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## Performance of newly developed *Hirsutum* genotypes and *Arboreum* variety of cotton to high density planting system

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### Abstract

A field experiment was conducted for initial evaluation of twenty compact cotton genotypes of *G. hirsutum* along with two checks to evaluate the effect of high density planting for yield and quality parameters at Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) during 2016-17. The experiment was laid out in completely randomized block design with three replications. The results of the experiment indicated that seed cotton yield of different genotypes found statistically significant and ranges from 3370 kg/ha to 6193 kg/ha. The genotype RHC-HD-1420 (6193 kg/ha) showed significantly superior over the best check Phule Yamuna (4781 kg/ha) at closer spacing (60 x 15 cm<sup>2</sup>) for seed cotton yield. Whereas, five genotypes viz. RHC-HD-1312 (5623 kg/ha), RHC-HD-1433 (5399 kg/ha), RHC-HD-1446 (5336 kg/ha), RHC-HD-1438 (5187 kg/ha) and RHCHD-1430 (5176 kg/ha) showed numerical higher yield over best check Phule Yamuna. The highest ginning percentage was recorded by the strain RHC-HD-1427 (38.9%) followed by RHC-HD-1433 (38.0 per cent), RHC-HD-1412 (37.6%), RHC-HD-1420 and RHC-HD-1425 (36.0%).

The, field experiment of *Arboreum* cotton was conducted at Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri to find out the optimum spacing for growth and yield of cotton variety Phule *Dhanwantary* with nine spacings in randomised block design during 2016-2017, 2017-18 and 2018-2019. The experimental findings revealed that *deshi* cotton variety Phule *Dhanwantary* planted at distance 45 x 15 cm<sup>2</sup> recorded higher seed cotton yield (18.30 q/ha) with higher gross monetary returns, net monetary returns and B:C ratio than all other spacing's.

**Keywords:** *G. hirsutum*, *G. arboreum*, high density planting system

### Introduction

India has the largest area in the world under cotton at 129 lakh ha and is the second largest producer in the world with 371 lakh bales. However, India's average cotton productivity is 487 lint yield kg/ha combining both irrigated and rainfed fields and this is low compared to other countries like China (1943), Brazil (1727), United States (909) and the World average yield was (766) lint yield kg/ha (Anonymous, 2020-2021).

The high density planting system or ultra narrow row system is popular in several countries like Brazil, China, Australia, Spain, Uzbekistan, Argentina, USA and Greece (Rossi *et al.*, 2004) [7]. The availability of compact genotypes, acceptance of weed and pest management technologies including transgenics, development of stripper harvesting machines and widespread application of growth regulators have made high density cotton production systems successful in these countries. The obvious advantage of this system is earliness (Rossi *et al.*, 2004) [7] since Ultra Narrow Row needs less bolls / plant to achieve the same yield as conventional cotton and the crop does not have to maintain the late formed bolls to mature. The ultra narrow row system cotton plants produce fewer bolls than conventionally planted cotton but retain a higher percentage of the total bolls in the first sympodial position and a lower percentage in the second position (Vories and Glover, 2006) [9]. The other advantages include better light interception, efficient leaf area development and early canopy closure which will shade out the weeds and reduce their competitiveness (Wright *et al.*, 2011) [10]. The early maturity in soils that do not support excessive vegetative growth (Jost and Cothorn, 2001) [2] can make this system ideal for shallow to medium soils under rainfed conditions, where conventional late maturity hybrids experience terminal drought. Therefore, the high density planting system (HDPS) is now being conceived as an alternate production system having a potential for improving the productivity and profitability, increasing input use

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efficiency, reducing input costs and minimizing the risks associated with the current cotton production system in India.

### Material and Methods

**Hirsutum genotypes:** The work was initiated during 2012-2013 to develop the suitable *Hirsutum* genotypes for high density planting system (HDPS). Efforts were made to develop short (2-3 Feet), zero monopodial, compact, early and synchronous maturing varieties with fruiting bodies close to the main stem. Twenty *Hirsutum* genotypes highly resembles to HDPS has been selected from germplasm as well as segregating population. For evaluation of these genotypes a field experiment was conducted in completely randomized block design with three replications at Cotton Improvement Project, MPKV, Rahuri during *kharif* 2016-2017 under irrigated condition. The topography of experimental field was fairly uniform, leveled and with a good drainage. The soil was deep black with rich in nutrients. Two rows of 7.2 m length of each genotype with a spacing of 60 x 15 cm<sup>2</sup> were sown. The biometric observations on growth and yield attributes were recorded as per the standard procedure.

**Arboreum variety:** This field experiment was conducted at Cotton Improvement Project, M.P.K.V., Rahuri to find out the optimum spacing for growth and yield of *arborium* cotton variety and also to study the economics of different treatments. The experiment was laid out in Randomized Block Design with three replications on medium deep black cotton soils during 2016-2017, 2017-2018 and 2018-2019. The experiment comprises with nine treatment spacings *viz.*, 45 x 15 cm<sup>2</sup>, 45 x 30 cm<sup>2</sup>, 45 x 45 cm<sup>2</sup>, 60 x 15 cm<sup>2</sup>, 60 x 30 cm<sup>2</sup>, 60 x 45 cm<sup>2</sup>, 90 x 15 cm<sup>2</sup>, 90 x 30 cm<sup>2</sup> and 90 x 45 cm<sup>2</sup>. The *Arboreum* cotton variety Phule *Dhanwantary* developed by M.P.K.V., Rahuri was tested in the experiment under irrigated condition (Protective irrigation). The experiment was fertilized with 80:40:40 NPK kg/ha and the experimental data was statistically analyzed with three years of pooled mean data is used.

### Results and Discussion

**Hirsutum genotypes:** Data on yield and yield attributes of twenty compact genotypes are presented in Table 1. The mean sum of squares due to treatment for all characters was highly significant except number of monopodia per plant. The genotype RHC HD-1420 recorded significantly higher seed cotton yield (6193 kg/ha) and lint yield (2230 kg/ha) over the best check Phule Yamuna (4781 kg/ha and 1590 kg/ha, respectively). Likewise, this genotype gave significantly higher seed cotton yield per plant (75 g) over the checks (52 g/plant). Among the genotypes five genotypes *viz.*, RHC-HD-1430 (5176 kg/ha and 1848 kg/ha), RHC-HD-1433 (5399 kg/ha and 2051 kg/ha), RHC-HD-1438 (5187 kg/ha and 1770 kg/ha), RHC-HD-1446 (5336 kg/ha and 1871 kg/ha) and RHC-HD-1312 (5623 kg/ha and 1931 kg/ha) gave numerical higher seed cotton yield and lint yield over the check. The genotype RHC-HD-1433 gave significantly higher lint yield (2051 kg/ha). Among the genotypes, RHC-HD-1502 recorded

significantly superior average boll weight (6.0 g) over the check (4.7 g). Most of the genotypes have excellent boll size (>4.5 cm) which shows positive increment in desirable direction. All the genotypes show synchronous maturity and earliness. But still more efforts required to develop extra early maturity *i.e.* 120-130 DAS genotypes to escape the pink boll worm infestation. Looking to the sympodia per plant, none of the genotypes recorded significantly superior number over the check. However, RHC HD-1420, RHC HD-1446, RHC HD-1312 and RHC HD-1314 recorded higher sympodia/plant. Ginning percentage, lint index, seed index and fibre quality parameters of twenty genotypes tested in Station trial are presented in Table 2. The superiority of genotypes was varying among the characters. The genotype RHC HD-1427 was superior in ginning percentage while genotype RHC HD-1433 was superior in lint index. Likewise, the genotype RHC HD-1438 showed superior seed index (100 seed weight). The fibre quality parameters were estimated on ICC mode at CIRCOT, Mumbai. All the genotypes showed excellent fibre properties. Staple length ranged from 28.3 mm (medium long) to 32.4 mm (Long staple cotton) and tenacity ranged from 19.7 g/tex to 24.0 g/tex. Among the genotypes RHC-HD-1405 recorded highest staple length whereas, Phule Yamuna (Check) recorded highest tenacity *i.e.* 24.0 g/tex. Among the genotypes studied, the RHCHD- 1420 had significant seed cotton yield, zero monopodial branched, more sympodial branches, highest boll weight with early maturity and hence it would be more desirable for High Density Planting System. Data further indicated that, genotypes RHC-HD-1430, RHC-HD-1433, RHC-HD-1438, RHC-HD-1446 and RHC-HD-1312 responded favorably to HDPS. Silva *et al.* (2002)<sup>[8]</sup> and Rossi *et al.*, (2007)<sup>[6]</sup> observed significant interaction between plant density and genotype and recommended a density dependent selection of genotypes.

**Arboreum variety:** The experimental data on ancillary observations, seed cotton yield and economics of *Arboreum* variety Phule *Dhanwantary* are presented in Table 3 and 4. Amongst the different spacings, the spacing 45 x 15 cm<sup>2</sup> (S<sub>1</sub>) obtained significantly maximum plant height (120.74 cm) than other spacing's. However, it was *at par* with spacing 60 x 15 cm<sup>2</sup> (117.68 cm) at harvest. The spacing 90 x 45 cm<sup>2</sup> (S<sub>9</sub>) recorded significantly higher bolls/plant (24.37) and average boll weight (4.60 g) than rest of spacing's. The spacing 45 x 15 cm<sup>2</sup> (S<sub>1</sub>) recorded significantly higher seed cotton yield (18.30 q/ha) than rest of all other spacing's and also observed 24 per cent higher seed cotton yield than normal spacing of 45 x 30 cm<sup>2</sup> (S<sub>2</sub>). The spacing 45 x 15 cm<sup>2</sup> (S<sub>1</sub>) recorded highest gross monetary returns (Rs.93,557/ha), net monetary returns (Rs.39,297/ha) and B:C ratio (1.71) than rest of spacing. Pradeep Kumar *et. al.*, (2017) reported that significantly higher seed cotton yield (2063 kg/ha), gross return (87586/ha), net monetary returns (50031/ha) and B: C ratio (2.33) was recorded at plant spacing of 45 x 15 cm<sup>2</sup> as compared to other spacing's. Similar findings observed by Paslawar *et. al.*, (2015)<sup>[4]</sup> and Kambe Ashish (2017)<sup>[2]</sup>.

**Table 1:** Seed cotton yield, lint yield and ancillary characters of different *Hirsutum* genotypes (kharif 2016).

Sr. No.	Genotypes	Yield (kg ha <sup>-1</sup> )		Branches and Bolls/plant (No)			Plant height (cm)	Average boll weight (g)	SCY / plant (g)
		Seed cotton	Lint	Mono	Symp	Bolls			
1	RHC-HD-1405	4728	1556	0.0	12.9	17	116	4.7	51
2	RHC-HD-1406	4689	1616	0.0	11.7	13	105	5.1	40
3	RHC-HD-1411	4191	1502	0.0	8.9	12	94	4.4	59
4	RHC-HD-1412	4097	1542	0.0	12.2	15	104	4.1	46
5	RHC-HD-1420	6193	2230	0.0	15.1	19	127	5.3	75
6	RHC-HD-1425	4567	1643	0.1	11.1	14	98	3.7	58
7	RHC-HD-1426	4555	1637	0.0	9.8	13	94	4.6	55
8	RHC-HD-1427	3370	1312	0.0	8.8	12	98	4.4	40
9	RHC-HD-1430	5176	1848	0.0	10.3	14	102	4.7	54
10	RHC-HD-1432	4289	1495	0.0	9.8	13	90	4.8	48
11	RHC-HD-1433	5399	2051	0.0	12.2	18	102	5.2	56
12	RHC-HD-1434	4517	1608	0.0	11.1	17	102	5.1	53
13	RHC-HD-1436	4519	1502	0.0	11.0	14	98	5.1	47
14	RHC-HD-1438	5187	1770	0.0	10.7	15	100	3.7	54
15	RHC-HD-1446	5336	1871	0.1	14.9	20	124	3.7	60
16	RHC-HD-1312	5623	1931	0.1	13.1	20	112	5.0	69
17	RHC-HD-1314	4757	1504	0.1	14.4	19	116	4.2	48
18	RHC-HD-1333	3847	1311	0.1	10.2	13	100	4.4	40
19	RHC-HD-1501	4193	1420	0.0	13.9	18	110	5.1	41
20	RHC-HD-1502	4438	1462	0.0	15.3	20	119	6.0	40
21	Phule-688(c)	4680	1473	0.0	11.3	14	109	5.0	40
22	Phule Yamuna(c)	4781	1590	0.1	12.8	17	118	4.7	52
General Mean		4688	1630	-	11.9	16	106	4.7	52
S.E. ±		356.29	125.75	-	1.30	1.41	4.19	0.32	5.47
C.D.at 5%		1016.86	358.89	NS	3.72	4.02	11.97	0.90	15.60

**Table 2:** Ginning percentage, lint index, seed index and fibre quality parameters of different *Hirsutum* genotypes (kharif 2016).

Sr. No.	Genotypes	Ginning (%)	Lint index	Seed index	2.5 per cent SL	Tenacity 3.2 mm g/tex
1	RHC-HD-1405	32.9	4.4	9.1	32.4	22.8
2	RHC-HD-1406	34.5	5.3	10.2	31.7	20.3
3	RHC-HD-1411	35.8	5.9	10.6	29.2	20.5
4	RHC-HD-1412	37.6	5.4	9.0	28.8	19.7
5	RHC-HD-1420	36.0	5.5	9.8	28.3	19.7
6	RHC-HD-1425	36.0	5.5	9.8	29.6	22.8
7	RHC-HD-1426	35.9	6.1	10.9	29.9	21.0
8	RHC-HD-1427	38.9	5.7	8.9	29.7	20.0
9	RHC-HD-1430	35.7	5.7	10.2	30.9	20.8
10	RHC-HD-1432	34.9	5.5	10.3	28.7	22.4
11	RHC-HD-1433	38.0	6.4	10.4	29.9	22.7
12	RHC-HD-1434	35.6	6.1	11.1	29.4	22.1
13	RHC-HD-1436	33.2	5.4	10.8	29.5	21.8
14	RHC-HD-1438	34.1	6.0	11.6	30.7	21.6
15	RHC-HD-1446	35.1	5.2	9.6	28.9	22.4
16	RHC-HD-1312	34.3	5.2	9.9	29.2	21.0
17	RHC-HD-1314	31.6	4.2	9.2	28.9	20.9
18	RHC-HD-1333	34.1	5.1	9.9	29.2	21.2
19	RHC-HD-1501	33.9	5.7	11.2	30.4	21.7
20	RHC-HD-1502	33.0	5.4	11.1	31.7	22.4
21	Phule-688(c)	31.5	4.8	10.5	28.3	23.3
22	Phule Yamuna(c)	33.3	4.0	8.1	28.5	24.0

**Table 3:** Ancillary observations and seed cotton yield as influenced by different treatments (2016-17 to 2018-19).

Treatments	Pooled mean				
	Plant height (cm)	Bolls/plant	Average boll weight (g)	Seed cotton yield/plant (g)	Seed cotton yield (q/ha)
S <sub>1</sub> : 45 x 15 cm <sup>2</sup>	120.74	12.91	2.82	34.70	18.30
S <sub>2</sub> : 45 x 30 cm <sup>2</sup>	111.97	19.03	3.42	63.81	14.76
S <sub>3</sub> : 45 x 45 cm <sup>2</sup>	104.55	19.98	4.12	80.25	12.40
S <sub>4</sub> : 60 x 15 cm <sup>2</sup>	117.68	16.50	3.13	48.74	16.27
S <sub>5</sub> : 60 x 30 cm <sup>2</sup>	108.02	21.46	3.87	80.42	13.08
S <sub>6</sub> : 60 x 45 cm <sup>2</sup>	103.30	23.29	4.24	97.67	11.22
S <sub>7</sub> : 90 x 15 cm <sup>2</sup>	109.84	18.27	3.71	65.39	14.16
S <sub>8</sub> : 90 x 30 cm <sup>2</sup>	98.68	22.15	4.36	92.20	10.88
S <sub>9</sub> : 90 x 45 cm <sup>2</sup>	98.25	24.37	4.60	111.12	10.74
S.E. ±	3.04	0.99	0.18	4.51	0.67
C.D.at 5 %	8.69	2.01	0.51	12.74	1.89

**Table 4:** Economics of different treatments (2016-17 to 2018-19).

Treatments	Pooled mean		
	Gross monetary returns/ha (Rs)	Net monetary returns/ha (Rs)	B : C ratio
S <sub>1</sub> : 45 x 15 cm <sup>2</sup>	93557	39297	1.71
S <sub>2</sub> : 45 x 30 cm <sup>2</sup>	75564	23212	1.43
S <sub>3</sub> : 45 x 45 cm <sup>2</sup>	63642	12685	1.24
S <sub>4</sub> : 60 x 15 cm <sup>2</sup>	83228	29991	1.56
S <sub>5</sub> : 60 x 30 cm <sup>2</sup>	66976	15620	1.30
S <sub>6</sub> : 60 x 45 cm <sup>2</sup>	57472	7214	1.14
S <sub>7</sub> : 90 x 15 cm <sup>2</sup>	72449	20620	1.39
S <sub>8</sub> : 90 x 30 cm <sup>2</sup>	55810	6032	1.11
S <sub>9</sub> : 90 x 45 cm <sup>2</sup>	55077	5307	1.10
S.E. ±	3570	3040	-
C.D.at 5 %	10088	8590	-

### Conclusion

It is concluded that the *Hirsutum* genotype, RHC-HD-1420 had significant seed cotton yield, zero monopodial branched, more sympodial branches, highest boll weight with early maturity and hence it would be more desirable for high density planting system at 60 x 15 cm<sup>2</sup>.

The *Arboreum* variety Phule *Dhanwantary* with irrigated condition (protective irrigation), planting at 45 x 15 cm<sup>2</sup> spacing produced higher seed cotton yield and monetary returns under high density planting system.

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