# Cotton Seed Scenario in India

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## ABSTRACT

*The species composition of cotton in India is 40% hybrids, 30% Gossypium hirsutum, 30% G. arboreum and G. herbaceum with G. barbadense occupying a negligible area. Seed requirement on 100% Seed Replacement Rate is about 0.8 million quintals. Seed certification is voluntary under the Govt. of India Seed Act of 1966, so certified, truthfully label and market planting seeds of dubious quality are used. Seeds are produced and marketed by both Public and Private sector, the latter mostly involved in hybrid seed production. The Private Seed Industry has flourished since hybrids were developed of sorghum, pearl millet, maize, cotton etc. While the country is self sufficient in hybrid seeds, barely 30% of the varietal seeds are certified. Efforts are under way to augment the supply on Certified Seed of varieties both by the Public and Private sector seed producing agencies. Hand emasculation and pollination are the main constraints in producing diploid inter specific hybrid seed. Genetic male sterility has been identified for use in developing diploid hybrids to overcome this problem. Field techniques to ensure genetic purity of hybrid seeds are time consuming and costly. Genetic purity tests by Random Amplified Polymorphic DNA (RAPD) and Polyacrylamide Gel Electrophorysis (PAGE) of seed protein can be substituted for field grow out tests to ensure timely supply of seed to growers.*

## Introduction

All four cultivated cotton species, *Gossypium arboreum*, *G.herbaceum*, *G.hirsutum* and *G.barbadense* and their hybrids, *G.arboreum* x G.*herbaceum*, *G.hirsutum* x *G.hirsutum* and *G.hirsutum* x *G.barbadense* are grown in India on 8.6 million hectares (1997-98) (Table 1). The seed rates of species and hybrids differ between and also within the species/hybrids, depending on the region of cultivation (Table 2). The 100% Seed Replacement Rate (SRR) annual seed requirements are 785,000 quintal (Table 2).

## Mode of Production of Cotton Seed

Indian cotton farmers use certified seed, truthful label seed, open market seed and rarely their own planting seed. Under the Seed Act of Govt. of India of 1966, designed to regulate seed quality, seed certification is not mandatory but labelling of seed is compulsory. The purpose of seed certification is to ensure planting material with genetic identity and genetic purity.

For production of certified seeds, the variety/hybrid has to be released and notified by the Committee on Crop Standard, Notification and Release of Varieties of the Govt. of India. Apart, from general seed certification standards, there are specific standards for cotton seed certification (Table 3).

For production of hybrid cotton seeds, seed certification agencies have drawn up a time table for various operations of hybrid seed certification that include the last date for stopping crossing, the last date of picking seed cotton from crossed bolls, transportation to ginning units, the movement of samples to the certification agency, 'grow out tests', analysis at the seed testing laboratory, the communication of results and picking of certified seed lots. Utmost care is taken during various stages of seed production and testing to maintain seed quality as per prescribed standards.

### *Truthful Label Seeds*

Seeds that are not certified, can be labelled and sold as 'truthful label' seeds. These seeds are of good quality, but spurious seeds and F2 seeds are sold by some unscrupulous seed dealers.

### *Market Seeds*

Substantial quantities of varietal seeds for planting belong to this category. Norms of purity and quality are not always maintained in this seed but seeds produced by farmers co-operatives have the prescribed standards of quality. Farmers purchase these seeds because they are cheap and easily available.

### *Seed Production Agencies*

The seed multiplication chain in India is Nucleus Seed > Breeder Seed > Foundation Seed > Certified Seed (Chart 1). While Breeder seed is produced from nucleus seed by the breeder who develops the variety, Foundation seeds and Certified seeds are generally produced by State Seeds Corporations (SSC), the Department of Agriculture (DOA), State Agricultural Universities (SAU), the National Seed Corporation (NSC), the State Farms Corporation of India (SFCI), Co-operatives (COOP) and Private Agencies (Pvt.)

### *Quality Control and Seed Certification*

There is an elaborate method for ensuring seed quality (certified seeds) including enforcement of seed law, testing of seeds for purity, germinability etc. in seed testing laboratories.

## Marketing of Cottonseeds

State Seed Corporations, Private Seed Companies and other seed producing agencies market certified seeds through their own seed outlets distributors and dealers. Agencies other than SSCS also produce truthful label seeds. Private Seed Companies have a major share (more than 55%) in production and marketing of both public and private bred hybrids.

### *Availability of Quality Cottonseeds*

According to a working group of cotton seed of the Ministry of Agriculture, Govt. of India, the availability of Certified seeds for varieties and quality seeds of hybrids during 1994 was:

| **Percent Availability of Seed** | |
|---|---|
| Variety | 30 |
| Hybrid | 117 |

(Basu, 1996)

Some of the constraints to further improvement in the availability of quality seeds are:

1. Difficulty in the precise estimation of the demand for seeds of different varieties in view of a very large number of varieties under cultivation in the country.
2. No restriction on the number of varieties grown in an area since there has been repeal/no enforcement of cotton control and cotton transport act. This leads to admixture of cotton and seeds (uncertified seeds) at the ginning units.
3. The indentors do not always lift breeder seeds. There is scope for better co-ordination in the conversion of breeder seeds to foundation seeds and foundation seeds to certified seeds.
4. There is mismatch between demand and supply of breeder seeds in terms of varieties/parental lines of hybrids.
5. Technologies available for production of more hybrid seeds per unit area have not been fully adopted.
6. Grow out tests to ascertain genetic purity for hybrid seeds is time consuming, deterring many private seed companies from certifying hybrid seeds. Genetic purity tests through electrophoresis have yet to be perfected.

## Constraints in Hybrid Seed Production

The main constraint in tetraploid hybrid seed production is its production through manual hand emasculation and pollination which increases the cost of hybrid seeds. Male sterility (GMS and CMS) based hybrids are few. In case of seed production of diploid (*G. arboreum* x *G. herbaceum*) hybrids, boll setting is very poor resulting in poor crossed seed production.

Male sterility based hybrids for both tetraploid and diploid cottons are therefore important for sustainable hybrid cotton production in India. Meyers' *Gossypium harknessii* based cytoplasmic genetic male sterility and Weavers' double recessive genetic male sterile line are used for development of male sterile based hybrids in India (Basu and Paroda, 1995). Attempt for diversification of male sterile cytoplasmic source in tetraploid hybrid and search for male sterility in diploids has resulted in induction of CMS in *G. hirsutum* by using *G. arboreum* cytoplasm, identification of a genetic male sterile line in *G. arboreum* and development of CMS in *G. arboreum* by interaction of *G. anomalum* cytoplasm with genome of *G. arboreum* (Basu, 1996).

While male sterile based hybrids reduce cost of hybrid seeds by 50%, further reduction in cost can be achieved by bee pollination for which research is in progress.

## Genetic Purity of Varietal/Hybrid Sees

In India, genetic purity testing for hybrids is mandatory for certified seeds. The grow out tests are expensive and time consuming. When perfected, new techniques will ensure the timely supply of hybrid seeds to growers.

Morphological traits are used for identification of variety/hybrid and for determination of its genetic purity. Genetic purity is tested in the field at flowering stage (grow out test) (Basu and Paroda, 1995). This is time consuming, tedious and expensive. New approaches that are rapid and less costly are being developed to determine genetic purity of cultivars. The two approaches are Polyacrylamide Gel Electrophoresis (PAGE) of seed proteins (Agarwal *et al.*, 1988, Cherry *et al.*, 1970, Narojji *et al.*, 1998) and DNA based Random Amplified Polymorphic DNA (RAPD) (Krishnan *et al.*, 1998)

Studies with PAGE showed clearly that seed protein polymorphism will serve as a quick and reliable method of determining genetic purity of cultivars (Narojji *et al.*, 1998). Hybrid seeds could be distinguished from selfed seeds of female parent. The technique can therefore replace 'grow out test'.

The RAPD technique, involving amplification of template DNA in the presence of a single primer by polymerase chain reaction, has been used to differentiate inbred parental lines from hybrid seed of NHH-44 hybrid (Krishna et. al., 1998).

## Conclusion

Neither increases in the area under cotton nor changes in the species composition are likely in the near future, so seed requirement will remain virtually unchanged.

However, the availability of Certified/Quality seeds can be improved by:

1. Reducing the number of varieties/hybrids
2. Registration of privately bred hybrids
3. Better co-ordination in production of Certified seeds from Breeder seeds through Foundation seeds
4. Incorporation of GMS in diploid interspecific hybrids
5. Reducing mismatch between demand and supply of certified seeds and
6. Replacement of GOT by simpler and less time consuming method.

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**Table 1.Cotton species composition.**

| Species | % Total Area |
|---|---|
| *G. arboreum* | 19 |
| *G. herbaceum* | 11 |
| *G. hirsutum* | 30 |
| Intra & Interspecies Hybrids | 40 |

**Table 2. Seed requirement.**

| Species | Area (Ml. ha) | Sd Rate (Kg/ha) | Required (Qtls) |
|---|---|---|---|
| North zone | | | |
| *G. hirsutum* | 1.6 | 20 | 320,000 |
| *G. arboreum* | 0.4 | 15 | 60,000 |
| Central & South zone | | | |
| *G. hirsutum* ⎫ | | | |
| *G. arboreum* ⎬ | 3.2 | 10 | 320,000 |
| *G. herbaceum*⎭ | | | |
| Hybrid | 3.4 | 2.5 | 85,000 |
| TOTAL | 8.6 | | 785,000 |

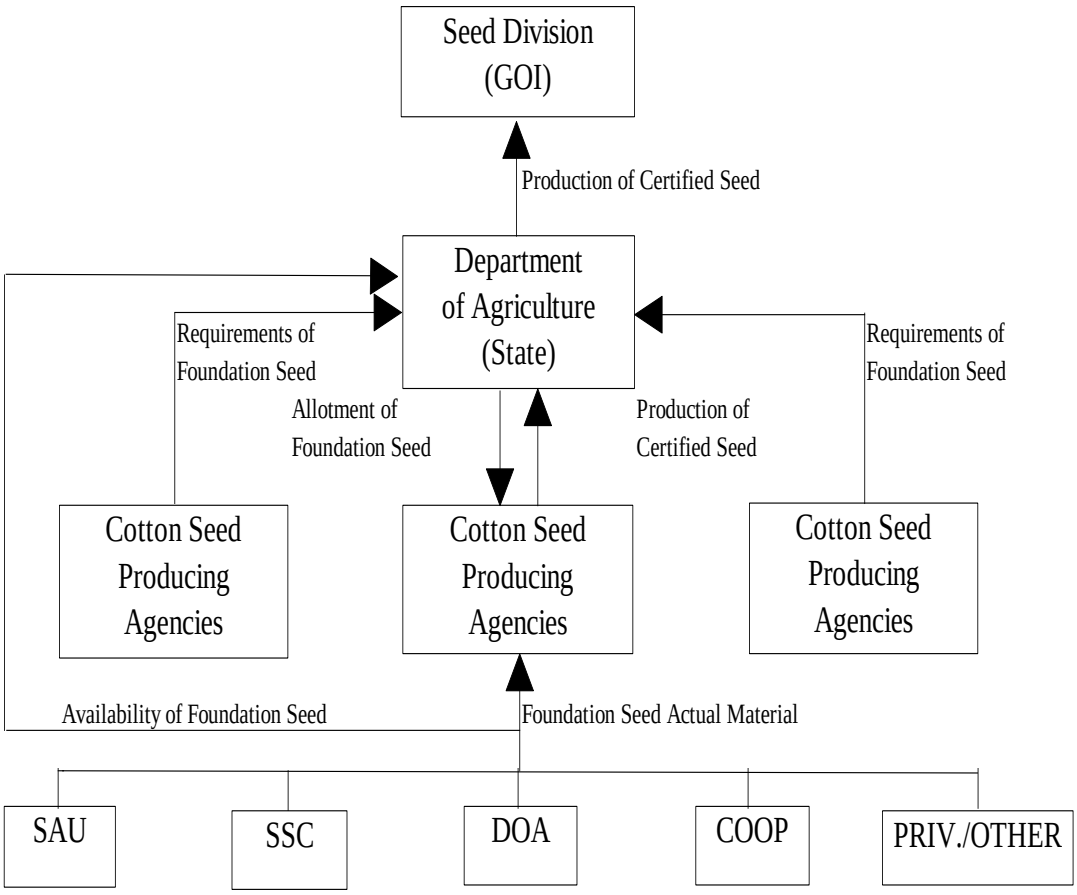
N.B. *G.barbadense* is grown in very small area

**Table 3. Cotton seed certification standards.**

| Factor | Foundation (%) | Certified (%) |
|---|---|---|
| Pure seed (minimum) | 98.0 | 98.0 |
| Inert matter (maximum) | 2.0 | 2.0 |
| Other crops seeds (maximum) | 5/kg | 10/kg |
| Weed seeds (maximum) | 5/kg | 10/kg |
| Germination (minimum) | 65.0 | 65.0 |
| Moisture(maximum) | 10.0 | 10.0 |
| For vapour proof containers(maximum) | 6.0 | 6.0 |

(Source: Rai, 1990)

**Chart 1. Flow chart for certified seed production.**




Cotton Seed Producing Agencies: NCS/SFCI/SC/DOA/COOP/PRIVATE/SAU

(Source: Agrid, National Informatics Centre)