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Population dynamics of aphids and their natural enemies on lucerne in western Maharashtra

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Abstract
Studies on seasonal abundance of aphids and their natural enemies in relation to the climatic factors were undertaken on lucerne (*Medicago sativa)* during 2005-07. During the study, 3 aphid species *viz.,* pea aphid (*Acyrthosiphon pisum* Harris), spotted aphid (*Therioaphis maculata,* Buckton) and cowpea aphid (*Aphis craccivora* Koch.) were found predominant on lucerne. Infestation of pea aphid was noticed from December,2005 to middle of March, 2006 and middle of Nov.,2006 to 2nd week of February, 2007 with maximum population in 4th week of January, 2007 (57.80 aphids/tiller). Whereas, cowpea aphid was found from January, 2006 to 2nd week of February, 2007 and last week of Dec., 2006 to 2nd week of February, 2007. During this period, peak infestation noticed in 3rd week of January, 2007 (23.50 aphids/tiller). However, spotted aphid showed two population peaks from December, 2005 to end of February, 2006 and 2nd week of July, 2006 to 1st week of August, 2006 with maximum population built up in the month of January (73.90 aphid/tiller). Infestation of pea aphids showed negative correlation with minimum temperature and positive correlation with evening relative humidity. However, spotted aphids and cowpea aphids showed negative correlation with maximum and minimum temperatures. Predators, Coccinellid, *Chrysoperla carnea,* syrphid and spiders showed highly significant positive correlation with aphids.

Keywords: Aphids, *Chrysopa,* Lady bird beetles, Lucerne, Predators, Syrphid

Introduction

Lucerne (*Medicago sativa* L.) is an important cultivated legume fodder crop (Sharma, 2013). It is originated in south western Asia and presently grown all over the world (Martin and Leonard*,* 1976). In India, it was introduced in 1900's and in Maharashtra, it is known as *lasun ghas*. Lucerne contributes maximum in feeding forage crops and contains 5 times as much protein as sorghum fodder. Lucerne green fodder contains 20.2 % crude protein, 16.2% digestible crude protein, 30.1% crude fibre, 1.24% calcium, 0.35% phosphorous and metabolic energy 2.17 Mcal/kg (Banerjee, 1978). Due to its herbaceous nature, under favorable temperature and humidity, the pests have enormous scope to perpetuate and build up their population on it. Lucerne suffers damages (Martin and Leonard, 1976) both qualitatively and quantitatively by aphids (*Acyrthiosiphon pisum* Harris, *Acyrthiosiphon kondoi* Shinjii and *Therioaphis trifolii* F.). The quantitative losses recorded in India are about 37.7% due to insect pests in lucerne (Ram and Gupta, 1989). In India insect pests associated with this crop are spotted aphids, blue green aphid, pea aphid, leaf hopper, lucerne weevil*,* alfalfa caterpillar, tobacco caterpillar, semilooper, galerucid beetle, gray weevil, pentatomid bug, thrips, cut worms and termites etc. (Panday *et. al.,* 1995). In Maharashtra, spotted aphid, pea aphid, cowpea aphid, *S. litura* and *H. armigera* are found major as insect pest and slugs/rats are non insect pest on lucerne. Various natural enemies also occur on lucerne aphid. The most important are Coccinellid predators including *Coccinella septempunctata* L., *Coccinella* sp. and *Chrysoperla carnea* Steph and Syrphids (Kesten, 1975). However, there is paucity of precise information on different aspects of pests infesting lucerne in Maharashtra. Therefore, the population fluctuation of aphids in relation to meteorological parameters and predators were studied.

Materials and Methods

The experiment was conducted on the farm of All India Coordinated Research on Forage Crops Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra from December, 2005 to February, 2007 on perennial lucerne variety RL-88. The abundance of the major pest on lucerne was recorded at weekly interval up to 14 months starting from December 15, 2005. Ten plants were selected randomly from each of the blocks and marked with bamboo sticks for recording the observations. Cutting of the block was adjusted to ensure availability of 7 days old tillers for recording observations

on aphids and their predators. The observations were taken early in the morning at an intervals of 7 days. The data on the seasonal fluctuation of aphids and their predators were statistically analyzed for studying the correlation of number of aphids with meteorological parameters and predators *viz.,* lady bird beetles *Chrysopa* larvae and syrphid grubs.

Results and Discussion

Aphids: The population of pea aphid (*Acyrthosiphon pisum* Harris) and spotted aphid (*Therioaphis maculata,* Buckton) were noticed on lucerne during last week of December, 2005 (52nd SMW) with average of 15.10 and 26.50 aphids/tiller whereas, cowpea aphid (*Aphis craccivora* Koch.) was noticed in 1st week of January, 2006 (1st SMW) with 3.70 aphids/tiller (Table 1). During the observation period the population peak of pea aphid (*A. pisum*) occurred in last week of December, 2005 to 2nd week of March, 2006 and 3rd week of November, 2006 to 2nd week of February, 2007. In first peak period, the highest population (45.60 aphids/tiller) was noticed during 3rd week of February, 2006 whereas, it was maximum (57.80 aphid/tiller) during 4th week of January, 2007 in second peak. Three population peaks of spotted aphid (*T. maculata*) were noticed during the period of observation. First population peak was observed during last week of December, 2005 to 3rd week of February, 2006 with maximum population (73.90 aphids/tiller) in 1st week of January, 2006. The second population peak was noticed from 2nd week of July, 2006 to 1st week of August, 2006 with the highest population (25.70 aphids/tiller) in 3rd week of July, 2006. The third peak period was seen from last week of December, 2006 to 2nd week of February, 2007. Maximum average number of aphid recorded in this peak was 31.70 aphids/tiller.

Average count of cowpea aphid (*A. craccivora*) was much low as compared to pea and spotted aphids. Cowpea aphid showed two population peaks, from 1st week of January, 2006 to 2nd week of February, 2006 and last week of December, 2006 to 2nd week of February, 2007. During these peaks, higher population was observed in 4th week of January, 2006 (17.50 aphids/tiller) and 3rd week of January, 2007 (23.50 aphids/tiller), respectively. The correlation coefficient of aphids on lucerne plant with meteorological parameters studies indicated that average number of pea aphid, spotted aphid and cowpea aphid per tiller showed highly significant negative correlation with minimum temperature (Table 2). However, spotted aphid and cowpea aphid showed significant negative correlation with maximum temperature. Evening relative humidity showed significant negative correlation with pea aphid on lucerne. It was observed that the infestation of aphids started increasing from December onwards and reached to a maximum during January. Normally, the temperature also started decreasing from December onwards and had the lowest during January. Hence, with decreasing in temperature, there was an increasing trend in the infestation of aphids. Evening relative humidity was also maximum in the month of January which resulted decrease in population of pea aphid.

Many researchers had carried out the work on seasonal abundance of lucerne aphids. Neilson and Barnes (1961) reported that population peak of spotted aphid occurred in July. Kain *et al.* (1979) observed the infestation of blue green aphid in spring and early summer, while pea aphid infestation was dominant in mid to late summer. It was observed by Chan (1982) that mass multiplication of pea aphid and spotted aphid on lucerne was occurred when the mean daily temperature was varied between15-20 ^{0}C. Faruqui *et al.* (1986) reported that maximum activity of aphids was occuurred in 3rd meteorological week. Bueno *et al.* (1996) reported that the number of *A. pisum* per stem was higher in autumn, whereas peaks of *T. trifolii* population occurred in May and October to December. Ingawale and Tambe (2007) also observed maximum population of lucerne aphids in middle of January. The infestation of aphids showed significant negative correlation with minimum temperature.

Predators: Three population peaks of Coccinellid predators occurred from end of December, 2005 to 3rd week of March, 2006, mid July, 2006 to mid August, 2006 and December 2006 to February, 2007. Maximum lady bird beetle grubs were noticed in 3rd week of February, 2006 (4.10 grubs/tiller), 3rd week of July, 2006 (1.90 grubs/tiller) and 4th week of January, 2007 (7.10 grubs/tiller) during first, second and third peak period, respectively. During the peak period, aphid population was also at maximum level. The correlation coefficient of grubs of lady bird beetles on lucerne plants with meteorological parameters and aphid population per tiller showed highly significant negative correlation (Table 2) with maximum and minimum temperatures. However, lady bird beetle grubs showed significant negative correlation with evening relative humidity. The correlation of average number of grubs of lady bird beetles per plant with pea aphids, spotted aphid and cowpea aphid was highly significant and positive. Minimum temperature showed

highly significant negative correlation with average number of larvae of *C. carnea*. The correlation of average number of *C. carnea* larvae with pea aphid, spotted aphid and cowpea aphid population was highly significant and positive. Thus, the decrease in minimum temperature and increase in aphid population per plant resulted in a corresponding increase in the population of *C. carnea* on lucerne.

Hughes *et al.* (1978) reported that when the population of aphids, *A. kondoi* and *A. pisum* increased on lucerne, the population of aphids predator *Coccinellla undecimpunctata* L. was also increased. Upadhyay *et al.* (1981) reported that the predatory Coccinellid *Coccinella septempunctata* and *Menochillus sexmaculatus* were appeared from last week of December and reached to a peak in the second week of February. Faruqui *et al.* (1986)

Table 1. Population dynamics of aphids and predators in lucerne ecosystem

Met. Week	Aphids/tiller			Lady bird beetle grubs / tiller	*C. carnea* Grubs/m^2
	Pea aphids	Spotted aphids	Cowpea aphids		
52 (2005)	15.10	26.50	0.00	0.50	0.20
1 (2006)	39.50	73.90	3.70	0.90	0.90
2	27.20	24.20	8.40	2.00	0.50
3	5.40	9.30	5.40	3.30	0.30
4	2.20	2.00	17.50	0.90	0.00
5	13.80	17.60	2.70	1.60	0.40
6	41.60	43.40	4.00	3.80	0.70
7	45.60	26.10	0.00	4.10	0.80
8	12.60	4.40	0.00	2.70	0.30
9	4.60	0.00	0.00	1.50	0.00
10	1.40	0.00	0.00	0.70	0.00
11	0.00	0.00	0.00	0.70	0.00
27	0.00	10.00	0.00	0.70	0.30
28	0.00	23.20	0.00	1.30	0.40
29	0.00	25.70	0.00	1.90	0.50
30	0.00	8.50	0.00	0.70	0.20
31	0.00	3.60	0.00	0.20	0.10
32	0.00	0.00	0.00	0.60	0.00
46	2.90	0.00	0.00	0.00	0.00
47	11.40	0.00	0.00	0.00	0.00
48	1.90	0.00	0.00	0.60	0.00
49	4.80	0.00	0.00	0.80	0.00
50	4.30	0.00	0.00	0.70	0.00
51	13.90	0.00	0.00	1.50	0.00
52	17.30	4.90	6.40	2.30	0.00
1 (2007)	22.40	14.70	10.00	2.50	0.00
2	42.80	13.00	14.70	4.70	0.70
3	49.10	21.50	23.50	5.70	0.90
4	57.80	31.70	17.90	7.10	0.70

Table 2. Correlation coefficient (r) of aphids with abiotic factor and their predators

Variable	LBB Grubs	*C. carnea*	Meteorological parameters				
			Temp. Max. (^{0}C)	Temp. Min. (^{0}C)	Humidity Morn. (%)	Humidity Even. (%)	Rainfall (mm)
Pea aphid	0.874**	0.852**	-0.233	-0.655**	0.069	-0.328*	-0.239
Spotted aphid	0.558**	0.857**	-0.291*	-0.474**	0.073	-0.171	0.185
Cowpea aphid	0.757**	0.563**	-0.266*	-0.561**	-0.097	-0.247	-0.185
LBB grub	-	-	-0.239*	-0.559**	-0.064	-0.263*	-0.217
C. carnea	-	-	-0.245*	-0.440**	0.032	-0.170	-0.177

LBB ï Lady bird beetle, *Significant at 5 % level (p=0.05), ** Significant at 1 % level (p=0.01)

reported that important predators of lucerne aphids were *Episyrphus halteatus, Coccinella septempunctata, Menochillus sexmaculata* and *Scymnus nubilus*. With decrease in minimum temperature and increase in morning relative humidity, there was a corresponding increase in aphid population, which resulted in the increase of their predators (Ingawale and Tambe, 2007).

The present investigations may help in a strategic planning to initiate control measures for effective management of aphids on lucerne. In fact, infestation status noticed in the present study and elsewhere indicated that this pest should be considered as major constraint for improved green forage production from lucerne.

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