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Interaction of different predators and prey (Aphid, *Dactynotus carthami*) in safflower crop

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Abstract

The present study was aimed to explore the interaction of predators with aphids on safflower. The perusal of data revealed that populations of various predators have close relationship with the occurrence of aphid. Minimum aphid population was recorded when mean temperature and relative humidity were 27 ± 1 and $59.41 \pm 2\%$, respectively. The population of aphid increased with the decreasing of temperature and relative humidity percent. The maximum aphid population was recorded when temperature and R.H. were 27.5 ± 1 and $68.45 \pm 2\%$, respectively. The positive correlation of aphid was recorded with temperature and negative with relative humidity percent.

The results further revealed that 06 predator species were found preying on safflower aphid. The predators such as 7-spotted beetle, zigzag beetle, *Brumus* beetle, 9-spotted beetle, green lacewing and hoverfly appeared during 1st week of December. The maximum activities of 7-spotted beetle and Zigzag beetle were recorded during 1st week of February whereas, maximum activities of Green-lacewing observed during 2nd week of February. Hoverfly during 4th week of February, *Brumus* beetle during 2nd week of January and 9-spotted beetle during 4th week of January. The overall mean population indicated that Zigzag beetle was the most abundant predator followed by 9-spotted beetle, 7-spotted beetle, Green lacewing, *Brumus* beetle and Hoverfly. The positive correlation was observed between temperature and natural enemies except *Brumus* beetle. Similarly, positive correlation of relative humidity with 7-spotted beetle, Green lacewing, *Brumus* beetle and Zigzag beetle was observed except 9-spotted beetle and Hoverfly.

Keywords: Predators, aphid, biological control, zigzag beetle, temperature, humidity

1. Introduction

Safflower (*Carthamus tinctorius* L.) is one of the world's oldest crops [1]. Evidence of seeds and dyes from *Carthamus* has been found in Egyptian tombs, along with pictographic representations [2]. In ancient era, Safflower crop was generally grown to produce carthamin, found in flowers which could be used to dye cloths as well as, flowers were used in Chinese herbal medicines and Chinese food for fragrance. Until 18th century, safflower was not grown as an oil crop [3].

Safflower is attacked by 36 species of pests [4]. Out of these, safflower aphid is considered to be major pest of the crop. The Safflower aphid alone is one of the most destructive pest which has reported to cause 35-72 percent loss in yield during heavy infestation period [5]. Insect damage to safflower can occur at the stage of crop establishment, during seedling and stem growth, and during the bud to flowering stage. The most susceptible period likely is the bud to flowering stage [6].

Safflower aphid, *Dactynotus carthami* is a serious pest of safflower and it is soft bodied insects having 1.5 to 2 mm in length. Adults are large sized, black with pear-shaped body and nymphs are reddish brown. Nymphs and adults suck the phloem sap during pre-flowering stage from different parts of the plants such as shoot apices, leaves, stem etc. resulting a secretion, similar to the honey dew on upper surface of leaves as well as, other parts of plants. This secretion tends to form a black sooty mold which restricts photosynthetic activities. Consequently, plants lead towards dry up because of stunted growth. Infestation may start even when the crop is 15 days old. About 40-50% yield losses are observed due to this insect pest and the infestation may occur on 30-45 days old crop [7].

Safflower aphid can be controlled by integrated pest management strategies, however, biological control has proved to be the safest and economical method for controlling safflower

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aphids. Aphidivore predators such as Coccinellids, Chrysopids, Syrphids, Spiders etc. were found effective in suppressing aphid population in many crops [7]. Therefore, present study was aimed to explore interaction of predators and safflower aphid (*Dactynotus carthami*) in safflower crop at Tandojam.

2. Materials and Methods

A field experiment was conducted at Experimental field, Faculty of Crop Protection, Sindh Agricultural University Tandojam, during winter, 2008-09, to study the “Insect predators and prey (aphid, *Dactynotus carthami*) interaction in Safflower crop”. Safflower was cultivated on November 25, 2008 in a plot measuring 70 x 80 meters. All agricultural practices were applied as usual from sowing till harvesting of safflower crop. No any pesticide was applied in the experimental area during study period.

Four sample points of 15 sq meter area were selected in the experimental plot. Each sample point was considered as a replicate. Five plants from each replicate were selected randomly and tagged. Five leaves from upper, middle and lower parts of each plant were observed. The observations were taken weekly and the number of aphids present on each plant (five leaves) was recorded. The whole plant was checked for the predator population. The assessment of predators on safflower was determined by direct count method as well as sweep net methods. During direct count method the pest population and predators present on each tagged plant was recorded. The sweep net method was adopted by applying thirty sweeps randomly in each sample points and number of predators collected were kept into plastic bags and brought in the laboratory for identification. The collected predators were reared on aphids to confirm their aphidivore habit. Meanwhile temperature and relative humidity percent was also brought from Agro met centre Research Institute Tandojam and maintained during course of study. The data was compiled and statistically analyzed using correlation coefficient.

3. Results

The field experiments on “Insect Predators and Prey (aphid, *Dactynotus carthami*) interaction in safflower” were conducted in experimental field, Faculty of Crop Protection, Sindh Agricultural University Tandojam, during winter, 2008-09. During this study period the safflower aphid and predators occurring on safflower crop were recorded and identified. The results on population occurrence of aphids are presented in Tables.

3.1 Aphid, *Dactynotus carthami*, (Aphididae: Homoptera)

The results present in Table-1 indicated that aphids occurred on safflower from the 1st week of December to 2nd week of March 2009.

The perusal of data revealed that aphid population gradually increased with the growth of safflower. The minimum population 4.3 aphids/plant was recorded in the 2nd week of December on safflower crop. The aphid population increased to (98.15/plant) during the 3rd week of February. Overall mean aphid population was recorded as (28.97±1.26/plant). The result further indicated that aphid remained the most active in the months of January and February. The population of aphid finally decreased in the month of March, 2009.

3.2 Population of predators

The result suggested that the most active and voracious predator on aphid was zigzag beetle followed by 7-spotted beetle, green lace wing and hoverfly. The population occurrence and abundance of each predator is given below.

3.3 7-spotted beetle, *Coccinella septempunctata* L. (Coccinellidae: Coleoptera)

The results presented in Table-2 reveal the population frequency of 7-spotted beetle on safflower crop. The perusal of data indicated that the appearance of this insect predator was slowly increased as the population of aphid gradually increased. The peak population of 7-spotted beetle was recorded as 0.55/plant during 1st week of February when maximum activities of aphid were recorded. The minimum population 7 spotted beetle was recorded as (0.05 / plant) during 2nd week of March

3.4 Zig-zag beetle, *Menochilus sexmaculatus* Feb. (Coccinellidae: Coleoptera)

The lady bird beetle is a common predator of aphids on different crops. It is the winter predator especially on winter crops. The results presented in Table-2 showed that among all predators, Zig-zag beetle was the most active predator on aphid during cropping season of safflower. The population of this predator was coincided with the population of aphid. The peak population was recorded during 2nd week of February (0.85 / plant) when the aphid was the most active on safflower crop. The overall mean population 0.49±0.16/plant was recorded during the period of study on safflower crop.

3.5 Green lace wing, *Chrysoperla carnea* (Stephen)

The green lace wing is the generalist predator their population also presents in the safflower. The data presented in Table – 2 indicated that the maximum population (0.70/plant) of predator was recorded during 2nd week of February, 2009 when the activity of aphid was its peak. The minimum (0.02/plant) population of *C. carnea* was recorded after 2nd week of crop germination. The occurrence of this predator was observed till the end of crop. The overall mean population was 0.29±0.12/plant.

3.6 Hoverfly, *Syrphus balteatus* (Wied.), Syrphidae

The results presented in Table-2 clearly indicate that the least active predator was hoverfly. Its occurrence was recorded from germination till harvest of the crop. The predator appeared initially and continued till the end of crop. The maximum mean population (0.48/plant) was recorded during 3rd week of February when the aphid population was more (98.15/plant) during 3rd week of February when the highest activities of aphid was recorded. The minimum population (0.02) of Hoverfly was recorded during 2nd week of December. The overall mean population of hoverfly was 0.26±0.11/plant throughout study period.

3.7 Interaction of aphid population with the a-biotic factors

The results in Table-3 showed the interaction of aphid with the temperature and relative humidity in safflower agro-ecosystem. The minimum population (4.45 aphids/plant) was recorded when mean temperature were recorded as (27.07) and R.H. % (59.14), respectively. The population if aphid increased with the decreasing of temperature and relative humidity. The maximum aphid population (98.15/plant) when

temperature was (27.57 °C) and (68.45%) R.H. % respectively. Aphid population was positively correlated with temperature and relative humidity.

3.8 Correlation coefficient of aphid and their natural enemies with the a-biotic factors

The data in Table-4 reveals the correlation of aphid and their

natural enemies with the temperature and relative humidity percent. The positive correlation of temperature with aphid and their natural enemies except *Brumus* beetle were recorded. The positive correlations of 7-spotted beetle, green lace wing, *Brumus* beetle and Zigzag beetle with relative humidity and negative correlations with aphid, 9-spotted beetle and hoverfly were recorded.

Table 1: Mean population (per plant) of Aphids on safflower during 2008-09

Date of observations	Black aphid
2-12-08	4.45
8-12-08	4.48
14-12-08	4.65
20-12-08	5.60
26-12-08	6.55
01-1-09	6.70
07-1-09	7.35
13-1-09	17.95
19-1-09	28.90
25-1-09	28.65
31-1-09	42.85
6-2-09	65.50
12-2-09	85.91
18-2-09	98.15
24-2-09	56.05
2-3-09	35.74
8-3-09	15.05
14-3-09	7.28
Mean ± S.E	28.97 ± 1.26

Table 2: Mean population (per plant) of natural enemies on safflower during 2008-09

Date of Observations	7 Spotted beetle	Lace green wing	9-Spotted beetle	Brumus beetle	Hover fly	Zigzag beetle
2-12-08	0.15	0.10	0.05	0.01	0.20	0.30
8-12-08	0.17	0.15	0.20	0.01	0.05	0.34
14-12-08	0.21	0.20	0.20	0.20	0.10	0.36
20-12-08	0.23	0.20	0.10	0.20	0.11	0.41
26-12-08	0.35	0.20	0.35	0.40	0.19	0.44
01-1-09	0.30	0.25	0.40	0.70	0.21	0.48
07-1-09	0.30	0.20	0.40	0.70	0.23	0.53
13-1-09	0.30	0.25	0.40	0.90	0.20	0.56
19-1-09	0.25	0.30	0.45	0.10	0.28	0.60
25-1-09	0.25	0.35	0.60	0.13	0.30	0.68
31-1-09	0.35	0.40	0.85	0.15	0.33	0.72
6-2-09	0.55	0.55	0.80	0.17	0.35	0.85
12-2-09	0.50	0.70	0.60	0.19	0.35	0.78
18-2-09	0.50	0.55	0.60	0.22	0.48	0.60
24-2-09	0.50	0.35	0.40	0.21	0.51	0.55
2-3-09	0.35	0.30	0.28	0.20	0.50	0.33
8-3-09	0.18	0.10	0.28	0.14	0.30	0.21
14-3-09	0.05	0.20	0.09	0.13	0.15	0.19
Mean ± S.E	0.30 ± 0.13	0.29 ± 0.12	0.39 ± 0.14	0.26 ± 0.13	0.26 ± 0.11	0.49 ± 0.16

Table 3: Interaction of aphid population with the abiotic factors on safflower during 2008-09

Date of observations	Black aphid	Temperature	R.H.%
2-12-08	4.45	27.07	59.14
8-12-08	4.30	21.21	77.0
14-12-08	4.65	24.64	69.71
20-12-08	5.6	25.92	74.0
26-12-08	6.55	23.78	77.91
01-1-09	6.70	22.28	65.28
07-1-09	7.35	22.85	64.0
13-1-09	17.95	26.21	72.71
19-1-09	28.90	25.92	67.85
25-1-09	28.65	29.21	68.28
31-1-09	42.85	28.50	65.14

6-2-09	65.50	28.53	69.85
12-2-09	85.91	27.78	69.71
18-2-09	98.15	27.56	68.45
24-2-09	56.05	28.22	65.78
2-3-09	35.74	29.78	66.71
8-3-09	15.05	27.42	65.28
14-3-09	7.28	29.98	68.63

Table 4: Correlation coefficient of aphid and their natural enemies with the abiotic factors on safflower during 2008-09

Insects	Correlation coefficient	
	Temperature	R.H.%
Aphid	0.0406	-0.7324
7-spotted beetle	0.1912	0.8764
Lace green wing	0.4064	0.9151
9-spotted beetle	0.2588	-0.0563
Brumus beetle	-0.3926	0.0677
Hoverfly	0.6039	-0.3914
Zigzag beetle	0.1649	0.0333

4. Discussion

The field experiments on “Insect Predators and Prey (aphid, *Dactynotus carthami*) interaction in safflower” were conducted during 2008. During this study period the safflower aphid and predators occurring on safflower crop were recorded and identified. During present study, it was observed that population of predators on safflower have close relationship with the occurrence of aphids. The aphid population increased with the normal temperature. The temperature and relative humidity were correlated with temperature in the months of February and March months. The present work agree with the Hanumantharaya *et al.* [8] who reported that severe crop losses have been observed at several places due to different insect species, which implies the need for planned strategic interventions to control the pests. The extent of yield decrease in relation to cost of protection is the major factor that affects the use of various management practices. Taking such factors into account control measures is quite essential for safflower aphid. Nevertheless, the pest management tactics like cultural practices, resistant varieties, use of bio-agent, botanical pesticides, chemical insecticides etc., have been found effective and profitable.

Many natural enemies (Parasitoids and predators) have been recorded on black aphid. In Karnataka state of India, the dipteran, *Pseudendaphis* sp. is known to cause up to 10 percent parasitization of the aphid during first week of January [9]. The lady bird beetles and the chrysopids are the major predators of safflower aphid. Mallapur *et al.* [10] and Balikai [11] reported that *Chrysoperla* sp., coccinellids and syrphids preying on aphids. Investigations made by Badgujar *et al.* [12] who reported that the larval releases of *C. carnea* (Stephens) @ 2 or 3 larvae/plant reduced the population level of 40 to 50 per cent. Egg releases of *C. carnea* larvae did not help in satisfactory reduction in aphid population. Hemagirish *et al.* [13] and Kamath *et al.* [14] reported that *C. carnea* @ 1.75 lacs/ha reduced the aphid population to the maximum (23%) and also recorded yield of 3.52 q/ha increase over control. But, the benefit cost ratio was quite discouraging in *C. carnea* released treatment. *C. carnea* is a potential predatory biological control agent that can be used in augmentation programs for sustainable crop pest suppression [15]. The present study agrees with the results of Hanumantharaya *et al.* [8] who reported that *chrysoperla* and Coccinellid predators are the biocontrol agents of safflower aphid. The results

agreement with the Karim and Adam [16] who collected the hunting insects of safflower insect pests included ladybugs (*Coccinella septempunctata* and *Hippodamia variegata*), bugs Anthocoridae (*Orius* spp.) and green lacewings (*Chrysoperla carnea*) and the (unknown) bugs (Miridae). Some species of parasitoid wasps from the mummified aphids were collected and sent to an institute for identification. Our study is in agreement with Singh and Mishra [17] that aphid is the destructive pest of safflower and coccinellid beetle were the effective predators against aphid when they were released.

5. Conclusion

From the above mentioned results it is concluded that aphid infest on safflower crop was recorded during its vegetative growth stages and up to harvesting. The maximum infestation was recorded in the month of February. The predators also appeared simultaneously with the abundance of pests population on safflower crop. Among predators, 7-spotted beetle, zigzag beetle, green lace wings, Brumus beetle, 9-spotted beetle and hoverfly were main predators of this crop.

6. Suggestion

It is suggested chemical sprays should be avoided to encourage development of predators on safflower crop. It is necessary that IPM methods of pest control i.e. cultural control, mechanical control and biological control should be enhanced and encouraged.

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