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Performance of Compact Cotton Genotypes under High Density Planting System in Irrigated Ecosystem

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A B S T R A C T

A field experiment entitled "Performance of compact cotton genotypes under high density planting system in irrigated condition" was conducted at Agricultural College, Raichur during *Kharif* 2016-17 and 2017-18 on medium black soil, neutral in nature with low available nitrogen, medium phosphorus and high in potassium. The experiment was laid out in split plot design with three compact cotton genotypes *viz*., G_1: SCS-1206, G_2: DSC-99 and G_3: Suraj as main plot treatments and three planting geometries *viz*., S_1: 60 cm x 10 cm, S_2: 75 cm x 10 cm and S_3: 90 cm x 10 cm as sub plot treatments and it was compared with conventional system of cotton cultivation with Bt cotton hybrid ATM with recommended spacing of 90 cm x 60 cm. Among the different compact cotton genotypes, G_1: SCS-1206 recorded highest seed cotton yield (2886 kg ha^{-1}) followed by genotype G_3: Suraj (2754 kg ha^{-1}) which were significantly superior over genotype G_2: DSC-99 (2486 kg^{-1}). Among the different planting geometries, a closer row spacing of S_1: 60 cm x 10 cm recorded significantly higher seed cotton yield (2896 kg ha^{-1}) over a medium row spacing of S_2: 75 cm x 10 cm (2758 kg ha^{-1}) and significantly lower seed cotton yield was recorded with a wider row spacing of S_3: 90 cm x 10 cm (2472 kg ha^{-1}). Among the different combinations, the genotype G_1: SCS-1206 grown at S_1: 60 cm x 10 cm spacing recorded significantly higher seed cotton yield (3096 kg ha^{-1}) and it was found at par with the combination of same genotype G_1: SCS-1206 with S_2:75 cm x 10 cm spacing (2949 kg ha^{-1}) and genotype G_3: Suraj with S_1: 60 cm x 10 cm spacing (2923 kg ha^{-1}). cotton grown under conventional system with Bt cotton hybrid ATM at a recommended spacing of 90 cm x 60 cm recorded significantly lower seed cotton yield (2314 kg ha^{-1}) when compared with the all the treatment combinations of cotton grown under HDPS except with the combinations of genotype G_2: DSC-99 at S_2:75 cm x 10 cm spacing and genotype G_2: DSC-99 at S_3: 90 cm x 10 cm spacing (2525 and 2263 kg ha^{-1}, respectively).

Introduction

The concept HDPS is widely adopted by several countries such as China, Brazil, Uzbekistan, Australia, Argentina and several other countries where in plant population of 1,00,000 to 2,00,000 per hectare is maintained and high seed cotton yield of 40 to 90 quintals per hectare is realized. HDPS is more relevant to India to establish sustainable production system as the productivity of cotton is low in India. Compact cotton type of genotypes have the advantage of short sympodial branches with reduced inter-nodal length giving morphological feature of compressed habit and clustered boll habit on account of low vertical and horizontal growth it occupies minimum space. The HDPS cotton not only provides scope for double cropping and mechanized harvesting but also has the added advantage of requiring few pickings only. Therefore, which in turn reduces the labour cost as well as seed cost as farmers will use the varietal seeds during next sowing season.

Therefore, the present investigation was undertaken to find out the suitable compact cotton genotypes and planting geometry with a view to achieve high yield levels under irrigated ecosystem of North Eastern Dry zone of Karnataka.

Materials and Methods

A field experiment entitled "Performance of compact cotton genotypes under high density planting in irrigated ecosystem" was conducted at Agricultural College, UAS, Raichur during *Kharif* 2016-17 and 2017-18 on medium black soil, neutral in nature with low available nitrogen, medium phosphorus, rich in potassium. The climatic condition during experimental period was favorable and regular irrigation was provided to crop during both the years at later part of crop growth stages *i.e*, from 60 DAS to till first picking.

The experiment was laid out in split plot design with three compact cotton genotypes *viz*., G_1: SCS-1206, G_2: DSC-99, G_3: Suraj as main plot treatments and three planting geometries *viz*., S_1: 60 cm x 10 cm (1,66,666 plants ha^{-1}), S_2: 75 cm x 10 cm (1,33,333 plants ha^{-1}) and S_3: 90 cm x 10 cm (1,11,111 plants ha^{-1}) as sub plot treatments along with conventional system of cotton cultivation with Bt cotton hybrid ATM at a recommended spacing of 90 cm x 10 cm (uneven control)

Results and Discussion

Genotypes

Among the different compact cotton genotypes, G_1: SCS-1206 recorded higher seed cotton yield (2886 kg ha^{-1} on pooled basis) followed by genotype G_3: Suraj (2754 kg ha^{-1}) and which were significantly higher when compared with genotype G_2: DSC-99 (2486 kg ha^{-1}). This difference in seed cotton yield was mainly attributed to significant difference in yield components *viz*., number of bolls per plant (12.82 and 12.12, respectively on pooled basis), boll weight (3.73 and 3.54 g, respectively on pooled basis) and seed cotton yield per plant (25.98 and 24.40 g, respectively on pooled basis) and which was further due difference in growth attributes. Similar results were also reported by Udikeri and Shashidhara (2017), Ajaykumar *et al*. (2017) and Sankaryanana *et al*. (2018).

Planting geometry

Difference in seed cotton yield due to different planting geometry was evident. Among different row spacings, a closer spacing of S_1: 60 cm x 10 cm recorded significantly higher seed cotton yield (2896 kg ha^{-1} on pooled basis) when compared with the medium row spacing of S_2: 75 cm x 10 cm (2758 kg ha^{-1} on pooled basis) and wider row

spacing of S_3: 90 cm x 10 cm (2472 kg ha^{-1} on pooled basis). This differences in seed cotton yield was attributed to higher plant population per unit area even though the growth and yield attributes were lower when compared to recorded under medium and wider row spacings and increase in the number of plants per unit area could be compensated for decrease in yield components per plant under narrow spacing. Significantly superior seed cotton yield observed was mainly due to higher number of harvested bolls and higher plants population per unit area as supported findings of Alur (2016) and Devi *et al*. (2018).

Table.1 Plant growth attributing characters of compact cotton genotypes under high density planting system

Treatments	Plant height (cm)			Sympodials/plant			Total dry matter production (g $plant^{-1}$)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Main plots (G)									
G_1	128.96^{a}	114.12^{a}	121.54^{a}	13.00^{a}	12.44^{a}	12.72^{a}	130.52^{a}	122.92^{a}	126.72^{a}
G_2	121.89^{b}	95.96^{b}	108.92^{b}	11.29^{b}	10.91^{b}	11.10^{b}	112.65^{c}	103.89^{b}	108.27^{c}
G_3	133.31^{c}	120.51^{a}	126.91^{a}	12.47^{a}	11.98^{a}	12.22^{a}	125.69^{b}	116.88^{a}	121.29^{b}
S.Em±	**2.28**	**1.78**	**1.77**	**0.25**	**0.23**	**0.19**	**1.18**	**1.82**	**1.20**
Sub plots (S)									
S_1	137.09^{a}	120.58^{a}	128.83^{a}	9.91^{c}	9.56^{c}	9.73^{c}	110.86^{c}	101.26^{c}	106.06^{c}
S_2	129.67^{b}	111.84^{b}	120.75^{b}	11.98^{b}	11.64^{b}	11.81^{b}	121.41^{b}	112.93^{b}	117.17^{b}
S_3	117.40^{a}	98.18^{c}	107.79^{c}	14.87^{a}	14.13^{a}	14.50^{a}	136.60^{a}	129.49^{a}	133.05^{a}
S.Em±	**1.78**	**2.34**	**2.31**	**0.36**	**0.26**	**0.28**	**1.52**	**1.63**	**1.08**
Interactions (G x S)									
G_1S_1	139.13^{a}	125.46^{ab}	132.30^{ab}	10.33^{de}	10.13^{ef}	10.23^{ef}	118.08^{cd}	108.95^{cd}	113.52^{d}
G_1S_2	129.40^{a-c}	114.39^{bc}	121.90^{b-d}	12.93^{c}	12.20^{cd}	12.57^{c}	129.38^{b}	121.64^{b}	125.51^{b}
G_1S_3	118.33^{cd}	102.52^{cd}	110.43^{de}	15.73^{a}	15.00^{a}	15.37^{a}	144.10^{a}	138.16^{a}	141.13^{a}
G_2S_1	130.80^{a-c}	106.47^{cd}	118.63^{cd}	9.47^{e}	8.80^{f}	9.13^{f}	102.30^{e}	91.39^{e}	96.85^{f}
G_2S_2	123.40^{b-d}	97.54^{d}	110.47^{de}	10.73^{de}	10.87^{de}	10.80^{de}	110.46^{d}	102.72^{d}	106.59^{e}
G_2S_3	111.47^{d}	83.86^{e}	97.66^{e}	13.67^{bc}	13.07^{bc}	13.37^{bc}	125.20^{bc}	117.57^{bc}	121.39^{bc}
G_3S_1	141.33^{a}	129.8^{a}	135.57^{a}	9.93^{e}	9.73^{ef}	9.83^{ef}	112.21^{d}	103.45^{d}	107.83^{de}
G_3S_2	136.20^{ab}	123.57^{ab}	129.89^{a-c}	12.27^{cd}	11.87^{cd}	12.07^{cd}	124.38^{bc}	114.44^{bc}	119.41^{c}
G_3S_3	122.40^{cd}	108.16^{cd}	115.28^{d}	15.20^{ab}	14.33^{ab}	14.77^{ab}	140.49^{a}	132.75^{a}	136.62^{a}
S.Em±	**3.95**	**4.05**	**3.99**	**0.63**	**0.45**	**0.49**	**2.64**	**2.83**	**1.87**
Control	119.07	106.30	112.69	20.73	19.27	20.00	180.00	171.06	175.53
S.Em±	**3.64**	**3.72**	**3.67**	**0.57**	**0.44**	**0.45**	**2.70**	**2.89**	**1.83**
CD (P=0.05)	**10.82**	**11.05**	**10.92**	**1.69**	**1.30**	**1.34**	**8.01**	**8.59**	**5.43**

Table.2 Yield attributing characters of compact cotton genotypes under high density planting system

Treatments	Number of bolls/plant			Boll weight (g)			Seed cotton yield/plant (g)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Main plots (G)									
G_1	13.22^{a}	12.42^{a}	12.82^{a}	3.80^{a}	3.66^{a}	3.73^{a}	26.42^{a}	25.55^{a}	25.98^{a}
G_2	11.04^{b}	10.20^{b}	10.62^{b}	3.35^{b}	3.29^{b}	3.32^{c}	22.90^{c}	21.32^{c}	22.11^{c}
G_3	12.56^{a}	11.69^{a}	12.12^{a}	3.64^{a}	3.54^{a}	3.59^{b}	24.97^{b}	23.82^{b}	24.40^{b}
S.Em±	**0.32**	**0.20**	**0.24**	**0.05**	**0.05**	**0.03**	**0.27**	**0.33**	**0.16**
Sub plots (S)									
S_1	10.42^{c}	9.40^{c}	9.91^{c}	3.36^{c}	3.25^{b}	3.30^{b}	23.18^{c}	21.61^{c}	22.40^{c}
S_2	12.07^{b}	11.29^{b}	11.68^{b}	3.49^{b}	3.44^{b}	3.46^{b}	24.47^{b}	23.39^{b}	23.93^{b}
S_3	14.33^{a}	13.62^{a}	13.98^{a}	3.95^{a}	3.80^{a}	3.88^{a}	26.64^{a}	25.68^{a}	26.16^{a}
S.Em±	**0.21**	**0.21**	**0.19**	**0.03**	**0.11**	**0.06**	**0.35**	**0.46**	**0.26**
Interactions (G x S)									
G_1S_1	11.13^{c}	10.13^{c}	10.63^{c}	3.58^{bc}	3.41^{a-c}	3.50^{bc}	25.06^{b-d}	23.63^{bc}	24.35^{cd}
G_1S_2	13.07^{b}	12.33^{b}	12.70^{b}	3.71^{bc}	3.69^{ab}	3.70^{ab}	25.94^{bc}	25.40^{ab}	25.67^{bc}
G_1S_3	15.47^{a}	14.80^{a}	15.13^{a}	4.12^{a}	3.89^{a}	4.00^{a}	28.26^{a}	27.6^{a}	27.93^{a}
G_2S_1	9.40^{d}	8.47^{d}	8.93^{d}	3.06^{e}	3.01^{c}	3.03^{d}	21.15^{f}	19.37^{d}	20.26^{f}
G_2S_2	10.73^{c}	9.93^{c}	10.33^{c}	3.27^{de}	3.19^{bc}	3.23^{cd}	22.77^{ef}	21.13^{cd}	21.95^{e}
G_2S_3	13.00^{b}	12.20^{b}	12.60^{b}	3.73^{b}	3.66^{ab}	3.70^{ab}	24.77^{cd}	23.44^{bc}	24.11^{d}
G_3S_1	10.73^{c}	9.60^{c}	10.17^{c}	3.44^{cd}	3.32^{a-c}	3.38^{bc}	23.34^{de}	21.82^{cd}	22.58^{e}
G_3S_2	12.40^{b}	11.60^{b}	12.00^{b}	3.47^{b-d}	3.43^{a-c}	3.45^{bc}	24.68^{c-e}	23.64^{bc}	24.16^{d}
G_3S_3	14.53^{a}	13.87^{a}	14.20^{a}	4.02^{a}	3.86^{a}	3.94^{a}	26.89^{ab}	26.00^{ab}	26.45^{b}
S.Em±	**0.37**	**0.36**	**0.33**	**0.08**	**0.18**	**0.10**	**0.60**	**0.79**	**0.45**
Control	37.07	35.99	36.53	4.32	4.24	4.28	143.45	138.14	140.80
S.Em±	**0.50**	**0.41**	**0.43**	**0.09**	**0.17**	**0.08**	**1.37**	**0.88**	**0.77**
CD (P=0.05)	**1.47**	**1.21**	**1.26**	**0.28**	**0.50**	**0.24**	**4.08**	**2.49**	**2.29**

Table.3 Yield and economics of compact cotton genotypes under high density planting system

Treatments	Seed cotton yield (kg ha^{-1})			Net returns (□ ha^{-1})			B C Ratio		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Main plots (G)									
G_1	2962^{a}	2811^{a}	2886^{a}	84064^{a}	78629^{a}	81346^{a}	2.81^{a}	2.64^{a}	2.73^{a}
G_2	2584^{b}	2388^{b}	2486^{b}	67407^{b}	59609^{b}	63508^{b}	2.45^{b}	2.24^{b}	2.35^{b}
G_3	2842^{a}	2666^{a}	2754^{a}	78764^{a}	72104^{a}	75434^{a}	2.70^{a}	2.51^{a}	2.60^{a}
S.Em±	**55.58**	**52.77**	**53.73**	**2445**	**2375**	**2390**	**0.06**	**0.05**	**0.05**
Sub plots (S)									
S_1	2974^{a}	2819^{a}	2896^{a}	83661^{a}	78068^{a}	80865^{a}	2.77^{a}	2.60^{a}	2.69^{a}
S_2	2841^{b}	2675^{b}	2758^{b}	78840^{a}	72624^{a}	75732^{a}	2.71^{a}	2.52^{a}	2.61^{a}
S_3	2573^{c}	2371^{c}	2472^{c}	67734^{b}	59650^{b}	63692^{b}	2.49^{b}	2.27^{b}	2.38^{b}
S.Em±	**42.38**	**43.68**	**42.87**	**1865**	**1966**	**1908**	**0.03**	**0.05**	**0.03**
Interactions (G x S)									
G_1S_1	3156^{a}	3035^{a}	3096^{a}	91669^{a}	87803^{a}	89736^{a}	2.94^{a}	2.80^{a}	2.87^{a}
G_1S_2	3020^{ab}	2879^{ab}	2949^{ab}	86706^{ab}	81819^{ab}	84263^{ab}	2.88^{a}	2.71^{a}	2.80^{ab}
G_1S_3	2711^{cd}	2518^{cd}	2615^{cd}	73816^{cd}	66265^{cd}	70041^{cd}	2.62^{b-d}	2.41^{bc}	2.52^{cd}
G_2S_1	2761^{cd}	2579^{cd}	2670^{cd}	74304^{cd}	67283^{cd}	70793^{cd}	2.57^{cd}	2.38^{bc}	2.48^{cd}
G_2S_2	2621^{d}	2428^{d}	2525^{d}	69180^{d}	61524^{d}	65352^{d}	2.50^{d}	2.29^{cd}	2.39^{d}
G_2S_3	2368^{e}	2157^{e}	2263^{e}	58739^{e}	50020^{e}	54379^{e}	2.29^{e}	2.06^{d}	2.18^{e}
G_3S_1	3005^{ab}	2842^{ab}	2923^{ab}	85010^{ab}	79118^{ab}	82064^{ab}	2.80^{ab}	2.62^{ab}	2.71^{ab}
G_3S_2	2882^{bc}	2717^{bc}	2799^{bc}	80634^{bc}	74529^{bc}	77582^{bc}	2.75^{a-c}	2.56^{a-c}	2.65^{bc}
G_3S_3	2639^{cd}	2438^{d}	2539^{d}	70648^{cd}	62665^{d}	66657^{cd}	2.55^{d}	2.33^{c}	2.44^{d}
S.Em±	**73.40**	**75.65**	**74.25**	**3230**	**3404**	**33.05**	**0.07**	**0.08**	**0.06**
Control	2419	2208	2314	57848	49195	53522	2.19	1.98	2.09
S.Em±	**77**	**78**	**75**	**3383**	**3488**	**3331**	**0.07**	**0.07**	**0.07**
CD (P=0.05)	**228**	**230**	**222**	**10052**	**10364**	**9898**	**0.22**	**0.22**	**0.21**

Interaction effect

Interaction effect of compact cotton genotypes and planting geometries were found significant. Among the different combinations, interaction of genotype G_1: SCS -1206 with a row spacing of S_1: 60 cm x 10 cm recorded significantly higher seed cotton yield (3096 kg ha^{-1} on pooled basis) when compared to rest of treatment combination. However, it remained at par with the combination of G_1: SCS-1206 with a row spacing of S_2: 75 cm x 10 cm (2949 kg ha^{-1} on pooled basis) and genotype G_3: Suraj with a row spacing of S_1: 60 cm x 10 cm (2923 kg ha^{-1} on pooled basis). Further, cotton grown under conventional system with Bt cotton hybrid ATM at a recommended spacing of 90 cm x 60 cm recorded significantly lower seed cotton yield (2314 kg ha^{-1} on pooled basis) when compared with all the treatment combinations of cotton grown under HDPS except with the combination of genotype G_2: DSC-99 with a row spacing of S_2: 75 cm x 10 cm (2525 kg ha^{-1} on pooled basis) and genotype G_2: DSC-99 with a row spacing of S_3: 90 cm x 10 cm (2263 kg ha^{-1}, on pooled basis). The results are in line with the findings of Tuppad (2015) and Parlawar *et al*. (2017).

Economics

Among the different compact cotton types, genotype G_1: SCS-1206 and G_3: Suraj recorded significantly higher net returns (□ 81,346 and 75,434 ha^{-1} respectively on pooled basis) and BC ratio (2.73 and 2.60, respectively on pooled basis). While the genotype G_2: DSC-99 recorded significantly lower net returns (□ 63,508 ha^{-1} on pooled basis) and BC ratio (2.35 on pooled bases). Among different planting geometries, a closer row spacing of S_1: 60 cm x 10 cm recorded significantly higher net returns (□ 80,865 ha^{-1} on pooled basis) and BC ratio (2.69 on pooled basis) and it was found at par with medium row spacing of S_2: 75 cm x 10 cm (□ 75,732 ha^{-1} and 2.61, respectively on pooled basis). While, wider row spacing of S_3: 90 cm x 10 cm recorded significantly lower net returns and BC ratio (□ 63,692 ha^{-1} and 2.38, respectively on pooled basis). Among different interactions of cotton grown under HDPS, a combination of genotype G_1: SCS-1206 with row spacing of S_1: 60 cm x 10 cm recorded significantly higher net returns and BC ratio (□ 89,736 ha^{-1} and 2.87 , respectively on pooled basis) and found on par with combination of genotype G_1: SCS-1206 with a spacing of S_2: 75 cm x 10 cm (□ 84,263 ha^{-1} and 2.80, respectively on pooled basis) and genotype S_3: Suraj with a row spacing of S_1: 60 cm x 10 cm (□ 82,064 ha^{-1} and 2.71, respectively on pooled basis). Significantly lower net returns and BC ratio (□ 54,379 ha^{-1} and 2.18, respectively on pooled basis) was observed with combination of genotype G_2: DSC-99 with a row spacing of S_3: 90 cm x 10 cm. Cotton grown under conventional system with Bt cotton hybrid ATM with a recommended spacing of 90 cm x 60 cm recorded significantly lower economic values (□ 53,522 ha^{-1} and 2.09, respectively on pooled basis) when compared with the cotton grown under HDPS. This result was supported by findings of Tuppad (2015) and UdiKeri (2017).

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