60
10	30.7	11.3	53	94.80	3.80
11	32.8	13.8	55	9.20	0.60

SMW= Standard Meteorological Weeks

Table 2: Seasonal incidence of aphid, *Hyadaphis coriandri* (Das) on coriander and their natural enemies in relation to meteorological parameters in *Rabi*, 2023-24.

SMW	Abiotic Factors			Population /five plants	
	Maximum	Minimum	RH	Aphid	coccinellid
2	21.9	3.3	57	0.00	0.00
3	23.2	3.5	55	8.20	0.00
4	24.0	4.3	52	16.80	0.40
5	26.0	11.1	57	92.40	4.80
6	22.9	6.6	53	144.60	6.00
7	26.6	7.2	50	263.00	9.20
8	28.0	10.4	52	341.60	11.20
9	26.4	11.6	70	210.40	15.80
10	28.3	8.9	36	25.80	10.40
11	30.6	7.6	52	14.20	6.20

SMW= Standard Meteorological Weeks

Table 3: Correlation coefficient (R) between population of coriander aphid, *H. coriandri, coccinelids* and abiotic factors during *Rabi* 2022-23 and 2023-24.

Sr. No.	Abiotic and biotic factors	Coriander aphid		Coccinellid predators	
		2022-23	2023-24	2022-23	2023-24
1.	**Temperature °C**				
	a. Maximum	0.637*	0.255	0.538	0.608*
	b. Minimum	0.443	0.584*	0.391	0.838**
2.	Average relative humidity	-0.646*	0.208	-0.458	0.100
	Coccinellid	0.967**	0.694*		

* Significant at 5 per cent level of significance; ** Significant at 0.01 per cent level of significance

CONCLUSIONS

The study revealed that coriander aphid, *Hyadaphis coriandri* was the major pest on coriander, while whitefly, thrips and mites occurred in negligible numbers as minor pests. Aphid incidence began in January and peaked in February, showing a positive correlation with maximum temperature and a negative correlation with relative humidity. The coccinellid predator, *Coccinella septempunctata*, appeared shortly after aphid infestation and its population also peaked in February, showing a significant positive correlation with aphid density in both years. Thus, aphid population dynamics were strongly influenced by weather parameters, while coccinellid predators followed the aphid trend, confirming their role as a key natural enemy in regulating aphid populations on coriander.

FUTURE SCOPE

This study emphasizes the scope for formulating weather-based forecasting models to ensure timely management of *Hyadaphis coriandri* in coriander. The notable effect of relative humidity and sunshine hours on aphid incidence underlines the importance of adopting climate-resilient pest management approaches. Future investigations may focus on broadening surveillance across regions, incorporating pest–climate interactions into decision support tools, and assessing the performance of resistant coriander genotypes. Furthermore, exploring the influence of climatic factors on natural enemies could improve the efficiency of sustainable and eco-friendly biological control strategies.

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Conflict of Interest. None.

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