



Research Paper

Technological Evolution and Current Practices in the Indian Ginning Industry

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ABSTRACT: The Indian ginning industry occupies second position in the world. In India, there are about four thousand ginning factories located across the cotton belt mostly equipped with double roller ginning machines except factories which adopted saw gin technologies in Punjab, Haryana, and Rajasthan. Ginning is a systematic process of removing fibre, debris, and cottonseed from kapas. The kapas which heaped in the form of a large conical pile in the open yard of the ginning factory catches moisture and contamination. This results into material loss and cost escalation due to additional technical process required to get quality output. Now, a modest attempt made in this paper to study the ginning practices and technological adoption in changing scenario of the Indian industry. The traditional DR gin machines now improved with versatile highest capacity model gin machines which are economical, productive, and consume less power.

KEYWORDS: Heap, Kapas, Precleaning, Roller Ginning, Saw Gin

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I. INTRODUCTION

Knowledge of the conditions and practices of the storage of kapas and of their ginning for the separation of cotton from the seed will help in an understanding of the composition and quality of the cottonseed produced in India. According to the report of a survey (Iyengar and Nanjundayya, 1959) undertaken in 1966 by the Indian Central Cotton Committee to examine the conditions existing in the ginneries in the country, the working conditions in ginning factories were far from satisfactory and malpractices were also in vogue.

II. STORAGE AND HANDLING OF KAPAS

The kapas picked from the field brought to the ginning factory in bullock carts or lorries. Large storage space required as the kapas is a bulky material. Covered sheds maintained for this purpose. But the kapas heaped in the form of a large conical pile in the open yard of the ginning factory, and usually covered by tarpaulins. In 54 percent of the factories, the kapas kept in sheds and in 41 percent the kapas kept in the open but protected during rains by tarpaulins. In 5 percent of the factories, even this protection is a not available. It would be beneficial if well-ventilated covered sheds provided for storing the kapas, though this will increase the cost of ginning to a certain extent. In all the ginning factories, the kapas managed only by manual labour (Iyengar and Nanjundayya, 1959). Now, tractor attachment technologies used in handling/transporting kapas from fields to ginning factories and protective measures taken in all ginning factories to keep kapas moisture/contamination free.

III. CLEANING OF KAPAS BEFORE GINNING

The kapas received at the ginning factory is composed of different grades. There is an estimation that 26 percent of the factories deal with clean kapas, 56 percent with medium clean, 14 percent with a combination of clean, medium clean and trashy, and 3 percent with clean early in the season and trashy later (Iyengar and Nanjundayya, 1959). Thus, three-fourths of the factories manage kapas containing various proportions of foreign matter. Before ginning, 64 percent of the factories do not clean the kapas at all, 23 percent hand-clean it,

6 percent clean it using Platt's opener, and 7 percent using locally made openers. Various cleaning treatment technologies are introduced recent past to achieve optimum quality ginning output.

IV. PRECLEANING AND GINNING

A precleaning or opening treatment given to the kapas before ginning removes the trash present in the form of hulls, boll rests, stalk bits, leaf, dirt, dust and yields a cleaner cotton which therefore causes a lower wastage in the mill. The factories dealing with trashy varieties of kapas should install cleaning machines. In few ginning firms, cotton dumped on unpaved ground, opened, and spread for drying in the sun for further processing. In each of these stages it picks up sand, dust, and other materials. The trashy cottons in principle require pre-cleaning so that only pure seed cotton fed into the ginning machines (Vizia et al., 1999). At the same time, the mill owners and cotton merchants should offer adequate premiums for the cleaned samples to encourage marketing of Indian cotton in a finer state. This would lead also to better quality linters from the seed and lower losses in processing cottonseed.

Investigations conducted at the Technological Laboratory of the Indian Central Cotton Committee have shown (Nanjundayya, 1957) that the trash content varied with different cottons from 4 percent and above to 2 percent and below. Precleaning would be definitely advantageous to cottons which give a trash content of over 3 percent and to the extent to those which have 2-3 percent. Further, experiments conducted at the Technological Laboratory on roller gins have shown that precleaning improved the outturn of the lint and its grade, reduced the blow room loss, and cut down the transport charges from the ginning factory to the mill and is therefore very desirable. It is obvious that such precleaning will yield cleaner cottonseed for subsequent processing.

Gins broadly classified as roller gins and saw gins. The roller gins subdivided into single-roller and double-roller gins. The former further classified as gins having a single moving knife and those with double moving knives. According to the survey (Iyengar and Nanjundayya, 1959), 75.6 percent of the factories equipped with single-roller gins (22.8 percent with one knife and 52.8 percent with two knives) and about 24.4 percent with double-roller gins. At that time, there were hardly any saw gins, but subsequently, several saw gins were erected, notably in Punjab.

Few gins are as old as a hundred years, and one third of the factories had gins more than 50 years old. Only about 20 percent of the factories had gins less than 30 years old and 3.4 percent less than 20 years old (Hardin and Byler, 2013). In consequence, the ginning operations with these old and worn-out equipment are inefficient, and considerable amounts of ginnable lint left on the cottonseed coming out of the gins. Few gins are old and obsolete, and their output is also low. Ginning inefficiency is one of the crucial factors influencing the lint content of Indian cottonseed of all varieties. Complete replacement, or at least overhauling and modernization, of the gins would benefit both the cotton and cottonseed processing industries.

V. STRENGTH OF ATTACHMENT OF FIBRES TO SEED

Few varieties of kapas required more power to gin a specific quantity than others. Fragments of the seedcoat pulled out in few instances during ginning. Thus, the force required to extract fibres from the seeds varies with variety. The strength of attachment of fibre to seed was much higher at the micropylar or the pointed end of the seed than at other locations. There was no difference in strength between the right and the left sides of the seed. The strength of attachment of fibre to seed was much lower than the fibre strength itself, which explains why fibres pulled out from the seed and not broken. The power expended in ginning was much more than the actual work required to pull out fibres from seed. Seed-coat bits pulled out invariably from the chalaza or the broad end. Thus, the linters content of ginned cottonseed is a varietal factor.

VI. ADVANTAGES AND DISADVANTAGES OF SAW GINS

In America, 95 percent of the ginneries equipped with saw gins (Hughes and Armijo, 2015). In India saw gins introduced lately in certain localities, particularly in the dense cotton growing areas of Punjab such as Ahobal and Hissar. Mostly roller gins used even today. However, with a per-width basis technology, high-speed roller gin machines now compete modern-day saw gins (Hughes et al., 2020). Few advantages of saw gins working in India are:

- A much greater turnover achieved by a saw gin and hence it is less expensive than a roller gin. The labour requirement is also less for saw gins. The saw gins consume the least power per bale of lint produced.
- Saw-ginned lint is of more uniform staple than roller-ginned lint; it also yields stronger yarn.
- Saw-ginned lint and seed are cleaner than roller-ginned products.
- The blow room loss is less for saw-ginned lint (5-6 percent) than for roller-ginned lint (9-10 percent).

6.1 Saw gins also have disadvantages

- Less lint removed by saw gins from the kapas (about 32 percent) than by roller gins (about 34 percent), i.e., the yield of lint is less, and the residual lint left on the seed is greater when saw gins used in place of roller gins. This may partly explain the higher residual lint on American type seed such as Lakshmi, Buri, and Cambodia as they come out of the gins in India. However, saw-ginned lint is cleaner and fetches a better price. Governments reported to have fixed a price higher than for roller-ginned lint.
- Saw gins are more expensive and more complicated to operate than roller gins and require more skilled supervision.

On balance, it appears profitable to replace the existing roller gins with saw gins on technological grounds. However, the economic feasibility under the market conditions in India considered. First, there is the disinclination on the part of the factory owners to incur a heavy initial outlay on saw gins when their profits assured with the existing roller gins. Secondly, there are not tracts in India producing sufficient seed cotton to feed saw gins, which have a high productive capacity. Moreover, proper facilities for transporting seed cotton from distant cotton fields to the ginneries are meagre. After careful consideration of the various factors involved, both economic and technical, the Indian Central Cotton Committee concluded that roller ginning is to be preferred to saw ginning and recommended that the advantages of roller ginning might be brought to the notice of the growing, ginning, and manufacturing industries.

VII. ADVANCED TECHNOLOGIES IN GINNING

The world technologies used in the ginning process classified into four viz., saw gin technology, DR (double roller) gin technology, rotary knife roller gin technology or rotobar ginning, and single roller gin technology. Each technology has its own advantages and disadvantages. The saw ginning technology widely used in developed countries. However, roller ginning technology has few merits as compared to saw gin in terms of greater recovery and higher retaining capacity of cotton length. The modern developments in ginning technologies include (Patil and Arude, 2020):

1. The tractor attachment technologies for heaping of cotton and loading and unloading of vehicles introduced after 2010 in the place of conventional practices such as manual loading and unloading, heap making, and conveyer system of feeding which cause contamination and need more labour (Funk and Wanjura, 2017).
2. The ginning efficiency of the seed cotton improved by reducing moisture content with sensor controlled on-line stifling air humidification method as well as vertical tower dryers (Byler, 2005).
3. The seed cotton obtained through hand picking, hand stripping, machine picking, and machine stripping contains trash material like immature and unopened bolls, stems, leafy particles, bracts. (Armijo et al., 2019). This trash content removed by inclined or horizontal cylinder pre-cleaning systems. The lint obtained after ginning cleaned through devices of spade and cylinder cleaners. The cleaning equipment such as stick machines, impact cleaners, and stripper cleaners provides complete treatment for the machine picking cottons.
4. The uniformity in feeding kapas to drying, cleaning, and ginning equipment is achieved through the utilization of Cotton Dispenser and Cotton Feed Control Box machines.
5. A modern technology of double line overhead delivery conveying system identified in the year 2012. It has sophisticated auto regulatory system and can feed two ginning machines at a time on similar lines. This technology has transformed ginning process from single feeding to double roller gin feeding. It requires comparatively low capital and consumes less power.
6. The traditional DR gin machines now improved with versatile highest capacity model gin machines which are economical, productive, and consume less power.
7. The problems of traditional chrome composite leather roller ginneries are now treated with DR gin with self-grooving rubber roller discs which are made up with soft and stiff rubber compound material.
8. The conventional type of double stage bale presses replaced with modern automatic single stage bale press handling system. This latest technology works for either single box pressing and/or double box pressing. It also facilitates up-packing system and/or down-packing system. They are useful for smaller capacities and/or higher capacities.
9. The risk of fire hazards in ginneries effectively controlled by sensor-based fire detection and diversion systems.
10. The types of mechanical, pneumatic, and electromechanical conveyer methods for handling kapas, fibre, and cottonseed established domestically (Patil, 2020).
11. Colour sensing contamination scanner technology is now available to ginning industry.

VIII. CONCLUSION

There is lot of change observed in ginning practices from the past to present. The ginning industry in India is in the transitional stage from hand picking to mechanical picking, hand stripping to mechanical stripping. The implementation of modern technologies in all stages of seed cotton processing is in progressive track. Moreover, future factories to be situated in or around extensive areas under cotton, especially of the American type, should be equipped with saw gins. In other areas, where cotton is not grown, the factories equipped with double-roller gins. The ginning efficiency of the existing gins should be enhanced and pre-cleaning equipment should be installed in factories which gin trashy cotton.

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