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Effect of moisture regimes and split application of nitrogen and potassium on quality parameters of *Bt* and non-*Bt* cotton genotypes

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Abstract
Field investigation was conducted in summer 2021 in order to study the effect of moisture regimes and split application of nitrogen and potassium on cotton quality parameters. Split plot design with three replications was chosen for experimental study. The main plot consists of four treatments with moisture regimes based on IW/CPE ratio (0.8 and 0.4) with RCH 659 hybrid (non *Bt*) cotton and RCH 659 BG II (*Bt*). Sub plot comprises of N and K application in split doses *viz.*, N_1 - 50% N and K as basal + 25% N and K at 45 DAS + 25% N and K at 60 DAS, N_2 - 25% N and K as basal+ 25% N and K at 45 DAS + 25% N and K at 60 DAS + 25% N and K at 75 DAS, N_3 - 50% N and K as basal + 12.5% N and K at 45 DAS + 12.5% N and K at 60 DAS+ 12.5% N and K at 75DAS + 12.5% N and K at 90 DAS, N_4 - 0% N and 50% K in basal + 25% N and 50% K at 45 DAS + 25% N at 60 DAS + 25% N at 75DAS + 25% N at 90 DAS with 16 treatment combinations in total. The results of the study revealed that RCH 659 BG II when irrigated at 0.8 IW/CPE ratio registered higher fibre quality (maturity ratio, bundle strength, uniformity index, elongation percentage micronaire value and span length) when compared to other moisture levels and non – *Bt* genotypes. There was no significant effect as regards split application of N and K. Interaction was also not significant.

Keywords: Cotton, irrigation, nitrogen, potassium, quality

Introduction
Cotton being a commercial fibre crop is cultivated all over the world owing to its necessary role in textile industry. India is the one of the major producers and stands second in chief raw cotton export. The textile industry of India contributes to around 5 percent GDP, 14 percent industrial production and 11 percent from export earnings. Bt cotton occupied maximum acreage for the past two decades in view of its enhanced yield, fiber quality and economic profitability. The fibre quality is the main attribute that determines the profitability of cotton. Fiber quality is driven by various factors such as cultivar, management aspects like irrigation and nutrient application, pest management besides climatic conditions in prevailing season (Sathishkumar *et al.*, 2021) [4] Quality of lint is affected by irrigation in multiple ways, especially at the time of fiber elongation stage, fiber length, strength, uniformity, fineness and micronaire (Witt *et al.*, 2020) [8]. Fibre strength is determined by the actin cytoskeleton formation which triggers the synthesis of secondary cell wall is negatively affected by moisture stress in cotton (Wang *et al.*, 2010) [7]. Scheduling irrigation at critical growth phases facilitates cotton plants to attain maximum growth resulting in production of more matured bolls with high fiber quality, besides alleviating stress. Impact of split application of N and K on yield and fiber quality are to be explored. Hence, the present study was undertaken with an objective to assess the influence of various moisture regimes and split application of nitrogen and potassium on fibre quality parameters of *Bt* and non-*Bt* genotypes.

Materials and Methods
A field study was carried out during summer 2021 in Agricultural College and Research Institute, Madurai for assessing the effect of irrigation levels and split application of nitrogen and potassium on fiber quality parameters in cotton.

The experiment was laid out in split plot design with three replications consisting of two different moisture regimes (IW/CPE ratio of 0.8 and 0.4) and two cotton genotypes RCH 659 hybrid (*Bt*) and RCH 659 BG II(non *Bt*) in main plot *viz.,* I_1V_1 – *Bt* cotton with IW/CPE ratio 0.8, I_1V_2 – Non- *Bt* cotton with IW/CPE ratio 0.8, I_2V_1 – *Bt* cotton with IW/CPE ratio 0.4 and I_2V_2 – Non- *Bt* cotton with IW/CPE ratio 0.4 and split application of N and K upto 90 days in sub plots. The sub plots comprises of N_1 - 50% N and K as basal + 25% N and K at 45 DAS + 25% N and K at 60 DAS, N_2 - 25% N and K as basal+ 25% N and K at 45 DAS + 25% N and K at 60 DAS + 25% N and K at 75 DAS, N_3 - 50% N and K as basal + 12.5% N and K at 45 DAS + 12.5% N and K at 60 DAS+ 12.5% N and K at 75DAS + 12.5% N and K at 90 DAS, N_4 - 0% N and 50% K in basal + 25% N and 50% K at 45 DAS + 25% N at 60 DAS + 25% N at 75DAS + 25% N at 90 DAS. Sowing was done during second week of February with a spacing of 90 x 60 cm. The recommended dose of 120: 60: 60 kg of NPK was applied through urea, single super phosphate and muriate of potash with full dose of P as basal wherein, recommended dose of N and K was applied as per treatments. The quality parameters were assessed by using Statex high volume instrument, TNAU Coimbatore.

Results and Discussion

Maturity ratio and uniformity index

Maturity ratio and uniformity index were significantly higher (0.88 and 83.84) with I_1V_1 – *Bt* cotton with IW/CPE ratio 0.8. Lower values (0.68 and 82.42) were obtained with the treatment I_2V_2 – Non- *Bt* cotton with IW/CPE ratio 0.4. Application of nutrient in split doses and interaction effect were found to be non-significant. The improvement in maturity ratio could be due to the better translocation of assimilated photosynthates as result of sufficient moisture levels at critical growth stages. Similar results were documented by (Hallikeri *et al.*, 2010) [2]. Application of nutrient in split doses in various time and interaction effect was found to be non-significant. Bhati and Manpreet (2015) [1] also documented that split application of N and K quality had no significant effect on fiber quality parameters.

Fiber length

Elongation percentage (5.91%), bundle strength (29.32 g tex^{-1}) and span length (0.64 mm) were maximum with I_1V_1 – *Bt* cotton with IW/CPE ratio 0.8 and I_2V_2 – Non- *Bt* cotton with IW/CPE ratio 0.4 recorded minimum values (5.26%, 27.29 g tex^{-1} and 30.22 mm) respectively. Split application of N and K at different stages and interaction had no significant effect. The fiber growth, strength and extension process primarily depends on the turgor pressure and supply of carbohydrate which is higher under sufficient moisture conditions whereas decline in plant moisture status and photosynthesis occurring under water stress conditions results in lesser fiber growth (Loka *et al.*, 2011) [3]. The results were confirmed by (Hallikeri *et al.*, 2010) [2] and (Srinivasana and Ananthi 2017). Split application of N and K was found non-significant. Similar results were confirmed by Bhati and Manpreet (2015) [1].

Fiber fineness

Micronaire value which is a measure of fiber fineness is mainly affected by irrigation, wherein the higher irrigation condition confronts to better cellulose deposition of seeds to lint and decreases with declining irrigation (Srinivasan and Ananthi 2017). *Bt* cotton genotype at 0.4 IW/CPE ratio (I_2V_1) attained higher micronaire value (4.96) which was followed by (I_2V_2) (4.72). The least value (4.37) was recorded under I_1V_1 treatment. The split application of N and K was found to be non-significant. The findings are in line with earlier research results of (Seilsepour and Rashidi 2011) [5].

Table 1: Effect of irrigation regimes and split application of nutrients on maturity ratio and uniformity index

Treatments	Maturity ratio					Uniformity index				
	I_1V_1	I_1V_2	I_2V_1	I_2V_2	Mean	I_1V_1	I_1V_2	I_2V_1	I_2V_2	Mean
N_1	0.81	0.78	0.74	0.71	0.76	83.61	83.63	83.01	82.47	83.18
N_2	0.86	0.80	0.74	0.70	0.77	83.85	83.48	83.11	82.57	83.25
N_3	0.87	0.81	0.74	0.66	0.77	84.00	83.39	82.52	82.37	83.07
N_4	0.97	0.86	0.72	0.64	0.80	83.89	83.22	82.47	82.26	82.96
Mean	0.88	0.81	0.74	0.68		83.84	83.43	82.78	82.42	
	IV	N	I at N	N at I			IV	N	I at N	N at I
S.Ed.	0.02	0.02	0.05	0.05		S.Ed.	0.12	1.58	4.46	4.46
C.D (0.05)	0.05	NS	NS	NS		C.D (0.05)	0.29	NS	NS	NS

Table 2: Effect of irrigation regimes and split application of nutrients on elongation (%) and bundle strength (g tex^{-1})

Treatments	Elongation (%)					Bundle strength (g tex^{-1})				
	I_1V_1	I_1V_2	I_2V_1	I_2V_2	Mean	I_1V_1	I_1V_2	I_2V_1	I_2V_2	Mean
N_1	5.81	5.66	5.27	4.96	5.42	29.28	29.19	28.39	27.95	28.70
N_2	5.91	5.44	5.45	5.25	5.51	29.27	28.67	28.16	27.36	28.37
N_3	5.93	5.81	5.61	5.40	5.69	29.14	28.47	27.81	26.58	28.00
N_4	5.98	5.86	5.63	5.43	5.73	29.60	28.36	27.36	27.27	28.15
Mean	5.91	5.69	5.49	5.26		29.32	28.67	27.93	27.29	
	IV	N	I at N	N at I			IV	N	I at N	N at I
S.Ed.	0.06	0.11	0.31	0.31		S.Ed.	0.18	0.55	1.56	1.56
C.D (0.05)	0.14	NS	NS	NS		C.D (0.05)	0.43	NS	NS	NS

Table 3: Effect of irrigation regimes and split application of nutrients on Micronaire value and 2.5 span length (mm)

Treatments	Micronaire value					2.5 span length (mm)				
	I_1V_1	$I_1 V_2$	$I_2 V_1$	$I_2 V_2$	Mean	I_1V_1	I_1V_2	I_2V_1	I_2V_2	Mean
N_1	4.43	4.21	5.03	4.76	4.61	31.32	31.11	30.78	30.33	30.88
N_2	4.38	4.16	4.96	4.74	4.56	31.56	31.19	30.59	30.27	30.90
N_3	4.33	4.10	4.92	4.72	4.52	31.82	31.26	30.78	30.20	31.02
N_4	4.33	4.00	4.90	4.66	4.47	31.88	31.34	30.97	30.08	31.07
Mean	4.37	4.12	4.96	4.72	4.54	31.64	31.23	30.78	30.22	
	IV	N	I at N	N at I			IV	N	I at N	N at I
S.Ed.	0.08	0.08	0.23	0.23		S.Ed.	0.14	0.63	1.78	1.78
C.D (0.05)	0.19	NS	NS	NS		C.D (0.05)	0.34	NS	NS	NS

Conclusion

From the results of the study it can be concluded that fiber quality parameters were higher when *Bt* -RCH 659 BG II was irrigated with IW/CPE ratio 0.8. However split application of N and K had no significant impact on fiber quality.

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