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RESEARCH PAPER

Influence of real time nitrogen management on fiber quality parameters of Bt cotton

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Abstract: Increase in productivity alone cannot benefit the cotton growers as quality of cotton fibre is the primary concern for fetching higher price. In view of this the present investigation was carried out at Main Agricultural Research Station, Dharwad during *kharif* 2019 and 2020 to study the influence of real time nitrogen management practices on quality of Bt cotton. Experiment was conducted with two genotypes (main plot) and eight real time nitrogen management practices (sub plots) in split plot design. Pooled data indicated that genotypes did not show any significant difference (P >.005) to quality parameters. Real time nitrogen management practices significantly influenced quality parameters (P <.0001). N supplementation at 1.1 - 1.5 response index (RI), 81 - 90 % sufficiency index (SI) and RDF recorded significantly higher fibre span length (28.88, 28.69 and 28.71 mm, respectively) and fibre strength (27.22, 26.95 and 27.13 g tex^{-1}, respectively). Further, significantly higher uniformity ratio (86.00 %), fibre elongation (5.70 %) and ginning percentage (36.17 %) was recorded at N supplementation of 1.1 - 1.5 RI as compared to N omission (84.00, 5.55 and 33.17 %, respectively). Micronaire value did not differed significantly to genotypes and real time nitrogen management practices. Interactions were found non-significant (P > .005) for quality parameters but when subjected to DMRT, genotypes with N supplementation at 1.1 -1.5 RI, 81 - 90 % SI and RDF were found on par and superior over N omission.

Key words: Genotypes, Fibre quality, Response Index, Sufficiency Index

Introduction

Cotton (*Gossypium* spp.), is the king of fibres and popularly known as the 'white gold', having a predominant position among cash crops in India and world as well. Cotton is the nature's most precious gift to the mankind, contributed by the genus "*Gossypium*" to cloth the people all over the world. In India, cotton is grown under diverse agro-climatic conditions and contributes nearly 60 per cent of the total raw material needs of textile industry. Cotton plays a major role in India's economy, both in terms of providing employment directly or indirectly to about 60 million people and earning foreign exchange for the country to the tune of Rs. 60,000 crores. Cotton is the only natural fibre used in the textile industry.

Since, quality of fibre is most important for getting higher price, increasing productivity alone cannot benefit the cotton farmers. Quality of the cotton fiber is primarily influenced by genotype and secondarily by agronomic practices and environmental qualities (Subhan *et al*., 2001).

Cotton is an indeterminate crop, excess application of nitrogen delays maturity, promotes vegetative growth results in lower cotton yields. Reduction in the lint percentage by 0.16 per cent due to excessive nitrogen application rates and increases mineral uptake, photosynthetic assimilation and accumulation in sinks (Sawan *et al*., 2006). Gerik *et al*. (1989) reported reduced yield or fibre quality due to excess nitrogen application than required for optimum crop performance. There are some reports showed non-significant differences for fibre quality parameters due to different N application rates (Seilsepour and Rashid, (2011). Similarly Bilalis *et al*. (2010), Pettigrew and Adamczyk (2006) reported insignificant difference in fibre strength, length, maturity and micronaire due to varying source, amount or application timing of nitrogen fertilization. In contrast, Constable and Hearn (1981) and Rochester *et al.* (2001) indicated positive response of increased N fertilizer rates on fibre quality parameters except micronaire value.

Agronomic practices such as nitrogen management significantly influenced crop yield and quality by directly affecting physiological and biochemical processes in plants. On the other hand, amount of N fertilization cannot represent the plant nutrition status because N fertilization is susceptible to NH_3 volatilization losses and the losses depended on fertilizer practices, soil type and environmental conditions and bolls undergo different soil-applied nutrients intakes as flowering dates shifts (Boquet and Breitenbeck, 2000). The nitrogen concentration per unit area in the subtending leaf, containing both the information of subtending leaf N concentration per unit weight and specific leaf area (Yoshida *et al*., 2007) can reflect the N nutrition level of cotton plant in any nitrogen and soil conditions (Bondada *et al*., 1996; Grindlay, 1997). Investigations on the relationship between formation of fiber quality and nutrient availability may be an available method to explain the contradicted N fertilization effects on fiber quality to some extent. Thus, supply of nitrogen as per crops demand, is a trending approach for increasing nitrogen use efficiency and to increase fibre quality to some extent. Therefore, the present investigation was planned to study the influence of real time nitrogen management practices on fibre quality of Bt cotton.

Material and methods

Experiment was conducted during *kharif* seasons of 2019 and 2020 at the Main Agricultural Research Station, UAS Dharwad. The soil of the experimental site was medium deep black soil with pH value of 7.65, electrical conductivity (0.31 dS m^{-1}), low in organic carbon (0.45 %). The available nutrient status indicated that soil is medium in available nitrogen and P_2O_5 (278.30 & 34.35 kg ha^{-1}, respectively) and high in available K_2O (357.65 kg ha^{-1}). The experiment was laid out in a split-plot design with three replications. The main plot consisted of two Bt cotton genotypes (BG-II) namely, Ajeet 155 (G_1) and First Class (G_2) and the subplot consisted of eight different optical sensor-based nitrogen treatments *i.e.* N_1-N_3: N supplementation at 60-70, 71-80 and 81-90 per cent Sufficiency Index (SI), respectively; N_4– N_6: N supplementation at 1.1-1.5, 1.6-2.0 and 2.1-2.5 Response Index (RI), respectively; N_7: RDF; N_8: N omission. Recommended dose of fertilizer was 150:75:75 kg N, P_2O_5 and K_2O ha^{-1} for irrigated conditions is followed for the present investigation. Under N omission treatment N was omitted and P_2O_5 and K_2O were retained as per RDF. Two nitrogen-rich strip (200 % RDF) plots and absolute control were maintained for respective genotypes. The SPAD and GreenSeeker values were recorded at 7 days intervals from early squaring up to the mid-bloom stage.

The Sufficiency Index (SI) was calculated from SPAD value and Response Index (RI) from GreenSeeker NDVI. Nitrogen was top-dressed at the rate of 30 kg N ha^{-1} whenever SI and RI values fall in the set range. Fifty percent of nitrogen fertilizer and a full dose of phosphorus and potassium was applied at the time of sowing as basal dose in all the treatments (N_1 to N_7) except N omission (N_8) where the only full dose of phosphorus and potassium was applied. The remaining 50 per cent N in the form of nitrogen was applied in two splits at 30 and 60 days after sowing (DAS) in the recommended dose of fertilizer (RDF) treatment (N_7). In the rest of the treatments (N_1 to N_6) nitrogen top dressing was done when the decision aids indicated the readings within threshold level.

Seed cotton was randomly selected and picked from each treatment during first picking. Thus collected seed cotton was hand cleaned for dried leaves, insect damaged bolls and subjected for ginning. Cleaned and ginned lint samples of about 100 g was packed and labeled for quality testing. The fibre quality parameters were tested at Regional Quality Evaluation Unit of CIRCOT, ARS, Dharwad farm. Various conventional instruments are integrated into a single compact operating system by using the state of the art technology in optics, mechanics and electronics. HVI system provides measurement of fibre span length (mm), fibre elongation, uniformity ratio, fibre strength (g tex^{-1}), micronaire value and ginning percentage. Cotton samples were tested for fibre quality parameters from Sujwala Bio Fuels, KIADB Industrial area, Belur, Dharwad with Compact HVI instrument (in ICC mode) by the method adopted from ASTM D-5867 procedure (Sundaram, 2002).

The pooled data (two years) of the experiment was statistically analysed by adopting Fischer's method of analysis of variance technique as outlined by Gomez and Gomez (1984). At 5 per cent level of significance 'F' test was carried out and the critical difference (CD) values were calculated wherever 'F' test is significant. The mean value of main plot, sub plot and interactions were separately and subjected to Duncan Multiple Range Test (DMRT) using the corresponding error mean sum of squares and degrees of freedom.

Results and discussion

Results of pooled data indicated that, genotypes recorded non-significant difference with respect to fibre quality parameters (Table 1, 2 and 3). This might be due to similar genetic potential of the genotypes. Extensive studies comparing transgenic cotton varieties with their recurrent parents showed that fiber uniformity, length, strength, and elongation showed no significant differences due to transgenic technology (Ethridge and Hequet, 2000). Studies of gene action and heterosis have suggested that there is little non-additive gene action in fibre length, strength and fineness in cotton genotypes (Meredith and Bridge, 1972).

Different optical sensor-based N management practices significantly ($P<.0001$) influenced the fibre quality parameters (Table 1, 2 and 3). Considerably higher and comparable fibre span length was recorded with N supplementation at 1.1 - 1.5 RI, 81 - 90 % SI (top dressing at pin head square and first bloom stage) and RDF (early squaring and early flowering stage top dressing) (28.88, 28.69 and 28.71 mm, respectively) as compared to rest of the treatments (Table 1). Lower fibre span length was noticed with N omission (26.61 mm). Significantly higher fibre elongation was recorded with N supplementation at 1.1 - 1.5 RI (5.70 %) as compared to N omission (5.55 %) and it was found on par with rest of the treatments (Table 1). However, during first year non-significant difference was noticed with different optical sensor-based N management practices. This might be due to supplementation of nitrogen on real time basis has improved its availability and carbohydrate reserves for cell elongation. During course of investigation in both the years' heavy rainfall was received at early growth stages might have prolonged the vegetative and reproductive phases. This might have also increased the duration of fibre elongation process. Zhao *et al.* (2012) also observed increase in fibre quality parameters to split application of nitrogen.

Significantly higher uniformity ratio was recorded with N supplementation at 1.1 -1.5 RI (86.00 %) as compared to rest of the treatments except for N supplementation at 81 - 90 % SI, RDF, 71 - 80 % SI and 2.1 -2.5 RI (85.67, 85.83, 85.42 and 84.67 %, respectively) (Table 2). Uniformity in fibre maturity due to delayed flowering and supply of nitrogen during peak demand of the crop might have increased the uniformity ratio. Increased supplementation at 1.1 - 1.5 RI, 81 - 90 % SI and RDF recorded comparable and significantly superior fibre span length (29.25, 29.07 and 29.08 mm, respectively) over rest of the treatment combinations, except for Ajeet 155 with N supplementation at 1.1 - 1.5 RI, 81 - 90 % SI and RDF (28.50, 28.32 and 28.33 mm, respectively) and First Class with N supplementation at 71 - 80 % SI (28.05 mm). Lower fibre length was noticed with N omission

Table 1. Fibre span length and fibre elongation of Bt cotton as influenced by optical sensor-based nitrogen management practices

Treatments	Fibre span length (mm)									Fibre elongation (%)								
	2019-20			2020-21			Pooled			2019-20			2020-21			Pooled		
	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean
N_1	27.23^{cd}	27.63^{a-d}	27.43^{a}	26.43^{de}	26.87^{de}	26.65^{b}	26.83^{e}	27.25^{cde}	27.04^{b}	5.63^{a}	5.67^{a}	5.65^{a}	5.60^{abc}	5.53^{c}	5.57^{b}	5.62^{ab}	5.60^{ab}	5.61^{ab}
N_2	28.23^{a-d}	28.40^{a-d}	28.32^{a}	26.90^{de}	27.70^{bcd}	27.30^{b}	27.57^{b-e}	28.05^{a-d}	27.81^{ab}	5.67^{a}	5.67^{a}	5.67^{a}	5.60^{abc}	5.63^{abc}	5.62^{ab}	5.63^{ab}	5.65^{ab}	5.64^{ab}
N_3	28.27^{a-d}	28.87^{abc}	28.57^{a}	28.37^{abc}	29.27^{a}	28.82^{a}	28.32^{abc}	29.07^{a}	28.69^{a}	5.70^{a}	5.67^{a}	5.68^{a}	5.63^{abc}	5.63^{abc}	5.63^{ab}	5.67^{ab}	5.65^{ab}	5.66^{ab}
N_4	28.47^{a-d}	29.17^{a}	28.82^{a}	28.53^{ab}	29.33^{a}	28.93^{a}	28.50^{ab}	29.25^{a}	28.88^{a}	5.70^{a}	5.63^{a}	5.68^{a}	5.70^{ab}	5.73^{a}	5.72^{a}	5.70^{a}	5.70^{a}	5.70^{a}
N_5	27.37^{a-d}	27.67^{a-d}	27.52^{a}	26.40^{e}	27.13^{cde}	26.77^{b}	26.88^{de}	27.40^{b-e}	27.14^{b}	5.70^{a}	5.67^{a}	5.67^{a}	5.60^{abc}	5.57^{bc}	5.58^{b}	5.65^{ab}	5.60^{ab}	5.63^{ab}
N_6	27.33^{bcd}	27.67^{a-d}	27.50^{a}	26.47^{de}	27.10^{cde}	26.78^{b}	26.90^{de}	27.38^{b-e}	27.14^{b}	5.70^{a}	5.67^{a}	5.68^{a}	5.60^{abc}	5.57^{bc}	5.58^{b}	5.65^{ab}	5.62^{ab}	5.63^{ab}
N_7	28.47^{a-d}	29.10^{ab}	28.78^{a}	28.20^{abc}	29.07^{a}	28.63^{a}	28.33^{abc}	29.08^{a}	28.71^{a}	5.70^{a}	5.67^{a}	5.68^{a}	5.60^{abc}	5.70^{ab}	5.65^{ab}	5.65^{ab}	5.68^{ab}	5.67^{ab}
N_8	26.97^{d}	27.23^{cd}	27.10^{a}	26.00^{e}	26.23^{e}	26.18^{b}	26.48^{e}	26.73^{e}	26.61^{b}	5.53^{a}	5.60^{a}	5.67^{a}	5.57^{bc}	5.50^{c}	5.53^{b}	5.55^{b}	5.55^{b}	5.55^{b}
Mean	27.79^{a}	28.24^{a}		27.18^{a}	27.80^{a}		27.45^{a}	28.00^{a}		5.67	5.65		5.61	5.61		5.64	5.63	
*N Rich	28.00	28.70	28.35	28.20	28.90	28.55	28.10	28.80	28.45	5.80	5.80	5.80	5.70	5.70	5.70	5.75	5.75	5.75
*Control	26.90	27.80	27.35	26.00	26.10	26.05	26.45	26.95	26.70	5.60	5.60	5.60	5.50	5.50	5.50	5.55	5.55	5.55
SV	S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value	
G	0.04	0.0180		0.15	0.0849		0.06	0.0207		0.009	0.4621		0.003	0.3096		0.003	0.1325	
N	0.36	0.0059		0.25	0.0000		0.24	0.0000		0.038	0.4073		0.030	0.0064		0.030	0.0620	
G×N	0.12	0.9999		0.42	0.9803		0.16	0.9923		0.052	0.9378		0.008	0.5049		0.007	0.9843	

Table 2. Uniformity ratio and Fibre strength of Bt cotton as influenced by optical sensor-based nitrogen management practices

Treatments	Uniformity ratio (%)									Fibre strength (g/ tex)								
	2019-20			2020-21			Pooled			2019-20			2020-21			Pooled		
	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean
N_1	85.00^{abc}	84.33^{c}	84.67^{a}	84.33^{b-e}	83.67^{de}	84.00^{cd}	84.67^{b-e}	84.00^{de}	84.33^{cd}	27.20^{b-e}	26.03^{e}	26.62^{a}	25.60^{bc}	25.53^{bc}	25.57^{a}	26.40^{bc}	25.78^{c}	26.09^{ab}
N_2	86.33^{ab}	84.67^{bc}	85.50^{a}	85.33^{a-d}	85.33^{a-d}	85.33^{a-d}	85.83^{abc}	85.00^{a-e}	85.42^{a-d}	27.63^{a-d}	26.00^{e}	26.82^{a}	25.67^{abc}	26.43^{abc}	26.05^{a}	26.65^{bc}	26.22^{bc}	26.43^{ab}
N_3	86.67^{a}	84.67^{bc}	85.67^{a}	85.67^{abc}	85.67^{abc}	85.67^{abc}	86.17^{ab}	85.17^{a-e}	85.67^{abc}	28.03^{abc}	26.67^{cde}	27.35^{a}	26.57^{abc}	26.53^{abc}	26.55^{a}	27.30^{ab}	26.60^{bc}	26.95^{ab}
N_4	86.67^{a}	85.33^{abc}	86.00^{a}	86.33^{a}	85.67^{abc}	86.00^{a}	86.50^{a}	85.50^{a-d}	86.00^{a}	28.30^{ab}	26.80^{cde}	27.55^{a}	27.23^{a}	26.53^{abc}	26.88^{a}	27.77^{a}	26.67^{bc}	27.22^{a}
N_5	85.67^{abc}	84.00^{c}	84.83^{a}	84.67^{a-e}	83.67^{de}	84.17^{bcd}	85.17^{a-e}	83.83^{e}	84.50^{bcd}	27.47^{b-e}	26.27^{de}	26.87^{a}	25.93^{abc}	25.97^{abc}	25.95^{a}	26.70^{bc}	26.12^{c}	26.41^{ab}
N_6	85.67^{abc}	84.33^{c}	85.00^{a}	84.67^{a-e}	84.00^{cde}	84.33^{a-d}	85.17^{a-e}	84.17^{de}	84.67^{a-d}	27.43^{b-e}	26.17^{de}	26.80^{a}	25.87^{abc}	26.07^{abc}	25.97^{a}	26.65^{bc}	26.12^{c}	26.38^{ab}
N_7	86.67^{a}	85.00^{abc}	85.83^{a}	85.67^{abc}	86.00^{ab}	85.83^{ab}	86.17^{ab}	85.50^{a-d}	85.83^{ab}	29.00^{a}	26.43^{de}	27.72^{a}	27.00^{ab}	26.07^{abc}	26.53^{a}	28.00^{a}	26.25^{bc}	27.13^{a}
N_8	84.67^{bc}	84.00^{c}	84.33^{a}	84.00^{cde}	83.33^{e}	83.67^{d}	84.33^{cde}	83.67^{e}	84.00^{d}	26.97^{b-e}	25.97^{e}	26.47^{a}	25.53^{bc}	25.13^{c}	25.33^{a}	26.25^{bc}	25.55^{c}	25.90^{b}
Mean	85.90^{a}	84.56^{a}		85.08^{a}	84.67^{a}		85.54^{a}	84.67^{a}		27.75a	26.29a		26.18a	26.03a		26.97a	26.16a	
*N Rich	86.00	86.00	86.00	86.00	85.00	85.50	86.00	85.50	85.75	27.20	26.90	27.05	27.20	26.50	26.85	27.20	26.70	26.95
*Control	84.00	84.00	84.00	84.00	83.00	83.50	84.00	83.50	83.75	26.20	25	25.60	25.20	25.00	25.10	25.70	25.00	25.35
SV	S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value	
G	0.28	0.0758		0.15	0.1835		0.17	0.0650		0.146	0.0192		0.405	0.8301		0.228	0.1308	
N	0.37	0.0280		0.35	0.0001		0.29	0.0001		0.318	0.0818		0.337	0.0454		0.244	0.0044	
G×N	0.80	0.8690		0.42	0.8759		0.48	0.9912		0.412	0.7570		1.147	0.7267		0.646	0.6143	

*reference plots - not subjected to statistical analysis; Means followed by the same letter (s) within a column and row are not differed significantly by DMRT (P = 0.05); SV- Source of Variation

Main plot: Bt cotton genotypes (G)
G_1: Ajeet – 155
G_2: First Class

Sub plot: Optical sensor-based N management (N)
N_1: N supplementation at 60 – 70 % Sufficiency Index
N_2: N supplementation at 71 – 80 % Sufficiency Index
N_3: N supplementation at 81 – 90 % Sufficiency Index
N_4: N supplementation at 1.1 – 1.5 Response Index
N_5: N supplementation at 1.6 – 2.0 Response Index
N_6: N supplementation at 2.1 – 2.5 Response Index
N_7: RDF (150:75:75 N:P_2O_5:K_2O kg ha^{-1})
N_8: Absolute control (0:75:75 N:P_2O_5:K_2O kg ha^{-1})

Table 3. Ginning percentage and micronaire value of Bt cotton as influenced by optical sensor-based nitrogen management practices

Treatments	Ginning percentage (%)									Micronaire value (µg inch^{-1})								
	2019-20			2020-21			Pooled			2019-20			2020-21			Pooled		
	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean
N_1	34.23^{cde}	33.63^{de}	33.93^{bcd}	33.20^{d}	33.10^{d}	33.15^{c}	33.72^{cd}	33.37^{cd}	33.54^{c}	3.83^{a}	4.10^{a}	3.97^{a}	3.33^{a}	3.63^{a}	3.48^{a}	3.58^{bc}	3.87^{abc}	3.73^{a}
N_2	34.77^{b-e}	34.50^{b-e}	34.63^{bcd}	33.93^{cd}	34.20^{bcd}	34.07^{bc}	34.35^{bcd}	34.35^{bcd}	34.35^{bc}	4.10^{a}	4.17^{a}	4.13^{a}	3.47^{a}	3.66^{a}	3.57^{a}	3.78^{abc}	3.92^{abc}	3.85^{a}
N_3	35.27^{a-d}	35.67^{abc}	35.47^{ab}	34.63^{a-d}	35.37^{abc}	35.00^{ab}	34.95^{abc}	35.52^{ab}	35.23^{ab}	4.17^{a}	4.23^{a}	4.20^{a}	3.50^{a}	3.73^{a}	3.62^{a}	3.83^{abc}	3.98^{a}	3.91^{a}
N_4	36.00^{ab}	36.60^{a}	36.30^{a}	35.80^{ab}	36.27^{a}	36.03^{a}	35.90^{ab}	36.43^{a}	36.17^{a}	4.17^{a}	4.23^{a}	4.20^{a}	3.53^{a}	3.70^{a}	3.62^{a}	3.85^{abc}	3.97^{a}	3.91^{a}
N_5	33.27^{e}	33.43^{e}	33.35^{d}	33.03^{d}	33.10^{d}	33.07^{c}	33.15^{d}	33.27^{d}	33.21^{c}	4.03^{a}	4.10^{a}	4.07^{a}	3.73^{a}	3.60^{a}	3.67^{a}	3.88^{abc}	3.85^{abc}	3.87^{a}
N_6	33.43^{e}	33.80^{de}	33.62^{cd}	33.30^{d}	33.53^{d}	33.42^{bc}	33.37^{cd}	33.67^{cd}	33.52^{c}	4.00^{a}	4.00^{a}	4.00^{a}	3.33^{a}	3.60^{a}	3.47^{a}	3.67^{abc}	3.80^{abc}	3.73^{a}
N_7	34.87^{b-e}	35.60^{abc}	35.23^{abc}	34.63^{a-d}	35.27^{abc}	34.95^{ab}	34.75^{a-d}	35.43^{ab}	35.09^{ab}	4.00^{a}	4.20^{a}	4.10^{a}	3.47^{a}	3.67^{a}	3.57^{a}	3.73^{abc}	3.93^{ab}	3.83^{a}
N_8	33.20^{e}	33.23^{e}	33.22^{d}	33.13^{d}	33.10^{d}	33.12^{c}	33.17^{d}	33.17^{d}	33.17^{c}	3.80^{a}	3.90^{a}	3.85^{a}	3.30^{a}	3.43^{a}	3.37^{a}	3.55^{c}	3.67^{abc}	3.61^{a}
Mean	34.38^{a}	34.56^{a}		33.96^{a}	34.24^{a}		34.17^{a}	34.40^{a}		4.01a	4.12a		3.46a	3.63a		3.74a	3.87a	
*N Rich	36.23	36.77	36.50	36.03	36.17	36.10	36.13	36.47	36.30	4.30	4.40	4.35	3.60	3.80	3.70	3.95	4.10	4.03
*Control	33.00	33.07	33.04	33.00	33.07	33.04	33.00	33.07	33.04	3.80	3.90	3.85	3.20	3.30	3.25	3.50	3.60	3.55
SV	S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value		S.Em±	P value	
G	0.062	0.1747		0.086	0.1473		0.055	0.0925		0.03	0.1564		0.02	0.0163		0.009	0.0087	
N	0.367	0.0001		0.360	0.0001		0.350	0.0001		0.09	0.1648		0.11	0.5709		0.074	0.0821	
G×N	0.174	0.9120		0.243	0.9865		0.154	0.9682		0.09	0.9807		0.04	0.9034		0.026	0.9150	

*reference plots - not subjected to statistical analysis; Means followed by the same letter (s) within a column and row are not differed significantly by DMRT (P = 0.05); SV- Source of Variation

Main plot: Bt cotton genotypes (G)

G_1: Ajeet – 155

G_2: First Class

Sub plot: Optical sensor-based N management (N)

N_1: N supplementation at 60 – 70 % Sufficiency Index

N_2: N supplementation at 71 – 80 % Sufficiency Index

N_3: N supplementation at 81 – 90 % Sufficiency Index

N_4: N supplementation at 1.1 – 1.5 Response Index

N_5: N supplementation at 1.6 – 2.0 Response Index

N_6: N supplementation at 2.1 – 2.5 Response Index

N_7: RDF (150:75:75 N:P_2O_5:K_2O kg ha^{-1})

N_8: Absolute control (0:75:75 N:P_2O_5:K_2O kg ha^{-1})

for both the genotypes (26.73 and 26.48 mm with First class and Ajeet 155, respectively). Similarly First Class and Ajeet 155 with N supplementation at 1.1 – 1.5 RI (5.70 %) recorded significantly superior fibre elongation over N omission of both the genotypes (5.55 %) and it was found on par with rest of the treatments. Except during first year, no-significant difference was noticed with genotypes, N management practices and their interactions

Significantly higher uniformity ratio was recorded with Ajeet 155 with N supplementation at 1.1 – 1.5 RI (86.50 %) over rest of the treatment combinations, except for Ajeet 155 with N supplementation at 81 – 90 % SI, RDF, 71 – 80 % SI, 1.6 – 2.0 RI and 2.1 – 2.5 RI (86.17, 86.17, 85.83, 85.17 and 85.17 %, respectively) and First Class with N supplementation at 1.1 – 1.5 RI, 81 – 90 % SI, RDF and 71 – 80 % RI (85.50, 85.17, 85.10 and 85.00 %, respectively). Least uniformity ratio was noticed in N omission with First Class Bt genotype (83.67 %).

Further, Ajeet 155 with N supplementation at 1.1 - 1.5 RI and RDF recorded significantly higher fibre strength (27.77 and 28.00 g tex^{-1}, respectively) as compared to all other treatments except Ajeet 155 with N supplementation at 81 – 90 % SI (27.30 g tex^{-1}), which found at par with each other. Significantly lower fibre strength was noticed with N omission in First Class genotype during both the years (25.97 and 25.13 g tex^{-1}, respectively). The genotype, First Class with N supplementation at1.1 -1.5 RI (36.43 %) recorded significantly higher ginning percentage and it was found on par with First Class with N supplementation at 81 - 90 % SI and RDF (35.52 and 35.43 %, respectively) and Ajeet 155 with N supplementation at 1.1 -1.5 RI, 81 – 90 % SI and RDF (35.90, 34.95 and 34.75 %, respectively). However, significantly lower ginning percentage was recorded with N omission of both the genotypes (33.17 % with both the genotypes). Timing of fertilizer applications ensured the high availability of the applied nutrient corresponds to the peak nutrient requirements of the developing root system enhanced the quality of cotton fibre was reported by Gerik *et al.,* 1998. Similar findings were obtained by Amaresh (2018).

Micronaire value of cotton did not differ significantly in response to genotypes and also with different optical sensor based N management practices and their interactions. Significantly lower quality parameters were noticed with N omission and its interaction with both the genotypes. This might be due to nitrogen-deficient plants, yellowing of older leaves and mainly disruption of the chloroplast membrane and the accumulation of starch granules and lipid globules reduced the quality parameters of cotton (Malavolta *et al.*, 2004).

Conclusion

The results revealed that real time monitoring of cotton through GreenSeeker and N supplementation at 1.1 – 1.5 response index (RI) significantly influenced fibre span length, uniformity ratio and ginning percentage. Similarly real time monitoring through SPAD meter and N supplementation at 81–90 % SI significantly influenced fibre span length, uniformity ratio and ginning percentage. Both 1.1 – 1.5 RI and 81 – 90 % SI were found similar with RDF for fibre span length.

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