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RESEARCH PAPER

Studies on seasonal incidence of aphids in lucerne [*Medicago sativa* (L.)] and their relationship with weather parameters

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Abstract: Seasonal incidence of aphids on lucerne *Medicago sativa* (L.) were observed at Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research station (SRRS), Dharwad, during *rabi* 2020-21.The Seasonal incidence of aphids in lucerne and their relationship with weather parameters revealed that, the peak population of pea aphid, *Acyrthosiphon pisum* was noticed during second week of March 2021. Pea aphid population showed significantly positive correlation with the maximum temperature (0.426*) and highly significant negative correlation with relative humidity (-0.54*). Pea aphid population was significantly positively correlated with coccinellids (0.55*). Peak population of cowpea aphid *Aphis craccivora* was observed during 4th week of December, 2020. Cowpea aphid population was significantly and negatively correlated to maximum temperature and minimum temperatures (-0.48* & -0.41*) and significant positive correlation was found between aphid population and its natural predator coccinellids (0.49*)

Key words: Aphid, Caterpillar, Coccinellids, Lucerne

Introduction

Lucerne (*Medicago sativa* L.), family: Fabaceae is an important leguminous fodder crop. It is also called as alfalfa. Lucerne has been most likely, the first crop under cultivation for forage production since ancient time. Roman writers described its importance as feed for horses and other animals as early on 490 BC. Lucerne is derived mainly from *Medicago coerulea,* a diploid (2n=16) that grows wild in grasslands of South-West Iran, Caucasan region and eastern Anatolia. Tetraploids are regularly more vigorous than diploids. Earliest farmers esteemed the differences and adopted cultivation of tetraploid. Lucerne originated in Mesopotamia and from there spread to Arabia and then to Mediterranean region. Spaniards passed it to new world. It was passed to Europe and South America by invading armies, explorers and missionaries (Anon, 2011). Presently it is grown everywhere in the globe.

In Asian countries insect pests observed in crop are pea aphid, cowpea aphid, plant leaf hopper, lucerne beetle, lucerne caterpillar, tobacco caterpillar, semi-looper, galerucid beetle, grey beetle, pentatomid bug, thrips, cut worms, *Helicoverpa armigera* and termites. Blue aphid *Acyrthosiphon kondoi* is stated to occur in Japan and Manchukuo, Asian country, Afghanistan, Iran, U.S.A, Mexico and Argentina, New Zealand and Australia. Among insect pests of lucerne, sucking pests like pea aphid and cowpea aphid are important ones and they affect the quality and quantity of lucerne crop.Understanding of seasonal incidence of these aphids in lucerne and their relationship with weather parameters is very important to know more about these pests and for their management. At present very little information is available on the seasonal incidence of aphids in lucerne and their relationship with weather parameters. There is a need to understand the type of relationship of aphids and coccinellids. Therefore, present investigations were undertaken to know the seasonal incidence of aphids in lucerne and their relationship with weather parameters and type of relationship between aphids and coccinellids.

Material and methods

The trial was conducted at Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research station (SRRS), Dharwad during 2020-21. Lucerne crop was raised during *rabi* season of 2020-21 by following the recommended package of practices. Anand-2 variety of lucerne was selected for the studies and spacing 30 × 10 cm was maintained. Weekly observations on the incidence of aphid were taken on randomly selected 20 plants from four different spots in "Z" fashion. Aphid count was taken on 10 cm/tillers/plant. For this purpose, the reserve area of lucerne crop of about 300 $m^2$was earmarked and maintained without any chemical or bio pesticide sprays. Weather data *viz*., temperatures (^{0}C), relative humidity (%), rainfall (mm) were recorded.

The mean value of aphid and the weather data was calculated for respective week. For calculation of correlation co-efficient (r) the mean aphid population was considered as a dependent variable (y) and weather parameters as the independent variable (x). The data was subjected to statistical analysis and correlation coefficient and regression analysis was carried out to know the type and extent of relationship. Correlation co-efficient (r) between weekly averages of weather parameters and average number of insects recorded at weekly interval were worked out by the method of Snedecor and Cocharan to find out the influence of different variables on population dynamics of lucerne aphids and their natural enemies. The data on weather parameters *viz.,* maximum temperature (^{0}C), minimum temperature (^{0}C), rainfall (mm) and relative humidity (%) were collected from meteorological unit of Main Agricultural Research station (MARS), University of Agricultural sciences (UAS), Dharwad, for statistical analysis.

Results and discussion

Seasonal incidence of aphid in lucerne and their relationship with weather parameters

Seasonal abundance of pea aphid (*Acyrthosiphon pisum,* Harris) and cowpea aphid (*Aphis craccivora* Koch.) were observed during this study. The data on average number of aphid per10 cm of tillers in respect of both species were recorded from November 2020 to June 2021 are presented in Table 1 to Table 4.

Pea aphid (*Acyrthosiphon pisum,* Harris): Pea aphid *Acyrthosiphon pisum* infestation was observed from 3rd week of November to 1st week of May (Table 1). Aphid infestation (4.5/tillers) started from 47th meteorological standard week (MSW) *i.e.* Nov 15-21 of 2020 and maximum population (476.25/ 10 cm of tillers) was noticed during 11th MSW 2020 *i.e.* March 7-13 of 2021 (Table, 1). Aphid population started declining after first week of March and reached nil during second week of May *i.e.* 20th MSW. Weather parameters during peak infestation period were maximum temperature of 34.20 ^{0}C and minimum temperature of 17.40^{0}C; morning and afternoon relative humidity were 73.14 and 26.70 per cent, respectively with almost nil rainfall.

Correlation studies of pea aphid *Acyrthosiphon pisum* with weather parameters indicated significant positive correlation with maximum temperature (r= 0.426*) and negative correlation with morning and evening relative humidity (r=-0.54* and r= -0.75*). There was non-significant relationship with minimum temperature and rainfall (r= 0.174, r= -0.13) (Table 2). Aphid population and their natural enemies coccinellids are significantly positively correlated with each other (r= 0.55*). Both aphid and its predators were seen together when the weather was warm and their survival was negatively affected by relative humidity.

Cowpea aphid *(Aphis craccivora* Koch.): Cowpea aphid *Aphis craccivora* population was noticed from first week of December, 2020 (50th MSW) with (2.65 aphid / 10 cm of tillers) and highest population of cowpea aphid (17.90 aphid/10 cm of tillers) was observed on 1st MSW *i.e.* Dec 27- Jan 2, with prevailing weather parameters during the peak period were maximum and minimum temperatures of 28.70 ^{0}C, 12.31^{0}C, morning and evening relative humidity of 76.87, 47.70 per cent and with rainfall being nil. Population started declining after the 1st week of January and almost nil after last week of January, 2021 (5th MSW) (Table 3).

Table 1. Seasonal incidence of pea aphids (*Acyrthosiphon pisum)* in lucerne and prevailing weekly weather parameters during *rabi* 2020-21

Weeks	MSW	Average number of Aphids/10 cm of tillers	Coccinellids /tillers	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)
				Max	Min	Morning	Evening	
Nov 1-7	45	0	0	30.7	17.00	68.85	46	0.00
Nov 8-14	46	0	0	31.1	16.22	73.42	47.42	0.00
Nov 15-21	47	4.5	0	30.25	18.42	75.85	51.71	0.00
Nov 22-28	48	10.5	1.2	29.2	16.00	77.85	46.85	0.00
Nov 29-Dec 5	49	0.00	0	27.50	15.94	82.85	57.00	0.00
Dec 6-12	50	3.5	0.6	28.92	14.12	76.42	52.57	0.00
Dec 13-19	51	65.25	1.5	29.40	14.75	75.00	42.42	0.00
Dec 20- 26	52	64.95	1.4	28.10	14.78	74.14	42.57	0.00
Dec 27-Jan 2	01	99.85	1.6	28.70	12.31	76.87	47.70	0.00
Jan 3- 9	02	39.55	1.2	27.70	14.58	84.14	65.70	0.00
Jan 10-16	03	81.20	1.6	29.00	18.30	78.10	55.00	0.00
Jan 17- 23	04	82.15	1.6	30.30	15.57	73.42	45.57	0.00
Jan 24-30	05	144.25	2.2	30.78	14.58	72.43	36.28	3.88
Jan 31- Feb 6	06	154.80	3.2	29.71	15.05	65.71	42.28	0.00
Feb 7- 13	07	141.25	2.0	30.35	13.61	56.71	30.85	0.00
Feb 14-20	08	467.75	5.8	30.15	12.80	75.00	34.14	0.00
Feb 21-27	09	394.25	4.6	30.60	16.61	75.71	42.57	1.40
Feb 28- Mar 6	10	424.65	5.0	34.10	18.64	52.14	23.42	0.00
Mar 7-13	11	476.25	6.0	34.20	17.40	73.14	26.70	0.00
Mar 14-20	12	274.50	4.2	34.74	17.20	60.5	24.42	0.00
Mar 21- 27	13	308.75	4.6	35.70	19.41	50.87	27.00	0.00
Mar 28-April 3	14	237.45	3.4	36.40	19.90	64.60	27.25	0.00
April 4-10	15	150.90	2.4	36.80	19.05	75.40	40.20	5.40
April 11-17	16	106.35	2.0	34.50	17.25	74.40	42.30	8.17
April 18-24	17	102	1.8	35.4	17.5	72	43.1	41.2
April 25-May 1	18	95	1.6	34.4	17.2	72.1	50	16.6
May 2-8	19	52	1.3	33.92	16.96	82.14	45.28	11.28
May 9-15	20	0	0	32.82	16.41	86.85	51.28	2.85
May 16-22	21	0	0	29.27	14.63	93.42	65	5.54
May 23-29	22	0	0	30.037	15.18	88.85	57.71	0.94
May 30-June 5	23	0	0	30.62	15.31	86	49	10.5

MSW = Meteorological standard weeks

Table 2. Correlation of pea aphids (*Acyrthosiphon pisum)* with weather parameters and coccinellids in lucerne

	Correlation coefficient (r)						
	Max.temp.(°C)	Min.temp.(°C)	Morning RH (%)	Evening RH (%)	Rainfall (mm)	R^2	Coccinellids
Aphids	0.426*	0.174	-0.54*	-0.75*	-0.13	0.59	0.55*
Coccinellids	0.06	0.05	0.36*	-0.40*	0.15	0.22	-

Table value – 0.3061 * Significant at 5 % Table value – 0.24071 **Significant at 1 %

Table 3. Seasonal incidence of cowpea aphids (*Aphis craccivora)* in lucerne and prevailing weather parameters during *rabi* 2020-21

Weeks	MSW	Average number of Aphids/ 10 cm of tillers	Coccinellids /tillers	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)
				Max	Min	Morning	Evening	
NOV 1-7	45	0	0	30.7	17.00	68.85	46	0.00
NOV 8-14	46	0	0	31.1	16.22	73.42	47.42	0.00
Nov 15-21	47	0	0	3.25	18.42	75.85	51.71	0.00
Nov 22-28	48	0	0	29.2	16.00	77.85	46.85	0.00
Nov 29-Dec 5	49	0	0	27.50	15.94	82.85	57.00	0.00
Dec 6-12	50	2.65	2.4	28.92	14.12	76.42	52.57	0.00
Dec 13-19	51	6.45	4	29.40	14.75	75.00	42.42	0.00
Dec 20- 26	52	12.3	6	28.10	14.78	74.14	42.57	0.00
Dec 27-Jan 2	01	17.9	8	28.70	12.31	76.87	47.70	0.00
Jan 3- 9	02	11.25	5	27.70	14.58	84.14	65.70	0.00
Jan 10-16	03	8.65	5	29.00	18.30	78.10	55.00	0.00
Jan 17- 23	04	6.43	3	30.30	15.57	73.42	45.57	0.00
Jan 24-30	05	0	1	30.78	14.58	72.43	36.28	3.88
Jan 31- Feb 6	06	0	0	29.71	15.05	65.71	42.28	0.00
Feb 7- 13	07	0	0	30.35	13.61	56.71	30.85	0.00
Feb 14-20	08	0	0	30.15	12.80	75.00	34.14	0.00
Feb 21-27	09	0	0	30.60	16.61	75.71	42.57	1.40
Feb 28- Mar 6	10	0	0	34.10	18.64	52.14	23.42	0.00
Mar 7-13	11	0	0	34.20	17.40	73.14	26.70	0.00
Mar 14-20	12	0	0	34.74	17.20	60.5	24.42	0.00
Mar 21- 27	13	0	0	35.70	19.41	50.87	27.00	0.00
Mar 28-April 3	14	0	0	36.40	19.90	64.60	27.25	0.00
April 4-10	15	0	0	36.80	19.05	75.40	40.20	5.40
April 11-17	16	0	0	34.50	17.25	74.40	42.30	8.17
April 18-24	17	0	0	35.4	17.5	72	43.1	41.2
April 25-May 1	18	0	0	34.4	17.2	72.1	50	16.6
May 2-8	19	0	0	33.92	16.96	82.14	45.28	11.28
May 9-15	20	0	0	32.82	16.41	86.85	51.28	2.85
May 16-22	21	0	0	29.27	14.63	93.42	65	5.54
May 23-29	22	0	0	30.037	15.18	88.85	57.71	0.94
May 30-June 5	23	0	0	30.62	15.31	86	49	10.5

MSW = Meteorological standard weeks

Table 4. Correlation of cowpea aphids (*Aphis craccivora*) with weather parameters and coccinellids in lucerne

	Correlation coefficient (r)						Coccinellids
	Max.temp. (^{0}C)	Min.temp. (^{0}C)	Morning. RH (%)	Evening. RH (%)	Rainfall (mm)	R^2	
Aphids	-0.48*	-0.41*	0.155	0.27	-0.20	0.26	0.49*
Coccinellids	-0.38*	-0.39*	0.17	0.30*	-0.24	0.35	-

Table value – 0.3061* Significant at 5 % Table value – 0.24071** Significant at 1 %

Correlation of cowpea aphid with weather parameters indicated that population of cowpea aphid was significantly negatively correlated with maximum temperature and minimum temperature (-0.48*and -0.41*). Aphid and predatory coccinellids always co-existed together and and it showed significant positive correlation (0.49*) (Table 4).

In case of coccinellides they had significantly positive correlation with aphid population (r=0.49*) and non-significantly positive correlation to morning relative humidity (r=0.17) and evening relative humidity (0.30*) and Negative correlation to maximum and minimum temperature r=-0.38* &-0.39*. Also negative correlation to rainfall r=-0.24. Fecundity

rates were unaffected by temperature, but increased with increasing temperatures.

These findings are in agreement with the results of Ingawale and Tambe (2007) who reported maximum population of lucerne aphids during middle of January. The infestation of aphids showed significant negative correlation with minimum temperature. Tambe (2008) noticed that cowpea aphid (*Aphis craccivora* Koch) on lucerne in Maharashtra with peak infestation in the month of January and exhibited negative correlation with maximum and minimum temperature. Godwal (2010) reported that the connection between aphid *A. craccivora* population and minimum temperature showed significant negative correlation. Infestation of pea aphids showed positive correlation with maximum and minimum temperature and negative correlation with morning and evening relative humidity. However, cowpea aphids showed negative correlation with maximum and minimum temperatures. Predators, Coccinellid, *Chrysoperla carnea*, syrphid and spiders showed highly significant positive correlation with aphids, as reported by Tambe and Kadam (2015). Aphid (*A. pisum*) population was increased when rainfall was reduced and the maximum temperature was increased, were reported by Melesse and Singh (2012), Nithin *et al.,* 2018.

The present findings are disagreement with the observation of previous workers like Ingawale and Tambe (2007) and Tambe (2008) due to climatic variations prevailed at experimental location. By observing the infestation period of lucerne aphids, its effective management can be intended by initiating control measures. This pest was considered as a key constraint in green forage production of lucerne.

Conclusion

Seasonal incidence of aphids on lucerne and their natural enemies in relation to abiotic factors were documented at weekly interval in *rabi* 2020-21. The first peak period of pea aphid, *Acyrthosiphon pisum* was observed in 8th Meteorological standard week of February, 2021. Second peak period was noticed with population of aphids during 11th MSW. Among the different meteorological parameters, temperature and relative humidity were affecting the variation in infestation of aphids. Average number of aphids/tiller showed highly significant negative correlation with relative humidity and rainfall. The highest population of cowpea aphid was observed during 4th week of December, 2020 (1st MSW). Correlation study of cowpea aphid population was significantly and negatively correlated with maximum and minimum temperatures. Aphid population showed significant positive correlation with its predator scoccinellids indicating that predators need aphid population for their survival.

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