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Research Paper

Ginning, spinning, wet processing and fabrication: A means of value addition to organic kapas

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■ **ABSTRACT :** Organic cotton is grown without pesticides and insecticides and seeds are not genetically modified. India is still the largest producer of organic cotton in the world, accounting for two-third of the global organic cotton production. Textile in the form of fibre, yarn, fabric, garment and fashion accessory is of at most adorable substrate. It is but true that cotton as Kapas (cotton wool with seeds) has very little value as raw goods but the post harvest processes shall definitely fetch better (premium) price. Two varieties of cottons selected for the study were DHH - 11 and DHB - 915. The efficiency of ginning in conversion of Kapas into lint was 49 per cent and remaining 51 per cent was wastage. The efficiency of spinning was 64 per cent and wastage was 36 per cent. Thrash, handling during spinning, wastage during mechanical processing were the main causes for wastage. The quantity of yarn obtained from 10.66 Q of Kapas was 3.36 q almost 1/3 of the total weight; but the returns were 5.82 folds. The calculated profit from Kapas to finished cloth was 29.60 per cent.

■ **KEY WORDS:** Organic cotton, Ginning, Spinning, Wet processing, Weaving

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Organic cotton is grown without pesticides and insecticides; furthermore the organic cotton seeds are not genetically modified. For organic cotton cultivation, the methods and materials adopted have very low impact on the environment also referred as organic farming. Though organic cotton farming replenishes and maintains soil fertility, organic cotton cultivation reduces the use of toxic and persistent pesticides and fertilizers and builds biologically diverse agriculture.

The first organic cotton project started was in Egypt during the year 1990. Today organic cotton is grown in over 22 countries. As of 2007 the largest producers of organic cotton are Turkey and India. According to "Organic exchange" China, Syria, Peru, Uganda, Tanzania, Isreal, the United States and Pakistan are under the top ten organic cotton producing countries in the world.

Reasons for organic cotton and against conventional cotton :

The amount of conventional cotton produced per year is 25 million tons. The amount of water needed for 1 kilo of non-organic cotton is 29,000 litre. High levels of agro-chemicals are used in the production of non-organic cotton. According to the "Pesticide Action Network" cotton uses 25 per cent of the world's insecticides and more than 10 per cent of all pesticides. The cultivation of cotton accounts for only 2.4 per cent of agriculturally used areas. Thus, cotton production uses more chemicals per unit area than any other crop (*http://en.wikipedia.org/wiki/Organic_cotton*).

According to a report of the Central Institute of Cotton Research, Nagpur, cotton is the second largest polluter in agriculture, accounting for 25 per cent of the pollution from the pesticides used on the crop.

The yearly produced organic cotton is 25,000 tons which is only 0.1 per cent of the worldwide production in organic cotton. Amount of water needed for 1 kilo of organic cotton is about 7,000 litre. Application of pesticides and insecticides is forbidden in organic cotton cultivation. In organic cotton cultivation only organic herb mixtures, crop rotation and

natural enemies are used in fighting pests. Organic cotton farmers have a healthy work environment. The cultivation of the fields is sustainable. It is mentioned that in the post harvest processing there was no secondary damage to factory workers in organic cotton production. In fact organic farming has social and human benefits too.

Organic cotton production and the environment :

About 25 per cent of the world's insecticide is used and more than 10 per cent of the world's pesticide goes to cotton crops. In 2003 itself it was amounted to about 55 million pounds of pesticides that was sprayed on 12.8 million acres of cotton, according to the Organic Trade Association. Some of these chemicals in fact are considered to be the most toxic chemicals in the world. The health risks of pesticide exposure include birth defects, reproductive disorders and weaker immune systems. Organic cotton may cost more up front, but it has substantial benefits over the long term. (*http:// www.motherearthnews.com/nature-and-environment/ organic-cotton-benefits*).

India is still the largest producer of organic cotton in the world, accounting for two-third of the global organic cotton production. But, the total organic fibre production of the country has fallen by close to 50 per cent as global brands shift to Better Cotton Initiative (BCI). A marketing-driven green alternative to conventional cotton grown using chemicals, BCI is growing rapidly and getting premium over the conventional cotton.

Cotton induces images of white, fluffy purity and many people think of cotton being a natural, pure fabric. It is a wonderfully versatile and globally important fibre that is used for a vast variety of fibre and food products, making it one of the most widely traded commodities on earth. Versatility, softness, breath-ability, absorbency, year-round comfort, performance, and durability are just a few of the qualities that have earned cotton its popular status.

The cotton worn next to skin breathes, absorbs and offers comfort and also has a reputation for being pure, the best fabric for children wear.

Textile in the form of fibre, yarn, fabric, garment and fashion accessory is of at most adorable substrate that is utilized by every mankind. Weaving as one of the methods of fabric constructions involves a series of simple and fancy constructions. It is but true that cotton as Kapas (cotton wool with seeds) has very little value as raw goods but the post harvest processes shall definitely fetch better (premium) price.

The focal point of the project is post harvest technology on organic cotton and capacity building of artisans. It encompasses the thrust areas of organic farming, organic cotton, ginning, spinning that form a means of livelihood security for the farming community.

Keeping in view the impact of various processes involved in conversion of Kapas into yarn, yarn into fabric and finish applied to organic fabric, the research was designed with the following objectives:

Objectives :

- To evaluate the quality parameters of organic cotton fibre.
- To assess the efficiency of ginning and baling of organic cotton.
- To estimate the efficiency of spinning on value addition to cotton.
- To calculate the combined effect of ginning and spinning on yarn quantity.
- To determine the value addition of textile processing/ s on lint, yarn and fabric.

■ RESEARCH METHODS

The methodology adopted for the present study is detailed as below:

Procurement of raw material :

The organic cotton of two varieties *viz.,* DHH-11 and DHB -915, were procured from the Institute of Organic Farming, University of Agricultural Sciences, Dharwad in two lots once during the 2011 and secondly in 2012 totalling to 10.66 q.

The various agriculture activities involved while procuring raw material are- Organic cotton cultivation, manual picking, Kapas, and hessian of Kapas.

Industry linked processes :

The important processes involved industry linkages are sorting, opening and mixing, ginning and baling and spinning.

- Ginning and baling.
- Spinning.

Experimental procedure :

The assessment of fibre parameters *viz.,* fibre length, fibre fineness and tenacity was carried out in the cotton research lab applying BIS system.

Estimation of value at every conversion stage :

The cost estimation was made at each and every conversion stage considering variable costs and profit of 30 per cent or as applicable.

■ RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Procurement of raw material :

Before spinning and weaving the organic fabric, it was

found essential to assess the fibre properties of selected organic cotton varieties, procured from Institute of Organic Farming, UAS, Dharwad.

Steps involved in conversion of Kapas into cotton yarn :

Organic cotton is grown without pesticides and insecticides, furthermore organic cotton seeds are not genetically modified. Organic cotton cultivation reduces the use of toxic and persistent pesticides and fertilizers and builds biologically diverse agriculture. Organic cotton agriculture abdicates form toxic and persistent pesticides, choosing organic cotton products are the easiest way to protect ones skin (Fig. 1).

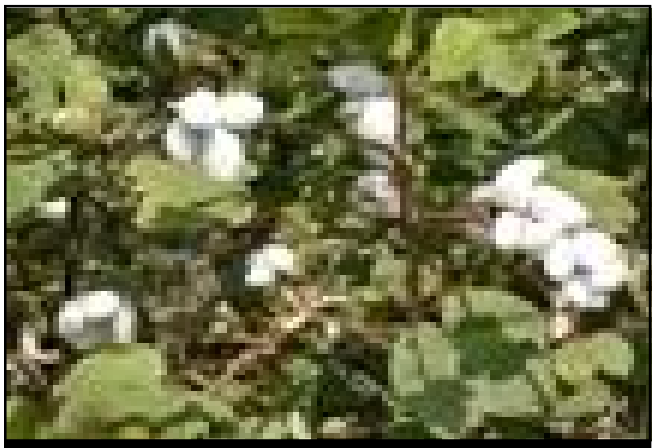

Fig. 1 : Organic cotton agriculture

Cotton can either be picked by hand or by machines. Manual picking is slow but better preserves fibre characteristics of cotton. A longer stay of the open bolls in the field may change the colour and also make the fibres shrink, thus affecting the three most important fibre characters, *i.e.* length, strength and micronaire. In the case of handpicking, it is possible to pick open bolls at frequent intervals, and weather effects on the fibre, after bolls have opened, can be minimized (Fig. 2).

Fig. 2 : Open bolls of Kapas

Kapas - Cotton is a soft, fluffy staple fibre that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus *Gossypium*. The fibre is almost pure cellulose. Under natural conditions, the cotton bolls will tend to increase the dispersion of the seeds.

Hessians of Kapas :

Loads of Kapas received in ginning factory are sorted before opening and mixing. The hessian is stored in the godown, in dry weather for quite some time till required quantity of Kapas is procured (Fig. 3).

Fig. 3 : Storing of hessians

Industry linked processes :

Opening and mixing :

Before ginning the cotton received in the mill needs to be opened to remove the lumps. The unlocking of Kapas does release thrash and dust to some extent. Sometimes, during opening, care is taken to mix up the different lots of Kapas received from single source of single variety. Opening and blending of Kapas is a pre-ginning operation, mandatory in ginning factory which enhances the efficiency of ginning process (Fig. 4).

Fig. 4 : Opening and blending of Kapas

Ginning :

Cotton fibres are produced in the seed pods ("bolls") of the cotton plant; as a result, the fibres ("lint") in the bolls are interspersed with the seeds. The seeds must be removed from the lint to make the fibres usable (Fig. 5). Historically, this task was performed by hand. The production of cotton required hundreds of man-hours to separate the seeds from a useful amount of lint. Many simple seed-removing devices have been invented over the years, but until the invention of the cotton gin most required significant operator attention and worked on a small scale.

Fig. 5 : Removal of seeds through ginning

Baling :

The gin is a large press box that separates the cotton fibres from the cotton seed and must be operated at specified speeds. A bale of cotton weighs approximately 500 pounds. A bale measures 56 inches long - 48 inches height (Fig. 6). Texas grows about 4.5 million bales of cotton in a year making it the largest cotton producing state in the US.

Spinning :

This is the process of converting fibre into a yarn by inserting twist, holding the constituent fibres together. The processes to make yarn short-staple yarn (typically spun from fibres from 0.75 to 2.0") are blending, opening, carding, pin-drafting, roving, spinning, and if desired plying and dyeing. In long staple spinning, the process may start with stretch-break of tow, a continuous "rope" of synthetic fibre (Fig. 7). In open-end and air-jet spinning, the roving operation is eliminated. The spinning frame winds yarn a bobbin. Generally, after this step the yarn is wound to a cone for knitting or weaving.

Experimental procedure :

The important fibre properties *viz.*, fibre length (mm), fibre fineness (mic) and fibre tenacity (g/tex) were assessed for individual variety and resultant observation on blending both the varieties. The detail of analysis of fibre parameters is listed below:

Fig. 6 : Height and weight of a bale of cotton

Fig. 7 : Spinnnig of cotton

Analysis of fibre parameters :

- Quality parameters of organic cotton.
- Quality parameters of organic cotton (%).
- Fibre parameters of mixed cotton lint.
- Efficiency of ginning and baling of cotton.
- Efficiency of spinning on value addition to cotton.
- A combined effect of ginning and spinning on yarn quantity.
- Value addition of textile processing/s on lint and yarn.

Two varieties of cottons selected for the study were DHH-11 and DHB-915 (Table 1). The staple length of DHB-915 was found to be 33.50 mm with tenacity of 24.00 g/tex and was much longer and stronger than DHH-11 (28.25 mm and 21.00 g/ tex, respectively). However, DHH-11 was found to be relatively finer (4.56 mic.) than DHB–915 (3.58 mic.).

Table 1: Quality parameters of organic cotton fibre

Varieties	Staple length (mm)	Fineness (mic)	Tenacity (g/tex)
DHH-11	28.25	4.56	21.00
DHB -915	33.50	3.85	24.00

It was found that the calculated staple length values of DBH-915 was longer by 18.58 per cent, finer by 18.44 per cent and stronger by 14.29 per cent than that of DHH-11. In other words, the staple length of DHH-11 was shorter by 15.67 per cent, coarser by 15.57 per cent and weaker by 12.50 per cent (Table 2).

Table 2 : Quality parameters of organic cotton fibre (%)

Varieties	Staple length (%)	Fineness (%)	Tenacity (%)
DHH-11	Shorter by 15.67	Coarser by 15.57	Weaker by 12.50
DHB -915	Longer by 18.58	Finer by 18.44	Stronger by 14.29

Table 1 and 2 clearly indicate that shorter the staple length, coarser and weaker the fibre; whereas longer the staple, finer and stronger the fibre is and mean while longer the fibre spin, finer yarn and shorter fibre into coarser fibre.

Both the genotypes (DHH-11 and DHB -915) were mixed and blended thoroughly and the fibre parameters of mixed cotton lint were assessed. It was found that the resultant staple length was 30.87 mm, fineness 4.20 mic. and tenacity to be 22.50 g/tex (Table 3).

Table 3 : Fibre parameters of mixed cotton lint

Varieties	Staple length (%)	Fineness (%)	Tenacity (%)
DHH-11	28.25	4.56	21.00
DHB 915	33.50	3.80	24.00
Mixed	30.87	4.20	22.50

The efficiency of ginning in conversion of Kapas into lint was 49 per cent and remaining 51 per cent was wastage (Table 4). This wastage is comprised of seed, thrash, impure and unclean, soiled Kapas, discoloured/ contaminated Kapas, manual handling during ginning and baling. The greater per cent of wastage is attributed to cotton picking accomplished at different timings, which was later mixed and made into single bundle. Thus, the results indicated that there is a need for sorting of Kapas picked at different timings before sending it to ginning. In other words, cotton of different picking/s need to be packed separately to enhance the efficiency of ginning and to produce quality yarn.

Table 4 : Efficiency of ginning and baling: Value addition to cotton

Sr. No.	Details	Information
1.	Total wt. of Kapas	10.66 q
2.	Total wt. of cotton lint	5.24 q
3.	Efficiency of ginning and baling	49 %
4.	Wastage	51 %

The efficiency of spinning was 64 per cent and wastage was 36 per cent (Table 5). Thrash, handling during spinning, wastage during mechanical processing are the main causes for wastage.

Table 5: Efficiency of spinning on value addition to cotton

Sr. No.	Details	Information
1.	Total wt. of cotton lint	5.24 q
2.	Total wt. of yarn	3.36 q
3.	Efficiency of spinning	64 %
4.	Wastage	36 %

The impact of ginning and spinning is evident from Table 6 which clearly indicated that 10.66 quintal of Kapas reduced to 5.24 quintal of lint on ginning; and 5.24 quintal of lint evolved 3.36 quintal of yarn as evident from Tables 4 and 5. The combined effect of ginning and spinning indicated that wastage was comprised of 2/3 of the total weight of Kapas and efficiency was only 30 per cent of the total weight of Kapas.

Table 6: Impact of ginning and spinning on yarn efficiency

Sr. No.	Details	Information	Efficiency (%)	Wastage (%)
1.	Total wt. of Kapas	10.66 q	–	–
2.	Total wt. of cotton lint	5.24 q	49 %	51 %
3.	Total wt. of yarn	3.36 q	64 %	32 %
4.	Impact of ginning and spinning	7.30 q	31.52 %	68.48 %

Ginning is the process that converts the Kapas into lint separating seeds and thrash; and lint is transformed into yarn by spinning process. In this physical transformation, there is loss in weight at each stage but surely showed gain in returns. The cost of Kapas was about Rs. 32/kg but the cost of lint was increased by 2.32 folds *i.e.* 74.55/kg. Similarly, quantity of yarn obtained from 10.66 q of Kapas was 3.36q, almost 1/3 of the total weight; but the returns was 5.82 folds (Table 7). Thus, it may be stated that at every level of transformation of fibre into yarn and yarn into further form/ structure add value to the final product to earn better returns.

The calculated profit from Kapas to finished cloth was 29.60 per cent. In fact the profit will be multi - fold when commercially manufactured (Table 8).

Conclusion :

– Organic cotton cultivation reduces the use of toxic and persistent pesticides and fertilizers and builds biologically diverse agriculture. Organic cotton agriculture abdicates form toxic and persistent

Table 7: Value addition of textile processing/s on lint and yarn

Sr. No.	Material details	Quantity	Textile processing	Processing cost (Rs.)	Cost/kg (Rs.)	Value addition
1.	Kapas	10.66 q	–	34, 058/-	31.94 (32/-)	–
2.	Cotton lint	5.42 q	Ginning	05, 000/-	74.55	2.32 folds
3.	Yarn	3.36 q	Spinning	23, 520/-	186.30	5.84 folds
			Total Rs.	62, 587/-		

Table 8 : Value addition to fabric – calculated values

Sr. No.	Details	Quantity	Textile processing	Processing cost (Rs.)	Cost/kg (Rs.)	Value addition
1.	Kapas	10.66 q	–	34, 058/-	31.94/-kg (32/-)	–
2.	Cotton lint	5.42 q	Ginning	05, 000/-	74.55/-kg	2.32 folds
3.	Yarn	3.36 q	Spinning	23, 520/-	186.30/-kg	5.84 folds
4.	Fabric	3900 m		58,000/-	30.92/-m	
	Wastage 15 % (585 m)	585m				
5.	Kora cloth	3315m	Wet finishes	31,200/-	49.40/-m	64/-m (30 % profit)
6.	Overhead charges: logistics, electricity, rent etc.	3315m		11,500/-	–	–
			Total Rs.	1,62, 708/-		2,12,160/-

pesticides, choosing organic products are the easiest way to protect ones skin.

- It was found that the calculated staple length values of DBH-915 was longer by 18.58 per cent , finer by 18.44 per cent and stronger by 14.29 per cent than that of DHH-11; in other words the staple length of DHH-11 was shorter by 15.67 per cent, coarser by 15.57 per cent and weaker by 12.50 per cent.
- The efficiency of ginning in conversion of Kapas into lint was 49 per cent and remaining 51 per cent was wastage. This wastage was comprised of seed, thrash, impure and unclean, soiled Kapas, discoloured/ contaminated Kapas, in manual handling during ginning and baling.
- The efficiency of spinning was 64 per cent and wastage was 36 per cent.
- The combined effect of ginning and spinning indicated that wastage was comprised of 2/3 of the total weight of Kapas and efficiency was only 30 per cent of the total weight of Kapas.
- At every level of transformation of fibre into yarn and yarn into further form/ structure add value to the final product which earns better returns. The cost of Kapas was about Rs. 32/-kg but the cost of lint was increased by 2.32 folds *i.e.* 74.55/kg. Similarly, quantity of yarn obtained from 10.66 q of kapas was 3.36 q, almost 1/3 of the total weight; but the returns was 5.82 folds.
- The calculated profit from Kapas to finished cloth was 29.60 per cent. In fact the profit will be multi fold when commercially manufactured.
- It may be stressed that any entrepreneur can earn a minimum of more than 30 per cent profit on this venture of spinning, weaving and probably more than 50 per cent when convert 2D fabric into 3D garments.

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