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RESEARCH ARTICLE

Optimization of Spacing and Fertilizer Requirement for Pre-release Cotton Varieties Under Irrigated Condition

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ABSTRACT

Field experiments were carried out at Cotton Research Station, Srivilliputtur from August to January 2017-18 and 2018 -19 to optimize fertilizer requirement of prerelease varieties of cotton with two levels of spacing under irrigated conditions. The experiments were conducted in a split-split-plot design with three replications. The treatments consisted of two pre-release cotton varieties (GSHV 177 and CCH 14-1 during 2017-18 and BGDS 1033 and CCH 15-1 during 2018 -19) in main plots and two levels of plant geometry (75 x 30 cm and 75 x 45 cm) in subplots and three doses of fertilizers (75 % RDF - 60:30:30 Kg NPK/ha, 100 % RDF - 80:40:40 Kg NPK / ha and 125% RDF- 100:50:50 Kg NPK/ha) were accommodated in sub-subplots. The results revealed that the genotypes GSHV 177 and CCH 15-1 performed better by producing taller plants, a higher number of sympodia, bolls per plant, and a number of bolls/m^2 with higher seed cotton yield and economic benefits. Adoption of normally recommended spacing of 75 x 30 cm recorded significantly more bolls production and higher seed cotton yield than the wider spacing of 75 x 45 cm during both the years of study. The effect of both 125 and 100 per cent RDF on a number of bolls / m^2 was on par. Application of 125 per cent RDF registered comparable seed cotton yield during 2017-18 and significantly higher than 100 per cent RDF during 2018-19. Higher total income, net income and benefit-cost ratio were also observed with under 75 x 30 cm spacing and 125 per cent RDF.

Keywords: Cotton varieties, economics, fertilizers, seed cotton yield, spacing.

INTRODUCTION

Cotton, also known as “white gold,” is an important fibre cum cash crop in India and Tamil Nadu as well. In Tamil Nadu, cotton is cultivated in an area of 1.42 lakh ha during 2015-16 with a production of 2.80 lakh bales and productivity of 599 kg/ ha which is below the world average yield of 788 kg/ ha (AICCIP, 2017). Fertilizer is one of the major input in cotton production. The response of cotton to applied nutrients, is governed by environment and cultural factors. Among various production factors, spacing and fertilization play a very significant role in efficient utilization of available sources. The cotton plant being a heavy feeder, needs proper fertilizer application. Balanced fertilization is one of the major key factors for sustaining and enhancing the cotton yields. Balanced fertilizer application is not only to maintain soil fertility but also for the proper functioning of plant mechanisms such as photosynthesis, metabolism, growth, and yield formation. Determination of optimum plant spacing with fertilizer dose for realizing optimum yield is necessary for maximum utilization of various resources like light, soil moisture and CO_2 to augment crop yield. The effect of nutrients may differ with spacing because of their profound impact on canopy structure, phrenological behavior, and fruiting pattern. Efficient cotton production packages from the modern agronomy of cotton with optimum spacing and fertilizer application explore the avenues for realizing the potential yields. With these background, the present studies were, undertaken to optimize the spacing and fertilizer requirement of promising prerelease cotton varieties.

MATERIAL AND METHODS

Field experiments were carried out at Cotton Research Station, Srivilliputtur from August to January 2017-18 and 2018 -19 to optimize fertilizer requirement of pre-release varieties of cotton with two levels of spacing under irrigated conditions. The experiments were conducted in a split- split-plot design with three replications. The treatments consisted of two pre-release cotton varieties (GSHV 177 and CCH 14-1 during 2017-18 and BGDS 1033 and CCH 15-1 during 2018 -19) in main plots, and two levels of plant geometry (75 x 30 cm and 75

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x 45 cm) in subplots and three doses of fertilizers (75 % RDF - 60:30:30 Kg NPK/ha, 100 % RDF - 80:40:40 Kg NPK/ha, 125% RDF- 100:50:50 Kg NPK /ha) were accommodated in sub- subplots. The soil of the experimental field was sandy clay loam with a pH of 8.3. The available nutrient N, P and K status of the soil was low (196 Kg /ha), high(40 Kg/ha), and high (440 Kg/ha), respectively. One-third dose of nitrogen and potash and a full dose of phosphorus was applied as a basal application at the time of sowing. Top dressing of remaining dose of nitrogen and potash was given as each one-third dose at 20 -25 and 40- 45 days after sowing. The sources of nutrients were urea (46% N), Single Superphosphate (46% P_2O_5) and Muriate of potash (60 % K_2O). All other recommended agronomic practices were followed uniformly. The biometric observation on plant height, yield attributes, and seed cotton yield were recorded, and economics were also worked out.

RESULTS AND DISCUSSION

Growth characters

The height of cotton genotypes at harvest during both the years of study and monopodia during 2018-19 was not significantly influenced by genotypes, spacing, and fertilizer levels. However, a significant variation in monopodia production was effected by genotypes only during 2017-18 (Table 1).

Table1. Effect of pre release varieties, spacing and fertilizer levels on growth and yield attributes of cotton

Treatments	Plant height at Harvest (cm)		Monopodia (No./plant)		Sympodia (No./plant)		Bolls (No./m^2)		Boll weight (g)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Pre release varieties										
V_1 (GSHV 177 during 2017-18 & CCH 14-1 during 2018 -19)	111.0	103.1	2.08	1.31	14.89	15.14	82.55	80.76	4.65	4.66
V_2 (BGDS 1033 during 2017-18 & CCH 15-1 during 2018 -19)	100.9	105.3	0.95	1.43	15.45	15.57	71.82	87.41	4.78	4.73
SE.d	4.42	4.19	0.29	0.27	0.27	0.24	2.58	2.21	0.07	0.80
CD (P=0.05)	NS	NS	0.80	NS	0.76	NS	7.17	6.01	NS	NS
Spacing										
Normal spacing (75 x 30 cm)	104.4	102.5	1.347	1.36	16.11	14.85	88.77	93.95	4.61	4.60
Wider spacing (75 x 45 cm)	102.4	101.4	1.444	1.48	15.65	15.02	61.53	71.20	4.65	4.77
SE.d	4.27	4.05	0.18	0.17	0.21	0.20	2.17	2.94	0.13	0.11
CD (P=0.05)	NS	NS	NS	NS	0.52	NS	5.33	5.88	NS	NS
Fertilizer levels										
75 % RDF (60:30:30 Kg NPK / ha)	100.2	98.6	1.245	1.22	15.30	14.44	71.60	75.97	4.47	4.38
100 % RDF (80:40 :40 Kg NPK /ha)	103.7	102.2	1.431	1.34	15.94	15.26	76.85	85.08	4.80	4.58
125 % RDF (100:50:50 Kg NPK/ ha)	106.4	106.8	1.511	1.43	16.40	15.39	77.04	91.22	5.06	4.71
SE.d	4.71	4.56	0.34	0.20	0.44	0.49	2.49	2.48	0.18	0.14
CD (P=0.05)	NS	NS	NS	NS	NS	NS	5.14	5.28	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Among the genotypes, CCH 14-1 produced significantly taller plants than GSHV 177. The results were in accordance with Singh *et al*. (2012), who observed the variation in plant height and monopodia by different cotton genotypes.

Yield attributes

Different genotypes, geometry, and levels of fertilizer exhibited significant influence on the number of sympodia during 2017-18 and the number of bolls per square meter during both the years of study (Table 1). Among the genotypes, GSHV 177 and CCH 15-1 produced the highest number of bolls per square meter than CCH 14-1 and BGDS 1033 respectively. Adoption of normal spacing of 75 x 30 cm produced significantly higher boll number per square meter than the wider spacing of 75 x 45 cm in both the years of experimentation. Though the nutrient levels did not significantly influence the sympodia production, application of 125 % RDF produced a significantly higher number of bolls than 100 % RDF and both were significantly higher than the lesser dose of 75 % RDF. However, genotypes, geometry, and levels of fertilizer did not show any significant effect on boll weight. Production of higher yield attributes under higher fertilizer dose may be because nitrogen helps in cell division and cell elongation, leading to an increased number of lateral branches. Kumar *et al*. (2011); and Sandeep Rawal *et al*. (2015), reported similar results of higher yield attributes with higher doses of fertilizers.

Seed cotton yield

The results revealed that the prerelease cotton varieties, spacing, and fertilizer levels exerted a significant effect on seed cotton yield (Table 2).

Table 2. Effect of pre release varieties, spacing and fertilizer levels on yield and economics of cotton

Treatments	Seed cotton yield (kg/ha)		Cost of cultivation (Rs/ ha)		Total Income (Rs/ ha)		Net Income (Rs/ ha)		B-C Ratio	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Pre release varieties										
V_1 (GSHV 177 during 2017-18 & CCH 14-1 during 2018 -19)	2015	1930	50800	52900	92690	94570	41890	41670	1.82	1.79
V_2 (BGDS 1033 during 2017-18 & CCH 15-1 during 2018 -19)	1745	2073	50800	52900	80270	101577	29470	48677	1.58	1.92
SE.d	70.1	73.2	-	-	-	-	-	-	-	-
CD (P=0.05)	194.2	NS	-	-	-	-	-	-	-	-
Spacing										
Normal spacing (75 x 30 cm)	2002	2098	50800	52900	92092	102802	41292	49902	1.81	1.94
Wider spacing (75 x 45 cm)	1819	1905	50100	52200	83674	93345	33574	41145	1.67	1.79
SE.d	57.7	70.1	-	-	-	-	-	-	-	-
CD (P=0.05)	141.2	141.2	-	-	-	-	-	-	-	-
Fertilizer levels										
75 % RDF (60:30:30 Kg NPK / ha)	1807	1718	50000	52100	83122	84182	33122	32082	1.66	1.62
100 % RDF (80:40 :40 Kg NPK /ha)	1921	2021	50800	52900	88366	99029	37566	46129	1.74	1.87
125 % RDF (100:50:50 Kg NPK/ ha)	2001	2266	51600	53600	92046	111034	40446	57434	1.78	2.07
SE.d	68.3	52.0	-	-	-	-	-	-	-	-
CD (P=0.05)	140.1	110.7	-	-	-	-	-	-	-	-
Interaction	NS	NS								

Among the genotypes, GSHV 177 produced the higher seed cotton yield (2015 kg/ha) than CCH 14-1 (1745 kg/ha) during 2017-18, but different varieties failed to produce significant variation during 2018-19. Singh *et al.*(2012) observed a significant difference among the cotton cultivars on seed cotton yield.

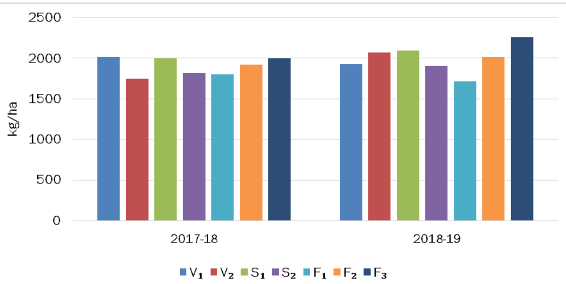

Figure 1. Effect of prerelease varieties, spacing and fertilizer levels on seed cotton yield

Concerning spacing, normal spacing significantly improved the seed cotton yield than wider spacing. During both the year of experimentation, the closer spacing of 75 x 30 cm produced higher seed cotton yield (2002 and 2098 kg/ha) than wider spacing of 75 x 45 cm (1819 and 1905 kg/ha during 2017-18 and 2018-9 respectively). A similar result of higher seed cotton yield with closer spacing was also reported by Shukla *et al.*(2013) and Divya *et al.* (2016). The higher seed cotton yield with closer spacing was due to higher yield attributes, and a higher plant population accommodated per unit area. Manjunatha *et al.* (2010) reported that increasing the plant density/unit land area increased the interplant competition within the plot for natural resources and because of higher competition between plants, the contribution of yield components/plant with closer spacing was lower when compared to wider spacing, but the loss in yield attributes/plant was compensated through higher plant population/ha.

Among the fertilizer doses, application of 125 per cent RDF registered seed cotton yield of 2001 and 2266 kg/ ha, during 2017-18 and 2018-19 respectively which were on par during 2017-18 and significantly higher than 100 per cent RDF during 2018-19 and both were significantly higher than 75 per cent RDF during both the years of study. Similar results of the significant increase in seed cotton yield with the application of higher fertilizer levels over RDF as reported by Ghongane *et al.* (2009), Venugopalan *et al.*(2009) and Pandagale *et al.* (2015) were in conformity with the present investigation. Significantly higher yield under higher fertilizer doses was due to the corresponding increase in bolls/plant and boll weight. The interaction effect was not significant.

Economics

The economic analysis clearly showed that the genotypes GSHV 177 and CCH 15-1 registered higher total income, net income, and Benefit-Cost ratio (BC / ratio) than BGDS 1033 and CCH 14-1. Regarding geometry, the normal spacing of 75 x 30 cm recorded higher net returns and BC ratio than the wider spacing of 75 x 45 cm during both the years of study. Among the fertilizer levels, 125 per cent RDF resulted in higher economic returns than other doses of fertilizers during both the years of experimentation. Association of higher economic returns with a higher plant population with closer spacing was noticed by Asewar *et al.* (2013) and Divya *et al.* (2016). Similar findings of higher economic benefits with higher dose of fertilizer in cotton was observed by Bharathi *et al. (*2016)

CONCLUSION

Thus it is concluded from the study that normal recommended spacing of 75 x 30 cm with 125 per cent recommended dose of fertilizers was optimum for prerelease varieties of cotton under irrigated conditions for higher yield and economic benefits.

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