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Influence of Management Practices on Yield and Economics of Compact Cotton Grown under HDPS in Irrigated Ecosystem

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A B S T R A C T

A field experiment was conducted at Department of Agronomy, Agricultural College, UAS, Raichur during *Kharif* season of 2016-17 and 2017-8 to know the effect of planting geometry, fertilizer levels along with growth retardant spray on seed cotton yield and economics of cotton grown under HDPS in irrigated condition. The experiment was laid out in split plot design consisting of three levels of 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}) in main plots and six levels of management practices *viz*., M_1: 60:30:30 N:P_2O_5:K_2O kg ha^{-1} M_2: 80:40:40 N:P_2O_5:K_2O kg ha^{-1}, M_3: 100:50:50 N:P_2O_5:K_2O kg ha^{-1}, M_4: M_1 + mepiqnat chloride @ 250 ppm sprayed at 60 DAS, M_5: M_2 + mepiquat chloride @ 250 ppm sprayed at 60 DAS and M_6: M_3 + mepiquat chloride @ 250 ppm sprayed at 60 DAS in sub plots. The result revealed that the closer row spacing of 60 cm x 10 cm produced significantly higher seed cotton yield (2875 kg ha^{-1}) over other planting geometries and significantly lower seed cotton yield (2388 kg ha^{-1}) was recorded under wider row spacing of 90 cm x 10. Among different fertilizer levels, application of 100:50:50 N:P_2O_5:K_2O kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recoded significantly higher seed cotton yield (2915 kg ha^{-1}) and lower was recorded with the application of 60:30:30 N:P_2O_5:K_2O kg ha^{-1} (2392 kg ha^{-1}). In case of economics, row spacing of 60 cm x 10 cm and 75 cm x 10 cm recorded significantly higher net returns (□ 78,121 ha^{-1} and □ 71,857 ha^{-1}, respectively) and BC ratio (2.57 and 2.48, respectively). Among fertilizer levels, application of 100:50:50 N:P_2O_5:K_2O kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recoded higher net returns (□ 79,870 ha^{-1}) and BC ratio (2.60) while significantly lower was observed with the application of 60:30:30 N:P_2O_5:K_2O kg ha^{-1} (□ 58,986 and 2.25, respectively).

Introduction

Cotton (*Gossypium hirsutum* L.) possesses a position of major fibre and cash crop, which plays a vital role to sustain economy of our country. It is an important cash crop of North Eastern Dry Zone of Karnataka. In Karnataka it is grown on area of 5.07 lakh hectares with a production of 18 lakh bales and productivity of 604 kg per hectare (Anon., 2017).

Among the various factors responsible for low yield of cotton in the country, low plant population and use of low potential varieties are of primary importance. Various techniques like maintaining suitable plant density, use of optimum fertilizer dose, growth retardants are being used to overcome these constraints in cotton production. Under this context, the concept of HDPS in cotton that is ideally suited for both rain fed and irrigated ecosystems has the potential of improving yield by increasing plant population by 3 to 4 folds over recommended plant population per hectare. Compact cotton produces excessive vegetative growth under the condition of higher fertility status of soil and irrigation resulting in mutual shading and shedding of reproductive parts, thereby reducing yield. This has led to the interest in the use of plant growth retardants as it prevents excessive vegetative growth.

Keeping these points in view, field investigation under irrigated condition was carried out to know the suitable planting geometry, optimum fertilizer level and growth retardant spray to get a sustained higher yield under HDPS system.

Materials and Methods

Field experiment entitled "Influence of management practices on yield and economics of compact cotton grown under HDPS in irrigated ecosystem" was conducted at Agricultural College, UAS, Raichur during 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 planting geometries *viz*., S_1: 60 cm x 10 cm (1,66,666 plants ha^{-1}), 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 main plot treatments and six fertilizer levels with growth retardant spray *viz*., M_1: 60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1}, M_2: 80:40:40 $N:P_2O_5:K_2O$ kg ha^{-1}, M_3: 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1}, M_4: M_1+ mepiquat chloride @ 250 ppm sprayed at 60 DAS, M_5: M_2 + mepiquat chloride @ 250 ppm sprayed at 60 DAS and M_6: M_3 + mepiquat chloride @ 250 ppm sprayed at 60 DAS as sub plot treatments with three replications.

Results and Discussion

Planting geometries

Among the different planting geometries, significantly higher seed cotton yield (2875 kg ha^{-1} on pooled basis) was recorded with a closer row spacing of 60 cm x 10 cm. Seed cotton yield was decreased significantly with further increase in row spacing and recorded lowest with the wider spacing of 90 cm x 10 cm (2388 kg ha^{-1} on pooled basis). This significant increase in the seed cotton yield was mainly due to the higher plant population per unit area even though the yield attributes were lower compared to the yield attributes recorded under wider row spacing and due to the fact that increase in plants per unit area could compensated for the decrease in yield components per plant under narrow row spacing. Similar results were also reported by Tuppad (2015) and Udikeri (2017).

Fertilizer levels with growth retardant spray

Significant difference in seed cotton yield was noticed with different fertilizer levels with growth retardant spray. Application of higher fertilizer dose of 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recorded significantly higher seed cotton yield (2915 kg ha^{-1} on pooled basis) while significantly lower seed cotton yield (2392 kg ha^{-1} on pooled basis) was observed with the application of lower fertilizer dose of 60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1}. It could be attributed to the significant difference in number of bolls per plant and seed cotton yield per plant. Similar result was also reported by Ikbal *et al*. (2007), Tuppad (2015) and Malakannavar (2017).

Interaction effect

Different treatment combinations influenced significantly on seed cotton yield. Combination of closer row spacing of 60 cm x 10 cm along with the application of higher fertilizer dose of 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recorded significantly higher seed cotton yield (3178 kg ha^{-1} on pooled basis) and it was found on par with the combination of closer row spacing of 60 cm x 10 cm along with the application of medium fertilizer dose of 80:40:40 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS (3103 kg ha^{-1} on pooled basis). Whereas, significantly lower seed cotton yield was observed with the combination of wider row spacing of 90 cm x 10 cm along with the application of lower fertilizer dose of 60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1} (2170 kg ha^{-1} on pooled basis). These results are in close conformity with the finding of Yasari and Vahed (2012), Malakannavar (2017) and Udikeri (2017).

Economics

Among different planting geometries, significantly higher gross returns, net returns and BC ratio was recorded with the closer row spacing of 60 cm x 10 cm (Rs. 1,27,895 ha^{-1}, Rs. 78,121 ha^{-1} and 2.57, respectively on pooled basis) and economic returns were decreased with increase in row spacings and recorded significantly lower gross returns, net returns and BC ratio with the wider row spacing of 90 cm x 10 cm (Rs. 1,06,212 ha^{-1}, Rs. 58,653 ha^{-1} and 2.23, respectively on pooled basis). Among the different fertilizer levels with mepiquat chloride spray, application of higher fertilizer dose of 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recorded significantly higher gross returns, net returns and BC ratio (Rs. 1,29,666 ha^{-1}, Rs. 79,870 ha^{-1} and 2.60, respectively on pooled basis). Whereas, significantly lower economic values were recorded with the application of lower fertilizer dose of 60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1} (Rs. 1,06,371 ha^{-1}, Rs. 58,986 ha^{-1} and 2.25, respectively on pooled basis). The difference in economic values may be attributed to difference in seed cotton yield.

Interaction effect also influenced significantly on economic values of cotton grown under HDPS. A treatment combination of closer row spacing of 60 cm x 10 cm along with the application of higher fertilizer dose of 100:50:50 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS recorded significantly higher gross returns, net returns and BC ratio (Rs. 1,41,372 ha^{-1}, Rs. 90,396 ha^{-1} and 2.78, respectively on pooled basis) and it was remained at par with the combination of closer row spacing of 60 cm x 10 cm along with the application of medium fertilizer dose of 80:40:40 $N:P_2O_5:K_2O$ kg ha^{-1} + mepiquat chloride @ 250 ppm sprayed at 60 DAS (Rs. 1,33,995 ha^{-1}, Rs. 84,068 ha^{-1} and 2.69, respectively on pooled basis). Whereas, significantly lower economic values were recorded with the combination of wider row spacing of 90 cm x 10 cm along with the application of lower fertilizer dose of 60:30:30 $N:P_2O_5:K_2O$ kg ha^{-1} (Rs. 96,516 ha^{-1}, Rs. 50,165 ha^{-1} and 2.09, respectively on pooled basis). Similar results were also reported by Malakannavar (2017) and Udikeri (2017).

Table.1 Yield attributing characters and yield of compact cotton genotype as influenced by management practices under high density planting system

Treatments	Number of bolls/plant			Seed cotton yield/plant (g)			Seed cotton yield (kg ha^{-1})		
	2016-17	**2017-18**	**Pooled**	**2016-17**	**2017-18**	**Pooled**	**2016-17**	**2017-18**	**Pooled**
Main plots (S)									
S_1	9.91^{c}	8.24^{c}	9.08^{c}	26.71^{c}	24.53^{c}	25.62^{c}	3003^{a}	2748^{a}	2875^{a}
S_2	11.28^{b}	9.98^{b}	10.63^{b}	28.87^{b}	26.34^{b}	27.60^{b}	2836^{b}	2574^{b}	2705^{b}
S_3	13.49^{a}	11.99^{a}	12.74^{a}	31.71^{a}	28.95^{a}	30.33^{a}	2511^{c}	2266^{c}	2388^{c}
S.Em±	**0.12**	**0.21**	**0.16**	**0.38**	**0.37**	**0.36**	**32.35**	**29.97**	**23.96**
Sub plots (M)									
M_1	10.18^{c}	8.53^{d}	9.36^{c}	25.06^{d}	22.88^{e}	23.97^{e}	2513^{e}	2271^{e}	2392^{d}
M_2	10.91^{bc}	9.56^{c}	10.23^{b}	28.06^{c}	25.63^{cd}	26.85^{cd}	2715^{cd}	2471^{cd}	2593^{c}
M_3	11.44^{b}	10.22^{bc}	10.83^{b}	29.88^{b}	27.19^{bc}	28.53^{bc}	2846^{bc}	2586^{bc}	2716^{b}
M_4	11.29^{b}	9.67^{c}	10.48^{b}	27.41^{c}	25.10^{d}	26.25^{d}	2675^{d}	2409^{d}	2542^{c}
M_5	12.44^{a}	10.82^{ab}	11.63^{a}	31.03^{b}	28.52^{ab}	29.78^{b}	2904^{ab}	2656^{ab}	2780^{b}
M_6	13.09^{a}	11.62^{a}	12.36^{a}	33.13^{a}	30.32^{a}	31.73^{a}	3049^{a}	2782^{a}	2915^{a}
S.Em±	**0.28**	**0.33**	**0.26**	**0.61**	**0.64**	**0.59**	**54.82**	**47.10**	**37.31**
Interactions (S x M)									
S_1M_1	8.73^{h}	7.20^{g}	7.97^{i}	23.24^{g}	21.24^{i}	22.24^{h}	2695^{c-f}	2443^{d-f}	2569^{gh}
S_1M_2	9.33^{gh}	7.87^{fg}	8.60^{hi}	26.04^{e-g}	23.81^{f-i}	24.93^{f-h}	2927^{b-d}	2678^{b-d}	2803^{c-f}
S_1M_3	9.73^{f-h}	8.20^{e-g}	8.97^{g-i}	27.07^{d-f}	24.79^{e-i}	25.93^{e-g}	3075^{ab}	2822^{a-c}	2948^{b-d}
S_1M_4	9.73^{f-h}	7.87^{fg}	8.80^{hi}	25.30^{e-g}	23.22^{g-i}	24.26^{f-h}	2879^{b-d}	2605^{c-e}	2742^{d-g}
S_1M_5	10.80^{e-g}	8.93^{e-g}	9.87^{f-h}	28.62^{de}	26.44^{d-g}	27.53^{d-f}	3135^{ab}	2890^{ab}	3013^{ab}
S_1M_6	11.13^{ef}	9.40^{d-f}	10.27^{e-g}	29.96^{cd}	27.67^{b-e}	28.82^{c-e}	3307^{a}	3050^{a}	3178^{a}
S_2M_1	9.93^{f-h}	8.33^{e-g}	9.13^{g-i}	24.81^{fg}	22.59^{hi}	23.70^{gh}	2559^{e-g}	2312^{f-i}	2436^{hi}
S_2M_2	10.67^{e-g}	9.33^{d-f}	10.00^{f-h}	27.79^{d-f}	25.32^{e-h}	26.55^{d-g}	2765^{c-e}	2515^{d-f}	2640^{e-h}
S_2M_3	11.13^{ef}	10.07^{c-e}	10.60^{ef}	29.84^{cd}	27.04^{c-f}	28.44^{c-e}	2900^{b-d}	2630^{b-e}	2765^{c-g}
S_2M_4	11.00^{ef}	9.60^{d-f}	10.30^{e-g}	27.10^{d-f}	24.74^{e-i}	25.92^{e-g}	2724^{c-f}	2453^{d-g}	2588^{gh}
S_2M_5	12.13^{c-e}	11.00^{b-d}	11.57^{c-e}	30.62^{b-d}	28.16^{b-e}	29.39^{b-d}	2963^{bc}	2703^{b-d}	2833^{b-e}
S_2M_6	12.80^{cd}	11.53^{bc}	12.17^{b-d}	33.04^{bc}	30.19^{a-c}	31.62^{b-c}	3107^{ab}	2829^{a-c}	2968^{bc}
S_3M_1	11.87^{de}	10.07^{c-e}	10.97^{d-f}	27.13^{d-f}	24.80^{e-i}	25.96^{e-g}	2283^{g}	2057^{i}	2170^{j}
S_3M_2	12.73^{cd}	11.47^{bc}	12.10^{b-d}	30.36^{cd}	27.78^{b-e}	29.07^{c-e}	2452^{e-g}	2220^{g-i}	2336^{ij}
S_3M_3	13.47^{bc}	12.40^{ab}	12.93^{bc}	32.72^{bc}	29.72^{a-d}	31.22^{bc}	2562^{e-g}	2306^{f-i}	2434^{hi}
S_3M_4	13.13^{b-d}	11.53^{bc}	12.33^{b-d}	29.81^{cd}	27.33^{b-f}	28.57^{c-e}	2421^{fg}	2169^{hi}	2295^{ij}
S_3M_5	14.40^{ab}	12.53^{ab}	13.47^{ab}	33.86^{ab}	30.96^{ab}	32.41^{ab}	2612^{d-f}	2375^{e-h}	2494^{hi}
S_3M_6	15.33^{a}	13.93^{a}	14.63^{a}	36.40^{a}	33.11^{a}	34.75^{a}	2733^{c-f}	2466^{d-g}	2600^{f-h}
S.Em±	**0.49**	**0.57**	**0.44**	**1.06**	**1.11**	**1.02**	**94.95**	**81.59**	**64.62**

Table.2 Economics of compact cotton genotype as influenced by management practices under high density planting system

Treatments	**Gross returns** (Rs. **ha^{-1}**)			**Net returns** (Rs. **ha^{-1}**)			**B C Ratio**		
	2016-17	**2017-18**	**Pooled**	**2016-17**	**2017-18**	**Pooled**	**2016-17**	**2017-18**	**Pooled**
Main plots (S)									
S_1	132130^{a}	123660^{a}	127895^{a}	83408^{a}	72834^{a}	78121^{a}	2.71^{a}	2.43^{a}	2.57^{a}
S_2	124799^{b}	115813^{b}	120306b	77403^{b}	66311^{b}	71857^{b}	2.63^{a}	2.34^{a}	2.48^{a}
S_3	110472^{c}	101953^{c}	106212^{c}	63966^{c}	53341^{c}	58653^{c}	2.37^{b}	2.10^{b}	2.23^{b}
S.Em±	**1423**	**1349**	**1065**	**1423**	**1349**	**1065**	**0.03**	**0.02**	**0.02**
Sub plots (M)									
M_1	110557^{e}	102185^{e}	106371^{d}	64224^{d}	53747^{d}	58986^{e}	2.38^{d}	2.11^{d}	2.25^{c}
M_2	119445^{cd}	111190^{c-d}	115318^{c}	72045^{c}	61685^{c}	66865^{cd}	2.52^{cd}	2.24^{cd}	2.38^{b}
M_3	125204^{bc}	116370^{b-c}	120787^{b}	76756^{bc}	65817^{bc}	71287^{bc}	2.58^{bc}	2.30^{bc}	2.44^{b}
M_4	117680^{d}	108410^{d}	113045^{c}	71052^{cd}	59677^{cd}	65365^{d}	2.52^{cd}	2.22^{cd}	2.37^{b}
M_5	127756^{ab}	119520$_{ab}$	123638^{b}	80061^{ab}	69720^{ab}	74891^{b}	2.68^{ab}	2.40^{ab}	2.54^{a}
M_6	134156^{a}	125175^{a}	129666^{a}	85413^{a}	74327^{a}	79870^{a}	2.75^{a}	2.46^{a}	2.60^{a}
S.Em±	**2412**	**2120**	**1658**	**2412**	**2120**	**1658**	**0.05**	**0.05**	**0.03**
Interactions (S x M)									
S_1M_1	118595^{c-f}	109950^{d-g}	114272^{gh}	71082^{e-h}	60332^{d-h}	65707^{ef}	2.50^{c-f}	2.22^{d-g}	2.36^{e-h}
S_1M_2	128788^{b-d}	120510^{b-d}	124649^{g-f}	80208^{b-f}	69825^{b-e}	75017^{b-e}	2.65^{a-e}	2.38^{a-e}	2.51^{b-e}
S_1M_3	135285^{ab}	126975^{a-c}	131130^{b-d}	85657^{a-d}	75242^{a-c}	80450^{bc}	2.73^{a-d}	2.45^{a-d}	2.59^{b-d}
S_1M_4	126661^{b-d}	117240^{c-e}	121951^{d-g}	78853^{b-g}	67327^{b-f}	73090^{c-e}	2.65^{a-e}	2.35^{b-f}	2.50^{c-e}
S_1M_5	137940^{ab}	130050^{ab}	133995^{ab}	89065^{ab}	79070^{ab}	84068^{ab}	2.82^{ab}	2.55^{ab}	2.69^{ab}
S_1M_6	145508^{a}	137235^{a}	141372^{a}	95585^{a}	85207^{a}	90396^{a}	2.91$_{a}$	2.64^{a}	2.78^{a}
S_2M_1	112611^{e-g}	104040^{f-i}	108325^{hi}	66423^{f-i}	55747^{f-i}	61085^{fg}	2.44^{e-g}	2.15^{e-h}	2.30^{f-h}
S_2M_2	121645^{c-e}	113160^{d-f}	117403^{e-h}	74390^{c-h}	63800^{c-g}	69095^{d-f}	2.57^{b-f}	2.29^{b-g}	2.43^{d-g}
S_2M_3	127585^{b-d}	118365^{b-e}	122975^{c-g}	79282^{b-g}	67957^{b-e}	73620^{c-e}	2.64^{a-e}	2.35^{b-f}	2.49^{c-f}
S_2M_4	119841^{c-f}	110370^{d-g}	115106^{gh}	73358^{d-h}	61782^{d-h}	67570^{ef}	2.58^{b-f}	2.27^{c-g}	2.42^{d-g}
S_2M_5	130387^{bc}	121635^{b-d}	126011^{b-e}	82837^{a-e}	71980^{b-d}	77408^{b-d}	2.74^{a-c}	2.45^{a-d}	2.60^{a-d}
S_2M_6	136723^{ab}	127305^{a-c}	132014^{bc}	88125^{a-c}	76602^{ab}	82363^{a-c}	2.81^{ab}	2.51^{a-c}	2.66^{a-c}
S_3M_1	100467^{g}	92565^{i}	96516^{j}	55169^{i}	45162^{i}	50165^{h}	2.22^{g}	1.95^{h}	2.09^{i}
S_3M_2	107903^{e-g}	99900^{g-i}	103901^{ij}	61538 ^{hi}	51430^{hi}	56484^{gh}	2.33^{fg}	2.06^{gh}	2.19^{hi}
S_3M_3	112743^{e-g}	103770^{f-i}	108256^{hi}	65330 $^{g-i}$	54252^{g-i}	59791^{fg}	2.38^{e-g}	2.10^{f-h}	2.24^{g-i}
S_3M_4	106539^{fg}	97620^{hi}	102079^{ij}	60946 $^{h-i}$	49922^{hi}	55434^{gh}	2.34^{fg}	2.05^{gh}	2.19^{hi}
S_3M_5	114943^{d-f}	106875^{e-h}	110909^{hi}	68283 $^{f-i}$	58110^{e-h}	63196^{fg}	2.46^{d-g}	2.19^{d-h}	2.33^{e-h}
S_3M_6	120237^{c-f}	110985^{d-g}	115611^{f-h}	72529 $^{d-h}$	61172^{d-h}	66851^{ef}	2.52^{c-f}	2.23^{d-g}	2.37^{e-h}
S.Em±	**4178**	**3671**	**2871**	**4178**	**3671**	**2871**	**0.08**	**0.08**	**0.06**

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