

# Genetic improvement of *Gossypium arboreum* for quality cotton

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## ABSTRACT

*Arboreum* cottons are drought tolerant, coarse and short staple with high moisture absorbency. The common *arboreum* breeding goals have the development of varieties with high yield, high ginning out-turn and insect disease resistance. *Arboreum* cottons under cultivation are short staple (2.5% span length 17.5 mm to 20.5 mm), coarse (micronaire value 7.0 to 8.0) and spinable up to 6 to 8 counts. Development of *G. arboreum* varieties in medium staple length group comparable to *G. hirsutum* varieties, spinable up to 20-30 counts need more attention in future *arboreum* breeding program. Efforts to breed quality *arboreum* cotton made at Agricultural Research Station, Sriganaganagar resulted in development of *G. arboreum* varieties RG-284 (1774 kg/ha) with 2.5% span length 25.7 mm and micronaire value 5.0 and ALL-20 (2.5% span length 25 mm and micronaire value 5.3). These *arboreum* genotypes indicated improvement in the fiber length and fineness. However, the fiber properties, which can shots in the trade, are available in *arboreum* cotton with a wide range to match *G. hirsutum* cotton, which may satiate present day spinning needs.

## Introduction

It is an established fact that cultivation costs of tetraploids are increasing because of pest incidence. Performance to these cottons is mainly due to finer fiber properties when compared to diploid desi cotton varieties, which were characterized by short and coarse staple. It has been our efforts to improve fiber properties of desi cotton for higher count spinning since few years. The genotypes isolated from backcross segregating generation between *G. arboreum* x *G. hirsutum* have been exhibiting fiber properties with length up to 25-26 mm and strength above 20 with finer fiber (Micronaire between 4.0 to 5.0). Hence, 50% of our requirement between 21s to 40s can be met out through introduction of long linted *G. arboreum* responded well under irrigation in north India and the yield level recorded there has been about 20 q/ha of seed cotton yield. These are also sucking pest tolerant and bollworm tolerant compared to tetraploids.

## Impact points for improving quality of *arboreum* cotton

Tremendous achievements have been achieved in the fiber quality especially for fiber length and spinning capacity. K-8 is the first long staple variety of *arboreum* released in 1971 from TNAU. Later on K-9, K-10, K-11 were released from TNAU. Development

of these varieties is a significant landmark in the quality improvement in *arboreum* cotton. These varieties have fiber length of 25 mm and are capable of spinning 36 counts, which is comparable to several *G. hirsutum* varieties. Race indicum has been used for improvement of the fiber length. Efforts are being made to develop *G. arboreum* varieties in medium staple group in the North Zone (Table 1).

## Heterosis breeding

The inter-specific crosses exhibited higher heterosis than specific crosses in diploid cotton. Boll numbers in inter specific crosses, boll number and boll weight in intra specific crosses were reported as major components of heterosis for seed cotton yield (Singh, et al., 1975). The heterosis was high for yield and boll number, moderate for seed number and seed oil content and low for ginning out-turn and halo -length (Chahal and Singh, 1975). The first diploid hybrid (DH-7) for commercial cultivation in the world was released in 1983 from GAU surat. The heterosis breeding for cotton provided rich dividends in increasing production and productivity of cotton in Central and Southern cotton Zone of India. In the North zone no cotton hybrid was grown due to (a) long duration of hybrid (b) sowing of whole area of cotton under double cropping (cotton-wheat rotation) (c) limited fruiting period (July 15 to Sept.15) and (d) indirect dampening effect on high yield potential of recommended varieties on the development of hybrids. Efforts are under way in North Zone to breed suitable *arboreum* hybrids on back ground of genetic male sterility system to reduce the cost of seed production.

Highly heterotic inter specific hybrids have been identified at ARS-Sriganaganagar, which show stable performance over the years and environment (Table 2).

## Studies on insect resistance

Several insect pests attack the cotton crop, but jassids and bollworm are major concern. The density of hairs, length of hairs and thickness of leaf lamina were found to confer jassids resistance (Muthuthamby, et al., 1969). Various morphological characters viz. glabrous surface, red plant body, nectariless fregobract, high bud gossypol, high and thick boll rind long pedicel and earliness were found to confer some degree of resistance either singly or in combination to bollworm in cotton (Shaver and Lukefahr, 1969; Shaver and Parrot, 1970). Dhoon and Singh (1980) reported that bollworm resistance in *G. arboreum* was associated with red pigmentation of the plant. The most promising variety RG-18 possessed red pigmentation high yield and quality characters released from Agricultural Research Station, Rajasthan Agricultural University, Sriganaganagar in 1997 (Table 3).

## Fiber quality

Although the entire North Zone is identified for the cultivation of medium staple, *G. arboreum* cottons have attained tremendous popularity in the region over the year. Arboreum cottons presently under cultivation are short staple (2.5% span length 17.5 mm to 20.5 mm) coarse (micronaire Value 7.0 to 8.0) and spinable up to 6 to 8 counts. To the large extent they are being used as stuffing material, surgical cottons, and blending purpose. However, the fiber properties, which can be the shots in the trade, are available in *arboreum* cotton with a wide range to match *G. hirsutum* cotton (Santhanam, 1995) (Table 4).

This concept of improving the quality parameters of *G. arboreum* was further stimulated by sanctioning of a project on "Genetic improvement of *G. arboreum* for fiber quality parameters, high yield and insect pest resistance" by Cotton Corporation of India, Mumbai at Agricultural Research Station, Sriganaganagar in 1998, which acted as a spark and provided necessary financial assistance for intensification of research on *arboreum* quality cotton in Rajasthan.

## Development of cotton variety having higher oil content

Cotton is contributing not only fiber for the manufacturing of textiles, but also edible oil and cakes worth Rs.1150 crores annually. Edible oil is extracted from cotton seed to the tune of 5 lakh tones along with 30 lakh tones of cakes. Generally cotton varieties contain 15-20 percent oil. This percentage seems to be very low and as such, there is scope to increase the oil content in cottonseed. To achieve this goal there is need to develop a suitable cotton variety having oil to the tune of about 30 percent without making any loss in lint and other fiber characters. With the increase of oil percentage country will be saving a lot of foreign exchange by decreasing the edible oil import.

## Conclusion

In recent times cotton cultivation is becoming less attractive because of number of reasons. To improve this situation a multi-dimensional approach is needed. The *arboreum* genotypes with high a harvest index and

better tolerance to biotic and abiotic stresses, apart from well established phenomenon of less input requirement, open an entirely new and promising aspect of research. The inherited resistances of *arboreum* cottons towards adverse conditions should be enmeshed to the fullest of its potential. Qualitative improvement of these species will go a long way in improving the present day gloomy scenario of cotton cultivation.

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**Table 1.** Performance of improved diploid cotton strains isolated by pedigree selection at A.R.S. Sriganaganagar strains.

	Average seed cotton yield (kg/ha)	2.5 % span length (mm)	Micronaire value
RG-284	1775	25.7	5.0
RG-277	1636	25.0	5.0
RG-271	2114	23.0	5.2
ALL-20	1744	25.0	5.3
RG-8 (LC)	1693	17.5	7.4

**Table 2.** Heterotic response of promising *G. arboreum* hybrids.

Hybrids	Seed cotton yield (kg / ha)	Ginning out-turn (%)	2.5 % span length	Micronaire value
RAJDH-9	2899	39.0	19.6	7.0
RAJDH-10	1967	39.0	18.7	7.5
RAJDH-71	2156	40.0	20.5	6.9
RAJDH-21	2381	39.0	19.2	6.5
RAJDH-47	1595	38.0	19.9	7.0

**Table 3.** Performance *G. arboreum* of RG-18 from 1990 to 1994.

Year	No of trials	Average cotton yield (kg/ ha)		Reaction to boll worm (% Boll damage)		Reaction to root-rot disease (% Mortality)	
		RG-18	RG-8	RG-8	RG-8	RG-18	RG-8
1990-94	13 (Res)	2789	2506	21.9	25.3	29	100
1993-94	10(Adaptive)	2257	2072	-	-	-	-

**Table 4.** Available variability of fiber properties.

Fiber character	<i>G. arboreum</i>	<i>G. hirsutum</i>
Span length (mm)	13-27	15-37
Uniform Ratio	44-55	34-52
Micronaire Value	3.1-8.0	2.6-5.6
Mature fiber percentage	70-93	55-79
Fiber strength (0 gauge)	32-59	31-56