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Effect of environmental factors on natural enemies of mustard aphid

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Abstract

A study was conducted at Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar during the *rabi* season in the years 2017-18 and 2018-19. The natural enemies started arriving in the sixth standard week each year. Initially the population was low but as the time advanced, population of *Coccinella septempunctata* and *Syrphid* fly started increasing. The population of *Coccinella septempunctata* was always found more than the *Syrphid* fly in both the experimental years. Rainfall was having not any significant role in their population outburst while the correlation of *Syrphid* fly was found positive with maximum temperature and minimum temperature (0.309 and 0.291 respectively) during the first year i.e. 2017-18. However, it was found negatively correlated (-0.280) with relative humidity at 1400 hr and positive and non-significant correlation (0.468) was between *Syrphid* fly and relative humidity at 0700 hr. in the first year i.e. 2017-18. In the second experimental year (i.e. 2018-19) both the maximum temperature as well as minimum temperature was having a negative correlation with *Syrphid* fly (-0.104 and -0.132) respectively. Meanwhile, relative humidity at 0700n hr was 0.332 and 0.497 at 1400 hr. The rainfall and the number of rainy days were having negative correlation. In case of *Coccinella septempunctata*, maximum temperature along with the minimum were correlated negatively (-0.091 and -0.119) respectively. The RH at 0700 hour was 0.371 and at 1400 hr it was 0.495.

Keywords: Natural enemies, mustard aphid, environment, oilseed crop

1. Introduction

Mustard is an important oilseed crop grown in the country. Oilseed *Brassicac*s contribute substantially to the oil economy of the world including India in the form of oil yield and their by-products for industrial use (Bharti *et al.*, 2002) [1]. About three dozen insect pests are responsible for the losses in mustard production. Mustard aphid *Lipaphis erysimi* causes 35.4 to 73.3 per cent yield loss, 30.09 per cent seed weight loss and 2.75 per cent oil loss (Bakhetia and Sekhon, 1989, Singh and Premchand, 1995 and Sharma and Kashyap 1998) [2, 3, 4]. Prey density is an important aspect of a predator's response (Solomon, 1949; Way and Banks, 1958; Hodek, 1966, 1973) [5, 6, 7, 8] and the ladybird response has been shown to depend on initial aphid densities (Mills, 1979; Shipp & Whitfield, 1991; Wiedenmann & Smith, 1993; Fan & Pettitt, 1994) and distribution of the prey (Dixon & Agarwala, 1999) [9, 10, 11, 12, 13]. Among the natural enemies of mustard aphid, *Coccinella septempunctata* and *Syrphid* flies are dominating. About 90% of the known 4200 *Coccinellid* species are predaceous by nature (Iperti and Paoletti, 1999) [14] and in India, *Coccinellid* diversity includes 119 predaceous species (Omkar and Parvez, 2000c) [15]. The natural enemies are self-powered, self-sufficient and self-regulating requiring no further investments in control (Pimental, 1991) [16]. The biological control method is highly effective and long lasting. The natural enemies reduce the population of mustard aphid by eating them and maintain a balance in nature and hence are safe for the environment.

The aim of this investigation was to find out the density dependent response of *C. Septempunctata* and *Syrphid* fly towards aphid as their prey in mustard crop at Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar.

2. Materials and Methods

Pusa Mustard 25 was grown as test crop. The sowing was done on 30th of November in both the year namely 2017-18 and 2018-19. The crop was grown in 100 square metre plots as per the recommended agronomic practices. There was not any application of insecticide. Observations on population of natural enemies in mustard crop was recorded at weekly

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intervals under natural field conditions. The recording was done from the initial appearance of the pest as well as its natural enemies to the final disappearance. No plant protection measure was taken throughout the crop season. The data are presented in table 1 and table 2.

The study was conducted during winters of 2018 and 2019. Meteorological observations with regards to ambient temperature (0°) C, relative humidity (%), rainfall (mm), mean number of aphid population and number of rainy days,

prevailing at T.C.A., Dholi (Muzaffarpur) were recorded daily in both the crop seasons that is, 2017-18 and 2018-19. The counting of natural enemies found in the field was counted on five randomly selected plants. The data is presented in table 1 and table 2 of the year 2017-18 and 2018-19 respectively. The impact of abiotic factors on population build-up of natural enemies of mustard aphid was worked out by using regression analysis and correlation coefficients. Simultaneously, data on different weather parameters were taken during that duration.

Table 1: Population dynamics of Natural Enemies on Pusa Mustard -25 (2017-18)

Month	Standard Week	Mean No. of <i>Syrphid</i> fly	Mean No. of <i>Coccinella septempunctata</i>	Maximum Temperature	Minimum Temperature	RH 0700 hr	RH 1400hr	Rainfall (mm)	No. of Rainy days
January	4 th	00	00	19.4	7.8	100	85.8	00	00
	5 th	00	00	21.4	9.2	97.5	73	00	00
February	6 th	0.20	0.80	25.2	9.7	98.5	83.8	00	00
	7 th	1.20	2.80	24.2	11	97.8	82.1	00	00
	8 th	3.8	4.2	27.7	12.8	99.1	79.2	00	00
	9 th	4.00	4.60	29.2	14.8	100	71.7	00	00
March	10 th	4.20	5.40	31.4	13.4	99.1	72.8	00	00
	11 th	1.80	2.00	31.6	15.7	97	65.7	00	00
	12 th	0.40	1.00	34.4	14.7	90.1	67.7	00	00
	13 th	00	00	33.3	18	92.7	77.7	00	00

Table 2: Population dynamics of Natural Enemies on Pusa Mustard -25 (2018-19)

Standard Week (2018-19)	Mean No. of <i>Syrphid</i> fly	Mean No. of <i>Coccinella septempunctata</i>	Maximum Temperature	Mini mum Temperature	RH 070 0 hr	RH 1400 hr	Rainfall (mm)	No. of Rainy days
4 th	0	0	22.8	12.2	99.4	89.7	0	0
5 th	0	0	23.9	7.5	100	73.8	0	0
6 th	0.2	0.5	23.2	10.2	98	85.7	8.4	1
7 th	0.8	1.1	24	11.5	98.5	83.8	0	0
8 th	1.2	1.9	26.1	11.9	100	83	0	0
9 th	2.4	3.6	24.9	11.5	99.1	90.4	0	0
10 th	1	2.1	27	12.8	99.7	83.8	0	0
11 th	0.8	1	31.3	14.5	96.4	73	0	0
12 th	0.2	0.6	32.1	16.2	97.2	65.2	0	0
13 th	0	0	31.3	18.2	90.2	67.5	0	0

Table 3: Correlation of Weather Parameters with the Natural Enemies on Pusa Mustard-25 (2017-18)

Weather Parameters	<i>Syrphid</i> fly	<i>Coccinella septempunctata</i>
Maximum Temperature	0.309	0.295
Minimum Temperature	0.291	0.242
Relative Humidity(0700hr)	0.468	0.443
Relative Humidity(1400hr)	-0.280	-0.222
Rainfall(mm)	NS	NS
No. of Rainy Days	NS	NS

Correlation is significant at 0.01 level and 0.05 level.

Table 4: Correlation of Weather Parameters with the Natural Enemies on Pusa Mustard-25 (2018-19)

Weather Parameters	<i>Syrphid</i> fly	<i>Coccinella septempunctata</i>
Maximum Temperature	-0.104	-0.091
Minimum Temperature	-0.132	-0.119
Relative Humidity(0700hr)	0.332	0.371
Relative Humidity(1400hr)	0.497	0.495
Rainfall(mm)	-0.213	-0.176
No. of Rainy Days	-0.213	-0.176

Correlation is significant at 0.01 level and 0.05 level.

3. Results and Discussion

The natural enemies of mustard aphid found on plant were *Syrphid* fly (also called flower flies or hoverflies) and *Coccinella septempunctata* (seven spotted ladybird) during the crop season. It was observed that as the population of

mustard aphid increased, the population of both the natural enemies also increased accordingly. The incidence of *Syrphid* fly and *Coccinella septempunctata* started from sixth standard week during both the experimental year i.e. in the year 2017-18 and 2018-19.

In the first year i.e. 2017-18, mean number of *Syrphid* fly was found 0.2 in the sixth standard week, it was 1.2 in seventh standard week while it was 3.8, 4 and a highest of 4.2 during eighth, ninth and tenth standard week respectively. Later during eleventh week it was 1.8 and gradually it became 0.4 in the twelfth standard week and finally it came to 0 while the incidence of ladybird was from sixth standard week i.e. 0.8 which increased gradually from 2.8, 4.2, 4.6 and a highest of 5.4 in the seventh, eighth, ninth and tenth standard weeks respectively. During the eleventh standard week it was recorded 2 and came to 1 in the twelfth standard week which in the thirteenth week it came to zero.

During the second experimental year 2018-19 the incidence of *Syrphid* fly started from sixth standard week i.e. 0.2 and gradually it became 0.8, 1.2 and a highest of 2.4 during seventh, eighth and ninth standard weeks respectively. Again, it was recorded 1, 0.8, 0.2 and became 0 in the tenth, eleventh, twelfth and thirteenth week respectively. The population of *Coccinella septempunctata* was 0.5 in the sixth standard week; it increased from 1.1, 1.9 and a highest of 3.6 in the seventh, eighth and ninth standard week respectively. After that it started declining from 2.1, 1.0, 0.6 and came to zero in the tenth, eleventh, twelfth and thirteenth week respectively. After thirteenth week, during both the experimental year no incidence of any of the two natural enemies was seen. The data for both the years are presented in table 1 and table 2 respectively. This is in accordance with other findings also. Arshad Ali and Rizvi (2012)^[17], Kulkarni and Patel (2001)^[18] also support the multiplication of Coccinellids was positively correlated with rainfall and relative humidity. Atwal (1971)^[19] also observed that *Coccinella* multiplied to reach its maximum population in spite of decline in aphid population. Vkaria and Patel (1999)^[20] also suggested that the population of *Syrphid* fly appeared in second week of January and attain its peak in fourth week of February. Yellow sarson attracted predators including *C. septempunctata* and *C. cerana* which were maximum when the mustard aphid was in abundance Singh *et al.* (2011)^[21]. *Syrphid* fly was observed later that is in the second standard week and gained its peak population (7 in number) in the 7th standard week as reported by Singh and Singh (2013)^[22].

The correlation of *Syrphid* fly was found positive with maximum temperature and minimum temperature (0.309 and 0.291 respectively) during the first year i.e. 2017-18. However, it was found negatively correlated (-0.280) with relative humidity at 1400 hr and positive and non-significant correlation (0.468) was between *Syrphid* fly and relative humidity at 0700 hr. As there was no rain during experimental period so no relation can be established.

The second natural enemy i.e. *Coccinella septempunctata* was positively correlated to maximum temperature (0.295) and minimum temperature (0.242) as well. The relative humidity at 0700 hr was found having positive correlation (0.443) with the insect (*C. septempunctata*) while at 1400 hr it was correlated negatively (-0.222).

In the second experimental year (i.e. 2018-19) both the maximum temperature as well as minimum temperature was having a negative correlation with *Syrphid* fly (-0.104 and -0.132) respectively. Meanwhile, relative humidity at 0700 hr was 0.332 and 0.497 at 1400 hr. The rainfall and the number of rainy days were having negative correlation.

In case of *Coccinella septempunctata*, maximum temperature along with the minimum were correlated negatively (-0.091 and -0.119) respectively. The RH at 0700 hour was 0.371 and

at 1400 hr it was 0.495. The rainfall as well as number of rainy days were correlated negatively.

4. Conclusion

From above findings it may be concluded that the natural enemies of mustard aphid at TCA Dholi Muzaffarpur were *Coccinella septempunctata* and *Syrphid* fly. Both started appearing in the field from sixth standard week onwards in both the years (2017-18 and 2018-19). However, both disappeared from the field at thirteenth standard week. The population of *Coccinella septempunctata* was anytime more than *Syrphid* fly. Rainfall was having no impact on the population fluctuations of both the natural enemies.

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