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Status of leaf hopper (*Amrasca biguttula biguttula* Ishida) in *Bt* cotton and impact of weather parameters and natural enemies on its population

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Abstract : A survey was conducted in 5 talukas each year of Buldana district of Maharashtra during 2008-2012. In these talukas, 2 circles were selected and from each circle, 2 villages and in each village 2 *Bt* cotton farmers field were selected. The data on leaf hopper population and their correlation with weather parameters revealed that, maximum mean population of 4.42 leaf hoppers/3 leaves as/5 year average was observed in 37th meteorological week. It was minimum of 0.51 leaf hopper/3 leaves in 2nd meteorological week of subsequent year. Among the weather parameters, maximum temperature was positively non significantly correlated with leaf hopper (0.358) and coccinelid (0.360) population however, highly significantly positively correlated with chrysopa (0.837**) and spider (0.574**) population. The minimum temperature had showed significant positive relationship with leaf hopper (0.912**) and coccinelid (0.719**) population. The rainfall was very favourable for the population buildup of leaf hoppers and coccinelids on *Bt* cotton as it showed highly significant positive impact on population buildup. Relative humidity both in morning and evening was positively correlated with leaf hoppers and coccinelids population. The bright sunshine hr (BSH) was found favourable for chrysopa eggs (0.502*). The effect of natural enemies' on leaf hoppers population revealed that the coccinelid showed highly significant positive relationship with leaf hopper population in early phase whereas, in later phase the leaf hoppers were effectively controlled by spider which recorded significant positive relationship with leaf hopper population. The chrysopa was not much effective in managing leaf hopper population as it indicated the positive non significant correlation.

Key words : *Bt* cotton, correlation, leaf hopper, natural enemies, relative humidity, temperature

Cotton (*Gossypium* sp) is the leading natural fibre and oil seed crop which plays a key role in Indian economy and offering livelihood security for the Indian farming community. Many allied activities like ginning, fabric production, textile processing, garment manufacture and their marketing etc. provide employment to around 6 million people.

The sucking pests *viz.,* aphids (*Aphis gossypii* Glover), leaf hoppers (*Amrasca biguttula biguttula,* Ishida) whiteflies (*Bemisia tabaci* Gennadius) and thrips (*Thrips tabaci* Lindeman) are most serious and destructive pests with regular occurrence. After introduction of *Bt* cotton hybrid, a general shift in status of sucking pest complex was observed. Among all the sucking pests, leaf hopper is found to be the major destructive insect pest and causes economic damage to the crop. Thus the present study was conducted to share the information on leaf hopper and natural enemies' scenario and central agencies for developing appropriate management strategies. The study on appearance and abundance of leaf hopper and different insect predators (natural enemies) against sucking insect pests of *Bt* cotton in the field conditions was conducted.

MATERIALS AND METHODS

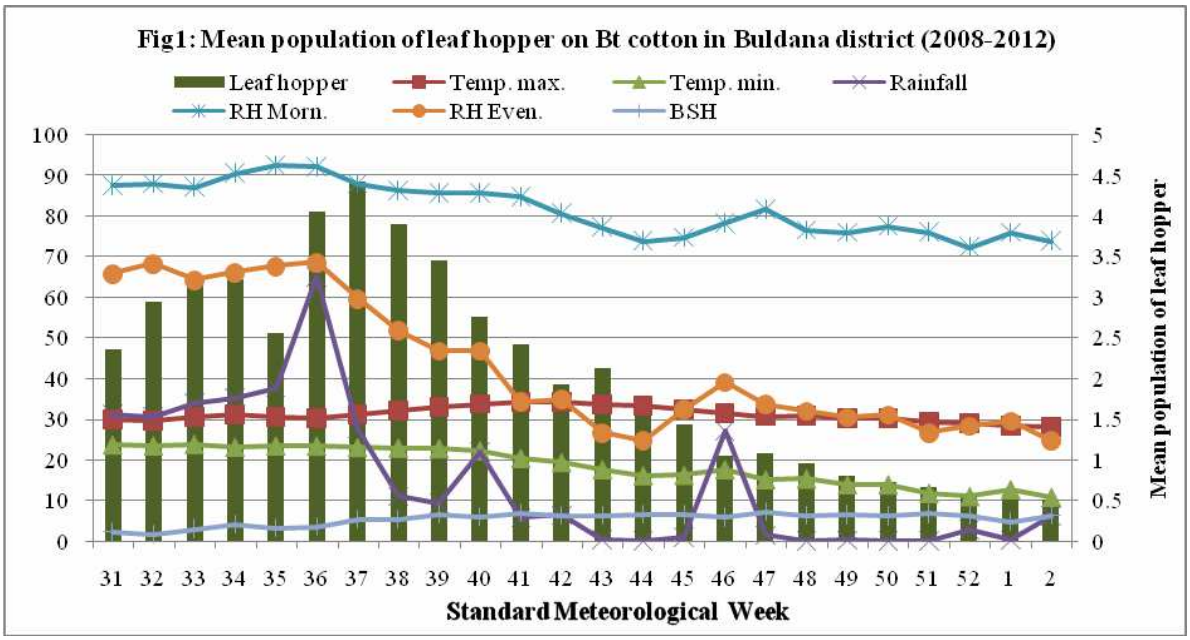
The field survey was conducted in Buldana district of Maharashtra during 2008-2012. In the present study 20 villages from 5 talukas were selected. In these talukas, 2 circles were selected and in each circle 2 villages and in each village 2 *Bt* cotton growers were

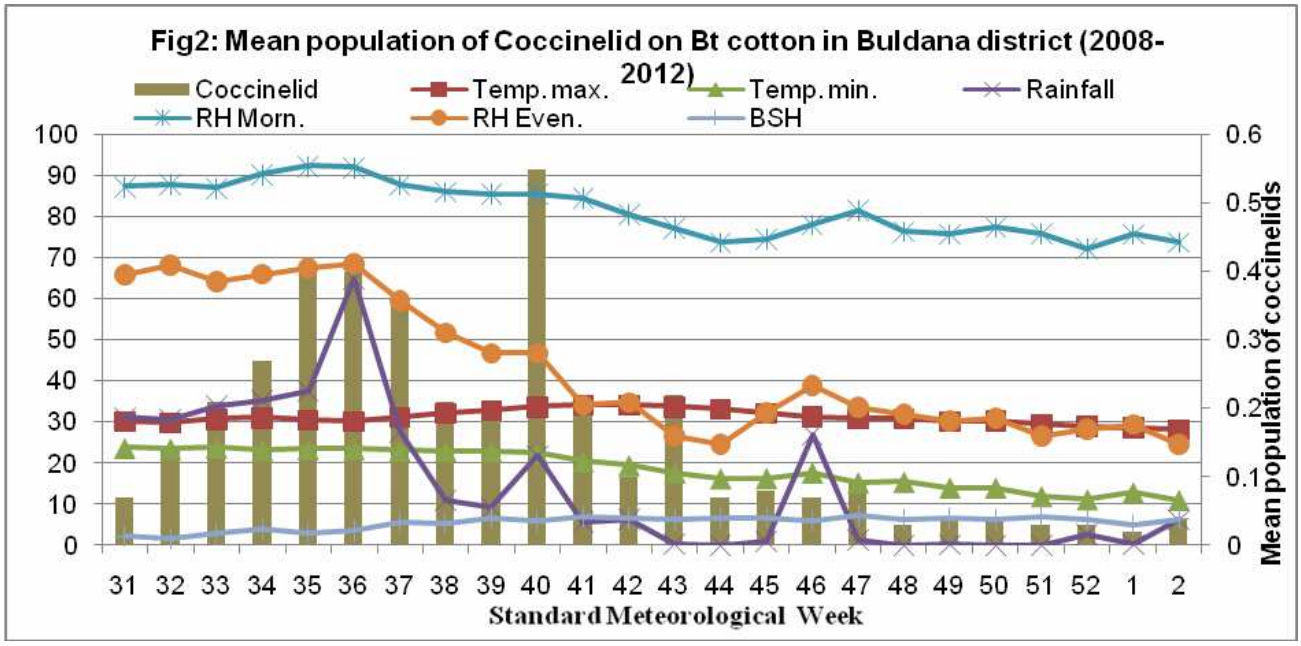
selected. On these farmers' field, observations were recorded in each week. Observations on leaf hoppers count were recorded by randomly selecting 20 plants/field plot from top, middle and bottom leaves/plant. Observations of natural enemies *viz.,* coccinelid (grubs and adults), eggs of chrysoperla and spider (adult) were recorded by randomly selecting 20 plants/field plot. Sowing of cotton was done from 15 th May to 1 st week of July every year at a different spacing under rainfed situation. For this, different *Bt* hybrids were selected for sowing purpose and regular agronomic practices were carried out.

RESULTS AND DISCUSSION

Population of leaf hoppers in *Bt* cotton : The result depicted in Fig. 1 revealed that population of leaf hopper ranged between 0.51 to 4.42/3 leaves. The peak period of leaf hopper population was observed during 31st to 41th standard meteorological week which showed that the maximum (4.42 leaf hopper/3 leaves) population was recorded in 5 year averaged in 37th meteorological week and it was observed minimum of 0.51 leaf hopper/3 leaves/plant in 2nd meteorological week of subsequent year and remained active through the season. This is in accordance with results of Saini *et al.*, (2008), Sitaramaraju *et al.*, (2010). However, in Guntur (Andhra Pradesh), Sitaramaraju *et al.,* (2010) and Soujanya *et al.,* (2010) observed the peak abundance of leafhoppers in 2nd week of October to 3rd week of November. Mohapatra (2008) also reported its peak in 2nd week of October in western Orissa.

Population of natural enemies : The mean population of predator's *viz.,* coccinelids, chrysopa eggs and spider was recorded during year 2008-2012. The result revealed that the average population of coccinelids ranged from 0.02 to 0.55/plant. The population of predator was established from 31st SMW and went on increasing upto 40th SMW. Thereafter, the second peak of population was observed in 43rd SMW after that it went on decreasing up to last SMW. The coccinelid recorded highest (0.55 coccinelid/plant) population in 40th SMW whereas; the lowest (0.02 coccinelid/plant) population was observed during 1st SMW of subsequent year (Fig. 2). Average population of Chrysopa ranged from 0.01 to 0.53 chrysopa eggs/plant. The maximum (0.53 chrysopa eggs/plant) was recorded in 43rd SMW;

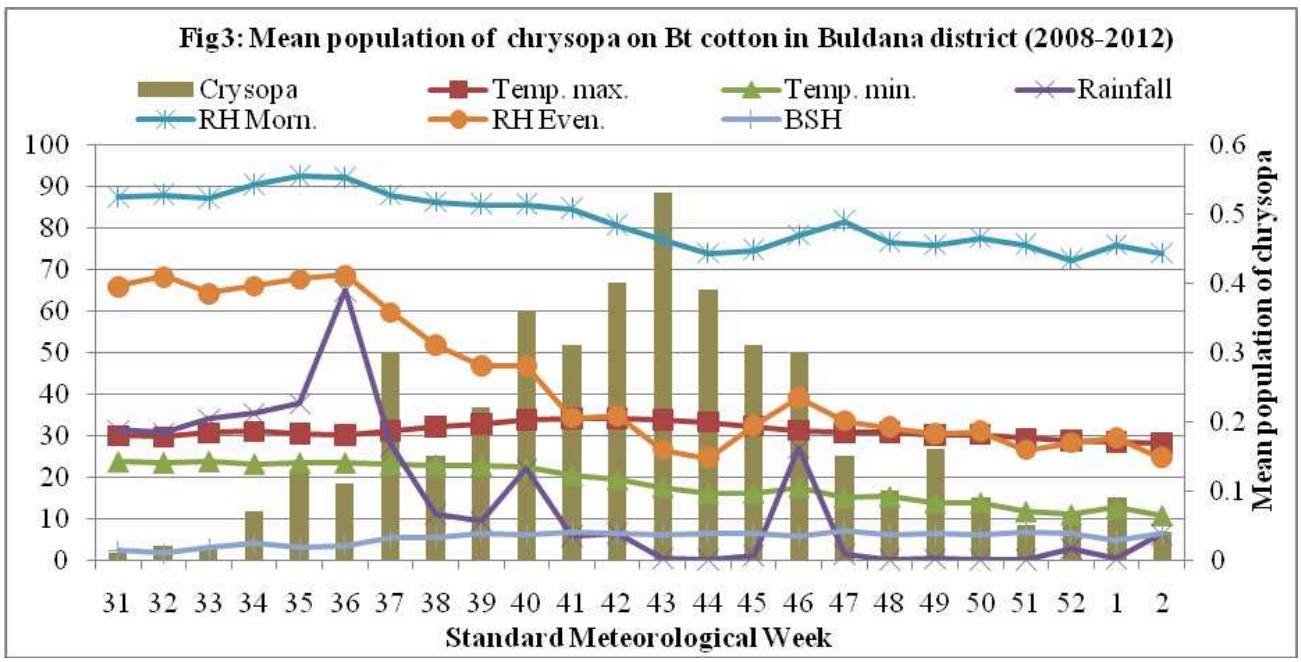




however it was lower (0.01 chrysopa eggs/plant) in 31st meteorological week.

The result depicted in Fig. 3 also showed that the peak population of chrysopa eggs increased up to 43rd standard meteorological week and thereafter the population started decreasing up to last SMW.

The average population of spider was observed in the range of 0.05 to 0.41 spiders/plant during the five year in respective SMW's. The peak activity of spider was recorded between 37th to 46rd SMW during which comparatively high population was observed (Fig. 4). Maximum (0.41 spider/plant) population was recorded in 38th standard meteorological week whereas, minimum of 0.05 spiders recorded in 31st and 32nd SMS.



Influence of weather factors on incidence of leaf hopper and natural enemies : The five years (2008 to 2012) mean weekly counts of various sucking pests from 31st std. week were correlated separately with weather parameters and the correlation coefficients are presented in Table 1.

I) Temperature : The correlation data revealed that the maximum temperature was positively correlated with leaf hopper (0.358) and coccinelid (0.360) population but correlation was non significant. However, it showed highly significant positive correlation with population of chrysopa (0.837**) and spider (0.574**).The minimum temperature had highly significant positive relationship with the population of leaf hopper (0.912**) and coccinelid (0.719**) indicating thereby that the minimum temperature was most favourable to the incidence of leaf hopper and coccinelid in *Bt* cotton. On the other hand, population of chrysopa and spider showed positively non-significant correlation (0.068 and 0.265, respectively) with minimum temperature.

II) Rainfall: The average maximum rainfall recorded was 64.98 mm (36 SMW) as against 0.0 mm (44 and 50 SMW) during the study period. The rainfall showed highly significant positive impact on population build up of leaf hopper (0.677**) and coccinelid (0.644**). This showed that the rainfall was very favourable for the population build up of leaf hopper and coccinelid on *Bt* cotton. However, the rainfall showed negatively non significant correlation with population of chrysopa (-0.260) and spider (-0.149).

III) Relative humidity: Relative humidity both morning and evening was positively correlated with leaf hopper and coccinelids. The average of morning relative humidity had high positive relationship with leaf hopper (0.849**) and coccinelid (0.748**) however, the spider showed the non significant positive correlation. The relative humidity at the evening had showed highly significant positive relationship with leaf hopper (0.789**) and coccinelid (0.619**) but it showed non significant negative relationship with chrysopa and spider.

IV) Bright sunshine hour (BSH) : The impact of BSH on the population revealed that

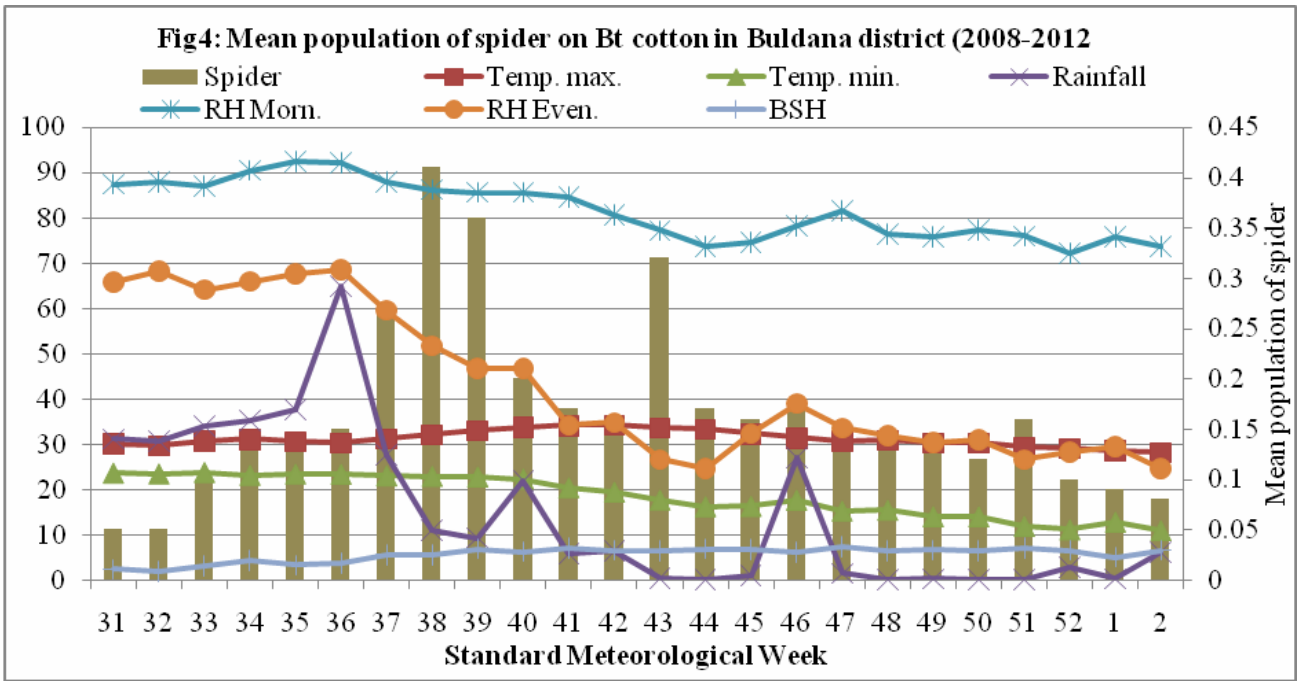


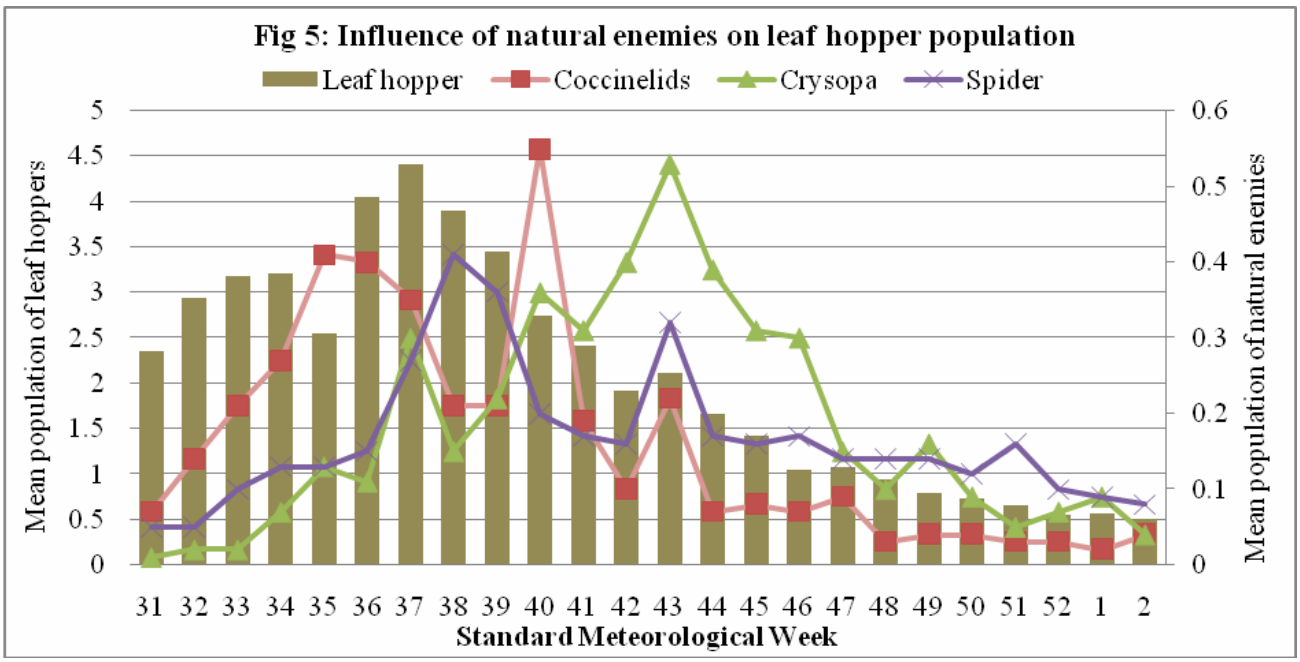
Table 1. Correlation of weather parameters and natural enemies with incidence of leaf hopper on *Bt* cotton

	Leaf hopper	Coccinelid	Chrysopa	Spider
Leaf hopper	-	**0.754****	0.111	**0.465***
Max. temp.	0.358	0.360	**0.837****	**0.574****
Min. temp.	**0.912****	**0.719****	0.068	0.265
Rainfall	**0.677****	**0.644****	-0.260	-0.149
Morn. RH	**0.849****	**0.748****	-0.171	0.122
Even. RH	**0.789****	**0.619****	-0.342	-0.053
BSH	-0.471	-0.300	0.502*	0.382

**Significant at P =0.01 *Significant at P =0.05 *r* (0.05) = 404 and *r* (0.01) = 515

the population of leaf hopper (-0.471) and coccinelid (-0.300) was significantly negatively correlated with BSH whereas, chrysopa (0.502*) showed significant positive relationship and spider (0.382) showed positive non significant relationship with BSH.

The present studies showed that population of *A. biguttula* showed significant positive correlation with minimum, rainfall and relative humidity while maximum temperature and BSH had non-significant effect. Shera *et al.,* (2013) reported that, based on mean of three years, the population of the *A. biguttula* showed positive and significant correlation with minimum temperature (r=0.636; p=0.003) and mean temperature (r=0.475; p=0.034). Selvaraj *et al.,* (2011) also reported non significant negative effect of leafhopper population with maximum temperature. The present findings are also in agreement with those of Dhaka and Pareek (2008), Prasad *et al.*, (2008), Kaur *et al.*, (2009), Shitole and Patel (2009) and Selvaraj *et al.,* (2011). The present findings are also in conformity with those of Purohit *et al.*, (2006). Shera *et al.,* (2013) reported that the population of the *A. biguttula* showed significant positive correlation with evening relative humidity (r=0.618; p=0.004) and rainfall (r=0.556; *p*=0.011). Soujanya *et al.*, (2010) also reported that evening relative humidity and rainfall was positively correlated with *A. biguttula* population.



Influence of natural enemies on leaf hopper population : The studies on the effect of natural enemies' *viz.,* coccinelid, chrysopa and spider revealed that the coccinelid showed highly significant positive relationship with leaf hopper after that the leaf hoppers was effectively controlled by spiders which showed significant positive relationship with leaf hopper population. The chrysopa population did not showed any relationship with leaf hopper population as the positive non significant effect on leaf hoppers population was noticed. The present result revealed that the leaf hoppers could be effectively controlled by coccinelid and spider. Thus, our study showed the seasonal abundance and crucial role of different weather parameters on the population fluctuation of *A. biguttula* and *B. tabaci* in cotton agroecosystem which can be helpful in forecasting and formulating effective management strategies for these insect pests. Further investigations are needed to strengthen and validate the status of these observations for more precise information.

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