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Original Research Article

Relative abundance of Coccinellid in cotton ecosystem in relation to environmental factors

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A B S T R A C T

The abundance of the lady bird beetles (LBB), *Coccinella septumpunctata* L. (Coleoptera-Coccinellideae) in relation to climatic factor was studied in two consecutive cropping seasons 2005-06 and 2006-07. The study revealed that, the cotton LBB was first recoded in the 27th SMW i.e. first week of July during both the year of study and remained up and remained active till 50th SMW (IInd week of December). The peak population was observed (9.76 / 5 plant) during 37th SMW i.e. 3rd week of September. The correlation studies between Population of LBB and weather factors revealed that the LBB population had a significant positive correlation with maximum temperature (0.542) & minimum temperature (0.560). The multiple coefficient value between the LBB population and group of variable clearly indicated that 79.50% change in LBB population were affected by maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind velocity, rainfall and rainy days respectively. The data also revealed that 20.50% variation caused by inexplicable reason or due to error beyond the control of experiment or due to factors not included in the investigation.Path coefficient analysis of LBB population and abiotic factors revealed that the minimum temperature had positive and high direct effect (1.6592) followed by morning relative humidity (0.1972), rainfall (0.1535), and sunshine hours (0.1519) and evening relative humidity (0.016) respectively.

Keywords

Population dynamics; *Coccinella septumpunctat;* Environmental factors; Cotton.

Introduction

The lady bird beetles, *Coccinella septumpunctata* L. (Coleoptera-Coccinellideae) is the most potential and effective predator of cotton pest (Mathur, 1983, Nirmala devi et al., 1996, debraj and Singh 1989, Soni et al., 2004, Gour and Pareek, 2005). The grub and adult stages of *C. septumpunctata* feed voraciously on cotton pest i.e. Aphids, Jassid and White fly and cuts down its population to a great extent (Brar et. al. 2008). But the feeding efficacy of a predator is greatly influenced by the population density of prey (Murdoch and Marks, 1973).The period

and intensity of activity of this predator mainly depends on the prey density, plant protection practices and environmental factors. Of these the climatic factors such as temperature, relative humidity, sunshine hours, wind velocity and rainfall influenced the predator population greatly. Keeping in view of that the present study was undertaken to study the population of LBB in relation to meteorological factors in the state so that timely and effective management strategies for cotton pest control could be developed.

Materials and Methods

The population dynamics of LBB in relation to metrological factor was assessed at the J.N. Krishi Vishwa Vidhyalaya, Cotton Research Station, Khandwa M.P. during 2005-06 & 2006-07. The cotton genotype JK-4 was sown on 29th June and 25th June during 2005 and 2006 respectively at a spacing of 60X60 cm. Normal agronomic practices recommended for the region were followed for raising the crop. No plant protection measure was taken throughout the crop season. The Regular observations on the population dynamics of *C.septumpunctata* was made at weekly interval by randomly selected 25 plants from the first appearance and continued throughout the season up to the crop maturity. The observation unit was five leaves par plant, two each from lower, middle and one from upper canopy of the plant. At the same time, observations on meteorological data *Viz.* minimum and maximum temperature, morning and evening per cent relative humidity, total rainfall per week, total rainy days per week, wind velocity (kmph) and sunshine hours per days were recorded daily. Standard meteorological week (SMW) average of all the data collected for the pest, predator and weather parameter were calculated before statistical analysis. The data thus collected were computed and subjected to suitable statistical analysis (Panse and Sukhatme, 1985). The influence of different meteorological parameters on population and infestation of pests were studied by graphical superimposition technique. All the possible Correlations, multiple regression and path analysis among the abiotic and biotic factors were worked out.

Results and Discussion

The perusal of the data on the population fluctuation of LBB revealed that it was a potensial predator of cotton pest regular pest on cotton in both the year of study (Fig.1). These findings are in accordance with the finding of Patel *et.al*.(2008).

Activity of *C. septumpunctata*

The present finding revealed that the *C.septumpunctata* population was first observed during the 27th SMW i.e. first week of July and remained active till 50th SMW (IInd week of December).The peak population was observed (9.76 / 5 plant) during 37th SMW i.e. 3rd week of September. The weather condition prevailed during this week viz. maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind velocity, rainfall and rainy day were 34.07°C, 26.31°C, 83.54 %, 60.56%, 6.39 hours per day, 6.00 kmph, 53.50 mm and 3 days respectively.

Simple correlation and regression

The perusal of data (Table:2) on simple correlation studies between Population of LBB and weather factors revealed that the

LBB population had a significant positive correlation with maximum temperature (0.542) & minimum temperature (0.560). After 37st SMW there was a decrease in Ladybird beetle population. It was estimated that every unit increase of maximum temperature & minimum temperature there is increase in population of Ladybird beetle population is 0.971and 0.31 respectively.

Multiple regressions

The multiple regression computed with eleven parameters i.e. maximum temperature (X_1), minimum temperature (X_2), morning relative humidity (X_3), evening relative humidity (X_4), sunshine hours (X_5), wind velocity (X_6), rainfall (X_7) and rainy day (X_8) as independent variables and LBB population as dependent variables was as follows (figure.2).

$Y= 0.814 -0.870X_1 +1.063X_2 +0.241X_3 - 0.032X_4 +0.209X_5 -1.340X_6 +0.007X_7- 0.554X_8$ (R^2=0.795).

The multiple coefficient value between the LBB population and group of variable clearly indicated that 79.50% change in LBB population were affected by maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind velocity, rainfall and rainy days respectively. The data also revealed that 20.50% variation caused by inexplicable reason or due to error beyond the control of experiment or due to factors not included in the investigation.

Path Analysis

Although correlations are very useful in determining components of population of LBB but they do not provide complete understanding of relative importance of direct association of the component character/ factors towards the low pest population. In such situation whereas more variable are included in correlations studies, the indirect association becomes complex. The path coefficient analysis has been useful in finding out the direct and indirect causes of association of specific force acting to produce a given correlation coefficient. The observations revealed that minimum temperature had positive and high direct effect (1.6592) followed by morning relative humidity (0.1972), rainfall (0.1535), and sunshine hours (0.1519) and evening relative humidity (0.016) respectively. Path coefficient effect revealed that the positive indirect effect of high magnitude of minimum temperature was obtained via rainfall (0.0854), sunshine hours (0.0514) and evening relative humidity (0.0006) respectively. The positive indirect effect of morning relative humidity was recorded via wind velocity (0.1308), rainfall (0.0414), sunshine hours (0.0177), evening relative humidity (0.0008) and maximum temperature (0.0007). Positive indirect effect of rainfall was obtained via minimum temperature (0.9229), morning relative humidity (0.0532), maximum temperature (0.0193) and evening relative humidity (0.0007).Positive indirect effect of sunshine hours was obtained via minimum temperature (0.5619), rainy days (0.0642) and morning relative humidity (0.0230).The data also revealed that the positive indirect effect of evening relative humidity was obtained via minimum temperature (0.5979), morning relative humidity (0.0932) and rainfall (0.0705).

Thus, it can be inferred that under the influence of various conductive environmental factors succulent growth of

Table.1 Correlation (r) and simple regression (Y) of lady bird beetle, *Coccinella septumpunctata* population with environmental factors (2005-07 and Pooled)

S.No	Character	2005-06	2006-07	Pooled
1	T MX (°C)	r= 0.381	r= 0.439	r= 0.542* Y=-26.609+0.971X
2	T MN (°C)	r= 0.487	r= 0.611* Y=-1.582+0.318X	r= 0.560* Y=-1.613+0.31X
3	RHM (%)	r= -0.013	r= 0.140	r= 0.072
4	RHE (%)	r= -0.036	r= -0.006	r= 0.014
5	SSH (hpd)	r= 0.492	r= -0.060	r= 0.333
6	WV (kmph)	r= -0.031	r= -0.121	r= -0.068
7	RF (mm)	r= 0.036	r= 0.034	r= -0.333
8	RD (dpw)	r= -0.010	r= 0.208	r= -0.345

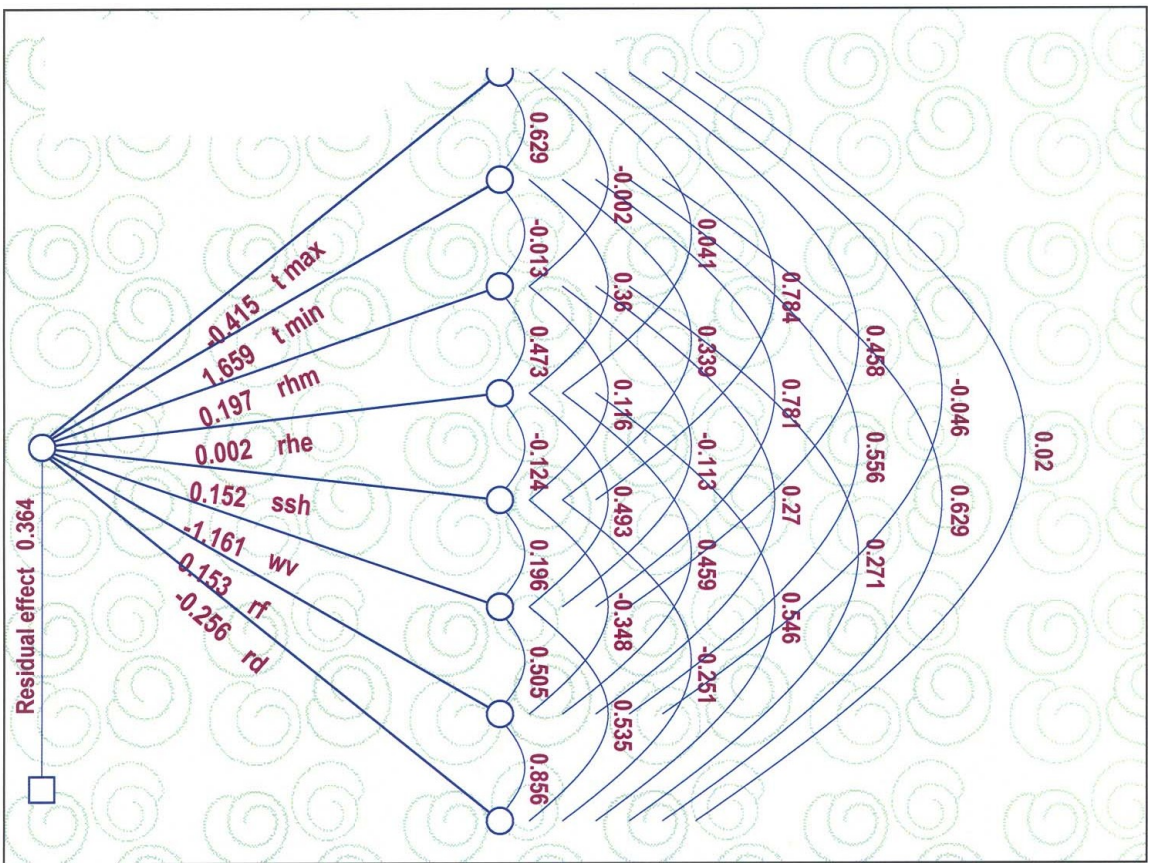
**& ** Showed significant at 5% & 1% level of significance respectively.*

Table.2 Path coefficient of abiotic factor on LBB, Coccinella spp. population on cotton ecosystem

Character	T MX (°C)	T MN (°C)	RHM (%)	RHE (%)	SSH (hpd)	WV (kmph)	RF (mm)	RD (dpw)	Correlation Coefficient
T MX	**0.4154**	1.0441	0.0003	0.0001	0.1191	0.5318	0.0071	0.0052	0.2034
T MN	0.2614	**1.6592**	0.0025	0.0006	0.0514	0.9066	0.0854	0.1609	0.4652******
RHM	0.0007	0.0208	**0.1972**	0.0008	0.0177	0.1308	0.0414	0.0692	0.2985
RHE	0.0171	0.5979	0.0932	**0.0016**	0.0189	0.5724	0.0705	0.1396	0.0152
SSH	0.3259	0.5619	0.023	0.0002	**0.1519**	0.2278	0.0535	0.0642	0.1937
WV	0.1902	1.2952	0.0222	0.0008	0.0298	**1.1615**	0.0775	0.1368	0.1075
RF	0.0193	0.9229	0.0532	0.0007	0.0529	0.5865	**0.1535**	0.2189	0.2913
RD	0.0085	1.0433	0.0534	0.0009	0.0381	0.6211	0.1313	**0.2559**	0.3053

Residual=0.3645, *& ** Showed significant at 5% & 1% level of significance respectively, The bold figures denote the direct effect of different factors on population of insect

Fig.3 Path diagram showing influence of various factors on the population of Lady bird beetle (Pooled)



the host plants take places which attract the pray of predator to colonize. A gradual increase of pray density is followed by the arrival of associated predators that play an important role in suppression of pest population. Summarizing the effect of abiotic and biotic parameter it can be inferred that both these factors play an important role in the sustainable management of cotton pest population in the cotton ecosystem.

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