

## Effect of weather parameters on incidence of safflower aphid, *Uroleucon compositae* (Theobald)

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### Abstract

The field experiment was conducted at Research Farm of the Department of Agricultural Entomology, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani, Dist. Parbhani (M.S.) during the year *rabi* 2020-21 and 2021-22. The studies on the seasonal incidence during *rabi* 2020-21 and 2021-22 revealed that the population of safflower aphid started from 50<sup>th</sup> MW and 51<sup>th</sup> MW during *rabi* 2020-21 and *rabi* 2021-22, respectively. The peak of the safflower aphid population was noticed on 6<sup>th</sup> MW and 5<sup>th</sup> MW in both the seasons, respectively. The population of natural enemies *viz.*, coccinellids and *Chrysoperla* observed in 51<sup>th</sup> and 1<sup>st</sup> MW during *rabi* 2020-21 and in 52<sup>th</sup> and 1<sup>st</sup> MW during *rabi* 2021-22, respectively. However, the peak coccinellids activity was noticed during 6<sup>th</sup> and 5<sup>th</sup> MW and that of *Chrysoperla* was observed during 6<sup>th</sup> and 5<sup>th</sup> MW of *rabi* 2020-21 and 2021-22, respectively.

Non-significant negative correlation was observed between maximum temperature, minimum temperature, morning relative humidity, rainfall and bright sunshine hours with the aphid population during the year 2020-21 and the correlation coefficient was -0.414, -0.341, -0.067, -0.365 and -0.036, respectively. Whereas, aphid population was positively non-significant (0.105) with the evening relative humidity.

During the year 2021-22, the correlations of aphid population with maximum and minimum temperature were significantly negative with correlation coefficients of -0.513\* and -0.619\*\*, respectively whereas non-significant positive correlations between morning relative humidity (0.368), evening relative humidity (0.262), rainfall (0.145) and bright sunshine hours (0.242).

There was non-significant negative correlation between maximum temperature, minimum temperature, morning relative humidity, rainfall and bright sunshine hours with the coccinellids population during first season 2020-21. Whereas, correlation of coccinellids population was positively non-significant (0.124) with the evening relative humidity. The correlations of coccinellids population with maximum and minimum temperature, morning relative humidity, evening relative humidity and rainfall were negatively non-significant during the year 2021-22 whereas non-significant positive correlation with bright sunshine hours (0.303).

The correlation studies revealed that there were significant negative correlations between minimum and maximum temperature with *Chrysoperla* population during the year 2020-21. The correlations of *Chrysoperla* population with morning relative humidity (0.365), evening relative humidity (0.273), rainfall (0.122), and bright sunshine hours (0.232) were positively non-significant. During the year 2021-22, there was non-significant negative correlation existed between *Chrysoperla* and maximum temperature (-0.381) while significant negative correlation with minimum temperature (-0.611\*\*). However, morning relative humidity (0.235), evening relative humidity (0.86), rainfall (0.048) and bright sunshine hours (0.408) recorded positive non-significant correlations with the *Chrysoperla* population.

**Keywords:** Safflower aphid, weather parameters, *Uroleucon compositae*, positive correlation, negative correlation, non-significant, correlation coefficient, coccinellids, *Chrysoperla*

### Introduction

Safflower, *Carthamus tinctorious* L. is one of the oldest cultivated oilseed crops which are well adapted to dry regions. It is one of the most important oilseed crops in Maharashtra State mainly grown in two agro-climatic zones *viz.*, scarcity zone and assured rainfall zone. The oil of this crop contains high amount of polyunsaturated fatty acids and high linoleic acid (75 to 80 per cent) which is best for heart patients for reducing blood cholesterol level (Rangarao, 1984) [18].

Safflower is attacked by many numbers of insect pests. Out of that, safflower aphid, *Uroleucon compositae* (Theobald) is the most serious pest in India. There was a heavy loss in safflower yield due to this pest. Many workers have been reported heavy yield loss from 24 to 80 per cent. Safflower aphid (*U. compositae*) is one of the most destructive pests

that damage the crop. Aphid, *U. compositae* is considered as a major pest. A yield loss up to 78.5% was recorded on susceptible variety, SSF - 658 whereas 48.5 % was observed on moderately resistant variety;

A-1 when proper control measures were not taken (Anonymous, 2015) [3]. Safflower aphid (*Uroleucon compositae*), however, is one of the most destructive pests that attacks safflower crop, particularly from its elongation to flowering period (Singh *et al.*, 2000) [22]. The losses in yield of safflower due to aphids are reported to be 60-80 % (Narayanan, 1961), 55-60% (Suryawanshi and Pawar, 1980) [15, 23], 55.9-67.9% (Basavangoud *et al.*, 1981), 74% - (Bhardwaj *et al.*, 1990) [5, 6] and 24.2% (Shetgar *et al.*, 1992) [21]. Therefore, it is the most important pest of safflower. Both nymphs and adults suck the sap from shoot and young leaves, due to which the plant growth is stunted. In case of

severe attack, the plants start showing yellowing and drying, resulting in premature death of plants. In addition, aphids also excrete honeydew, which falls on the upper surface of below leaves on which sooty mold develops hindering the photosynthetic activity (Balikai, 2000) [4].

There have been reports of losses in seed and oil content from aphids ranging from 20% to 80% in various regions of the country (Singh *et al.*, 2000) [22]. The safflower aphids attack petals, affecting the quality of the value-added product of this part of the plant and it is also responsible for decrease in seed yield and oil content (Sastry, 1997) [20].

The incidence of safflower aphid was observed in the Deccan regions of Maharashtra from December to February (Chavan, 1960) [7], Hyderabad (Andhra Pradesh) from November to February (Khan, 1964) [11], Jabalpur (Madhya Pradesh) from January to April (Rathore, 1981 and Pathak, 1999) [17, 19], Udaipur (Rajasthan) from December to March (Upadhyay *et al.*, 1980) [25] and drought-prone areas of Maharashtra and Karnataka from November to January end (Dhoble *et al.*, 1985) [8].

Therefore, the studies on seasonal incidence of aphid on safflower crop may help for timely management of aphid population below economic threshold level.

### Materials and methods

The field experiment was conducted in the research farm of the Department of Agricultural Entomology, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani during the *rabi* season 2020-21 and 2021-22. The experimental field was ploughed once and two harrowing were done before sowing of safflower seed. The field was cleaned by collecting stubbles and previous crop residue and the sowing was done. The seed of variety PBNS-12 was sown for the experiments of seasonal incidence. The seeds were sown in the field by dibbling at 45 × 20 cm<sup>2</sup> spacing. The sowing was done on 27-11-2020 during *rabi* 2020-21 and 28/11/2021 during *rabi* 2021-22. Thinning of plants was done at 15 days after sowing to maintain the optimum plant population. During both the seasons, there were no any protective measures were applied to the crop for the control of safflower aphid. The non-replicated experimental design was used for the experiment. The experiment was conducted in unprotected plot with net plot size 10 m x 10 m which was non replicated and divided in four quadrants. Ten plants were randomly selected from each quadrant for observations.

The observations on the number of aphids per 5 cm apical shoot length/plant were recorded at weekly intervals from randomly selected ten tagged plants from each quadrant starting from first aphid appearance till the harvest of the crop. The observations on number of ladybird beetles and *Chrysoperla* per plant were also recorded on randomly selected ten tagged plants from each quadrant. The weekly data on aphid population and natural enemies were correlated with weather parameters *viz.*, minimum and maximum temperature, morning and evening relative humidity, rainfall and sunshine hours. Meteorological data on weekly basis for *rabi* seasons during the year 2020-21 and 2021-22 was obtained from meteorological observatory, Department of Agricultural Meteorology, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. The standard statistical procedure was used for correlation studies.

### Results and discussion

**Safflower aphid, *U. compositae* (Theobald):** It is revealed from the table 1 that, the incidence of aphid found in the range of 0.08 to 219.53 aphids/5 cm apical shoot length per plant during *rabi* 2020-21. The aphid infestation on the safflower crop started in the second week of December *i.e.* 50 MW (5.83 aphids/5 cm apical shoot length per plant) and gradually increased later. The peak incidence of aphid was recorded in the second week of February *i.e.* 6<sup>th</sup> MW (219.53 aphids/5 cm apical shoot length/ plant) when the minimum temperature (11.2°C), maximum temperature (30.1°C), morning relative humidity (66 per cent), evening relative humidity (18 per cent) and bright sunshine hours 9.4 hrs/day was observed. However, from 52<sup>th</sup> to 7<sup>th</sup> MW, there was a severe aphid infestation.

The data presented in Table 2 showed that, the aphid population was observed from 51<sup>st</sup> MW (3.63 aphids/5 cm apical shoot length/plant) during *rabi* 2021-22 season. The aphid population gradually increased and reached its peak (236.63 aphids/5 cm apical shoot length/plant) in the first week of February *i.e.*, 5<sup>th</sup> MW and then decreased thereafter. The aphid population was found in the range of 0.20 to 236.63 aphids/5cm apical shoot length/plant. The population of aphid at the end of the cropping season was 0.20 aphids/5cm apical shoot length per plant in 12<sup>th</sup> MW.

The present findings are in agreement with the findings of Kumar *et al.* (1998) who reported that the aphid incidence was peaked during the last week of January and the first week of February. More or less similar observations were also reported by Neharkar (1999) [16] who revealed that the aphid incidence was significantly increased until the 3<sup>rd</sup> week of February and then started to decline. The results of the present findings are in agreement with the reports of Chavan (1960) [7] who revealed that the incidence of safflower aphid, was observed in the Deccan regions of Maharashtra from December to February. Upadhyay *et al.* (1983) [24] also stated that the safflower crop was more infested by the large number of aphids in the months of January and February due to the low temperature and high humidity. The present findings are also in conformity with the findings of Jagade *et al.* (1990) [9] who reported that postponing of sowing from 9 September to 22 September and 9 October to 17 November increased the incidence of *Uroleucon carthami* and decreased average seed yields from 373 to 370, 231 and 118 kg/ha, respectively. Akashe *et al.* (1995) [1] stated that the minimum temperature of 10.5 to 13.5 °C and RH of 47 to 70 per cent were found congenial for aphid multiplication during December and January at Solapur in Maharashtra state.

### Natural enemies

The results pertaining to the incidence of coccinellids and *Chrysoperla* during *rabi* 2020-21 and *rabi* 2021-22 are presented in Table 1 and 2, respectively.

#### A. Coccinellids

The prevalence of predatory coccinellids was seen throughout the crop season in *rabi* 2020-21. The coccinellid population (0.38 coccinellids/plant) was first noticed in the third week of December *i.e.* the 51<sup>th</sup> MW. The coccinellid population was found in the range of 0.15 to 4.05 coccinellids/plant from 51<sup>th</sup> to 9<sup>th</sup> MW. The peak incidence of coccinellids was observed during 6<sup>th</sup> MW with the population of 4.05 coccinellids/plant. The peak activity of

coccinellids was found when there was highest population of 219.53 aphids/ 5 cm apical shoot length.

During *rabi* 2021-22, the coccinellid population of 0.33 coccinellids/ plant was noticed first in the fourth week of December i.e. the 52<sup>th</sup>MW. The population of coccinellids was varied from 0.08 to 4.20 coccinellids/ plant from 52<sup>th</sup> to 10<sup>th</sup>MW. The highest incidence of coccinellids 4.20 coccinellids / plant was observed in 5<sup>th</sup> MW i.e. first week of February.

### B. *Chrysoperla*

During *rabi* 2020-21, *Chrysoperla* population (0.08 grubs/plant) on safflower crop noticed during the first week of January (1<sup>st</sup>MW) and the peak incidence was observed in 6<sup>th</sup>MW in second week of February with 1.95 *Chrysoperla* grubs/ plant and population started declining thereafter and the population at the end of cropping season was 0.13 *Chrysoperla* grubs/plant. The population of *Chrysoperla* ranged from 0.08 to 1.95 grubs/ plant during 1<sup>st</sup> to 8<sup>th</sup> MW.

The prevalence of *Chrysoperla* population was seen in the range of 0.15 to 2.08 grubs/plant throughout the crop season during *rabi* 2021-22. The *Chrysoperla* population of 0.15 grubs/plant was first noticed in 1<sup>st</sup> MW (First week of January). The highest population of *Chrysoperla* was observed in 5<sup>th</sup> MW i.e. first week of February with 2.08 grubs/ plant.

The present findings are more or less similar to the observations reported by Neharkar (1999) [16] who revealed that 6.42 and 8.10 coccinellids/plant and 3.20 and 3.80 *Chrysoperla* grubs/plant, were recorded in 5<sup>th</sup> MW and 6<sup>th</sup> MW, respectively. The results are also in line with the Kamath *et al.* (2001) who reported that the coccinellids and *Chrysoperla* were found one week after the appearance of aphid on safflower.

### Correlation of aphid population with weather parameters during *rabi* 2020-21 and 2021-22

The data presented in Table 3 showed that there were non-significant negative correlation between maximum temperature, minimum temperature, morning relative humidity, rainfall and bright sunshine hours with the aphid population during the year 2020-21 and the correlation coefficient was -0.414,-0.341, -0.067,-0.365 and -0.036, respectively. Whereas, aphid population was positively non-significant (0.105) correlation with the evening relative humidity.

During the year 2021-22, the correlations of aphid population with maximum and minimum temperature were significantly negative with correlation coefficients of -0.513\* and -0.619\*\*, respectively whereas non-significant positive correlations between morning relative humidity (0.368), evening relative humidity (0.262), rainfall (0.145) and bright sunshine hours (0.242) with the aphid population were observed.

The present results are in agreement with the finding of

Kumbhar (2018) [13] who stated that the safflower aphid incidence was negatively significant with maximum temperature and minimum temperature, while positive significant correlated with morning relative humidity. Moreover, the rainfall and evening relative humidity was found non-significant correlation. Mallapur *et al.* (2005) and Akashe *et al.* (2009) [2, 14] stated that the morning relative humidity showed positive and non-significant correlation with the population of safflower aphid.

### Correlation of natural enemies with weather parameters during *rabi* 2020-21 and 2021-22

#### Coccinellids

During the year 2020-21, it was revealed from the data presented in Table 3, there were non-significant negative correlation between maximum temperature, minimum temperature, morning relative humidity, rainfall and bright sunshine hours with the coccinellids population and the correlation coefficient values (r values) were -0.426, -0.335, -0.042, -0.327 and -0.058, respectively. Whereas, correlation of coccinellids population was positively non-significant (0.124) with the evening relative humidity.

The correlations of coccinellids population with maximum and minimum temperature, morning relative humidity, evening relative humidity and rainfall during the year 2021-22 were negatively non-significant with the correlation coefficients values of -0.180, -0.293, -0.297, -0.255 and -0.184, respectively whereas non-significant positive correlations between bright sunshine hours (0.303) with the coccinellids population were observed.

#### *Chrysoperla*

The correlation studies revealed that there were significant negative correlations between minimum and maximum temperature with *Chrysoperla* population during the year 2020-21 and showed -0.522\* and -0.616\*\* correlation coefficients values, respectively. The correlations of *Chrysoperla* population with morning relative humidity (0.365), evening relative humidity (0.273), rainfall (0.122), and bright sunshine hours (0.232) were positively non-significant.

During the year 2021-22, there was non-significant negative correlation existed between *Chrysoperla* and maximum temperature (-0.381) while significant negative correlation with minimum temperature (-0.611\*\*). However, morning relative humidity (0.365), evening relative humidity (0.273), rainfall (0.122) and bright sunshine hours (0.232) recorded positive non-significant correlations with the *Chrysoperla* population.

The present results are in close conformity with the findings of Kumbhar (2018) [13] who reported that the population of predator was negatively non-significant with maximum temperature, minimum temperature, rainfall and evening relative humidity, while positively significant correlated with morning relative humidity.

**Table 1:** Incidence of safflower aphid, *Uroleucon compositae* in different meteorological weeks (2020-21)

Sr. No.	MW	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Bright Sunshine hours (Hrs/day)	Aphids/5cm apical shoot length/plant	Coccinellids /Plant	<i>Chrysoperla</i> /Plant
		Max.	Min.	Morning	Evening					
1	50	30.3	15.3	82	37	0	6.9	5.83	0.00	0.00
2	51	28.7	8.9	89	33	0	8.1	32.50	0.38	0.00
3	52	29.2	10.1	86	34	0	8.1	52.23	1.18	0.00
4	1	28.5	15.4	88	50	0	4.2	94.18	2.05	0.08
5	2	30.7	15.2	89	40	0	6.3	126.38	2.43	0.13

6	3	31.2	15.0	82	34	0	7.6	162.98	2.78	0.65
7	4	31.5	13.6	83	34	0	8.2	178.15	2.93	0.83
8	5	30.4	12.9	78	29	0	7.3	187.13	3.08	1.15
9	6	30.1	11.2	66	18	0	9.4	219.53	4.05	1.95
10	7	32.7	14.2	76	24	1.8	8.6	140.15	3.13	1.63
11	8	29.5	13.0	93	40	14.5	7.7	8.93	0.48	0.13
12	9	36.1	15.5	97	14	0	9.0	2.08	0.15	0.00
13	10	36.5	16.6	61	14	0	9.3	1.18	0.00	0.00
14	11	36.6	16.8	60	21	0	8.9	0.65	0.00	0.00
15	12	34.9	20.1	74	28	14.3	6.9	0.08	0.00	0.00

**Table 2:** Incidence of safflower aphid, *Uroleucon compositae* in different meteorological weeks (2021-22)

Sr. No.	MW	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Bright Sunshine hours (Hrs/day)	Aphids/ 5 cm apical shoot length/plant	Coccinellids /Plant	<i>Chrysoperla</i> / Plant
		Max.	Min.	A.M.	P.M.					
1	50	29.2	13.2	88.0	35.0	0.0	5.9	0.00	0	0.00
2	51	27.7	9.4	91.0	30.0	0.0	7.1	3.63	0	0.00
3	52	28.9	13.6	88.0	44.0	0.0	4.9	23.80	0.33	0.00
4	1	28.0	13.0	89.0	39.0	0.0	6.3	64.48	1.28	0.15
5	2	27.1	15.9	87.0	55.0	0.2	4.1	119.48	2.13	0.73
6	3	26.7	11.8	92.0	44.0	0.0	5.9	168.83	3.35	1.05
7	4	26.8	9.9	78.0	34.0	0.0	7.6	187.58	3.78	1.63
8	5	30.0	8.0	83.0	19.0	0.0	9.6	236.63	4.20	2.08
9	6	30.4	11.8	75.0	28.0	0.0	8.3	147.78	2.93	1.75
10	7	31.1	14.4	72.0	25.0	0.0	8.0	119.45	2.18	0.83
11	8	34.0	14.6	74.0	20.0	0.0	8.9	64.18	1.23	0.58
12	9	34.9	16.4	62.0	16.0	0.0	8.6	23.98	0.35	0.25
13	10	34.3	17.5	62.0	21.0	0.0	6.9	7.18	0.08	0.00
14	11	37.4	16.3	56.0	10.0	0.0	8.4	1.23	0	0.00
15	12	39.3	20.6	43.0	13.0	0.0	6.5	0.20	0	0.00

**Table 3:** Correlation between weather parameters with aphid, Coccinellids and *Chrysoperla* population on safflower during 2020-21 and 2021-22

Weather parameters	Correlation coefficient (r values)					
	Aphid population		Coccinellids population		<i>Chrysoperla</i> population	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Maximum temperature °C	-0.414	-0.513*	-0.426	-0.180	-0.522*	-0.381
Minimum temperature °C	-0.341	-0.619**	-0.335	-0.293	-0.616**	-0.611**
Morning relative humidity (%)	-0.067	0.368	-0.042	-0.297	0.365	0.235
Evening relative humidity (%)	0.105	0.262	0.124	-0.255	0.273	0.086
Rainfall (mm)	-0.365	0.145	-0.327	-0.184	0.122	0.048
Bright Sunshine hours (Hrs/day)	-0.036	0.242	-0.058	0.303	0.232	0.408

\* Significant at 5% \*\* Significant at 1%

### Conclusion

The seasonal incidence of aphid on safflower crop and their correlation with weather parameters viz., maximum and minimum temperature, morning and evening relative humidity may help to develop the suitable forecasting and forewarning model. The seasonal incidence of aphid showed the severe infestation of aphids during 2<sup>nd</sup> MW to 7<sup>th</sup> MW and decreased gradually thereafter with temperature increase.

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