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Effect of Crop Geometry and Levels of Nitrogen on Nutrient Uptake and Fibre Quality of Compact Cotton (*Gossypiumhirsutum* L.) under Rainfed Vertisols

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ABSTRACT

A field experiment was conducted on clayey soils of Regional Agricultural Research Station, Lam, Guntur during the year 2018–2019 under rainfed condition. The treatments consisted of three crop geometries S_1 - 60cm × 10cm,S_2- 75cm × 10cm, S_3- 90cm × 45cm in combination with four nitrogen levels N_1- 45kg N ha^{-1}, N_2- 90kg N ha^{-1},N_3- 135kg N ha^{-1},N_4- 180kg ha^{-1}. The experiment was laid out in a randomized block design with factorial concept replicated thrice. Nutrient uptake by plants at harvest was significantly influenced by crop geometry and nitrogen levels but their interaction was found to be non-significant. Different crop geometry and nitrogen levels under the study and their interaction effects on quality components of seed index, lint index , ginning turnout, upper half mean length (UHML), uniformity ratio, micronaire, tenacity and elongation was found to be non-significant.

Key words: *Crop geometry, Compact cotton, Fibre quality, Ginning turnout, Seed index.*

Cotton (*G.hirsutum* L.)is the most important fibre as well as commercial crop of India and Andhra Pradesh. It presumes importance in agriculture as well as in Industrial economy. Cotton occupies a major share among cash crops as it support the large section of farming community as well as it provides raw material to textile industries. Commercially cotton is the best export-earning commodity in the country. Cotton is used not only for weaving of cloth but also for other purposes like preparation of edible oil from its seeds (16-24 %), oil cake as animal feed and also for surgical and sanitary purpose as absorbent cotton. Hence it is known as "white gold".

India occupies first rank in area and having second position in production. In India, it is grown in an area of 122.38 lakh hectares with an annual production of 361 lakh bales and productivity of 501kg lint ha^{-1}. Among the cotton growing states, Maharastra is the leading state in area (42.07 lakh hectares) and Gujarat is the leading state in production (104 lakh bales) with productivity (674 kg ha^{-1}). In Andhra Pradesh, cotton occupies an area of 5.51 lakh hectares with annual production of 20lakh bales and productivity of 688kg lint ha^{-1}(AICCIP, Annual Report,2018-2019).

High density planting system (HDPS) is now being considered as an alternate production system having a potential for improving the productivity and profitability, increasing input use efficiency, reducing input costs and minimizing the risks associated with current cotton production system in India. However, HDPS depends on the availability of compact genotypes with synchronized boll maturity, altering of crop geometry, application of growth regulators and application of fertilizers on need based which facilities mechanization of picking in cotton.

Proper nutrient management is also essential for maximizing lint production while minimizing input cost in HDPS cotton. The adoption of HDPS, along with good fertilizer management and better genotypes, is a viable approach to break the current trend of stagnating yields under primarily rainfed hirsutum (upland) cotton growing areas. So trend towards high density planting is moving fast.

MATERIAL AND METHODS

A field experiment was conducted at Regional Agricultural Research Station, Lam, Guntur during *kharif,* 2018**.** The experimental soil was classified as clayey in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium.Rainfall recived during the crop growth period was 371 mm and was 25% deficient than normal rainfallof this area. The experiment was laid out in a randomized block design with factorial concept replicated thrice. The treatments consisted of three crop geometries S_1- 60cm × 10cm, S_2- 75cm × 10cm, S_3- 90cm × 45cm in combination with four nitrogen levels N_1- 45kg N ha^{-1}, N_2- 90kg N ha^{-1},N_3- 135kg N ha^{-1},N_4- 180kg ha^{-1}. Nitrogen and potassium applied

Table 1. Nitrogen, Phosphorus and Potassium content (%) and uptake (kg ha^{-1}) at harvest as influenced by crop geometry and nitrogen levels

	Content (%)			Uptake (kg ha^{-1})		
Crop geometry (cm)	N	P	K	N	P	K
S_1- 90 X 45	0.79	0.23	0.78	31.5	9.0	30.8
S_2 - 75 X 10	0.79	0.23	0.77	57.2	16.3	55.8
S_3 - 60 X 10	0.79	0.22	0.77	64.1	18.1	62.6
SEm±	0.01	0.002	0.01	1.2	0.4	1.3
CD (0.05)	NS	NS	NS	3.6	1.2	3.8
Nitrogen levels (Kgha^{-1})						
N_1 -45	0.66	0.21	0.75	39.1	12.5	44.4
N_2-90	0.81	0.22	0.77	51.4	13.9	48.5
N_3 -135	0.83	0.23	0.78	55.5	15.5	52.0
N_4 -180	0.84	0.23	0.79	57.6	15.9	54
SEm±	0.01	0.00	0.01	1.4	0.5	1.5
CD (0.05)	0.03	0.01	0.02	4.0	1.4	4.4
Interaction (SXN)						
SEm±	0.01	0.01	0.01	2.4	0.8	2.6
CD (0.05)	NS	NS	NS	NS	NS	NS
CV (%)	3	4	3	8	10	9

Table 2. Seed index (g), Lint index (g), Ginning out turn (%) and fibre quality as influenced by crop geometry and nitrogen levels

Crop geometry (cm)	Seed Index (g)	Lint Index (g)	GOT (%)	UHML (mm)	UI (%)	Mic (ug/inch)	Tenacity 3.2mm (g/tex)	Elongation (%)
S_1- 90 X 45	8.6	3.9	33.9	24.8	80.9	4.9	26	5.3
S_2 - 75 X 10	8.5	3.9	33.9	24.8	80.8	4.9	25.7	5.3
S_3 - 60 X 10	8.5	3.9	34.0	25.1	81.0	4.8	26.7	5.3
SEm±	0.05	0.03	0.1	0.3	0.6	0	0.3	0.1
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen levels(Kgha^{-1})								
N_1 -45	8.5	3.8	33.8	24.6	80.8	4.9	25.9	5.2
N_2-90	8.5	3.9	34.0	25.1	81.1	4.9	26.1	5.3
N_3 -135	8.6	3.9	34.0	25.0	80.8	4.9	25.9	5.3
N_4 -180	8.6	3.9	34.0	24.9	80.9	4.8	26.7	5.3
SEm±	0.1	0.04	0.2	0.3	0.7	0.1	0.4	0.1
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Interaction (SXN)								
SEm±	0.1	0.1	0.3	0.5	1.2	0.1	0.7	0.1
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	6.6	2.8	2.4	4	3	3	4	5

in three equal splits at 30,60 and 90DAS and Phosphorus at the time of last plowing.

The dry matter samples of the cotton crop were collected at the time of harvest, dried, powdered and analyzed by standard methods for total nitrogen (Microkjeldhal method-Humphries, 1956), total phosphorus (Calorimetry-triple acid digestion method-Jackson,1958) and total potassium (Flame photo metry-triple acid digestion method- Jackson, 1958). From chemically analyzed data, uptake of individual nutrient was calculated using the following formula.

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%) x Dry matter production (Kg ha}^{-1}\text{)}}{100}$$

Lint index is the weight of lint present on100seeds. Seed cotton having hundred seeds was taken. The weight of lint obtained from those seed cotton after ginning was weighted and worked out (Santhanam,1976).After ginning hundred seeds was selected and counted. The weight of 100 seeds called seed index and expressed in gram (Santhanam, 1976). Ginning turn out is the ratio between weight of lint obtained after ginning to that of seed cotton and expressed in percentage.

Fiber properties upper half mean length (UHML) (mm), uniformity ratio (%), micronaire (ug/inch), Tenacity 3.2mm (g/tex) and elongation (%) was studied based on 100g lint obtained from picking of each net plot. The lint sample was analyzed at regional quality evolution unit of ICAR-Central Institute for Research on Cotton Technology, Guntur by the HVI-HVI mode (ASTM D-5867).

RESULTS AND DISCUSSION

NPK content in plants was not significantly affected by crop geometry. However, levels of nitrogen had significant influence on plant NPK content. The maximum NPK content in plant was observed with application of 180kg N ha^{-1} (0.85%N, 0.23% P and 0.79% K) and the minimum NPK content was recorded with application 45 kg N ha^{-1} .

Nutrient uptake by plants at harvest was significantly influenced by crop geometry and nitrogen levels but their interaction was found to be non-significant. The maximum uptake of nitrogen, phosphorus and potassium (64.1,18.1 and 62.6kg ha^{-1}) by plant was recorded with closer crop geometry of 60cm × 10cm as compared to 75cmx10cm and 90cm × 45cm.Nitrogen uptake by plants was significantly higher at closer crop geometry which might be due to more dry matter accumulation per unit area. More number of plants accommodated per unit area leads to increased growth and yield attributes in cotton. Application of 180kg N ha^{-1} recorded maximum uptake of nitrogen, phosphorus and potassium(57.65kg ha^{-1},15.9kg ha^{-1}and 54kg ha^{-1}) followed by 135kg N ha^{-1} and found to be significantly superior over 90kg N ha^{-1} and 45kg N ha^{-1}. These results were similar with the results reported by Venugopalan *et al.* (2014), Singh *et al* (2012), Deshmukh *et al*. (2016) and Khargkharate *et al*. (2017[a]) (Table.1).

Different crop geometry and nitrogen levels under study and their interaction effects on seed index, lint index and ginning turnout was found to be non-significant (Table.2). It might be because quality parameters are controlled by genetically influenced traits of crop. Similar findings are reported by Biradar *et al.* (2010), Ghule *et al*. (2013), Dadgale *et al*. (2015). However, these results are in contrast to inferences of Kumar *et al*. (2018) who stated that maximum ginning out turn recorded with high density planting. Effect of different crop geometry and increased levels of nitrogen on upper half mean length (UHML), uniformity ratio, micronaire, tenacity and elongation as influenced by different crop geometry and nitrogen levels failed to produce significant result (Table.2). It might be due to the fact that quality parameters are controlled by genetically influenced traits of crop. Similar result was reported by Biradar*et al.* (2010), Ghule*et al*. (2013) Dadgale*et al*. (2014) , Kumar *et al*. (2017)and Parihar *et al*. (2018).(Table.2).

CONCLUSION

It can be concluded that NPK content not influenced by crop geometry and application of 180 kg N ha^{-1} was recorded maximum NPK content in plants however, maximum nutrient uptake was recorded with closer crop geometry and application of 180kg N ha^{-1} seed index, lint index and ginning turnout was not significantly affected with alteration of crop geometry and increased nitrogen levels and determined by genotypic characters. Similarly fibre quality parameters also not influenced by crop geometry and levels of nitrogen.

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