



Naturally coloured cotton : A brief review

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ABSTRACT : In recent years coloured cottons are receiving increasing importance in view of their eco friendly character. The urge for eco friendly cotton can only be fulfilled preferably by organically grown coloured cotton, dispensing harmful chemicals in dyeing and processing. Cotton with naturally coloured lint, other than white, is commonly referred as coloured cotton. Because the colour is present in the fibres, fabrics made of them do not have to be dyed. The elimination of the dyeing process can save up to one half of the cost of preparing textiles and also lowers disposal costs for toxic dye waste dangerous to human health and the environment. In spite of the economic and ecological benefits resulting from the elimination of the dyeing process, the application of the naturally coloured cotton in the world textile industry is still limited. The low quality of fibres is considered as the most important reason for the limitation of naturally coloured cotton application.

Key words : Coloured, cotton, eco friendly, environment, human health, naturally, textiles

Naturally coloured cotton is believed to have originated in the Americas around 5000 years ago in the Andes. Evidence for its cultivation in India has been obtained from the remains of the Indus valley civilization. Naturally coloured cottons have a long history, dating from 3400 to 2300 BC in Mexico, 3100 BC in Peru (with fibers from 12 to 43 mm), 2250 BC in Egypt (19 to 22 mm) and sometime before 1200 AD in China.

Naturally coloured cotton today mostly comes from pre Columbian stocks created by the indigenous peoples of south America (James M. and Vreeland, 1999). Through the years, naturally coloured cotton has appeared primarily as a last-ditch effort to meet a need. During World War II (1939–1945), there was a shortage of dyes, so green and brown cotton was grown and used. Because the fibers had not been bred for length, after the war, naturally coloured cotton fell out of favour again.

In 1982, Sally Fox, started researching on coloured cotton introduced first long fiber of naturally coloured cotton with the help of her knowledge and experience in technology. Later started her company as a name of Natural Cotton Colours, Inc. In 1988, natural colour cotton of Sally Fox succeeded at commercial level (Baratta, 2015).

Sources of coloured lint in cotton : The vast majority of cotton grown commercially in the world has white lint. However, there are genotypes/species which produce naturally coloured cotton and most of the wild species of cotton have coloured lint or fuzz. Though historical evidence like the fossils obtained from the excavations at Huaca Preita in northern coastal Peru indicated the usage and cultivation of colour cottons with lint colour from tan to red shades before 2500 B.C., only some of which exist today. It seems others have been lost, as they

have never been described in the botanical literature. The ability of the white cotton to take up any colour to produce a large range of shades and colours in fabrics has led to the popularization of white cotton (Dianne, *et al.*, 1999).

Germplasm collection: Genetic resources are most vital for improvement of any crop. In India, about 40 coloured genotypes of upland cotton (*G.hirsutum*), mostly of various shades of brown and green colour are available in the National Gene Bank of Cotton maintained at the Central Institute for Cotton Research, Nagpur. These genetic stocks are indigenous collections as well as exotic accessions from USA, erstwhile USSR, Israel, Peru, Mexico, Egypt etc. In Asiatic diploid cottons (*G. arboreum* and *G. herbaceum*) about 10 germplasm lines possessing mostly light brown lint colour are also available. Most of the coloured linted germplasm lines have been evaluated for their economic attributes as well as fibre characteristics.

Wild species: Wild species are important sources of coloured lint. Many of the wild species of genus *Gossypium*, including putative donors of present day tetraploid cotton *i.e.* *G. herbaceum* race *africanum* and *G. raimondii* have coloured lint. The brown colour in different shades is most common.

DEVELOPMENT OF LINT COLOUR : Lint colour is a genetically controlled character. Accumulation of pigments in the lumen of lint starts before boll bursting. Complete expression of lint colour takes place only when the boll bursts open and the lint is

exposed to sunlight. It takes about a week for the lint to develop a complete natural colour. The intensity and the time taken for complete development of colour vary with the genetic background of the genotypes.

The two commonly occurring lint colours, *i.e.* brown and green are briefly discussed below:

Brown colour: Among the coloured cottons, brown is the most common colour. The brown colour is found in different shades which ranges from light brown to intense mahogany red. Depending on the intensity of colour, it is named as light brown, *khaki* / camel colour, brown, dark brown / chocolate colour, dirty grey, tan and red. Brown colour is found in all the four cultivated as well as many of the wild species. Brown colour is more stable than green colour. On continuous exposure to sunlight, brown colour also fades but gradually at a very slow rate. In India, brown linted varieties of *G. arboreum*, namely, Cocanada 1, Cocanada 2 and red northern were under commercial cultivation during first half of the 20th century.

Green colour: Green is the second important commonly occurring lint colour in cotton. Green colour is less common than brown and occurs mainly in two shades *i.e.* light green and green. Green colour is more prone to fading, fades faster than the brown colour. Prolonged exposure to sunlight during boll opening leads to rapid fading of green colour and the colour turns to white, off-white or brownish (Singh *et al.*).

ADVANTAGES OF COLOURED COTTON
: There are several advantages of naturally

coloured over the white cotton varieties. These are briefly discussed below:

Effect on human health: Cotton fabrics with artificial dyes have been reported to have adverse effects on the skin and human health. Artificial dyes cause allergy and itching on the skin and sometimes may cause skin cancer. In cotton mills, several labourers come in contact with artificial dyes. Artificial dyes have adverse effect on their health. There is risk of skin cancer among the persons who regularly come in contact with artificial dyes. It is a known fact that most of dyes used in textile industries are carcinogenic. The fabric prepared from naturally coloured cotton lint is free from such adverse effects. There is no need of using artificial dyes, when the fabric is manufactured from naturally coloured cotton. Such fabric can be safely used even by those having sensitive skin. Thus, fabric manufactured from coloured cotton has been found to be the best for human health.

Effect on environment: Various artificial dyes are being used for dyeing of cloth manufactured from the white lint. After dyeing, the chemical residues in the form of dyeing or finishing effluents are thrown in nearby river contaminating water and soil. This form a major source of environmental pollution. When the fabric is manufactured from naturally coloured lint, there is no need of artificial dyes. Hence the residues of artificial dyes will not accumulate in the drains. Textile effluents are high in toxicity to human beings and are also a serious threat to ground and surface water resources. Naturally coloured cotton is an attractive proposition for the textile industry as it will

eliminate the need for dyeing (Waghmare and Koranne, 1998). Thus use of naturally coloured cotton helps in reducing environmental pollution caused by artificial dyes.

Effect on cost of fabric production: The dyeing process adds to the cost of production of fabric. The dyeing process is omitted when naturally coloured lint is used for manufacturing of the fabric. Thus the cost of production of fabric can be reduced to some extent through the use of naturally coloured cotton. If the coloured cotton is paid higher price than white cotton, then the reduction in the cost of production of fabric caused by omitting dyeing process is compensated by high price of coloured cotton fabric. The elimination of the dyeing process can save up to one half of the cost of preparing textiles and also lowers disposal costs for toxic dye waste dangerous to human health and the environment (Frydrych, 2014).

LIMITATIONS OF COLOURED COTTON

: Limitations of the naturally coloured cotton are as follows:

Low yield potential: The yield potential of currently available coloured cotton genotypes is very low. The yield potential is almost half of the white linted varieties. Because of low yield potential, naturally coloured cotton could not become popular for commercial cultivation. In other words, low yield potential of naturally coloured cotton has acted as a barrier in the expansion of its cultivation. Its cultivation has been limited to small pockets in tribal areas only.

Poor fibre properties: The fibre of naturally coloured cotton genotypes, compared with white cotton, is of very low quality. Naturally coloured cottons are usually shorter in staple length, weaker in fibre strength and have low micronaire value. They also have low fibre maturity compared to white cottons. There is need to improve fibre properties of coloured cotton, particularly fibre strength to make it suitable for high speed spinning. The low quality of fibres is considered as the most important reason for the limitation of naturally coloured cotton application. It is commonly known that the majority of naturally coloured cotton varieties are of lower quality (strength, length, Micronaire, etc.) than the most conventional white cotton. Due to low quality during the industrial revolution, naturally coloured cotton was replaced by white cotton, which is better processed on industrial looms (Frydrych, 2014).

Limited colours: Naturally coloured cotton genotypes currently available in the germplasm have limited lint colours. There are only two colours i.e. brown in various shades and green. With only two colours, naturally coloured cotton can not compete with white cotton as varied treatments of colours and shades can be easily imparted to white cotton.

Instability of colours: The colour of naturally coloured cotton is not stable and long lasting. All colours do fade in the sunlight. In sunlight, the green colour fades more quickly than brown colour. Brown colour also fades but at a very slow rate. The green lint which is exposed to sunlight becomes almost white and the portion which is covered with the bur (at the

bottom of the locule) remains dark green.

Contamination natural: lint colour is governed by dominant / incomplete dominant genes. The green colour is controlled by one gene and brown colour with two or more genes. Cotton is an often cross-pollinated crop. In natural conditions, cross pollination occurs to the extent of 5-20 per cent. Growing of coloured and white cotton in the vicinity will enhance the chance of contamination of white linted genotypes with coloured genotypes and *vice versa*. Contamination may occur in three ways, *viz.*, (1) through natural out crossing with white cotton, (2) during ginning, and (3) during delinting. Growing of white cotton in the field in which coloured cotton was grown in the previous year may also lead to contamination through volunteers. Hence, cultivation of coloured cotton should be restricted to small areas only. Moreover, research work on coloured cotton should be restricted to only few research centres to avoid contamination of white cotton.

Low market demand: There is very limited demand of naturally coloured cottons in India. In the last few years, the demand of naturally coloured cotton has increased in some European countries, which is about 5-6 lakh bales per annum. Looking to low demand, it would be desirable to restrict cultivation of coloured cottons to limited areas and to registered growers only. This will help to Technical Bulletin from CICR (www.cicr.org.in) 9 naturally coloured cotton avert the possible loss to the growers possibly due to its over production and very less or no market demand.

Lack of marketing facilities: There is lack of proper marketing for the sale of naturally coloured cotton. It is necessary to develop marketing facilities before starting cultivation of coloured cotton on commercial scale. There should be written agreement between the purchaser and the producer for production of naturally coloured cotton. Naturally coloured cotton has been around for thousands of years. But the crop yield is typically too low and the short fibre unsuitable for mass manufacture of cloth with machines. Researchers at the Tamil Nadu Agricultural University (TNAU) are developing naturally coloured cotton that will not only eliminate the use of dyes, which are potential pollutants, but is also market friendly.

The sixth round of trials of coloured cotton crop is set to start in two months on a patch of land on the TNAU campus. Though TNAU conducted trials in 2014 which helped scientists identify a few strains producing lengthy fibres that are strong enough to withstand mid-speed spinning. (Ramkumar, 2017).

COLOURED COTTON IN INDIA :In current times, there is negligible area under coloured cotton varieties in India and elsewhere in the world. However, there has been an infrequent resurgence of interest, mostly through environment oriented passion. Over the past 3-4 years, concerns have been raised in the Indian parliament highlighting the need to promote research and development of naturally coloured cotton varieties in India. Currently, naturally coloured cotton is cultivated in a smaller scale in Dharwad region of Karnataka, Coimbatore region of Tamil Nadu, Vidharbha

region of Maharashtra and Guntur region of Andhra Pradesh under the patronage of Research Institution in the areas. The estimated total area under naturally coloured cotton is around 200 acres. The total production of naturally coloured cotton lint from these areas together is approximately 330 quintal. The lint thus produced at Dharwad is processed by converting into roving at the Chitradurga KVIC Sliver plant and the roving is distributed amongst different societies for hand spinning and weaving on handlooms, as also for knitting. It is noteworthy to state that the products made out of naturally coloured cotton do not undergo any chemical dyeing process. Hence it is eco friendly and sustainable. The product profile consists of hand made towels, saris, salwar suits, shirts, denim, etc. at present. The limited production and lack of visibility has led to lack of product innovation and market expansion. In order to promote colour cotton, the State Government of Karnataka, Maharashtra, Tamilnadu and Andhra Pradesh have been specifically requested to cultivate colour cotton on a commercial scale and extend required support from the research institution and *Khadi* and village industries board for processing and marketing of the products for giving a remunerative price to the growers (Report of Ministry of Textiles, 2015). There are more than 50 coloured cotton genetic stocks in the national gene bank of the Central Institute for Cotton Research, Nagpur that were collected indigenously or obtained from other countries such as Mexico, Egypt, Peru, Israel, Soviet and USA (Kranthi, 2014).

PROBLEMS OF COMMERCIAL CULTIVATION OF COLOURED COTTON

- Yield is low, about half that of white cotton (but this may be compensated by a higher price in the international market), and they are susceptible to certain types of pests.
- When cultivated in large areas, natural cross pollination may occur from white linted to colour and *vice versa*. Hence, isolation distance of the order of 50 meters or more may be required between varieties.
- Contamination may also occur during harvesting, transportation, ginning, pressing, and spinning.
- Since white cotton is still a major agricultural produce, its contamination with colour lint may have disastrous effects on agricultural economy.
- These, along with the application of biotechnology and modern farming techniques may give the much-needed boost to revive this gift of nature.

CONCLUSION

Naturally coloured cotton environment friendly, aesthetic and fascinating, but its continued patronage will be determined by economic outlook and long term benefits. Commercial production of colour-linted cotton does not appear to be in the interest of seed and textile industry at present. But biotechnology may have some interest, if there is a future demand.

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