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INFLUENCE OF WEATHER PARAMETERS ON THE POPULATION DYNAMICS OF INSECT PESTS AND THEIR NATURAL ENEMIES OF CARROT (*DACUS CAROTA* L.)

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ABSTRACT

An investigation was carried out in farmer's field at Nagaral village of Ron taluka on the incidence of insect pests and natural enemies of carrot during *rabi / summer* 2021-22 and correlated with the weather parameters. Major insect pest, which caused the maximum yield loss in carrot, was agromyzid fly (*Melanagromyza* sp.) and other minor pests were aphids (Aphis sp.), leafhoppers (*Blaclutha* sp.) and planthoppers (*Sogatella* sp.). *Melanagromyza* sp. was noticed from the second week of February and peaked during second week of April while sucking pests were observed from third week of January and reached peak at third week of February. Further, the activity of natural enemies, coccinellids, *Coccinella transversalis* (Fab.); chrysopids, *Chrysoperla zastrowi* sillemi (Esben-Petersen); reduviids, *Rhinocoris* sp. commenced from third week of January and reached peak at third week of February during *rabi / summer* 2021-22. A significant and positive correlation was observed between the incidence of agromyzid fly and minimum temperature (r = 0.894*) and non-significant and positive correlation was noticed with maximum temperature (r = 0.449). Further, a non-significant and negative correlation was observed with maximum relative humidity (r = -0.481) and minimum relative humidity (r = -0.398). A significant and negative correlation was observed with minimum temperature, nonsignificant and positive correlation with maximum temperature, nonsignificant and negative correlation with maximum relative humidity and minimum relative humidity for sucking pests of carrot.

The correlation studies between predator population and sucking insect pests, the coccinellids showed a significant positive correlation with aphids (r = 0.977**), leaf hoppers (r = 0.973**) and plant hoppers (r = 0.960**). Whereas, chrysopids exhibited a significant positive correlation with aphids (r = 0.978**), leaf hoppers (r = 0.986**) and plant hoppers (r = 0.997**). The reduviids showed a nonsignificant positive correlation with aphids (r = 0.787), leaf hoppers (r = 0.863) and plant hoppers (r = 0.877).

Key words : Carrot, Correlation coefficient, *Melanagromyza* sp., Natural enemies, Population dynamics.

Introduction

Carrot (*Daucus carota* L.) is an annual/biennial vegetable belongs to the family Apiaceae (Peirce, 1987). Originated from Afghanistan and Persia (Shinohara, 1984) and is mainly cultivated in temperate, tropical and subtropical regions (Rubatzky *et al*., 1999). Carrot is an essential root crop from a nutritional perspective (Yawalkar, 1985; Chadha, 2003). In India carrot is cultivated in 0.64 million hectares area with a production of 4.14 million tonnes. It is grown mostly in Punjab, Haryana, Uttar Pradesh, Andhra Pradesh, Karnataka and Assam. Karnataka holds 5.06 per cent share with respect to total production with a production of 96.63 million tonnes (Anonymous, 2021). Carrot is majorly grown in Belagavi, Gadag, Dharwad, Bengaluru, Bagalkot and Kolar districts in Karnataka (Neeru, 2021). Carrot production is limited by a range of variables, both biotic and abiotic. Among these biotic elements, the incidence

of insect pests during the crop season stands out. Numerous insects may attack carrot at every stage in its development, from seedling to harvest. The crop's luscious texture and succulent growth attract insect pests to thrive. Various insect pests are known to attack carrot crop, among these insect pest complex, root bores cause significant economic damage to the crop especially during *rabi / summer*. Sucking pests *viz*., aphids, leafhopper, plant hoppers and semilooper, *Thysanoplusia orichalcea* Fabricius and thrips, *Aeolothrips meridionalis* Bagnall from Jammu and Kashmir (Bhat and Ahangar, 2018) also cause damage to crop production. This study was undertaken to establish the complex relationships between weather parameters on the population build-up of different insect-pests of carrot.

Materials and Methods

In order to study the population dynamics of different insect- pests and their natural enemies of carrot prevalent in Gadag district of Karnataka, an experiment (fixed plot survey) was carried out at Nagaral village of Ron taluk in Gadag district during *rabi / summer* 2021-22. Carrot was cultivated during January 2022 as per the recommended package of practices (Anonymous, 2013) except the insect protection measures. The village, Nagaral is situated at 15º 25' North latitude and 75º 37' East longitude with an altitude of 655 meters above mean sea level which lies in northern dry zone of Karnataka (Zone III). The average annual rainfall is 650 mm.

The damage of *Melanagromyza* sp. was recorded from 40 days after sowing (DAS) to 100 DAS at fortnightly intervals by adopting destructive sampling method. Three spots were selected and in each spot five plants were selected randomly and per cent infestation was calculated.

$$\text{Per cent infestation} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100$$

Observations on the population of sucking insect pests were recorded soon after their appearance on the crop from 15 DAS to 75 DAS at fortnightly interval. Mean number of sucking insect pests were counted from three spots and each spot consisted of five plants. Mean number of natural enemies *viz*, coccinellids, green lacewings and reduviids were counted from three spots and each spot consisted of five plants from 15 DAS to 100 DAS at fortnightly interval. To study the effect of various weather parameters on the incidence of insect pests and their natural enemies, the meteorological data (maximum temperature, minimum temperature and maximum relative humidity and minimum relative humidity) were collected from the meteorological observatory Agricultural Research Station (ARS), Gadag, Karnataka. The per cent infestation of agromyzid fly, mean number of sucking pests as well as natural enemies and mean value of the meteorological data were calculated for each fortnight intervals. Further, the meteorological data was subjected to statistical analysis and correlation was worked out by using SPSS software.

Results and Discussion

Incidence of insect pests and natural enemies in carrot during *rabi/summer* 2021-22

Incidence of agromyzid fly, *Melanagromyza* sp. was ranged from 26.66 to 60.00 per cent and the incidence was observed at 7th standard week (12th February, 2022) *i.e.*, 40 days after sowing (26.66 % infestation) and reached the peak of 60.00 per cent infestation during the 15th Standard Week (13th April, 2022) *i.e.*, 100 days after sowing (Table 1). The population of aphids, *Aphis* sp. ranged from 4.21 to 11.53 aphids per three leaves during the cropping period and the incidence was recorded from the 3rd standard week (18th January, 2022) *i.e.*, 15 days after sowing (4.21 aphids /3 leaves). The population has shown increasing trend and reached peak at 7th standard week (17th February, 2022) with 11.53 aphids per three leaves. Leafhopper (*Blaclutha* sp.) population varied from 3.12 to 10.49 aphids per three leaves. The initial population of leafhoppers was noticed in 3rd standard week (18th January, 2022) with 3.12 leafhoppers per three leaves *i.e.*, 15 days after sowing and shown increasing trend and reached peak at 7th standard week (17th February,

Table 1 : Incidence of agromyzid fly, *Melanagromyza* sp. in carrot at rooting stage during *rabi/summer* 2021-2022.

Standard meteorological week (SMW)	Respective dates and months	Date of observation	Days after sowing (DAS)	Agromyzid fly
				Infestation (%)
7	12 Feb - 18 Feb	12th Feb 2022	40	26.66
9	26 Feb - 04 Mar	27th Feb 2022	55	33.33
11	12 Mar - 18 Mar	14th Mar 2022	70	40.00
13	26 Mar - 01 Apr	29th Mar 2022	85	53.33
15	09 Apr - 15 Apr	13th Apr 2022	100	60.00

Table 2 : Population dynamics of sucking insect pests and natural enemies in carrot during *rabi/summer* 2021-2022.

Standard meteorological week (SMW)	Respective dates and months	Date of observation	Days after sowing (DAS)	Mean number/3 leaves			Mean number/plant		
				Aphids	Leaf hoppers	Plant hoppers	Coccinellids (Grubs and adults)	Chrysopids (Grubs)	Reduviid bugs (Nymphs and adults)
3	15 Jan - 21 Jan	18th Jan 2022	15	4.21	3.12	2.02	0.33	0.23	0.13
5	29 Jan - 04 Feb	2nd Feb 2022	30	6.76	5.35	4.73	0.40	0.33	0.26
7	12 Feb - 18 Feb	17th Feb 2022	45	11.53	10.49	9.32	0.66	0.46	0.40
9	26 Feb - 04 Mar	4th Mar 2022	60	9.29	8.96	7.56	0.60	0.40	0.33
12	19 Mar - 25 Mar	19th Mar 2022	75	8.31	6.30	5.24	0.53	0.33	0.13

2022) with 10.49 leafhoppers per three leaves. Planthoppers, *Sogatella* sp. was ranged from 2.02 to 9.32 plant hoppers per three leaves. The population of plant hoppers was initially noticed at the 3rd standard week (18th January, 2022) with 2.02 plant hoppers per three leaves and shown increasing trend and reached peak at 7th standard week (17th February, 2022) with 9.32 plant hoppers per three leaves (Table 2).

The activity of coccinellids, *Coccinella transversalis* (Fab.) on carrot was commenced in 3rd standard week (18th January, 2022) with a population of 0.33 per plant and continued up to 12th standard week (19th March, 2022) with 0.53 per plant and reached peak at 7th standard week (17th February, 2022) with a population of 0.66 coccinellids per plant. Similarly, the activity of chrysopids, *Chrysoperla zastrowi* sillemi (Esben-Petersen) on insect pests of carrot commenced from 3rd standard week (18th January, 2022) with a population of 0.23 per plant and continued up to the 12th standard week (19th March, 2022) with 0.33 per plant and reached peak at 7th standard week (17th February, 2022) with a population of 0.46 chrysopids per plant. The activity of reduviids, *Rhinocoris* sp. was commenced from 3rd standard week (18th January, 2022) with a population of 0.13 per plant and continued up to 12th standard week (19th March, 2022) with 0.13 per plant and reached peak at 7th standard week (17th February, 2022) with a population of 0.40 reduviids per plant (Table 2).

Correlation between insect pests and their natural enemies in relation to weather parameters

A significant positive correlation was observed between the incidence of agromyzid fly and minimum temperature (r = 0.894*) and nonsignificant positive correlation with maximum temperature (r = 0.449). Further, a nonsignificant negative correlation with maximum relative humidity (r = -0.481) and minimum relative humidity (r = -0.398). Significant negative correlation was observed between the incidence of aphids (r = -0.910*), leafhoppers (r = -0.956*) and plant hoppers (r = -0.964**) with minimum temperature and nonsignificant positive correlation of aphids, (r = 0.533), leafhoppers (r = 0.489) and planthoppers (r = 0.439) with maximum temperature. Whereas nonsignificant and negative correlation was noticed with maximum relative humidity (r = -0.143) and minimum relative humidity (r = -0.433) for aphids. Similar relation correlation was noticed with minimum relative humidity (r = -0.399) and maximum relative humidity (r = -0.349) for leafhoppers. Further, plant hoppers have also similar association with minimum relative humidity (r = -0.341) and maximum relative

Table 3 : Correlation between insect pests and their natural enemies in relation to weather parameters during *rabi/summer* 2021-22.

Weather parameters	Agromyzid fly	Aphids	Leaf hoppers	Plant hoppers	Coccinellids	Chrysopids	Reduviids
Maximum Temperature	0.449	0.533	0.489	0.439	0.544	0.338	0.086
Minimum Temperature	0.894*	-0.910*	-0.956*	-0.964**	-0.872*	-0.914*	-0.802
Maximum Relative Humidity	-0.481	-0.143	-0.349	-0.304	-0.602	-0.419	-0.095
Minimum Relative Humidity	-0.398	-0.433	-0.399	-0.341	-0.771	-0.616	-0.398

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at 0.01 level (2 tailed).

Table 4 : Correlation between the incidence of sucking insect pests of carrot and natural enemies during *rabi/ summer* 2021-22.

Correlation between sucking pests and natural enemies	Aphids	Leaf hoppers	Plant hoppers
Coccinellids	0.977**	0.973**	0.960**
Chrysopids	0.978**	0.986**	0.997**
Reduviids	0.787	0.863	0.877

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed).

humidity (r = -0.304) (Table 3).

A significant negative correlation was found between the activity of coccinellids (r = -0.872*) and chrysopids (r = -0.914*) with minimum temperature. Whereas non-significant positive correlation of coccinellids (r = 0.544) and chrysopids (r = 0.338) with maximum temperature and nonsignificant negative correlation was noticed with minimum relative humidity (r = -0.771) and maximum relative humidity (r = -0.602) for coccinellids and nonsignificant negative correlation was noticed with minimum relative humidity (r = -0.616) and maximum relative humidity (r = -0.419) for chrysopids. A nonsignificant and positive correlation was observed between the activity of reduviids and maximum temperature (r = 0.086). Whereas nonsignificant and negative correlation was noticed with minimum temperature (r = -0.802), minimum relative humidity (r = -0.398) and maximum relative humidity (r = -0.095) (Table 3).

Correlation between sucking insect pests and their natural enemies

The correlation studies between predator population and sucking insect pests, the coccinellids showed a significant positive correlation with aphids (r = 0.977**), leaf hoppers (r = 0.973**) and plant hoppers (r = 0.960**). Whereas, chrysopids exhibited a significant positive correlation with aphids (r = 0.978**), leaf hoppers (r = 0.986**) and plant hoppers (r = 0.997**). The reduviids showed a nonsignificant positive correlation with aphids (r = 0.787), leaf hoppers (r = 0.863) and plant hoppers (r = 0.877) as envisaged in the Table 4.

Very limited studies have been documented on the population dynamics of insect pest fauna of carrot and correlation studies between pests, natural enemies and weather parameters. The information regarding above studies are very scanty. However, available literatures indicated that Swami *et al*. (2018) reported infestation of aphid from second week of January or third week of January on coriander and peaked in the fourth week of February. The peak activity of aphid was observed at 30.1 to 32.7°C maximum and 9.7 to 12.1°C minimum temperature with average relative humidity between 51 to 54.5 per cent. The maximum temperature had significant effect on aphid population, whereas, minimum temperature, average relative humidity and rainfall had non-significant effect, the present finding is contradictory with maximum temperature, where minimum temperature has a significant and negative correlation with aphid population. Among the natural enemies, coccinellid predators have been found preying aphid majorly. The peak activity of coccinellids coincided with the peak infestation of aphid. The maximum, minimum temperature and average relative humidity and rainfall had non-significant effect on the coccinellid predators. Mamata (2020) opined that the infestation of aphid was initiated from second week of January on all the varieties of coriander screened which increased gradually and reached to its peak on 21st February 2020. Pareek *et al*. (2013) recorded maximum aphid population on coriander crop during February month. Aphid population and maximum temperature exhibit positive significant correlation whereas, minimum temperature, relative humidity and rainfall exhibited nonsignificant correlation. But in our study, there is a significant and negative correlation with minimum temperature and nonsignificant with other weather parameters. This variation might be due to the variation in environment and ecological

situations in the study. The first appearance of predator coccinella species on the crop was noticed in 3rd standard week and the growth of beetle population increased with the population development of aphids on crop. Meena *et al*. (2008) and Kanjiya *et al*. (2018) have reported the peak period of aphid on coriander in February are in line with present findings. Similar report on the incidence of aphids and predatory beetles was documented by Krant *et al*. (2018) is also supportive to the present investigation.

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