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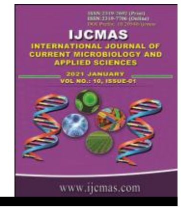

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Quality Parameters, Nitrogen Content and Uptake of Cotton Cultivar H-1098(i) and Nutrient Status of Soil Influence by Different Spacing and Nitrogen Application

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A B S T R A C T

An experimental research was performed at cotton research station at Sirsa district, CCS Haryana Agricultural University, Hisar during *kharif* to evaluate the different spacing and dose of nitrogen influences on quality and nutrient quality of cotton. The experimentation was laid out in split plot design having 4 spacing in main plots and 4 nitrogen doses in sub plots with 3 replications. The soil of the research field was loamy sand in texture with low nitrogen status. The trial results revealed that the nitrogen content in plant as well as in seed was also not affected by plant spacing however, uptake of nitrogen in seed was maximum with 67.5 cm × 15 cm spacing while nitrogen uptake in plant and total uptake was maximum in 67.5 cm × 10 cm spacing. Nitrogen content in seed increased significantly with 100% RD of nitrogen over 75% RD of nitrogen which remained at par with further increase in nitrogen levels however, nitrogen content in plant did not differ significantly with different nitrogen rates. The uptake of nitrogen in seed and plant as well as total uptake increased significantly up to application of 125% RD of nitrogen. The available nitrogen in soil was higher in 67.5 cm × 30 cm spacing. However, no significant variation in available P and K in soil was attained in different spacing treatments. Similarly, available N in soil after harvest of crop differed significantly under nitrogen levels, but it had no significant effect on available P and K in soil. The quality characters like ginning out turn (GOT), fiber length, micronaire value, and seed index were not affected significantly by different crop geometry and nitrogen levels.

Introduction

Cotton crop is one the most important commercial fibre crop also known as "white gold" grown all over the world. Cotton plant is shrubby, or tree-like cultivated in tropical and subtropical regions in India. It is perennial crop, but most of the cotton variety cultivated today has been developed into annuals. The plant height of cotton ranges from 2-6 feet, spiral arranged leaves, and main stem is erect having two branches (monopodial or vegetative type and sympodial or fruiting branches) with tap root system. The cotton inflorescence consists of solitary flowers which appear at the nodes opposite to leaf in sympodial branches. It can tolerate high temperature up to 45-46°C but below 25°C temperature is not suitable for cotton. The temperature between 27°C and 32°C is optimum for boll development and maturation but temperature reaches above 38°C cause yield reduction of cotton crop. Cotton is regarded as a foremost agricultural commodity sustaining Indian economy. Cotton provides a livelihood to more than sixty million citizens by way of engaging in agriculture, processing and textiles industry. Cotton is also used for preparation of edible oil from its seeds (16-24%). Like, cotton is grow for fibre purposes for making the fabric clothes in the industry but now a days, increasing population and enhancing income status of people, the demand of raw material of cotton is lift up therefore, there is urgent need to augment the production of cotton. To overcome this problem, superlative agronomic interventions are required to fully conquer the yield potential of any genotypes. The best option is to focus more on managing spacing distance between plants. Appropriate crop geometry helping individual plant to establish better and provide favorable micro-climate to plants in a specific portion of field area. Optimum plant spacing favors seed cotton yield by influencing plant population and physique of plants (Jagtap, 2008). Secondly, imbalanced use of fertilizer or less dose of fertilizer also distresses the vegetative and reproductive growth of plants. Cotton yield, quality and nutrient concentration are varied with different fertilizer dose under different spacing (Sharma *et al.,* 2001; Dhillon *et al.,* 2006). Cotton performs healthier to higher doses of fertilizers particularly nitrogen but the response may not always be in the form of seed cotton yield. However, response may be in form of production of vegetative parts such as plant height (Ahmad *et al.,* 2009; Jat *et al.,* 2014) and leaves count but, under limited supply of nitrogen, fiber fails to develop its full extent consequences into poor quality and also induce premature senescence leading to potential yield loss. Accordingly, observing the struggle between plants for plant nutrients, it is crucial to unearth the suitable combination of spacing and nitrogen dose (Malik *et al.,* 2019). Nitrogen is vital and imperative nutrient for obtaining higher yield and quality of cotton crop need to supply at proper quantity and time (Paslawar *et al.,* 2014). The production output of cotton improves under proper spacing condition and fertilizer application. Therefore, it is indispensable to familiar with agronomical practices such as acceptable spacing and nitrogen doses to save the cost and boost the productivity, improve the quality and enhance the nutrient content. Keeping above aspects in mind, an experimental was laid out to study the influence of different spacing and nitrogen application on quality parameters, nitrogen content and uptake of cotton and nutrient status of soil.

Materials and Methods

The field investigation was carried out during *kharif* season (2015) at cotton research station, Sirsa, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India). Sirsa is located 29°25′ N latitude, 74°40′ E longitude and at an altitude of 202 meters above mean sea level (msl). It lies in sub-tropical region of north western India, in the state of Haryana. The all weather parameters were favorable for the crop recorded Central Institute of Cotton Research (CICR), Sirsa**.** Representative soil samples were randomly collected from five places at a depth of 0-15 cm and 15-30 cm from the experimental field before sowing of crop to know the physico-chemical properties of the soil. The composite soil samples were subjected to mechanical and chemical analysis. The soil properties prevailing before sowing of crop are depicted in table 1.

The soil of field before sowing was loamy sand in texture. Chemical properties of the soil was normal with respect to electrical conductivity, slightly high in pH, low in organic carbon and available nitrogen, and medium in available phosphorus and high in available potash. The experiment was laid out in Split Plot Design having four spacing's in main plots and four nitrogen doses in sub plots with three replications. The layout of experiment field is presented in Fig. 1.

Design	Split plot design	**Treatment combinations**	4 × 4 = 16
Variety	H-1098 (i)	**Replications**	3
Gross plot size	5.4 × 6.3 m2	**Total number of plots**	48

The cultural operations such as tillage practices, thinning, hoeing, weeding, irrigation and plant protection measures were performed as per university guidelines however, during sowing, seed were buried deep at depth of 5 cm by hand dibbing according to spacing treatments and in fertilizer application, treatment wise nitrogen (N) dose was given (half at squaring stage; half at flowering stage) through urea while full dose of phosphorus (P) was applied through di-ammonium phosphate (DAP). The reading of ginning out turn (%) was measured by taking 100 g sample of *kapas* from the each plot was taken and ginned to get lint and seed and then GOT was calculated by the following formula.

$$\text{GOT} = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

And the fibre length is termed as distance spanned by a specified percentage of fibers in the specimen being tested when the fibers are paralyzed and randomly distributed The most commonly used measure is the 2.5 percent span length, which is the measure of fiber length and is tested using high volume instrument and fibre length is expressed in 'mm'. Whereas, Fibre fineness is the measure of fibre weight in mg per unit length of fibre and it was determined by using micronaire but recently measured by high volume instrument (HVI). It gives the resistance by the fiber to the flow of air and the value is termed as micronaire value. It is determined by micronaire instrument in which 50g of the sample is taken and compressed in a cylinder of specified dimension. Air at specific pressure is passed through the material. The amount of airflow is measured on a scale calibrated directly to read the weight per unit length of the fiber. Finer cottons have lower micronaire value. The seed index reading was worked out by taking weight of 100 seeds (g) from each net plot after ginning. It ensures evaluation of properly developed seeds and leads to development of lint index.

For determining the nitrogen content, plant sample (0.5g each) was digested in diacid mixture of H_2SO_4 and $HClO_4$ (9:1) to determine total nitrogen content. Nessler's reagent was used in this calorimetric procedure from which orange coloured complex Hg_2O (NH2I) was obtained. Intensity of this orange coloured complex was measured in spectrophotometer at 420 nm by using blue filter. The uptake was computed by multiplying the nitrogen content with plant biomass.

$$\text{N Uptake (kg ha}^{-1}\text{)} = \frac{\text{N content (\%)} \times \text{Yield (kg ha}^{-1}\text{)}}{100}$$

For calculating the available nitrogen from soil, it was estimated by alkaline permanganate method of Subbiah and Asija (1956). The easily oxidizable organic nitrogen present in the soil was oxidized by potassium permanganate in the presence of NaOH by distillation. During oxidation, the released ammonia was absorbed in boric acid to convert the ammonia to ammonium borate, which was titrated with the standard sulphuric acid. Whereas, the Olsen's method was used for determining available P in soil in which phosphorus was extracted from the soil using 0.5 M sodium bicarbonate ($NaHCO_3$), pH 8.5 as an extractant. Phosphorus was estimated colorimetrically by adding ammonium molybdate to aliquot and reducing the molybdenum phosphate complex in acidic medium. The intensity of blue colour was read on colorimeter using 660 nm red filters. However, available potassium i.e. exchangeable and water soluble K in soil was determined in neutral normal ammonium acetate (NH_4OAC) extract of soil. Shaking followed by filtration carried out the extraction and the potassium in extract was estimated by using flame photometer (Jackson, 1973). Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) described by Cochran and Cox (1963). To judge the significant difference between means of two treatments, the critical difference (C.D) was worked out using following formula:

$$C.D = (\sqrt{2 \text{ x } EMS / n}) \times t \text{ value at } 5\%$$

Where,

C.D = critical difference
EMS = error mean sum of square
n = number of observations
t = value of t-distribution at 5 % level of significance & error degree of freedom

Results and Discussion

Quality parameters

The data pertaining to ginning out turns, fibre length, micronaire value and seed index were present in table 2. The experimental result showed that the all quality parameters (G.O.T (%), fibre length (mm), and micronaire value (10^{-6}mm inch^{-1}), and seed index (g)) were not affected significantly by different crop geometry and nitrogen doses. But, there was an increasing trend in ginning out turn, fibre length and seed index with increasing various spacing and nitrogen doses. Because quality characters of crop depends upon genetic and environmental factors. Hence variations in quality parameters were not observed significantly. The results are in confirmity with those noted earlier by Ahmad *et al.*, 2009; Shekar *et al.*, 2012; Jat *et al.*, 2014; Bharathi *et al.*, 2012 and Paslawar *et al.*, 2014.

Nitrogen content and uptake

Nitrogen content and uptake in seed and plant as influenced by different treatments has been presented in table 3. The result indicated that various spacing did not affect nitrogen content in seed significantly. However, nitrogen uptake in seed was significantly influenced all the geometry treatments and maximum uptake was found in 67.5 cm × 15 cm spacing as compared to 67.5 cm × 22.5cm and 67.5 cm × 30cm but at par with spacing of 67.5 cm × 10 cm. The uptake of nutrients is a product of dry matter accumulation and nutrient concentration. Closer spacing of 67.5 cm × 10 cm recorded maximum total uptake of nitrogen by crop followed by 67.5 cm × 15 cm, 67.5 cm × 22.5 cm and 67.5 cm × 30 cm. The higher uptake of nitrogen recorded with higher plant population also reported by Dhillon *et al.*, (2006) and Devraj *et al.*, (2011).

Under different nitrogen doses, the nitrogen content in seed was statistically influenced. It was increased significantly with 100% RD of nitrogen over 75% RD of nitrogen but remained at par with further increase in nitrogen levels. Nevertheless, nitrogen uptake in seed increased significantly with increasing levels of nitrogen up to 125% RD and thereafter it remained statistically at par with further increase in nitrogen levels i.e. 150% RD of nitrogen. Whereas, data related to nitrogen content in plant which was not affected by different spacing and nitrogen doses. While, nitrogen uptake was significantly higher in plant in the spacing of 67.5 cm × 10 cm as compare to rest of spacing and lowest uptake was recorded by wider spacing (67.5 cm × 30 cm). In relation to nitrogen doses, as increased in nitrogen levels upto125% RD of nitrogen, N uptake in plant increased significantly.

Table.1 Physico-chemical analysis of experiment field before sowing of cotton crop

Soil property	Soil depth (cm)		Method of determination
	0-15	**15-30**	
Sand (%)	73.3	75.7	International pipette method (Piper, 1966)
Silt (%)	16.5	13.8	
Clay (%)	10.2	10.5	
pH (1:2, soil: water suspension)	8.5	8	pH meter with glass electrode in 1:2 soil water suspension (Jackson, 1973)
Electrical conductivity(dS m^{-1} at 25°C)	0.56	0.6	Conductivity bridge meter 1:2 soil-water suspension (Richards, 1954)
Organic carbon (%)	0.35	0.29	Walkley and Black rapid titration method (Jackson,1973)
Available N (kg ha^{-1})	137	133	Alkaline potassium permanganate method (Subbiah and Asija, 1956)
Available P (kg ha^{-1})	13.4	10.8	0.5 N sodium bicarbonate method
			(Olsen *et al*, 1954)
Available K (kg ha^{-1})	413	409	Ammonium acetate extraction method
			(Jackson, 1973)

Table.2 Effect of different spacing and nitrogen application on quality parameters of cotton

Treatments	Ginning out turn (%)	Fiber length (mm)	Micronaire value (10^{-6}mm $inch^{-1}$)	Seed index (g)
Main plot: Spacing (row × plant)				
S1: 67.5 cm × 10 cm	34.2	23.7	4.1	6.2
S2: 67.5 cm × 15 cm	34.4	23.9	4.2	6.3
S3: 67.5 cm × 22.5 cm	34.7	24.2	4.3	6.5
S4: 67.5 cm × 30 cm	35.1	24.4	4.3	6.7
SE(m)±	0.6	0.5	0.1	0.2
CD (P=0.05)	NS	NS	NS	NS
Sub plot (Nitrogen level)				
N1: 75% of RDN	34.3	23.5	4.2	6.3
N2: 100% of RDN	34.6	24	4.2	6.4
N3: 125% of RDN	34.7	24.2	4.2	6.5
N4: 150% of RDN	34.9	24.6	4.3	6.6
SE(m)±	0.5	0.6	0.1	0.1
CD (P=0.05)	NS	NS	NS	NS

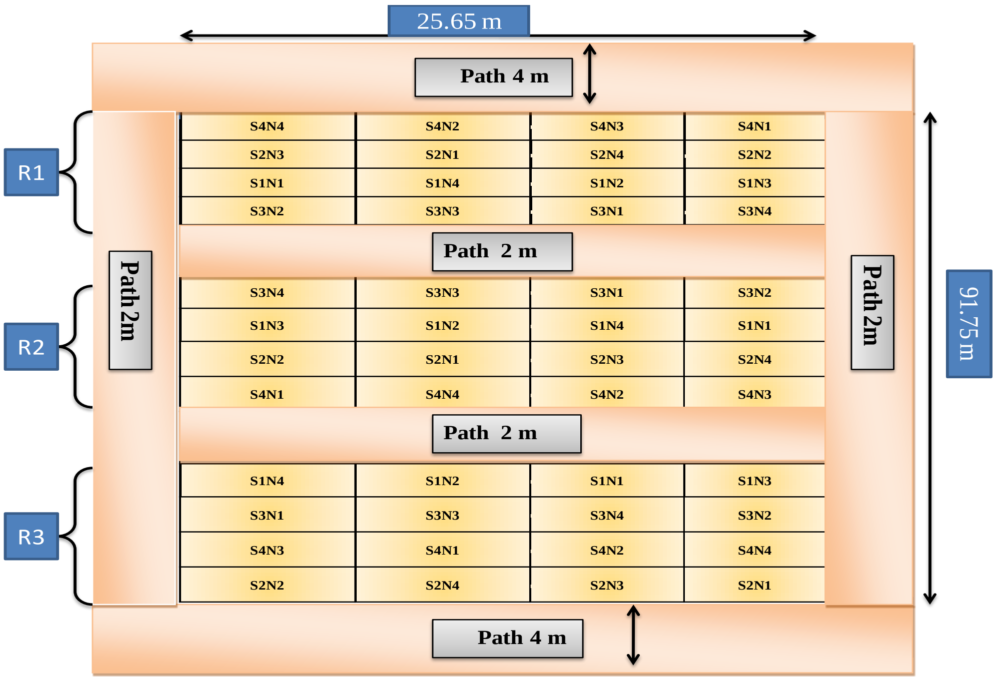
Table.3 Effect of different spacing and nitrogen levels on content and uptake of nitrogen by cotton

TREATMENTS	Nitrogen				Total uptake (Kg ha^{-1})
	Seed		Plant		
	Content (%)	Uptake (Kg ha^{-1})	Content (%)	Uptake (Kg ha^{-1})	
Main plot: Spacing (row × plant)					
S1: 67.5 cm × 10 cm	2.77	40	0.47	48.7	87.7
S2: 67.5 cm × 15 cm	2.78	44.5	0.48	43.8	87.3
S3: 67.5 cm × 22.5 cm	2.8	38.4	0.48	40.4	78.8
S4: 67.5 cm × 30 cm	2.83	36.4	0.5	39.6	76.1
SE(m)±	0.07	1.2	0.01	1.2	2.1
CD (P=0.05)	NS	4.2	NS	4.1	7.4
Sub plot (Nitrogen level)					
N1: 75% of RDN	2.6	32.3	0.46	36.7	66.5
N2: 100% of RDN	2.77	38.5	0.47	41.4	79.2
N3: 125% of RDN	2.87	44.2	0.49	45.3	90.5
N4: 150% of RDN	2.93	44.3	0.51	48	94
SE(m)±	0.05	1.2	0.01	1.3	1.6
CD (P=0.05)	0.16	3.6	NS	3.8	4.8

Table.4 Effect of spacing and nitrogen application on available status of N, P and K in soil after harvest of crop

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Main plot: Spacing (row × plant)			
S1: 67.5 cm × 10 cm	127.5	10	401.8
S2: 67.5 cm × 15 cm	129.8	10.1	402.9
S3: 67.5 cm × 22.5 cm	131	10.6	404.3
S4: 67.5 cm × 30 cm	132.5	11	407.7
SE(m)±	0.6	0.2	1.2
CD (P=0.05)	2.2	NS	NS
Sub plot (Nitrogen level)			
N1: 75% of RDN	125.5	9.8	405.5
N2: 100% of RDN	129.2	10.5	405.1
N3: 125% of RDN	132.7	10.6	403.5
N4: 150% of RDN	134.6	10.8	402.7
SE(m)±	0.8	0.4	1.6
CD (P=0.05)	**2.3**	**NS**	**NS**

Fig.1



The maximum nitrogen uptake in plant was recorded at application of 150% RD which was at par with 125% RD of nitrogen but significant higher than 75 % RD and 100% RD of nitrogen. The spacing of 67.5 cm × 10 cm recorded significantly higher total nitrogen uptake in cotton plant as compare to 67.5 cm × 22.5 cm and 67.5 cm × 30 cm but at par with 67.5 cm × 15 cm spacing as shown in Table 3. On the other hand, total uptake of nitrogen increased significantly with increasing levels of nitrogen up to 125% RD after which it remained statistically at par with 150% RD of nitrogen. This may be attributed to availability of more nitrogen leading to higher dry matter production. Total uptake of nitrogen was maximum with 150% RD of nitrogen. These results are corroborative with the findings of Katkar *et al.,* (2000) and Das and Reddy (2009).

Nutrient status of soil

Available nutrient status data of nitrogen (N), phosphorus (P) and potassium (K) in soil after harvest of crop is elucidated in Table 4. The perusal of data revealed that available nitrogen in soil after harvest of crop was influenced significantly by plant geometry.

The maximum available nitrogen (132.5 kg ha^{-1}) in soil was found in spacing of 67.5 cm × 30 cm which was at par with spacing of 67.5 cm × 22.5 cm (131 kg ha^{-1}) but significantly higher than narrow spacing of 67.5 cm × 10 cm and 67.5 cm × 15cm. It was because of less plant population in wider spacing which results in higher available nitrogen in soil but available P and K in soil were not affected by different spacing. These results are confirmed with Jat *et al.,* (2013) and Shukla *et al.,* (2014).However, application of 125% recommended dose of nitrogen exhibited significantly higher available N in soil over application of 75% RD and 100% RD of nitrogen, but it was statistically at par with150% RD of nitrogen levels. While, the different spacing and nitrogen doses did not influence the available phosphorus and potassium in the soil. This improvement in soil fertility status might be attributed to direct addition of nutrients to the available pool of soil. Similar results are also reported by Jat *et al.*, (2014).

In conclusion the results of experiment stated that the quality characters of cotton variety H-1098 (i) *viz*; ginning out turn, fiber length, micronaire value, and seed index were not affected significantly by different spacing and nitrogen rate application. Similarly, nitrogen content in seed and plant was also not affected due to different spacing but total uptake was maximum with spacing of 67.5 cm × 10 cm. but, increase in nitrogen doses can increase the nitrogen uptake in plant, seed and total uptake up to 125% RD of nitrogen. The available nitrogen in soil was higher under 67.5 cm × 30 cm spacing. However, no significant variation in available P and K in soil was observed in different spacing treatments. Likewise, available nitrogen differed significantly under different nitrogen doses, but had no significant result were obtained in relation to available Phosphorus and potassium in soil.

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