



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; 7(5): 419-424

Received: 13-02-2024

Accepted: 17-03-2024

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Comparative study of high-density planting straight cotton varieties with normal sown Bt hybrids

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i5f.712>

Abstract

Experimental data revealed that three-year (2020-2022) experiment and pooled analysis, it was observed that all the varieties exhibited early maturity, if sowing of cotton done with spacing 60cm x 20cm. Varieties sown under HDPS produces lesser number of bolls than normally sown hybrids, however produced a higher total boll numbers in particular area. Hybrid Rasi Magic, (51.1) was recorded significantly maximum bolls on plant basis, however, it was produced a minimum count of bolls per square meter (70.3), in contrast, the minimum boll number on plant basis were found under HDPS, but it was maximum under area basis and it has affected on seed cotton yield per plot and hectare. The genotype RHC-1651 exhibited maximum seed cotton yield under HDPS planting (52.7 q/ha), followed by Phule-688 (45.5 q/ha). However, in conventional sowing Bt cotton hybrids, Rasi Magic (35.5 q/ha), Dhanev (33.6 q/ha) and Ajeet-1155 (31.6 q/ha) and Dhanev (34.73 q/ha) exhibited minimum yield of seed cotton as compared to varieties under HDPS. Normal sowing of Bt cotton hybrids at 120 cm x 60 cm spacing, yield of seed cotton was found to be decreased because plant-to-plant and row-to-row spacing was more which caused plant population reduction which has ultimately resulted in yield reduction. It was revealed that varieties planted under HDPS recorded the more gross returns (RHC-1651-Rs. 321023 ha⁻¹), net returns (Rs. 206113 ha⁻¹) and B: C ratio (2.8) as compared to another varieties under HDPS and Bt hybrids under normal sowing.

Keywords: HDPS, Bt hybrid, cotton, straight varieties

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important cash and fibre crop in the world. Cultivation of this crop observed in tropical as well as sub-tropical regions, as most of the developed as well as developing countries. The agricultural and industrial economy of world is significantly influenced by cotton crop. Textile industries of India prominently depend on an average 60 per cent of cotton fibre. Our country having large area under this crop, India has one-third (13.40 million ha) of the global area (32.94 million ha), with significant lower productivity (487 kg/ha) as compared to the world's productivity (775 kg/ha) [Foreign Agricultural Service - September (2020)]^[1]. Many countries like Brazil, China, Turkey, and Australia have a maximum yield per hectare area as more than 1500 kg/ha. As regards China, cultivation with less than one-fourth area of the India (3.25 million ha) produces 27.25 million 480 lb. bales (as projected by USDA), which were compared to the Indian production as 30.00 million 480 lb. bales from 13.40 million ha. This has showing the considerable productivity breach with through India for cotton.

Moreover, the present-day cotton hybrids having a nature to produces maximum biomass and speed growth as well as spreading plant types. Accordingly, earliness as well as boll retention ratio if calculated found to lesser. We have need to match the ratio of earliness as well as boll retention with crop requirements like as a irrigation, maturity period, fertilizers, yield per unit area and per day productivity etc. A new technology arrived, a High Density Planting System (HDPS) by way of early maturing, compact or semi-compact lines as well as varieties for contributing maximum yield of seed cotton with minimum cost of cultivation in relation to rainfed as well irrigated situations. The major doctrine of this systems to retain maximum plant population (up to 1 lakh per hectare) with uniform boll retentions, maturation and bursting, it has capacity to adapt to certain situations and efficiency to utilization of nutrients etc.

The newly developed concept of 'High-Density Planting Systems' (HDPS) has the prospective to improve the productivity of rainfed cotton in India. HDPS cotton with straight varieties was found to be a viable option to improve the productivity of cotton by reduced costs of production. Under HDPS situations, a plant produces fewer bolls as compared to normally sown cotton, but maintains higher number of total bolls per meter square. An experiment was conducted on the field for three years at All India Coordinated Cotton Improvement Project M.P.K.V., Rahuri to evaluate the yield potential and economics of straight varieties under HDPS planting in comparison with Bt cotton hybrids under normal sowing.

Materials and Methods

Research investigation was carried out at All India Coordinated Cotton Improvement Project M.P.K.V., Rahuri during the *Kharif-2020 to Kharif 2022 for three years* in three replications with Randomised Block Design. The experimental material consists of five straight cotton varieties developed by MPKV, Rahuri and three Bt cotton Hybrids developed by the private sector. Straight varieties under HDPS were planted at 60cm x 20cm spacing with 12 lines and Bt cotton hybrids were planted with normal sowing by spacing 120cm x 60cm with 6 lines. Observations were recorded of 10 plants of each variety from three replications and data were analyzed by using

statistical software.

Table 1: Experimental material and details

Name of Genotype	Source	Plant Spacing (cm)
Phule 688	MPKV, Rahuri	60x20
Phule Yamuna	MPKV, Rahuri	60x20
RHC-1406	MPKV, Rahuri	60x20
RHC-1651	MPKV, Rahuri	60x20
RHC-1217	MPKV, Rahuri	60x20
Rasi Magic BG II	Private sector	120x60
Dhandev BG II	Private sector	120x60
Ajeet 111 BG II	Private sector	120x60

Weather report

Total rainfall received at All India Coordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri during the crop growth cycle 2020 was 1240 mm on 60 rainy days as against average rainfall of 535 mm, which is (+) 131.42 per cent excess than the average. In 2021 total of 964.5 mm of rainfall was received in 54 rainy days and 2022 it was 1028 mm in 55 rainy days. However, there was an uneven distribution of rainfall during the crop season of all three years. Mostly out of the total rainfall, more than 50 per cent of rainfall was received from the last week of September and the first and second week of October months.

Year	Date of sowing	Date of harvesting	Rainfall	Rainy days
2020	25.06.2020	1 st -02.11.2020 2 nd - 20.11.2020	1240.2	60
2021	28.06.2021	1 st -10.11.2021 2 nd - 25.11.2021	964.5	54
2022	20.06.2022	1 st -28.10.2022 2 nd - 12.11.2022	1028.4	55

Results and Discussion

Phenological and growth characteristics

As per the data revealed that for three year (2020-2022) experiment and pooled analysis, all the varieties exhibited early maturity, as sowing was done at a spacing of 60cm x 20cm. Plant height was observed more in hybrids sown in normal conditions as compared to varieties grown under HDPS. Under HDPS lower number of monopodia per plant was recorded in varieties, while hybrids under normal sowing produced more monopodia and sympodia per plant. Earlier authors, Wankhade *et al.*, (2003) [8]; Narayana *et al.*, (2007) [6], Sisodia and Khamparia (2007) [7], and Wagh *et al.*, (2021) [9] proposed the similar results regarding HDPS planting. The maximum number of sympodia was recorded in hybrid Dhandev 111 (17.4) followed by Hybrid Ajeet 1155 (17.0). In the HDPS planting system lower number of monopodia and a more number of sympodia are desirable characteristics, which retain maximum number of bolls and seed cotton yield per unit area and that kind of varieties are highly suitable for HDPS planting.

Yield contributing characters and seed cotton yield

Varieties sown under HDPS produced lesser bolls count as compared to normally sown hybrids, but more number of total bolls based on area produced by varieties. Considerably more bolls number per plant was exhibited by hybrid Rasi Magic (51.1), however, it was produced a lower number of bolls per square meter (70.3), on the contrary, the boll numbers per plant was minimum under HDPS, however maximum under per meter

square area and it has directly affected on seed cotton yield of plot and hectare. Hybrids sown under wider spacing (120 cm x 60 cm) exhibited superior growth of individual plants, the boll numbers of plant was found maximum but the bolls number per unit area was found lesser. The generally distanced sowing of plants received optimum sunlight's as well as its resulted in development of microclimate which produced a advantageous effects on plant growth and development. This type of results also reported by Wagh *et al.*, (2021) [9] and Nehra and Chandra (2001) [5].

The average weight of boll was notably affected as changing plant geometry as well as densities as reported by Moola and Giri (2006) [4] and Wagh *et al.*, (2022) [9]. Cotton sowing with 60 cm x 20 cm spacing found noticeably lesser boll weight as compared to spaced planting or normally sowing. The variety RHC-1651, exhibited the maximum yield of seed cotton under HDPS planting (52.7 q/ha), followed by Phule-688 (45.5 q/ha). However, in conventional sowing Bt cotton hybrids Rasi Magic (35.5 q/ha), Dhandev (33.6 q/ha) and Ajeet-1155 (31.6 q/ha) and Dhandev (34.73 q/ha) were exhibited minimum yield of seed cotton as compared to varieties sown under HDPS. Normal sowing of Bt cotton hybrids at 120 cm x 60 cm spacing, yield of seed cotton was observed to be decreased because plant-to-plant and row-to-row spacing was more which caused plant population reduction which has ultimately resulted in yield reduction. These above motioned results are accordance with the results reported by Giri and Gore (2006) [3]; Buttar and Singh (2007) [2]; Narayana and Aparna (2011) [6].

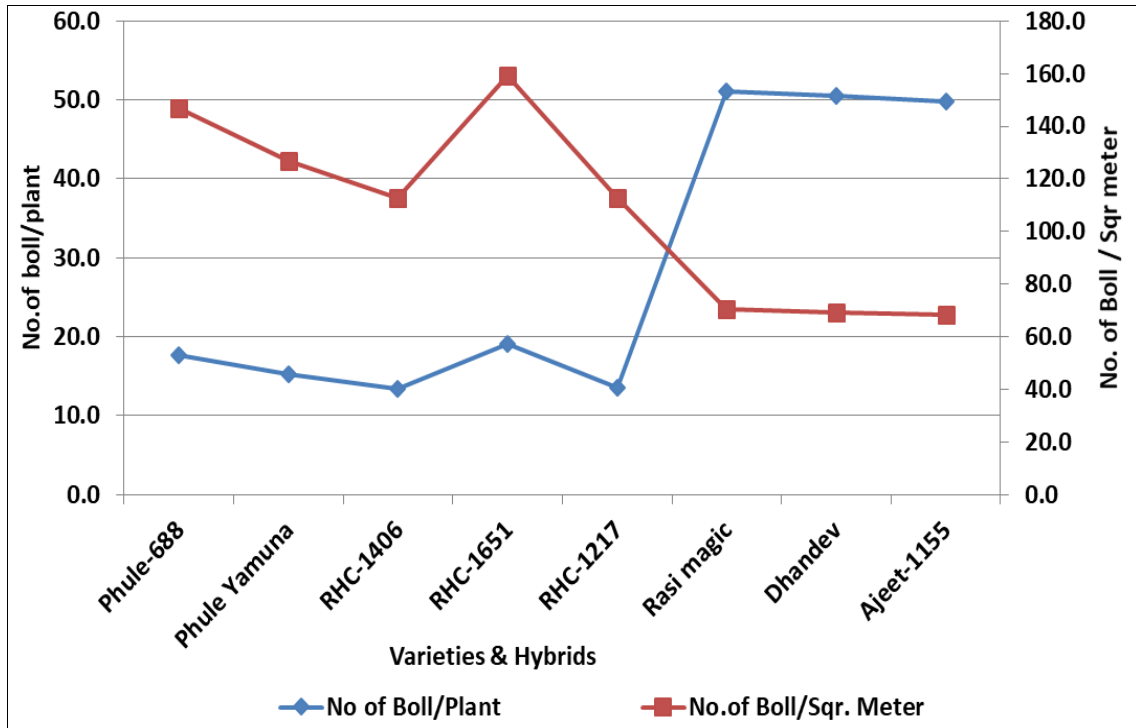


Fig 1: Number of bolls per plant and unit area by different varieties and hybrids

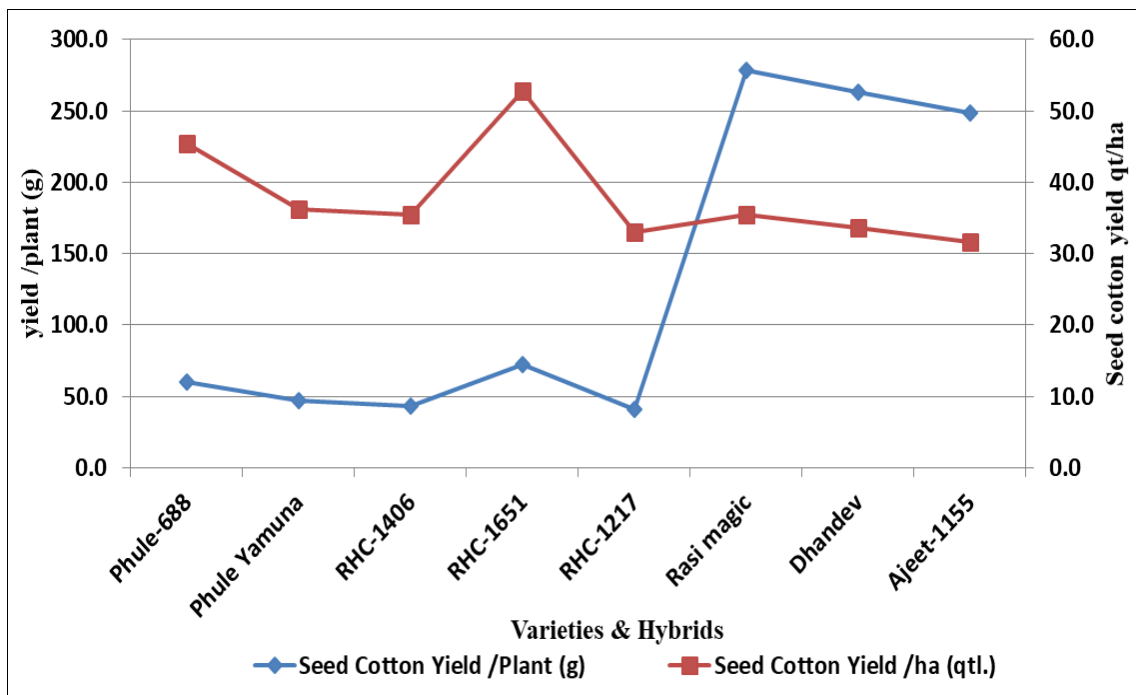


Fig 2: Seed cotton yield produced by varieties under HDPS and hybrids under normal planting

Economic variations in straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

As per data recorded for three years and pooled analysis for economics parameters, it was revealed that the varieties planted under HDPS recorded the more gross returns (RHC-1651-Rs. 321023 ha⁻¹), net returns (Rs. 206113 ha⁻¹) and B: C ratio (2.8) as compared to other varieties under HDPS and Bt hybrids under normal sowing. In between varieties and hybrids, all the varieties have more gross monetary return, net return and B: C

ratio as compared to normally sown Bt Hybrids.

As per the pooled data, it was shown that yield of seed cotton increased by 48% (RHC-1651) and 28% (Phule-688), over the best hybrid (Rasi Magic). Regarding to net monetary return, it was observed to be increase by 92% (RHC-1651) and 56% (Phule-688) over the best Bt hybrid Rasi Magic. It is indicted seed cotton yield as well as net monetary return increased by straight varieties with dense planting as compared to normally sown Bt hybrids.

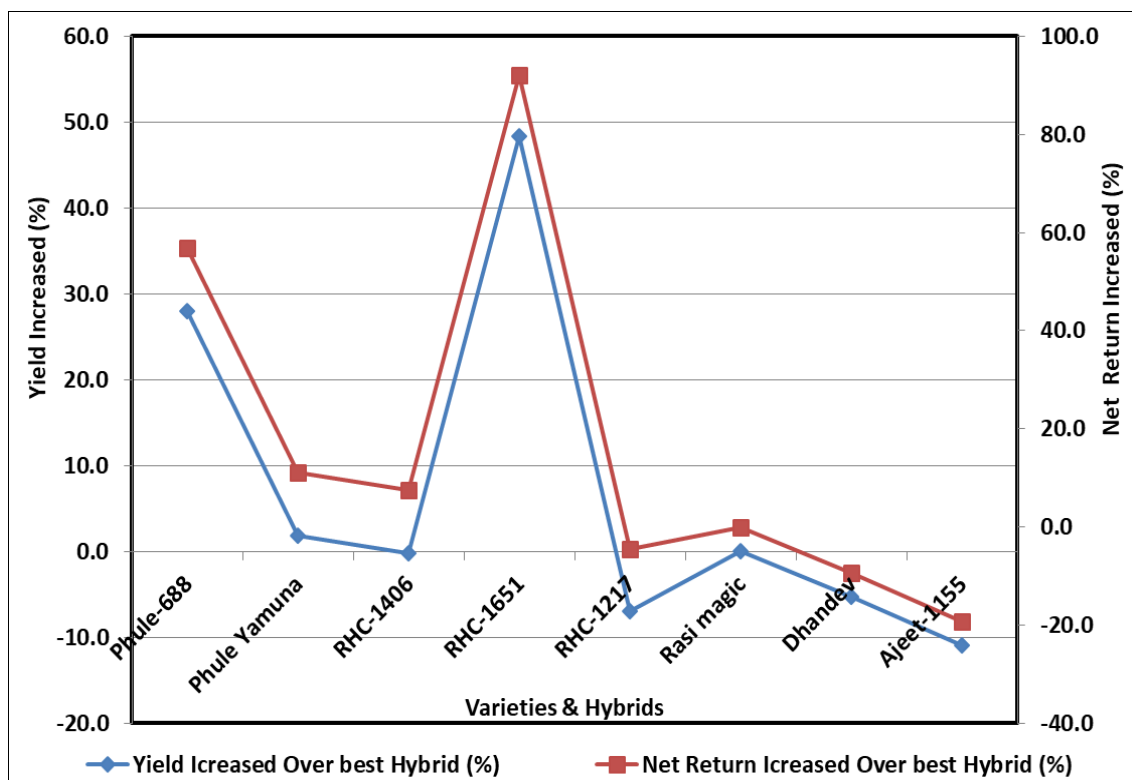


Fig 3: Percent Seed cotton yield and Net Return increased by varieties under HDPS over best hybrids under normal planting

Table 2: Phenological and Growth Characteristic variation in straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	Days to 50% Flowering				Days to Maturity				Plant Height (cm)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties												
Phule-688	47.0	48.7	51.3	49.0	129.7	131.0	133.3	131.3	101.7	108.0	111.3	107.0
Phule Yamuna	50.7	51.0	53.3	51.7	132.3	134.3	136.0	134.2	94.3	103.7	106.3	101.4
RHC-1406	45.3	46.0	48.0	46.4	127.7	125.7	128.3	127.2	87.7	93.7	97.0	92.8
RHC-1651	51.0	52.0	55.0	52.7	133.0	134.7	136.7	134.8	107.3	117.3	122.3	115.7
RHC-1217	45.3	44.7	47.7	45.9	125.7	123.7	125.7	125.0	85.0	91.3	96.7	91.0
Hybrids												
Rasi Magic	57.7	58.3	60.3	58.8	140.7	138.7	141.7	140.3	141.0	146.3	151.0	146.1
Dhandev	59.3	60.0	62.7	60.7	138.7	140.0	143.3	140.7	134.3	136.3	133.0	134.6
Ajeet-1155	54.3	55.7	59.0	56.3	135.3	137.7	139.7	137.6	129.0	134.3	131.0	131.4
GM	51.33	52.04	54.67	52.68	132.88	133.21	135.58	133.89	110.04	116.38	118.58	115.00
SE(+)	1.023	0.749	0.985	0.356	1.640	1.076	1.644	0.793	2.763	2.299	2.106	2.008
CD @5%	3.102	2.273	2.988	1.079	4.973	3.265	4.988	2.406	7.89	6.84	6.30	6.025
CV (%)	3.450	2.494	3.121	0.955	2.137	1.400	2.101	0.838	4.350	3.421	3.077	2.470

Table 3: Phenological and Growth Characteristic variation in straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	No. of Monopodia/Plant				No. of Sympodia/Plant			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties								
Phule-688	0.3	0.7	0.7	0.6	12.0	13.0	14.7	13.2
Phule Yamuna	0.7	0.3	1.0	0.7	10.7	11.7	13.0	11.8
RHC-1406	0.0	0.3	0.3	0.2	9.7	10.3	12.0	10.7
RHC-1651	0.7	1.0	0.7	0.8	13.7	14.7	17.0	15.1
RHC-1217	0.7	1.0	1.3	1.0	8.7	9.3	10.7	9.6
Hybrids								
Rasi Magic	2.3	3.3	3.7	3.1	15.7	17.3	18.0	17.0
Dhandev	1.7	3.0	3.7	2.8	16.7	18.0	17.7	17.4
Ajeet-1155	2.7	3.0	3.0	2.9	18.0	16.3	15.3	16.6
GM	1.13	1.58	1.79	1.50	13.13	13.83	14.79	13.92
SE(+)	0.324	0.388	0.305	0.262	0.408	0.406	0.569	0.694
CD @5%	0.980	1.159	0.892	0.785	1.238	1.231	1.725	2.104
CV (%)	49.926	42.480	29.52	24.66	5.387	5.081	6.659	7.049

Table 3: Yield contributing characters and seed cotton yield influenced by straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	No of Boll/Plant				No. of Boll/Sqr. Meter				Avg. Boll wt (g)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties												
Phule-688	15.3	17.7	20.0	17.7	127.7	146.7	166.6	147.0	3.7	3.3	3.1	3.4
Phule Yamuna	13.3	15.3	17.0	15.2	111.1	127.1	141.6	126.6	3.4	3.1	2.9	3.1
RHC-1406	12.7	14.3	13.3	13.4	105.5	121.5	111.1	112.7	3.4	3.2	3.1	3.2
RHC-1651	17.3	19.0	21.0	19.1	144.4	158.0	174.9	159.1	3.9	3.8	3.7	3.8
RHC-1217	13.3	14.7	12.7	13.6	110.8	121.5	105.5	112.6	3.1	3.0	3.0	3.0
Hybrids												
Rasi Magic	48.3	50.0	55.0	51.1	66.7	68.3	75.9	70.3	5.6	5.5	5.3	5.5
Dhandev	46.3	53.3	52.0	50.6	63.4	73.0	71.8	69.4	5.2	5.3	5.1	5.2
Ajeet-1155	51.3	47.7	50.3	49.8	70.8	65.4	69.5	68.6	4.9	5.0	5.0	5.0
GM	27.25	29.00	30.17	28.81	100.04	110.19	114.61	108.28	4.15	4.00	3.91	4.02
SE(+)	1.374	1.126	1.192	1.366	3.119	3.364	3.901	6.501	0.109	0.137	0.088	0.089
CD @5%	4.169	3.415	3.615	4.144	9.461	10.203	11.831	19.720	0.331	0.417	0.266	0.271
CV (%)	8.736	6.725	6.843	6.707	5.400	5.288	5.895	8.492	4.564	5.942	3.893	3.142

Table 4: Yield contributing characters and seed cotton yield influenced by straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	Seed Cotton Yield /Plant (g)				Seed Cotton Yield /ha (qt.)				Yield Increased Over best Hybrid (%)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties												
Phule-688	57.2	60.8	62.7	60.2	40.5	43.6	52.2	45.5	27.0	23.3	28.8	28.0
Phule Yamuna	44.9	47.1	49.8	47.3	31.8	35.3	41.5	36.2	-0.4	-0.4	2.3	1.9
RHC-1406	43.1	46.4	40.8	43.4	30.5	34.8	41.1	35.5	-4.5	-1.8	1.3	-0.2
RHC-1651	67.6	71.5	77.0	72.1	47.9	53.6	56.6	52.7	50.0	51.5	39.4	48.4
RHC-1217	40.9	43.6	38.1	40.9	29.0	32.7	37.4	33.1	-9.2	-7.6	-7.7	-6.9
Hybrids												
Rasi Magic	270.6	272.9	291.2	278.2	31.9	34.1	40.5	35.5	0.0	-3.6	0.0	0.0
Dhandev	241.1	282.4	266.9	263.5	28.5	35.4	37.1	33.6	-10.9	0.0	-8.6	-5.3
Ajeet-1155	253.5	238.3	253.3	248.4	29.9	29.8	35.2	31.6	-6.3	-15.9	-13.3	-10.9
GM	127.37	132.87	134.98	131.74	33.76	37.43	42.70	37.96				
SE(+)	6.753	4.077	4.181	6.368	1.442	1.523	1.976	1.040				
CD @5%	20.482	12.365	12.681	19.317	4.375	4.618	5.993	3.155				
CV (%)	9.183	5.314	5.365	6.837	7.401	7.047	8.015	3.874				

Table 5: Economics variations in straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	Cost of Cultivation (Rs/ha)				Gross return (Rs/ha)				Net return (Rs/ha)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties												
Phule-688	105182	107667	114550	109133	236146	262971	333354	277490	130964	155304	218804	168357
Phule Yamuna	98193	100965	105950	101703	185259	212491	264769	220840	87065	111527	158819	119137
RHC-1406	97154	100570	105639	101121	177694	209519	262288	216500	80540	108949	156649	115379
RHC-1651	111075	115663	117994	114911	279057	323191	360823	321023	167981	207527	242829	206113
RHC-1217	95945	98931	102705	99194	168892	197178	238895	201655	72947	98247	136189	102461
Hybrids												
Rasi Magic	106502	108268	113329	109367	186050	205741	258226	216672	79548	97472	144896	107305
Dhandev	103716	109279	110604	107866	165765	213356	236488	205203	62049	104076	125884	97336
Ajeet-1155	104894	104778	109100	106257	174339	179458	224497	192765	69446	74680	115397	86507

Table 6: Economics variations in straight varieties and Bt cotton hybrids under HDPS and normal sowing condition

Genotypes	B:C Ratio				Net Return Increased Over best Hybrid (%)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled
Varieties								
Phule-688	2.2	2.4	2.9	2.5	64.6	49.2	51.0	56.9
Phule Yamuna	1.9	2.1	2.5	2.2	9.5	7.2	9.6	11.0
RHC-1406	1.8	2.1	2.5	2.1	1.2	4.7	8.1	7.5
RHC-1651	2.5	2.8	3.1	2.8	111.2	99.4	67.6	92.1
RHC-1217	1.8	2.0	2.3	2.0	-8.3	-5.6	-6.0	-4.5
Hybrids								
Rasi Magic	1.7	1.9	2.3	2.0	0.0	-6.3	0.0	0.0
Dhandev	1.6	2.0	2.1	1.9	-22.0	0.0	-13.1	-9.3
Ajeet-1155	1.7	1.7	2.1	1.8	-12.7	-28.2	-20.4	-19.4

Conclusions

High-density planting Systems (HDPS) using straight varieties have the potential to increase yield with reduced cost of cultivations of rainfed cotton. Under the HDPS, cotton plants produce smaller number of bolls as compared to normally sown Bt cotton, however maintain the maximum total boll numbers per unit area. The variety RHC-1651 (52.7 q/ha) and RHC-688 (45.5 q/ha), exhibited the maximum yield of seed cotton under HDPS planting, it was 48 and 28 per cent higher as compared to normally sown Bt Hybrids respectively, straight varieties can be adapted in HDPS for increasing the yield of cotton under rainfed condition with minimum production cost.

HDPS planting is an emerging option to boost the production efficiency of cotton under rainfed over and above irrigated conditions. Base on results, it was concluded that cotton varieties sown with 60 cm×20 cm spacing (Under HDPS) will give higher seed cotton yield as well as net monetary return over the Bt cotton hybrids which were normally sown as like 120 cm×60 cm spacing.

Acknowledgements

We are very thankful to the All India Coordinated Cotton Improvement Project, MPKV, Rahuri, for providing all facilities and research grants to carry out this experimental work and authors cited in references for providing necessary literature material.

Conflict of Interest

The authors declare there are no conflict of interest relevant to this article.

References

1. Anonymous, Annual progress report of cotton; c2020 www.cab.com
2. Buttar GS, Singh S. Effect of date of sowing and plant spacing on the growth and yield of desi cotton (*Gossypium arboreum* L.). J. Cotton Res. Dev. 2007;21(1):49-50.
3. Giri AN, Aundhekar RL, Kaps PS, Suryavanshi SB. Response of Bt cotton hybrids to plant densities and fertilizer levels. J Cotton Res. Dev. 2008;22(1):45-47.
4. Moola R, Giri AN. Response of newly released cotton (*Gossypium hirsutum* L.) varieties to plant densities and fertilizer levels. J. Cotton Res. Dev. 2006;20(1):85-86.
5. Nehra PL, Nehra KC, Kumawat PD. Response of hirsutum cotton to wider row spacing and potassium in north-western plain zone of Rajasthan. J. Cotton Res. Dev. 2004;18(2):184-186.
6. Narayana E, Aparna D. Performance of cotton varieties (*Gossypium arboreum* L.) under different spacings and nitrogen levels in black cotton soils of coastal Andhra Pradesh. J. Cotton Res. Dev. 2011;25(1):59-62
7. Sisodia RI, Khamparia SK. American cotton varieties as influenced by plant densities and fertility levels under rainfed conditions. J. Cotton Res. Dev. 2007;21(1):35-40.
8. Wankhade ST, Turkhade AB, Katkar RN, Sakhare BA, Solanke VM. Effect of plant population on growth and yield of cotton hybrids under drip irrigation with mechanical cultivation. J. Cotton Res. Dev. 2003;17(2):142-145.
9. Wagh RS, Ingle AU, Deshmukh PH, Shinde HN, Pacharane DP. Enhancement of seed cotton yield by adopting HDPS technology. Front. In Crop. Improv. 2021;9:698-700.