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STUDY ON DEFOLIATOR PESTS IN BT- COTTON AND NON BT-COTTON FIELDS IN WARANGAL, ANDHRA PRADESH, INDIA

P. Laxman, Ch.Samatha, U.Thirupati and Ch.Sammaiah*

*Environmental Research Lab, Dept of Zoology, Kakatiya University, Warangal.

*Corresponding Author Email: sammaiah_ch@yahoo.com, peesarilaxman@yahoo.co.in

ABSTRACT

Extensive field survey conducted for infestation of defoliator pests on Bt-cotton and non Bt-cotton fields during June-2010 to March-2011 and June-2011 to March-2012 in Warangal .five defoliator pests viz, green semi-looper (Anomis flava), tobacco caterpillar (Spodoptera litura Fabricius), black cutworm (Agrotis ipsilon Hufnagel) leaf roller (Sylepta derogate Fab), and grasshopper (Melanoplus spp) were recorded as defoliator pests green semi-looper infestation was started in 8th week of Bt-cotton and 7th week of non Bt-cotton and maximum (5.32±0.37, 8.66±1.44, 11.66±0.71, 13.06±0.83) percentage of infestation was recorded in 19th week of crop. In case of tobacco caterpillar and black cut worm infestation was recorded 9th week of crop and maximum (8.92 ± 1.37, 12.66 ± 0.63, (8.49 ± 0.83, 13.99 ± 0.94), and (6.39 ± 2.35, 8.78 ± 0.60) and (9.19 ± 1.75, 12.62 ± 2.23) infestation in 18th week in both crops. In case of Leaf roller infestation was recorded in 8th week of crop high (2.83±1.03, 3.46±1.31 and 8.83±1.58, 10.49±1.25) infestation was recorded15th week both crops. The infestation of grass hopper was recorded in 13th week and 9th week in both crops respectively, 2010-2011 and 2011-2012, and with peak (14.99 ± 0.96, 9.66 ± 2.28), (21.90 ± 1.56, 12.33 ± 2.20) infestation in 23rd week of crop in B and non Bt-cotton. Green semi-looper, leaf roller, tobacco caterpillar, black cutworm and grasshopper infestation showed positive correlation with morning and evening relative humidity and negative correlation with maximum and minimum temperature and rainfall in Bt-cotton and Non Bt-cotton.

KEY WORDS

Bt-cotton, Non Bt-cotton, Defoliator pests and correlation with weather parameters.

INTRODUCTION

Green semi-looper: *Anomis flava*, (Lepidoptera: Noctuiidae) green semi-looper is a sporadic pest of cotton in the states of Andhra Pradesh, Gujarat, and Rajasthan. The larvae are usually found on the lower leaf surface and are most likely to be observed on the upper third of the plant. The young larvae congregate in groups and move actively, feed on the leaf lamina making small punctures. The caterpillars feed on tender shoots, buds and bolls occasionally. Leaf area is eaten up from edges, holes on leaves are seen larvae found amidst the terminal part of the plant and with looping movements. Green semi-looperhave been reported as pest of cotton in Australia, Philippines, India, and Madagascar (Bishop *et al.,* . 1978; Ferino *et al.,* . 1982; Kuklinski 2000),

***Spodoptera litura* Fabricius** (Lepidoptera, Noctuidae) is an important polyphagous pest in India. It is a serious pest of various crops such as cotton, groundnut, chilli etc., (Armes *et al.,* 1997; Niranjan Kumar and Ragupathy, 2001).

S.litura is a cotton leaf worm or tobacco caterpillar one of the important Lepidoptera pest that feeds on 112 cultivated crops all over the world (Moussa *et al.,* 1960). The *S.litura* is a noxious pest that damages cotton crop extensively by skeltonizing the leaves and thus reducing the photosynthetic capacity of the plant. The *S.litura* moths are found primarily active during night.

S.liture is a major pest of cotton emerging scenario (Jackson *et al.,* 2005, Adamczyk *et al.,* 2001 and Gore *et al.,* 2001). It is a secondary pest of cotton (Allen *et al.,* 2000). However, Bt cotton with Cry IAC proved not to be effective against *spodoptera spp* (Ponsard *et al.,* 2002, Arshad and Suhail 2011, Selvi *et al.,* 2012, Lalitha *et al.,* 2012). It has been found that *S. litera* has a greater potential to survive in the presence of Bt toxins when compared to other bollworms.

***Agrotis ipsilon* (Hufnagel) Black cutworm:** (Lepidoptera: Noctuiidae). It is cosmopolitan pest that possess an economic threat to many agricultural plant species. These months are relatively large compared to similar species. Black cutworm caterpillars are gray to brown and generally look greasy. Black cutworm has been reported as the key insect pests of cotton (Dhaka and Pareek, 2007).

Leaf roller; *Sylepta derogate*Fab**:** (Lepidoptera: Pyralidae). The larva of leaf roller is glistening green in colour and semi-translucent with dark brown head. This moth is medium sized with yellowish wings having series of brown wavy markings. The larvae feed on the lower surface of leaves when they are young, later they feed on the edges of leaves and roll in wards up to the midrib into a trumpet shape fastened by means of silken thread and feed on leaf tissues. Severe infestation results in complete defoliation of the plant. The young larvae feed gregariously on the leaf epidermis under a loose web of threads strung between leaf hairs on the underside of the leaves (Anioke 1989; Silvie 1990).At about four days old, the larvae cut the leaf margins perpendicular to the vein, roll it under towards the midrib and fix it with silk. They then feed within the protection of the rolled leaf. The leaf remains green and open at the apex (Silvie 1990; Vennila *et al.,* .2007; Arora *et al.,* . 2009). They occur within the leaf roll, but sometimes can occur on shed leaves or in leaf litter on the ground (Vennila *et al.,* .2007).

Grass hopper: *Melanoplus spp* (Orthoptera; Acridoidea). It is widely distributed in India. Grasshoppers are great economic importance, because they constitute an important group of pests and pose a constant threat to several crops, pulses, vegetables, orchards, and grassland and forest plantations all over the world. Grasshoppers cause significant damage to tree seedlings and agricultural crops (Mulkern 1967, Joshi *et al.,* 1999).

Grasshopper can damage cotton in all stage of crop growth. Both nymphs and adults can feed on leaves by cutting the edges of leaves. When found in greater number can feed even midribs and total leaves and cause extensive defoliations.

MATERIAL AND METHODS

We carried out a survey by "fixed plot method Govindaiah and Gunashekar V. (1992) .The survey was made during June-2010 to March-2012. In each selected cotton field five plots of 5 m × 5 m were marked out (one each in the four corners, 10m away from the border, and one in the center), thus making a total of 25 plots in five fields. Total number of plants and number of pests on each plant were counted and collected in each plot and Calculated percentage of pests every week after sowing. The data was recorded at morning hours (8-10am), the pest were identified with help of guide on cotton pest and predators (2008), Regional Agricultural research station ANGRAU, Warangal and with help of literature.

RESULTS

Five insect pests belonging to two orders including Lepidoptera and Orthoptera, and three families, average weekly population of defoliators *Anomis flava* (Fabricius), *Spodoptera litura* (Boised), *Agratis ipsilon* (Hufnagel) and *Syllepte derogate* (Fabricius) and Orthoptera represented by *Melanoplus spp*.

Green semi-looper: (*Anomis flava* Fabricius)

The infestation of ***Anomis flava* (Fabricius)** was recorded 8th week of the Bt-cotton and 7thweek in Non Bt-cotton crop after sowing. The mean percentage of infestation was maximum in October (19th week) (5.32 ± 0.73, 8.66 ± 1.44 and 8.66 ± 1.44, 13.06 ± 0.83) in Bt-cotton and Non Bt-cotton during 2010-2011 and 2011-2012.. The infestation was gradually decreased by end of the December and no infestation was recorded up to March in both Bt and Non Bt-cotton crops **(Table-2, 3).**

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Table-1 Percentage of plants attached by Defoliator insect Pests (Mean and SE) 2010-2011

Sl. No	Month – Year-2010-2011	Green semi -looper		Leaf worm		cutworm		Leaf Roller		Grasshopper	
	months	Bt - Cotton	Non Bt	Bt- cotton	Non-Bt	Bt-Cotton	Non-Bt	Bt-Cotton	Non-Bt	Bt-Cotton	Non-Bt
1	Jun	0	0	0	0	0	0	0	0	0	0
2	July	0	0	0	0	0	0	0	0	0	0
3	Aug	3.16 ± 1.19	3.83 ± 0.73	1.16 ± 0.25	2.24 ± 0.71	0.66 ± 0.19	1.32 ± 0.94	2.33 ± 0.71	3.49 ± 0.83	0	0
4	Sep	4.49 ± 1.54	6.66 ± 1.58	2.49 ± 0.73	4.99 ± 0.74	2.82 ± 0.90	3.16 ± 0.79	2.83 ± 1.03	3.16 ± 0.88	2.66 ± 0.66	2.16 ± 0.5
5	Oct	5.32 ± 0.73	8.66 ± 1.44	8.92 ± 1.37	12.66 ± 0.63	6.39 ± 2.35	8.78 ± 0.60	2.39 ± 0.45	3.46 ± 1.13	5.59 ± 0.80	3.86 ± 0.49
6	Nov	1.66 ± 0.69	2.49 ± 0.16	4.16 ± 1.54	7.49 ± 1.25	0.83 ± 0.45	0.99 ± 0.63	0.49 ± 0.31	1.16 ± 0.61	14.99 ± 0.96	9.66 ± 2.28
7	Dec	0	0	0.49 ± 0.31	1.33 ± 0.76	0	0	0	0	6.66 ± 1.65	4.66 ± 1.51
8	Jan	0	0	0	0	0	0	0	0	0	0
9	Feb	0	0	0	0	0	0	0	0	0	0
10	Mar	0	0	0	0	0	0	0	0	0	0

Table-2 Percentage of plants attached by Defoliator insect Pests (Mean and SE) 2011-2012

Sl. No	Month – Year-2011-2012	Green semi -looper		Leaf worm		cutworm		Leaf Roller		Grasshopper	
	months	Bt - Cotton	Non Bt	Bt- cotton	Non-Bt	Bt-Cotton	Non-Bt	Bt-Cotton	Non-Bt	Bt-Cotton	Non-Bt
1	Jun	0	0	0	0	0	0	0	0	0	0
2	July	0	0	0	0	0	0	0	0	0	0
3	Aug	2.16 ± 0.99	4.66 ± 1.21	5.32 ± 1.15	3.49 ± 0.83	0.83 ± 0.49	2.16 ± 1.25	0.66 ± 0.63	1.49 ± 0.90	1.49 ± 0.87	0.66 ± 0.38
4	Sep	4.66 ± 1.45	7.66 ± 2.34	6.49 ± 1.54	8.33 ± 2.93	2.83 ± 1.19	3.06 ± 0.77	8.83 ± 1.58	10.49 ± 1.25	5.33 ± 1.73	2.49 ± 0.78
5	Oct	11.66 ± 0.71	13.06 ± 0.83	8.49 ± 0.83	13.99 ± 0.94	9.19 ± 1.75	12.62 ± 2.23	7.32 ± 1.15	8.39 ± 0.59	15.99 ± 1.38	9.46 ± 1.58
6	Nov	2.66 ± 0.55	4.82 ± 1.34	4.66 ± 1.74	7.66 ± 1.10	2.16 ± 0.95	3.32 ± 0.87	2.16 ± 0.99	2.66 ± 0.16	21.90 ± 1.56	12.33 ± 2.20
7	Dec	0	0	0.66 ± 0.23	1.19 ± 0.74	0	0	0	0	8.13 ± 2.28	2.66 ± 1.13
8	Jan	0	0	0	0	0	0	0	0	0	0
9	Feb	0	0	0	0	0	0	0	0	0	0
10	Mar	0	0	0	0	0	0	0	0	0	0

Table-3.Correlation coefficient of Defoliator insect pests infestation with weather factors -2010-2011.

Correlation coefficient (r) 2010-2011											
Sl. No	**Weather factors**	**Green semi - looper**		**Leaf worm**		**cutworm**		**Leaf Roller**		**Grasshopper**	
		Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt
1	**Max. Tem(ºc)**	-0.197	-0.185	-0.200	-0.235	-0.129	-0.134	-0.187	-0.216	-0.335*	-0.346*
2	**Min Tem(ºc)**	0.376*	0.346*	0.112	0.100	0.236	0.238	0.441**	0.424**	-0.340*	-0.342*
3	**R. H.M%**	0.448**	0.422**	0.418**	0.408**	0.370*	0.414**	0.434**	0.516**	0.153	0.155
4	**R.H.E%**	0.732**	0.733**	0.638**	0.626**	0.697**	0.705**	0.685**	0.706**	0.087	0.100
5	**Rainfall(mm)**	-0.008	-0.029	-0.187	-0.186	-0.097	-0.106	0.064	0.026	-0.292	-0.293

Table-4.Correlation coefficient of Defoliator insect pests infestation with weather factors -2011-2012.

Correlation coefficient (r) 2011-2012											
Sl. No	**Weather factors**	**Green semi -looper**		**Leaf worm**		**cutworm**		**Leaf Roller**		**Grasshopper**	
		Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt
1	**Max. Tem(ºc)**	-0.065	-0.034	-0.167	-0.064	-0.104	-0.078	-0.008	-0.016	-0.209	-0.148
2	**Min Tem(ºc)**	0.231	0.272	0.270	0.188	0.187	0.176	0.320*	0.332*	-0.161	-0.108
3	**R. H.M%**	0.159	0.236	0.288	0.261	0.131	0.120	0.301*	0.305*	0.225	0.224
4	**R.H.E%**	0.114	0.042	0.177	0.026	0.190	0.161	0.038	0.079	0.193	0.139
5	**Rainfall (mm)**	-0.033	-0.054	-0.118	-0.022	-0.100	-0.116	0.197	0.218	-0.295	-0.293

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level

Max. Tem (Maximum Temperature)

Min .Tem (Minimum Temperature)

R. H.M (Relative humidity morning)

R. H.E (Relative humidity evening)

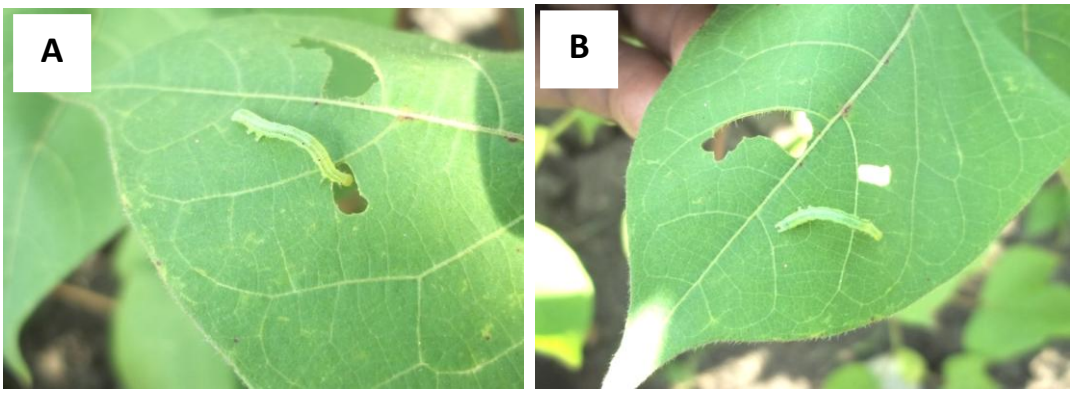

Fig -1: *Anomis flava* Fabricius green semi-looper larva in Bt-cotton (A) and Non Bt-cotton fields (B).

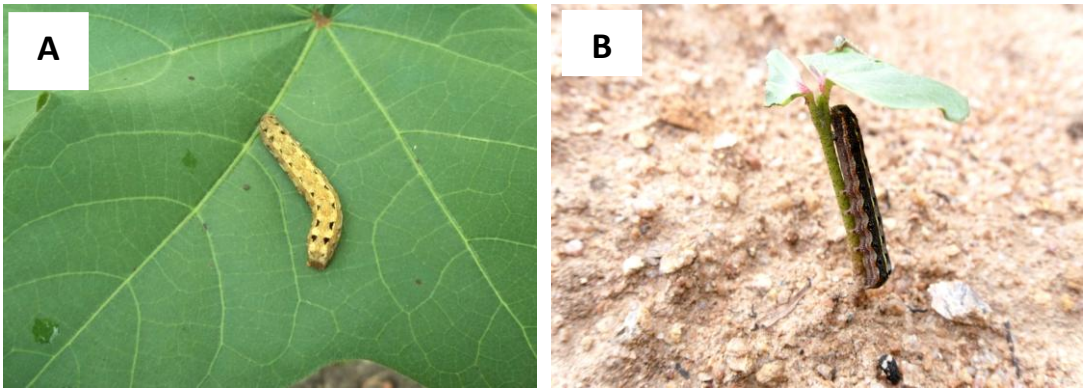

Fig -2: *Spodoptera litura* spodoptera leaf worm in Bt-cotton (A) and Non Bt-cotton fields (B).

Leaf worm *Spodoptera litura* (Boisd):

The infestation of *spodoptera litura* was observed 9th week of Bt-cotton and Non Bt-cotton after sowing. The maximum mean percentage of infestation was recorded (8.92 ± 1.37, 12.66 ± 0.63 and 8.49 ± 0.83, 13.99 ± 0.94) in Bt and Non Bt-cotton in October (18th week) in Bt and Non Bt-cotton respectively two cropping seasons during 2010-2011 and 2011-2012.

Black cut worm: (*Agrotis ipsilon* Hufnagel):

The infestation of *Agrotis ipsilon* was recorded 9th weeks of the Bt-cotton and Non Bt-cotton crops. The maximum percentage of infestation was recorded in October (18th week) (6.39 ± 2.35, 8.78 ± 0.60 and 19 ± 1.75, 12.62 ± 2.23) in Bt and Non Bt-cotton in 2010-2012 the infestation gradually decreased by end of the December.

Leaf roller: *Syllepte derogate* (Fabricius)

The infestations of *Syllepte derogate* Fabricius was recorded 8th week of the Bt-cotton and Non Bt-cotton crop. The maximum percentage of infestation was recorded in September (15th week) (2.83 ± 1.03, 3.46 ± 1.13 and 8.83 ± 1.58, 10.49 ± 1.25) in Bt and Non Bt-cotton during 2010-2011 and 2011-2012 respectively **(Table-1, 2).**

Grass hopper: **(*Melanoplus spp*):**

The infestation of grasshopper was recorded13th week and 9th week of Bt and Non Bt-cotton crops both years. Its infestation was recorded in November (23rd week) (14.99 ± 0.96, 9.66 ± 2.28 and 21.90 ± 1.56, 12.33 ± 2.20) in both Bt and Non Bt-cotton crops respectively, 2010-2011 and 2011-2012 **(Table-1, 2,**).

Statistical Analysis

The correlation between incidence of insect pest and weather factors such as maximum temperature, minimum temperature, Morning relative humidity, Evening relative humidity and Rainfall .

The correlation between a biotic factors with semi-looper had no significant negative correlation with maximum temperature and rainfall and significant positive correlation between minimum temperature, morning and evening relative humidity in Bt-cotton

and Non Bt-cotton fields during the study period 2010-2011 and 2011-2012 **(Table – 4,5).**

Correlation among weather factors and infestation of tobacco caterpillar showed that there was no significant negative correlation between maximum temperature and rainfall, No significant with minimum temperature, significant positive correlation with morning and evening relative humidity in two cropping seasons **(Table – 4,5).**

Correlation between weather factors and black cutworm infestation indicated that there was no significant negative correlation with maximum temperature and no significant positive correlation with minimum temperature, significant correlation with morning and evening relative humidity, in both Bt-cotton and Non Bt-cotton fields during study period2010-2011 **(Table – 4, 5).**

The leaf roller infestation with shows that negative correlation between maximum temperature and significant positive correlation between minimum temperature, morning and evening relative humidity and no significant correlation with rainfall in Bt-cotton and Non Bt-cotton fields during the study period 2010-2012 **(Table – 4,5).**

Correlation among weather factors and infestation of grass hopper in showed that there was significant negative correlation with maximum and minimum temperature and no significant rainfall 2010-2011 and 2011-2012. No significant positive correlation with morning and evening relative humidity in both Bt-cotton and Non Bt-cotton fields during the study period **(Table – 4, 5).**

DISCUSSION

The present results supported by Cui and Xia (2000) who reported that Bt cotton was highly resistant to cotton semi looper (*Anomis flava*).

Anonymous (1992), Zag and Kushwada (1983), reported that the population of s. litura in cabbage crop to be negatively correlated with maximum and minimum temperature, the present results are similar that of Zag and kushwada (1983). This is first results in Warangal; there is no literature for comparison for leaf roller, black cutworm and grasshoppers.

CONCLUSION

It has been found that *S. litera* has a greater potential to survive in the presence of Bt toxins when compared to other bollworms. It maybe concluded that climatic factors determine seasonal activity and infestation of different insect pests of cotton. The results of present study would be helpful in developing efficient pest management strategies against insect pests of Bt-cotton and Non Bt-cotton crops for increased yields, profit, besides safety to the environment.

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***Corresponding Author:**
Ch.Sammaiah*
Environmental Research Lab,
Dept of Zoology,
Kakatiya University, Warangal.