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Influence of crop phenology on population dynamics of aphid, *Uroleucon compositae* Theobald and its predators

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Abstract
Field experiment was conducted during 2001-02 *rabi* to study the influence of crop phenology and meteorological factors on the incidence of aphid (*Uroleucon compositae* Theobald) on safflower (*Carthamus tinctorius* L). The aphid appeared in the safflower field in 51st standard week during 2007, i.e., December 3rd week when the crop was seven weeks old. Later the population gradually increased up to 2nd standard week of 2002 and reached the peak (118.4 aphids/ 5cm apical twig in 3rd standard week. The mean maximum temperature of 28-30°C and minimum temperature of 13-16°C and relative humidity of 83.4% were found most conducive for aphid multiplication. The peak aphid population was observed at 83.4 per cent relative humidity. Lower relative humidity of 74.2 per cent and increase in temperature during first week of February set in a decline in aphid population. The predators *C. septempunctata, M. sexmaculatus* and *C. carnea* were found to appear one week after the appearance of *U. compositae* on safflower. The predators population peaked during third week of January when aphids were also maximum in number. Mean maximum temperature coupled with relative humidity had significant negative correlation (r=-0.63) on aphid population. But coccinellids and chrysopids had highly significant and positive correlation (r=0.97 and r = 0.96, respectively) with the aphids. The partial regression equations showed a highly significant negative impact of mean minimum temperature and positive relation of coccinellids and chrysopids with aphids.

Key words: Safflower - *Uroleucon compositae* – Theobald - Coccinellids and Chrysopids - correlation coefficient

Introduction

Safflower (*Carthamus tinctorius* L.) is an important traditional *rabi* oilseed crop and India is the highest producer in the world. The crop is invaded by a host of insect pests (Singh *et al*., 1999). The aphid (*Uroleucon compositae* Theobald [Aphidae : Homoptera]) is the key pest causing 72% loss in seed yield of safflower and if no control measures are undertaken, whole crop is lost (Awasthi and Agrawal 1995, Arya *et al*., 1996, Singh *et al*., 2000). A coccinellid beetle and green lacewing (*Chrysoperla carnea* Stephens*, Chrysopidae: Neuroptera*) (*Menochilus sexmaculatus* Fab. [Coccinellidae : Coleoptera]) have been reported as an important predators of safflower aphid (Upadhyay *et al*., 1980; Devkumar *et al*., 1986; Singh *et al*., 1999). The studies were conducted to find out the influence of safflower crop phenology on population dynamics of safflower aphid and its predators.

Material and Methods

Safflower variety A1 was raised at 45 x 20 cm geometry during first week of November 2001-02 in plot size of 20 m x 10 m providing all agronomic practices in pesticide free zone of the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Observations on the population of safflower aphid per 5 cm apical twig, coccinellid beetles and green lacewing larvae per plant were recorded at weekly interval from 50 randomly selected plants. The meteorological parameters such as maximum and minimum temperature, relative humidity and rainfall were recorded for all the weeks from the meteorology laboratory.

To study the influence of phenology of the crop, mean maximum and mean minimum temperature (°C), mean relative humidity (%), total rainfall (mm), number of coccinellids and chrysopids on the aphid population, simple and multiple correlation and partial regression

techniques were worked out between pest incidence and meteorological data for the same period. The regression coefficient were estimated using least square estimation method.

Results

The perusal on the results indicated the aphid incidence (13.36 aphids/ 5 cm apical twig) from 51st standard week when the crop was in elongation phase of growth. Its population reached peak of 76.16 to 103.24 aphids/ 5 cm apical twig in the 2nd and 3rd standard week when the crop was 70 and 84 days old (Table 1). Then the aphid population dwindled slowly 3.64 apical/ 5 cm twig from 4th to 9th standard week. A set of weather parameters *viz*., mean maximum and mean minimum temperatures of 28.4°C and 13. 2°C respectively coupled with 83.4 per cent relative humidity (Table 1) were proved most conductive for the multiplication of safflower aphid coinciding with reproductive stage of the crop.

Predatory coccinellids, *Coccinella septempunctata* Linn and *Monochilus sexmaculatus* Fab. and the green lacewing *Chrysoperla carnea* Stephens were observed starting from initiation of aphid infestation till its disappearance on the crop. The maximum coccinellids (0.69/ plant) and chrysopid larvae (0.62/plant) were recorded at aphid peak incidence ie on 3rd standard week or eleventh week of crop growth (Table 1).

The mean maximum temperature and relative humidity together exerted a negative significant influence (r=-0.63) and maximum temperature with all other variables dipicted negative and non significant association on aphid population at 5 per cent level except with mean minimum temperature where the relation was positive and non-significant. The population of coccinellids; chrysopids and aphid exhibited a negative and significant relation (r=-0.79 and r=-0.81) at 1 per cent level with mean minimum temperature. The positive and non-significant impact was observed with relative humidity and rainfall whereas relative humidity had negative and non-significant association with both the predators on aphids density. Coccinellids and chrysopids alone and together exerted a positive and highly significant (r=0.97, r=0.96 and r=0.93 respectively) influence on the aphid population (Table 2). The multiple regression also indicated highly positive relation between aphid population and number of coccinellids and chrysopids. There was 97.3 per cent variability in aphid population (r=0.973) which was highly significant (Table 3).

Discussion and Conclusion

In a field study conducted during 2001-02 to find out the influence of crop phenology on population dynamics of aphid (*U. compositae*) and its predators in safflower, severe infestation of aphid reached during pre-flowering stage when the crop was of 70 days old. Crop phenology of two months i.e., 3rd standard week (SW) was crucial for survival and multiplication of safflower aphid. The temperature ranging from 13.2°C to 28.4°C coupled with 84.4 per cent RH proved conducive for aphid multiplication coinciding with crop reproductive stage. The meteorological conditions which were found conducive for aphid multiplication in the present studies are in agreement with those of Manjrekar (1972) and Hodek *et al*. (1972). The negative correlation of humidity with pest incidence are also in close agreement with the findings of Upadhyay *et al*. (1980). Minimum temperature of 15.30°C and lower level of humidity 44.20%, favourable for aphid multiplication. The findings regarding the significant correlation of aphid incidence with crop age are supported by the views of Awasthi and Agrawal (1995).

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Table 1: Influence of crop phenology on aphid (*U. carthami*) and its predators *M. sexmaculatus* and *C. carnea* in safflower *Carthamus tinctorius*

Age of the crop	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Standard weeks	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10
Max temp. (°C)	30.3	29.1	30.0	29.6	29.4	30.4	30.0	31.7	30.2	29.0	28.4	30.7	32.4	32.7	30.1	32.8	35.5	36.0
Min. temp. (°C)	20.7	20.0	19.1	20.1	19.8	18.1	18.6	19.2	16.5	15.9	13.2	16.1	18.7	17.8	18.4	18.8	17.8	18.7
Relative humidity (%)	87.7	93.0	88.0	86.3	83.4	84.3	82.6	84.1	83.2	80.5	83.4	82.4	74.2	71.3	77.3	72.6	73.8	71.5
Rainfall (mm)	0.00	23.2	22.4	6.60	0.00	11.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coccinellids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.28	0.34	0.68	0.52	0.40	0.32	0.12	0.00	0.00	0.00
C. carnea larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.16	0.54	0.62	0.48	0.36	0.30	0.22	0.14	0.00	0.00
Mean aphid population/ plant	0.00	0.00	0.00	0.00	0.00	0.00	13.36	21.44	48.68	76.16	118.40	103.24	81.48	53.62	27.24	8.52	3.64	0.00

Table 2: Correlation matrix of aphid population as influenced by biotic and abiotic factors

	Max. temp. (°C)	Min. temp. (°C)	RH (%)	Coccinellids (No.)	*C. carnea* larvae (No.)	Aphid population (No.)
X1	1.00	0.12	-0.63*	-0.13	-0.16	-0.16
X2		1.00	0.39	-0.79**	-0.81**	-0.82**
X3			1.00	-0.25	-0.37	-0.30
X4				1.00	0.93**	0.97**
X5					1.00	0.96**
Y						1.00

Table 3: Regression coefficients of biotic and abiotic factors on the aphid population

Sl. No.	Regression equation	Regression coefficients	't' values	Correlation coefficient	R^2	't' values
1	Y=141.68 – 3.56 X 1	-0.42	0.20	-0.16	0.025	0.62
2	Y=352.34 – 17.64 X 2	-0.66	0.30	-0.82	0.672	5.53
3	Y=197.61 – 2.02 X 3	-0.03	0.04	-0.30	0.090	1.22
4	Y=1.79 + 178.53 X 4	108.24**	3.47	0.97	0.941	16.67**
5	Y=1.11 + 181.25 X 5	71.48**	2.15	0.96	0.922	13.29**
a : Intercept		29.16	0.26			
Standard error of estimate		8.390				
Co-efficient determination (R^2)		0.973				

* Significant at 5%, ** Significant at 1% level

Note: Y Aphid population in number

X1 – Average max. temperature (°C), X2 – Average min. temperature (°C)

X3 – Average relative humidity (%), X4 – Coccinellids

X5 – *C. Carnea* larvae