



## Population Dynamics and Influence of Weather Parameters on the Incidence of Cotton Leafhoppers, *Amrasca biguttula biguttula* (Ishida)

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### ABSTRACT

Studies on population dynamics and influence of weather parameters on the incidence of cotton leafhoppers, *Amrasca biguttula biguttula* (Ishida) were carried out under Department of Entomology, Agricultural College, Bapatla at Regional Agricultural Research Station, Lam, Guntur during two seasons, *kharif*, 2009-10 and *kharif*, 2010-11. The leafhopper population was higher during 39<sup>th</sup> to 46<sup>th</sup> standard weeks with peak population (no./3 leaves/plant) of 13.64 (42<sup>nd</sup> std. week) in RCH 2 BG II, 6.92 (44<sup>th</sup> std. week) in Mallika BG II and 8.75 (41<sup>st</sup> std. week) in L 604 non-*Bt*. The favourable weather parameters that influences the build up of high population of leafhoppers (39<sup>th</sup> to 46<sup>th</sup> std. weeks) are in the range of maximum and minimum temperatures 29-35 and 21-25°C, morning and evening relative humidities 77 to 91 and 55-87 per cent, and the rainfall 3 to 39 mm. The population of leafhoppers showed strong significant positive correlation with maximum and minimum temperatures ( $r=0.487^{**}$  and  $0.740^{**}$ ), evening relative humidity ( $r=0.555^{**}$ ) and rainfall ( $r=0.358^{**}$ ), while a significant and negative association with morning relative humidity ( $r= -0.334^{*}$ ). The multiple linear regression analysis indicated that all the weather variables together contributed to 57.2 per cent variation in leafhoppers population significantly ( $R^2=0.572^{*}$ ). However none of these variables exerted significant influence on the variation of leafhopper population independently

**Key words :** Leafhoppers, Population dynamics, Weather parameters.

India is an important grower of cotton on a global scale. Amongst all the cotton producing countries in the world, India ranks first in area under cotton cultivation (12.19 million hectares) and second in seed cotton production (37 million bales) and productivity (482 kg/ha). In Andhra Pradesh, it is being cultivated in 1.85 million hectares with production of 54.50 lakh bales and productivity of 499.73 kg/ha (AICCIP, 2011-12). The cotton is not only principal cash crop but also each and every parts of the cotton plant are useful to farmer in one way or the other. Unfortunately, cotton is highly vulnerable to insect pests during different growth stages. Among different insect pests, leafhopper is one of the most important key pest and occur at all the stages of the crop growth and responsible for indirect yield losses. High populations of leafhoppers survive every year, despite extensive and intensive insecticide application. Abiotic factors, with a dominant role on the survival, development and reproduction capacity of insect pests exert a great influence on their population dynamics. The insects multiply tremendously during the favorable weather conditions and take huge toll (Aheer *et*

*al.*, 1994). A thorough understanding of the population fluctuation in field in relation to the weather parameters would provide an idea about the peak period of pest activity and it would help in developing an appropriate strategy for the management. Hence, the present investigation was therefore, undertaken to study the field population dynamics of leafhoppers and influence of weather factors on their incidence on cotton hybrids/variety.

### MATERIAL AND METHODS

The investigation was conducted under Department of Entomology, Agricultural College, Bapatla at Regional Agricultural Research Station (RARS), Lam, Guntur during two seasons, *kharif*, 2009-10 and *kharif* 2010-11. A bulk crop of two stacked *Bt* cotton hybrids *viz.*, RCH 2 BG II and Mallika BG II and non-*Bt* varietal cotton *i.e.* L 604 was raised in an area of 500 m<sup>2</sup> under normal agronomic practices without any insect pest management practices during both the years. Population of leafhoppers (no./top 3 leaves/plant) was recorded on a total of 25 plants, which were randomly selected and tagged in bulk plot of each

cotton type at weekly interval till last picking. The meteorological data (*viz.*, maximum and minimum temperatures, morning and evening relative humidities and rainfall) was recorded simultaneously from the observatory of RARS, Lam and used for correlation and multiple linear regression analysis studies.

## RESULTS AND DISCUSSION

### Population dynamics

The mean population of leafhoppers (Table 1) in both *kharif* seasons 2009-10 and 2010-11 from the common standard weeks showed that the leafhopper population crossed economic threshold level (ETL-6 no./top 3 leaves/plant) during 39<sup>th</sup> (Sept. 24-30) to 50<sup>th</sup> (Dec.10-16) standard weeks (std. week) in RCH 2 BG II (except in 49<sup>th</sup> std. week), 42<sup>nd</sup> (Oct. 15-21) to 45<sup>th</sup> (Nov. 5-11) std. weeks in Mallika BG II (except in 43<sup>rd</sup> std. week) and 39<sup>th</sup> (Sept. 24-30) to 46<sup>th</sup> (Nov. 12-18) std. weeks in L 604 non-*Bt* (except in 43<sup>rd</sup> std. week) with leafhopper population was ranged from 6.34 to 13.64, 6.08 to 6.92 and 6.02 to 8.75 no. per top three leaves per plant, in the respective hybrids. The highest leafhopper population recorded was 13.64 (42<sup>nd</sup> std. week) in RCH 2 BG II, 6.92 (44<sup>th</sup> std. week) in Mallika BG II and 8.75 (41<sup>st</sup> std. week) in L 604 non-*Bt*. The results indicated that 39<sup>th</sup>-50<sup>th</sup> std. weeks are the most favourable for leafhopper incidence. The seasonal mean population was high in RCH 2 BG II hybrid followed by L 604 non-*Bt* and Mallika BG II hybrid with 7.64, 4.87 and 3.84 leafhoppers per top three leaves per plant, respectively.

The leafhopper population was high during initial stages of crop growth (*i.e.* between 39<sup>th</sup> to 46<sup>th</sup> std. weeks with population ranged between 9-14, 4-7 and 5-9 leafhoppers per three leaves per plant in RCH 2 BG II, Mallika BG II and L 604, respectively) when maximum and minimum temperatures range between 29-35 and 21-25°C, respectively, morning and evening relative humidities in the range of 77 to 91 and 55-87 per cent and with the rainfall between 3 to 39 mm. The present observations are in agreement with that of Selvaraj *et al.* (2011) who reported that the favourable maximum and minimum temperatures were 30 to 33°C and 21 to 26°C, and morning relative humidity was 82 to 95 per cent. Similarly Prasad *et al.* (2008)

reported maximum temperature at 30.5 to 31.91°C and minimum temperature at 20.2 to 23.11°C were favourable for build up of leafhopper population in cotton.

The high population of leafhoppers with reference to std. weeks can as well vary depending up on the favourable weather parameters. Prasad *et al.* (2008) reported peak activity window of leafhoppers was observed from 37<sup>th</sup> to 47<sup>th</sup> std. week in cotton during 2001-2006 at RARS, Lam, Guntur, Andhra Pradesh. Similarly peak incidence of leafhoppers (3.14 no./leaf/plant) observed during 41<sup>st</sup> std. week on MCU-5 cotton variety in Nawarangpur District of Orissa (Mohapatra, 2008). Even during 34<sup>th</sup> to 37<sup>th</sup> std. weeks were reported to have peak incidence of leafhopper population (1.20-2.47 no./3 leaves/plant) on PA 225 desi cotton variety in Parbhani district of Maharashtra (Chavan *et al.*, 2010). Thus it could be concluded the coincidence of occurrence of peak incidence of leafhoppers in different std. weeks in different studies indicates the occurrence of favourable weather during those respective std. weeks.

### Influence of weather parameters

The weather parameters being density independent and are uniform to all the insect pests irrespective of cotton hybrids/variety, multiple linear regression (MLR) analysis was followed to assess the influence of weather parameters on mean incidence of the insect pests from the two crop seasons. The results were presented in the tables 2 and 3.

The population of leafhoppers showed strong significant positive correlation with maximum and minimum temperatures ( $r=0.487^{**}$  and  $0.740^{**}$ ), evening relative humidity ( $r=0.555^{**}$ ) and rainfall ( $r=0.358^{**}$ ), while a significant and negative association with morning relative humidity ( $r=-0.3348$ ) (Table 2). The results of the present investigation are in accordance with those of Purohit *et al.* (2006) and Rohini (2010) who reported that significant positive correlation was found between the leafhoppers and maximum and minimum temperatures, and rainfall in cotton. Similarly Mohapatra (2008) and Prasad *et al.* (2008) who reported the significant positive association with evening relative humidity. A partial agreement with those of Neelima (2010) and Rohini

Table 1. Population dynamics of leafhoppers, *Amrasca biguttula biguttula* (Ishida) on *Bt* and non-*Bt* varietal cottons (Mean of *kharif* 2009-10 and 2010-11).

Std. week.	Period	No./3 leaves/plant			Max. temp. (°C)	Min. temp. (°C)	Morning R.H. (%)	Evening R.H. (%)	Rain-fall (mm)
		RCH 2 BG II	Mallika BG II	L 604 non- <i>Bt</i>					
39	Sept.24 to 30	12.26	5.38	6.92	32.90	24.30	83.30	64.95	38.70
40	Oct. 1 to 7	12.06	4.22	7.04	31.15	23.30	86.80	74.10	37.00
41	8 to 14	10.37	4.72	8.75	34.60	23.40	77.40	55.85	3.50
42	15 to 21	13.64	6.82	7.80	32.70	22.75	85.20	68.65	15.80
43	22 to 28	13.46	5.22	5.60	32.85	22.40	85.75	59.60	31.15
44	29 to Nov. 4	11.06	6.92	7.84	31.25	21.65	87.45	71.10	24.40
45	5 to 11	10.96	6.08	6.02	29.50	21.55	90.85	75.15	25.20
46	12 to 18	9.37	5.04	6.44	29.85	22.10	90.05	86.35	28.00
47	19 to 25	8.62	3.38	5.40	30.60	21.30	90.80	72.90	40.00
48	26 to Dec. 2	6.84	5.48	5.70	31.40	19.10	88.00	59.30	5.40
49	3 to 9	4.80	1.85	2.24	28.20	18.90	89.10	64.45	57.65
50	10 to 16	6.34	3.52	5.00	29.95	19.35	89.40	57.40	0.00
51	17 to 23	4.74	2.62	4.15	28.65	16.80	86.65	52.25	4.70
52	24 to 31	2.68	1.37	1.46	30.70	18.55	91.25	55.90	0.00
1	Jan. 1 to 7	4.31	2.10	2.91	29.45	16.90	87.50	53.40	0.00
2	8 to 14	3.07	2.36	1.99	29.85	15.75	83.20	52.45	0.00
3	15 to 21	1.78	1.44	1.64	30.30	16.30	90.55	44.95	0.98
4	22 to 28	1.12	0.52	0.82	30.45	15.40	90.60	45.40	0.00
<b>Mean</b>		<b>7.64</b>	<b>3.84</b>	<b>4.87</b>	<b>30.80</b>	<b>19.99</b>	<b>87.44</b>	<b>61.90</b>	<b>17.36</b>

Table 2. Correlation between weather parameters and incidence of leafhoppers, *Amrasca biguttula biguttula* (Ishida).

Weather parameter	Correlation coefficient (r)
Maximum temperature	0.487**
Minimum temperature	0.740**
Morning relative humidity	-0.334*
Evening relative humidity	0.555**
Rainfall	0.358**

\*Significant at 5% level

\*\* Significant at 1% level

Table 3. Multiple linear regression analysis between weather parameters and incidence of leafhoppers, *Amrasca biguttula biguttula* (Ishida).

Regression equation	R <sup>2</sup>
$= -2.183 + 0.009X_1 + 0.721X_2 - 0.126X_3 + 0.072X_4 - 0.027X_5$	0.572*

(2010) who stated that the relationship between the leafhopper population and morning relative humidity was negative and non-significant during *kharif* 2009-10 at RARS, Lam, Guntur, Andhra Pradesh.

The present findings are contradictory to the reports of Srinivasa Rao (2004) and Selvaraj *et al.* (2011) who reported maximum and minimum temperature had significant negative influence, while Gosalwad *et al.* (2009) who reported that correlation between leafhoppers and evening relative humidity was significant negative in cotton. Likewise Srinivasa Rao (2004) who reported that the morning relative humidity and rainfall had significant positive and negative influence on the leafhopper population, respectively during both 2002-03 and 2003-04 at Agricultural College Farm, Bapatla, Guntur. This difference may be due to different ecological condition and difference in crop growth on which the experiment was conducted.

The multiple linear regression analysis (Table 3) indicated that all the weather variables together contributed to 57.2 per cent variation in leafhoppers population significantly ( $R^2=0.572^*$ ). However none of these variables exerted significant influence on the variation of leafhopper population independently. The present findings are close to the earlier report of Sessa Mahalakshmi (2007) who stated that the total population variation in leafhoppers due to all the weather variables was significant and it was ranged between 59.1 to 62.0 per cent in different cotton hybrids at RARS, Lam, Guntur during 2004-06.

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