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Incidence of leafhopper, *Amrasca devastans* (Distant) on Cotton under High Density Planting System (HDPS)

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ABSTRACT

An investigation was carried out to know the incidence and development of leafhopper, *Amrasca devastans* (Distant) under High Density Planting Systems (HDPS) of cotton during 2015 -2016 at the Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh. The results indicated that the plant density exerted positive affect on the incidence and development of cotton leafhopper, *Amrasca devastans* (Distant). The leafhopper population ranged from 1.60 to 18.27 per three leaves during the crop growth period. The lowest population of 1.60 leafhoppers per three leaves was recorded in the plots with 14814 plants ha^{-1} at 93 Days After Sowing (DAS) and highest population of 18.27 leafhoppers per three leaves was recorded in the treatment where plant density was 111111 plants ha^{-1} (HDPS) at 45 DAS. Plant density has affect on the overall mean population of leafhoppers as it was increased from 5.03 to 6.97 leafhoppers per three leaves as plant density increased from 14,814 plants ha^{-1} to 1,11,110 plants ha^{-1}.

Key words: *Cotton, HDPS, Incidence, Leafhopper.*

Cotton (*Gossypium hirstum*) is the leading natural fibre which plays a key role in Indian economy and offering livelihood security for the Indian farming community. The crop is grown in about 80 countries in an area of 33 m ha. It is being cultivated in 118.8 lakh ha and 6.63 lakh ha in India and in Andhra Pradesh respectively (AICCIP, 2015-2016). Cotton is cultivated in Andhra Pradesh under diverse farming situations with high inputs.

Though, globally India has the largest acreage under cotton, productivity is low because of various reasons, among which insect pests cause 50 per cent loss in seed cotton yield (Satpute *et al.,* 1990). Productivity can be considerably improved by cultivation of cotton varieties with suitable agronomic practices *e.g.,* proper spacing, method of planting and nutrient management. Spacing affects plant growth, fruiting and microclimate in the crop.

The sucking pests viz., aphids - *Aphis gossypii* (Glover), leaf hoppers - *Amrasca devastans* (Distant), whiteflies - *Bemisia tabaci* (Gennadius) and thrips - *Thrips tabaci* (Lindeman) are most serious and destructive pests with regular occurrence. Among all the sucking pests, leaf hopper is the major destructive insect pest and causes economic damage to the crop. Thus the present study was conducted to share the information on leafhopper scenario under HDPS for developing appropriate management strategies.

MATERIAL AND METHODS

The experiment was laid out in a Randomized Block Design with seven plant densities *viz*., 1,11,110 plants ha^{-1} (90 x 10 cm), 55,555 plants ha^{-1} (90 x 20 cm), 37037 plants ha^{-1} (90 x 30 cm), 27,777 plants ha^{-1} (90 x 40 cm), 22,222 plants ha^{-1} (90 x 50 cm), 18,518 plants ha^{-1} (90 x 60 cm) and 14814 plants ha^{-1} (90 x 75 cm) which were replicated thrice with variety NDLH-1938 (non- *Bt*) under unprotected conditions. Incidence of leafhoppers was recorded on five randomly selected plants in each plot regularly at weekly interval starting from 30 DAS. The population of both nymphs and adults of leafhoppers was recorded from three leaves *viz.,* one each from top, middle and bottom canopies of the plant. The average of all the five observations was expressed as mean population. Leafhopper injury grade was recorded simultaneously on five plants per plot as follows; Grade 1 : Undamaged leaves, Grade 2 : Yellowing of outer margins of leaves, Grade 3 : Brick red colour of margins, crinkling and curling,

Grade 4 : Entire leaf turns to brick red colour and extreme curling and drying of leaves.

RESULTS AND DISCUSSION

The leafhopper incidence was recorded from 31 DAS to 140 DAS. The affect of plant density on leafhopper incidence was presented in Table 1. The leafhopper population ranged from 1.60 to 18.27 per three leaves. The lowest population of 1.60 leafhoppers per three leaves was recorded in the plots with 14,814 plants ha^{-1} at 93 DAS and highest population of 18.27 leafhoppers per three leaves was recorded in the treatment where plant density was 1,11,110 plants ha^{-1} at 45 DAS. Differences in leafhopper population among the treatments were observed till 60 DAS and also at 93 DAS.

However, leafhopper population crossed ETL of six leafhoppers per three leaves from 38 DAS to 77 DAS. The leafhopper population crossed ETL in all the treatments at 38, 45 and 52 DAS. At 38 DAS the lowest population of 6.27 leafhoppers per three leaves was noticed at plant density of 14814 plants ha^{-1} and the highest population of 8.93 leafhoppers per three leaves was recorded at plant density of 1,11,110 plants ha^{-1}. The peak incidence was observed at 45 DAS. At this stage lowest population of 15.40 leafhoppers per three leaves was recorded at plant density of 14814 plants ha^{-1} and highest population of 18.27 leafhoppers per three leaves was noticed at 1,11,110 plants ha^{-1}. Like wise, at 52 DAS also the lowest population of 6.80 leafhoppers per three leaves was recorded at plant density of 14,814 plants ha^{-1} and the highest population of 10.73 leafhoppers per three leaves was recorded at plant density of 1,11,110 plants ha^{-1}. At 60 DAS the leafhopper population crossed ETL only in the treatments where plant density was more than or equal to 18518 plants ha^{-1}. The highest population of 8.27 leafhoppers per three leaves was recorded at plant density of 111111 plants ha^{-1} followed by 7.67 and 7.20 leafhoppers per three leaves at plant densities 55555 and 37037 plants ha^{-1}. The lowest population of 5.80 leafhoppers per three leaves was recorded at plant density of 14814 plants ha^{-1}. At 71 DAS the leafhopper population crossed ETL only in the plots having plant density more than or equal to 27,777 plants ha^{-1}. The highest population of 7.27 leafhoppers per three leaves was recorded at plant density of 1,11,110 plants ha^{-1} followed by 6.93, 6.67 and 6.07 leafhoppers per three leaves at plant density of 55,555 plants ha^{-1}, 37,037 plants ha^{-1} and 27,777 plants ha^{-1}. The lowest population of 5.13 leafhoppers per three leaves was recorded at plant density of 14814 plants ha^{-1}. It was evident from the data that more leafhopper incidence levels were observed with increasing plant densities from 14814 plants ha^{-1} to 1,11,110 plants ha^{-1}. Leafhopper injury grade in all the treatments as influenced by plant density was documented and presented in the Table 2. At 31 DAS first (I) grade injury symptoms were noticed in all the plant densities and at 38 DAS second (II) grade injury symptoms were noticed in all the plant densities. From 45 to 60 DAS third (III) grade injury symptoms were noticed in all the treatments.

However, at 71 DAS third grade injury symptoms were observed only in plant densities more than or equal to 22,222 plants ha^{-1} and at remaining plant densities leafhopper injury grade of (II) was observed. This may be due to less incidence of leafhopper population in these densities. Later, *i.e.,* from 85 DAS in all the plant densities leafhopper injury grade of (II) was noticed mainly because less leafhopper incidence and plants recouped under favourable weather conditions prevailed during later part of the crop growth period. The mean leafhopper population increased from 5.03 to 6.97 per three leaves as plant density increased from 14814 plants ha^{-1} to 1,11,110 plants ha^{-1} (Table 1).

The above findings are is in conformity with Biradar (2010) who reported that in cotton, leafhopper population was higher with a plant spacing of 90 cm × 30 cm at 30 and 45 DAS (1.88 and 2.88 leafhoppers leaf^{-1} plant^{-1}, respectively).

The increased leafhopper population at higher plant densities was in agreement with the results of Shwetha *et al.* (2009) who reported that higher population of leafhoppers was recorded at closer plant spacing of 90 cm × 30 cm (4.73 leaf^{-1} plant^{-1}) when compared to 90 cm × 60 cm spacing (3.93 leaf $^{-1}$ plant^{-1}). Kalaichelvi (2008) reported that leafhopper infestation was lower at plant spacing of 90 cm × 60 cm and 120 cm × 60 cm than closer spacing of 90 cm × 45 cm in *Bt* cotton.

Arif *et al.* (2006) revealed that leafhopper population affected by plant spacing and decreased with increase in plant spacing. The leafhopper population was decreased from 1.66 to 0.96 per leaf when the plant to plant distance increased from

Table 1. Incidence of leafhoppers on cotton (NDLH-1938) in different plant densities.

Treatment	Mean population of leafhoppers/ three leaves														
	31*	38	45	52	60	71	77	85	93	101	119	126	133	140	Over all mean
T_1 : 111111 plants ha^{-1} (90 × 10 cm)	4.60 (2.03)^{d}	8.93 (2.99)^{d}	18.27 (4.27)^{b}	10.73 (3.27)^{e}	8.27 (2.87)^{d}	7.27	6.73	4.93	3.07 (1.74)^{d}	5.33	5.33	5.07	5.07	3.93	6.97 (2.63)^{e}
T_2 :55555 plants ha^{-1} (90 × 20 cm)	3.60 (1.91)^{cd}	8.6 0(2.93)^{cd}	17.87 (4.23)^{b}	9.60 (3.10)^{de}	7.67 (2.77)^{cd}	6.93	6.53	4.60	2.80 (1.66)^{cd}	5.20	5.27	4.73	4.73	3.80	6.57 (2.56)^{de}
T_3 : 37037 plants ha^{-1} (90 ×30 cm)	3.20 (1.71)^{bc}	7.87 (2.80)^{bcd}	17.00 (4.12)^{ab}	8.80 (2.97)^{cd}	7.20 (2.68)^{bcd}	6.67	5.93	4.40	2.53 (1.58)^{bcd}	5.00	5.13	4.60	4.53	3.60	6.18 (2.48)^{cde}
T_4 : 27777 plants ha^{-1} (90 × 40 cm)	2.40 (1.65)^{ab}	7.27 (2.69)^{abc}	16.67 (4.08)^{ab}	8.13 (2.85)^{bc}	6.87 (2.62)^{abcd}	6.07	5.67	4.27	2.20 (1.48)^{bc}	4.87	4.93	4.47	4.47	3.47	5.84 (4.44)^{bcd}
T_5 : 22222 plants ha^{-1} (90 × 50 cm)	2.40 (1.90)^{ab}	6.93 (2.63)^{ab}	16.00 (4.00)^{a}	7.93 (2.81)^{abc}	6.53 (2.55)^{abc}	5.80	5.47	3.93	2.07 (1.44)^{abc}	4.53	4.87	4.27	4.33	3.27	5.60 (2.37)^{abc}
T_6 : 18518 plants ha^{-1} (90 × 60 cm)	2.80 (1.50)^{ab}	6.80 (2.61)^{ab}	15.87 (3.98)^{a}	7.27 (2.70)^{ab}	6.13 (2.47)^{ab}	5.33	5.13	3.73	1.87 (1.36)^{ab}	4.27	4.53	3.93	4.27	3.00	5.35 (2.30)^{ab}
T_7 : 14814 plants ha^{-1} (90 × 75 cm)	2.40 (1.45)^{a}	6.27 (2.50)^{a}	15.40 (3.92)^{a}	6.80 (2.61)^{a}	5.80 (2.41)^{a}	5.13	4.80	3.27	1.60 (1.21)^{a}	4.07	4.40	3.47	4.00	3.07	5.03 (2.24)^{a}
CD (P=0.05)	0.21	0.24	0.22	0.21	0.27	NS	NS	NS	0.25	NS	NS	NS	NS	NS	0.15
CV%	7.09	4.93	2.97	4.12	5.85	14.19	7.85	14.12	9.61	9.66	9.08	6.94	6.08	11.91	3.15

Figures in parentheses are $\sqrt{x+1}$ values. Numbers with same superscript are not statistically different.

NS : Non Significant *Days After Sowing

Table 2. Leafhopper injury grade on cotton (NDLH-1938) in different plant densities.

Treatment	Leafhopper injury grade/ plant													
DAS	31	38	45	52	60	71	77	85	93	101	119	126	133	140
T_1 : 111111 plants ha^{-1} (90 × 10 cm)	I	II	III	III	III	III	III	II	II	II	II	II	II	II
T_2 :55555 plants ha^{-1} (90 × 20 cm)	I	II	III	III	III	III	III	II	II	II	II	II	II	II
T_3 : 37037 plants ha^{-1} (90 ×30 cm)	I	II	III	III	III	III	II	II	II	II	II	II	II	II
T_4 : 27777 plants ha^{-1} (90 × 40 cm)	I	II	III	III	III	III	II	II	II	II	II	II	II	II
T_5 : 22222 plants ha^{-1} (90 × 50 cm)	I	II	III	III	III	III	II	II	I	II	II	II	II	II
T_6 : 18518 plants ha^{-1} (90 × 60 cm)	I	II	III	III	III	II	II	II	I	II	II	II	II	II
T_7 : 14814 plants ha^{-1} (90 × 75 cm)	I	II	III	III	III	II	I	II	I	II	II	II	II	II

Grade I : Undamaged leaves Grade II : Yellowing of outer margins of leaves
Grade III : Brick red colour of margins, crinkling and curling
Grade IV : Entire leaf turns to brick red colour and extreme curling and drying of leaves

12.5 cm to 38 cm. Mohite and Uthamasamy (1997) observed maximum leafhopper population (4.19 per leaf) at closer plant spacing (120 cm × 45 cm) and minimum leafhopper population (2.13 per leaf) at wider plant spacing (120 cm × 60 cm) in cotton. Contrary to the results obtained by several researchers, Butter *et al.* (1992) indicated that leafhopper incidence was 10 percent more under wider spacing (75 cm × 30 cm) than the closer spacing (75 cm × 15 cm). On the other hand, Sohi *et al.* (1995) reported that leafhopper population did not vary with different spacings (67.5 cm × 15 cm and 67.5 cm × 45 cm) in cotton. Aggarwal *et al.* (2007) observed that among various spacings *viz*., 67.5 cm × 75 cm, 67.5 cm × 90 cm and 67.5 cm × 105 cm, there were no differences in the population of leafhopper (3.74, 3.69 and 3.80 leafhoppers per three leaves respectively) in cotton.

The increased leafhopper incidence recorded at higher plant densities during *Kharif* 2015 at institute farm, Lam, Guntur which represents conventional cotton growing area of coastal Andhra Pradesh and hotspot for leafhoppers, may be due to congenial microclimate prevailing during September and October months of South-West monsoon period, may be due to the humid micro climate among the foliage which encourages the buildup of pest population, availability of food and more number of sites for oviposition which is extremely favourable for faster multiplication and growth of pest, closeness of plant which enabled pests to move easily from one plant to another plant.

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