Influence of Abiotic Factors on Occurrence of Predators on Safflower

**R.P. Palkar, V.K. Bhamare,
S.J. Shejulpatil**

ABSTRACT

Investigations on influence of abiotic factors on occurrence of predators on safflower were carried out on the Research Farm of Department of Agricultural Entomology, College of Agriculture, Latur (VNK-MV, Parbhani) during *rabi* 2020-21. The maximum populations of *C. sexmaculata*, *C. septempunctata*, Syrphid fly and *C. carnea* to the tune of 0.2, 0.2, 0.66 and 0.2 per plant were registered during 52nd, 7th, 1st and 7th SMW, respectively. Correlation studies stated that, before noon relative humidity exhibited positive significant correlation with *C. sexmaculata*, *C. sep-tempunctata* and Syrphid fly population. However, none of the weather parameters had a significant influence on the *C. carnea* population.

Keywords Safflower, Abiotic factors, Predators, Correlation, Significant.

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important drought-tolerant oilseed crop belonging to the family Asteraceae. A total of 101 insect pests have been recorded on safflower throughout the world; however, in India, 75 insect species have been reported (Patil and Halloli 2005). In India, safflower has been reported to be attacked by 36 species of pests (Bharaj *et al*. 2003). However, in Maharashtra, 12 insect pests are recorded on safflower (Akashe *et al*. 2013). The safflower aphid is the most serious pest in the crop and has been reported to cause a 35–72 % loss in yield during a heavy infestation period (Anonymous 2007). The nymphs and adults sucking the cell sap from the inflorescence, shoots, capitula and underside of leaves adversely affect crop health and seed yield. The use of biological fauna containing predators such as green lacewings, lady bird beetle and Syrphid fly help to reduce losses. Biological control is an essential component of integrated pest management strategies and is beneficial to pollination (Isaacs *et al*. 2009). The population of pests in many economically important crops is controlled by lady bird beetles, making them crucial agents in biological control.

R.P. Palkar[1*], V.K. Bhamare[2]

[2]Associate Professor

[1,2]Department of Agricultural Entomology, College of Agriculture, Latur 413512, Maharashtra Vasantrao Naik Marathwada Krishi Vidyapeeth, Maharashtra, India

S.J. Shejulpatil[3]

Research Associate, CROPSAP Commissionerate of Agriculture, Pune, Maharashtra, India

Email: ravindrapalkar08@gmail.com
*Corresponding author

The occurrence of climate change is evident from increases in global average temperature, changes in the rainfall pattern and extreme climatic events. These seasonal and long-term changes would affect the fauna, flora and population dynamics of insect pests as well as predators. The modulation of developmental rates, survival, fecundity, voltinism and dispersal by abiotic parameters is known to have a direct impact on insect population dynamics (Karuppaiah and Sujayanad 2012). As climate change progresses, the spread and intensity of abiotic as well as biotic stressors are expected to increase (Kissoudis *et al.* 2015). With this background, an attempt was made to study the influence of abiotic factors on the seasonal occurrence of predators on safflower.

MATERIALS AND METHODS

The non-replicated field experiment comprising forty-eight quadrats each of 2.70 m x 2.60 sq m size was laid to investigate the influence of abiotic factors on the occurrence of predators on safflower at the Research Farm of Department of Agricultural Entomology, College of Agriculture, Latur (MS) during the *rabi* season, 2020-2021. The safflower variety, PBNS-86 (PURNA) was sown at the spacing of 45 cm x 30 cm in 48 quadrats with all the package of practices recommended by VNMKV, Parbhani. Occurrences of predators *(Cheilomenes sexmaculata, Coccinella septempunctata,* syrphid fly and *Chrysoperla carnea*) on safflower were recorded on the whole plant. Randomly five plants were selected from each of the three quadrats twice in each meteorological week for recording the occurrence of predators. The predator population was not calculated per plant due to low values, which made statistical analysis difficult.

Weather parameters was used provided by VN-MKV, Parbhani. The statistical analysis of predators population on safflower and weather parameters was carried out by simple correlation using WASP 2.0 software developed by ICAR Research Complex, Goa.

RESULTS AND DISCUSSION

The seasonal occurrence of predators on safflower was studied during the *rabi* season 2020–21. During the course of the investigation, the weather parameters viz. minimum temperature, maximum temperature, before noon relative humidity, afternoon relative humidity, rainfall and wind speed were varied from 11.99 to 23.04 °C, 29.4 to 37.00 °C, 42.31 to 91.2 and 22.3 to 64.5 %, 0 to 6.25 mm and 18.4 to 27.8 km/hr, respectively. The data pertaining to the seasonal occurrence of predators on safflower in relation to weather parameters during the *rabi* season 2020–21 are presented in Tables 1–2 and represented graphically in Fig. 1.

Occurrence of predators on safflower

### *Cheilomenes sexmaculata* (Fabricius) and *Coccinella septempunctata* (Linnaeus)

The first occurrence of *C. sexmaculata* safflower in the 50th SMW (0.06 grub and adult per plant) with its peak population level (0.2 grub and adult per plant) in the 52nd SMW. At the maximum level of population of *C. sexmaculata*, the prevailing weather factors, viz., rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity and wind speed were 0.00 mm, 30.5 °C, 12.8 °C, 75.4 %, 43.6 % and 18.4 km/h, respectively (Table 1). The first prevalence of *C. septempunctata* was recorded on safflower in the 51st SMW (0.03 grub and adult per plant), with its peak population level (0.2 grub and adult per plant) in the 7th SMW. At the maximum level of the population of *C. septempunctata*, the prevailing weather factors, viz., rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity and wind speed were 0.00 mm, 32.9 °C, 15.44 °C, 65.86 %, 36.3 % and 24 km/h, respectively (Table 1). Present investigation are in uniformity with the findings of Kumbhar *et al.* (2020) who stated that the incidence of lady bird beetle on safflower was recorded during the 48th SMW (0.1 ladybird beetle per 5 cm twig per plant) and reached its peak during the 2nd SMW (ladybird beetle per 5 cm twig per plant). Choudhary *et al.* (2020) stated that the population of lady bird beetle, M. sexmaculatus on safflower commenced in 35th SMW and reached its maximum (6.4 per five plants) with the peak population of aphids, i.e., in 41st SMW. Mari *et al.* (2019) revealed that the peak population of *C. septempunctata* and *Menochilus sexmaculatus*

Table 1. Occurrence of predators on safflower in relation to weather parameters during *rabi* 2020-21.

Month	SMWs	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Wind speed (km/h)	Mean number of predator per plant			
			Min.	Max	Before noon	After noon		C.sexmacu-lata	C.septem-punctata	Syrphid fly	C. carnea
Nov 2020	48	-	17.5	29.4	79.4	64.5	22.3	-	-	-	-
Dec 2020	49	-	13.1	31.3	67.4	39.5	21.6	-	-	-	-
	50	-	15.6	31.2	67.7	45.2	21.4	0.06	-	-	-
	51	-	12.2	29.5	74.4	42.4	20	0.1	0.03	-	-
	52	-	12.8	30.5	75.4	43.6	18.4	0.2	0.13	-	0.13
Jan 2021	1	-	16.5	30.4	91.2	53.4	18.7	0.13	0.13	0.66	0.16
	2	1	16.86	31.9	82.53	51.5	19.9	0.1	0.13	0.63	0.06
	3	-	16.2	31.9	81.47	48.1	19.7	0.13	0.13	0.16	-
	4	-	16.7	32.8	75.83	43.5	20	0.13	0.06	0.16	-
	5	1.25	15.39	31.6	76.99	37.7	23.1	0.1	0.1	-	0.1
Feb 2021	6	0.5	11.99	30.9	60.24	32.5	21.7	0.06	0.1	-	0.06
	7	-	15.44	32.9	65.86	36.3	24	0.13	0.2	-	0.2
	8	6.25	14.6	30.8	72.9	39.6	25.7	0.03	0.1	-	0.1
	9	-	18.49	36	48.81	24.8	26.1	0.03	-	-	0.06
Mar 21	10	-	23.4	37	42.48	25.8	26.1	-	-	-	-
	11	-	19.1	36.7	42.31	22.3	27.8	-	-	-	-

on safflower was recorded during the 1st week of February (0.55 per plant) and 2nd week of February (0.85 per plant), respectively when maximum activities of aphid were recorded. Singh *et al*. (2019) showed that the population of *C. septempunctata* on green gram was in the range of 0.40 to 3.80 per plant, with the minimum being in the 33rd SMW and the maximum in the 37th SMW. Khattab *et al*. (2019) stated that *Coccinella undecimpunctata* L. was observed on soybean plants and attained the highest numbers during
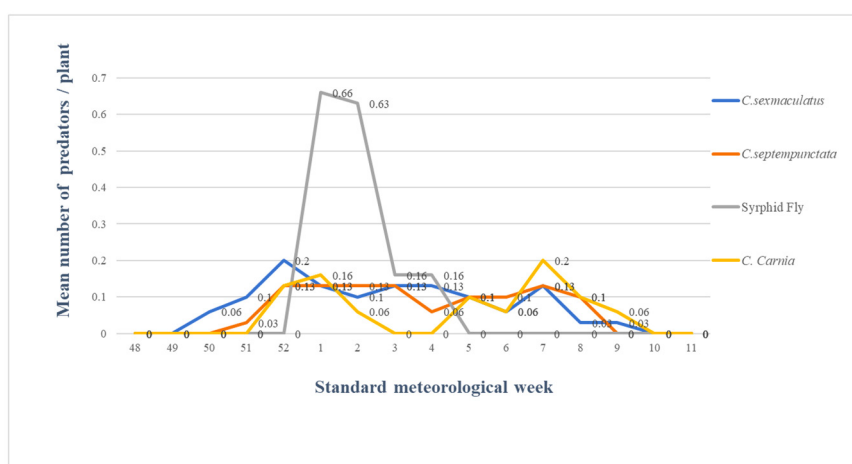
Fig.1. Occurrence of predators on safflower in relation to weather parameters during *rabi* 2020-21.

July in the first season and during July and August in the second one. El-Sarand *et al*. (2018) revealed that *Coccinella undecimpunctata* L. and *Scymnus* sp. were the most dominant ones in soybean. Charjan *et al*. (2017) stated that lady bird beetle population was recorded from 52nd to 7th SMW on safflower and the peak population was in the 2nd SMW.

Syrphid fly

The syrphid fly was first observed on safflower in the first SMW (0.66 maggots and adult per plant). At the maximum level of population of syrphid fly the prevailing weather factors, viz., rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity and wind speed were 0.00 mm, 30.4 $^\circ$C, 16.5°C, 91.2 %, 53.4 % and 18.7 km/h, respectively (Table 1). The results of the present investigation are in homogeny with the findings of Choudhary *et al*. (2020) who stated that the population of syrphid flies, *Xanthogramma scutellare* on Indian bean commenced in the 36th SMW and reached a maximum (7.4 per five plants) in the 40th SMW. Mari *et al*. (2019) observed the peak population of *Syrphus balteatus* was recorded during the third week of February (0.48 per plant). Gocher and Ahmad (2019) stated that the population of maggots of the syrphid fly appeared in the first week of August and reached its maximum in the third week of September on groundnut.

Chrysoperla carnea (Stephens)

The first prevalence of *C. carnea* was noticed on safflower in the 52nd SMW (0.13 grub and adult per plant) with its maximum population level (0.2 grub and adult per plant) in the 7th SMW. At the maximum level of population of *C. carnea*, the prevailing weather factors viz., rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity and wind speed were 0.00 mm, 32.9 $^\circ$C, 15.44 $^\circ$C, 65.86 %, 36.3 % and 24 km/h, respectively (Table 1). The current findings are consistent with the findings of Mari *et al*. (2019), who discovered that the peak population of *C. carnea* was recorded during the second week of February (0.70 per plant) when aphid activity on safflower was at its peak. Khattab *et al*. (2019) stated that *C. carnea* was

the most abundant predator on soybean and attained the highest numbers during July in the first season and during July and August in the second one. El-Sarand *et al*. (2018) revealed that *C. carnea* was the most dominant predator observed on soybean.

Correlation between the occurrence of predators and weather parameter

Cheilomenes sexmaculata (Fabricius)

The data evidenced that before noon relative humidity (r=0.594*) exhibited a positive significant association with the *C. sexmaculata* population, while wind speed (r=-0.705) registered a negatively significant correlation with the *C. sexmaculata* population. However, rainfall (r=-0.161), maximum temperature (r=-0.381) and minimum temperature (-0.442) noticed a negatively non-significant relationship with the *C. sexmaculata* population. Kumbhar *et al*. (2020) stated that lady bird beetle population on safflower showed a non-significant correlation with maximum temperature, minimum temperature, rainfall and evening relative humidity, while was positively correlated with morning relative humidity. Mari *et al.* (2019) revealed that relative humidity was positively correlated with *M. sexmaculatus* population on safflower. Kamath and Hugar (2001) reported that the partial regression equations showed the highly significant negative impact of mean minimum temperature and the positive relation of coccinellids with aphids. Choudhary *et al*. (2020) indicated that *M. sexmaculatus* on Indian beans had a non-significant correlation with maximum temperature, minimum temperature rainfall and relative humidity. Gocher and Ahmad (2019) stated that the population of lady bird beetle on groundnut had a significant positive correlation with relative humidity other parameters were found to be non-significant. El-Sarand *et al.* (2018) illustrated that temperature, relative humidity and wind velocity exerted insignificant effects on *C. undecimpunctata* L. and *Scymnus* sp.

Coccinella septempunctata (Linnaeus)

The data indicated that before noon relative humidity (r=0.600*) exhibited a positive significant correlation with the *C. septempunctata* population. However,

rainfall (r=0.251) and afternoon relative humidity (0.292) showed a positive but non-significant relationship with *C. septempunctata* population. Maximum temperature (r=-0.377), minimum temperature (r=-0.390) and wind speed (r=-0.530) negatively non-significance association with the *C. septempunctata* population. Mari *et al*. (2019) revealed that relative humidity was positively correlated with the *C. septempunctata* population on safflower. El-Sarand *et al*. (2018) illustrated that temperature, relative humidity and wind velocity exerted insignificant effects on *C. undecimpunctata* L. and *Scymnus* sp.

Syrphid fly

The data evidenced that before noon relative humidity (r=0.558*) exhibited a positively significant correlation with the syrphid fly population. While afternoon relative humidity (r=0.462) and minimum temperature (r=0.077) showed positive but non-significant association with the syrphid fly population (Table 2). However, rainfall (r=-0.053), maximum temperature (r=-0.164) and wind speed (r=-0.483) noticed a negative non-significant impact on the syrphid fly population. Choudhary *et al*. (2020) stated that maximum temperatures (r = 0.24), minimum temperature (r= 0.51), relative humidity (r= -0.30)

and rainfall (r= -0.37) indicated a non-significant correlation with a population of syrphid flies, *Xanthogramma scutellare* on Indian beans. Gocher and Ahmad (2019) stated that the population of maggots of a syrphid fly on groundnut had a non-significant correlation with weather parameters.

Chrysoperla carnea (Stephens)

The data indicated that rainfall (r=0.225), before noon relative humidity (r=0.280) and afternoon relative humidity (r=0.032) exhibited positive but non-significant correlation with the *C. carnea* population. While, maximum temperature (r=-0174), minimum temperature (r=-0.238) and wind speed (r = -0.126) noticed a negatively non-significant association with the *C. carnea* population (Table 2). The present investigation is analogous to the findings of Mari *et al*. (2019) who documented that relative humidity was positively correlated with the *C. carnea* population on safflower. Kamath and Hugar (2001) reported that the partial regression equations showed the highly significant negative impact of mean minimum temperature and the positive relation of chrysopids with aphids. El-Sarand *et al*. (2018) illustrated that the weather factors, viz., temperature, relative humidity and wind velocity exerted insignificant effects on *C. carnea*.

Table 2. Simple correlation of weather parameters with predators population on safflower.

Weather parameter	Correlation coefficient ('r' values)			
	Cheilomenes sexmaculata	*Coccinella septempunctata*	Syrphid fly	*Chrysoperla carnea*
Rainfall (mm)	-0.161	0.251	-0.053	0.225
Maximum Temperature (ºC)	-0.381	-0.377	-0.164	-0.174
Minimum temperature (ºC)	-0.442	-0.39	0.077	-0.238
Before noon relative humidity (%)	0.594*	0.600*	0.558*	0.28
Afternoon relative humidity (%)	0.317	0.292	0.462	0.032
Wind speed (Km/h)	-0.705*	-0.530*	-0.483	-0.126

N=16
*Significant at 5%

REFERENCES

Akashe VB, Shinde MA, Kadam JR (2013) Biodiversity of insect pests of safflower and their natural enemies in Maharashtra. *Bioinfolet - A Quarterly J Life Sci* 10 (4b): 1389-1392.

Anonymous (2007) AICRP (Safflower) Annual Report 2007, DOR, Hyderabad 2007b:165.

Bharaj GS, Deshpande SL, Saxena MK (2003) Field screening of safflower genotypes for resistance against safflower aphid. In: ISOR, National Seminar on Stress management in Oilseeds: (pp 126-127). January 28-30, 2003.

Charjan YD, Wankhade SR, Karale GV (2017) Seasonal incidence of aphid and its predator on safflower crop (*Carthamus tinctorius* L.). *Trends in Biosci* 10 (35): 7361-7363.

Choudhary S, Kantegari AR, Kumawat KC (2020) Succession and incidence of sucking insect pests and their natural enemies on Indian bean, Lablab *Purpureus* var. *typicus* (L.) sweet in relation to meteorological parameters. *J Entomol Zoology Stud* 8 (4): 64-68.

El-Sarand EA, ES EL-Zahi, Refaei EA, Gawad AA (2018) Population dynamics of certain piercing-sucking insects and the common associated predators in soybean fields at Kaf rel-Sheikh governorate. *Egyptian J Pl Protection* 6 (2): 54-70.

Gocher S, Ahmad S (2019) Seasonal incidence of major sucking insect pests of groundnut in relation to weather parameters of semi-arid region of India. *Int J Current Microbiol Applied Sci* 8 (8): 1106-1111.

Isaacs R, Tuell J, Fiedler A, Gardiner M, Landis D (2009) Maximizing arthropod mediated ecosystem services in agricultural landscapes: The role of native plants. *Frontiers in Ecology and Environment* 7: 196-203.

Kamath SP, Hugar PS (2001) Population dynamics of aphid, *Uroleucon compositae* Theobald (Aphididae: Hemiptera) on safflower. *Karnataka J Agric Sci* 14 (1): 154-156.

Karuppaiah V, Sujayanad GK (2012) Impact of climate change on population dynamics of insect pests. *World J Agric Sciences* 8 (3): 240-246.

Khattab MA, Hegazy FH, Eissa GM, Khalafalla EME, Mesbah II (2019) Population fluctuation of some piercing-sucking insects and its relation to associated predators and the prevailing weather factors in soybean fields at Kafrel-Sheikh governorate. *Egyptian J Agric Res* 97 (1): 147-158.

Kissoudis C, Chowdhury R, Heusden SV, Wiel CV, Richard Finkers, Richard GF Visser, Yuling Bai, Gerard van der Linden (2015) Combined biotic and abiotic stress resistance in tomato. *Euphytica* 202: 317-332.

Kumbhar SC, Mutkule DS, Dhuppe MV (2020) Influence of abiotic factors on seasonal abundance of natural enemies on safflower during *rabi* season. *J Oilseeds Res* 37 (Special Issue): 232-234.

Mari JM, Syed SA, Kanasro MA (2019) Interaction of different predators and prey (Aphid, *Dactynotus carthami*) in safflower crop. *J Entomology and Zoology Stud* 7 (2): 217-221.

Patil RH, Halloli SP (2005) Recent developments in the diagnosis and management of safflower insect pests. *In Proceedings of the VIth Int Safflower Conference* (pp 229-235) Istanbul-Turkey.

Singh M, Bairwa DK, Jat BL (2019) Seasonal incidence of sucking insect pests of green gram. *J Entomol Zoolo Stud* 7 (2): 654-658.