Maintaining Quality of Stripper Harvested Cotton from Field to Textile Mill

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ABSTRACT

Since fiber quality cannot be improved after it has been removed from the cotton plant, it is very important that fiber quality be maintained during harvesting and ginning. Recent developments in harvesting and ginning practices have made significant advances that will better preserve fiber quality during these critical steps. One recent development for stripper cotton production involves the use of earlier harvest dates to reduce exposure to inclement weather conditions and to allow for a more favourable harvest period. Although several factors have led to earlier harvest dates, the recent utilization of boll openers and the availability of new defoliants and desiccants that better prepare the cotton plant for stripper harvesting, are the biggest contributors. Additional factors such as modifications of the cotton stripper have reduced foreign matter, in particular stick content, which can have a significant effect on reducing bark content in lint. Modifications of the stripper include changing the combinations of brushes and bats, use of a wider spacing between stripper rolls and between combing pans, and improved adjustment of grid bars in field cleaners. Improved seed cotton drying systems along with new developments in seed cotton cleaning at the cotton gin have significantly enhanced seed cotton cleaning in the gin thus reducing lint-cleaning requirements. New lint cleaning equipment and procedures have minimized the amount of cleaning required while maintaining fiber cleanliness and quality. These improvements in harvesting and ginning technologies are critical elements in maintaining the quality of stripper cotton as it moves from the cotton field to the textile mill.

Introduction

The quality of fiber delivered to the textile mill is affected by many factors. Genetics, of course, plays a primary role. So, cultivar selection is a crucial first step in producing a quality product. Whether or not a cotton reaches its genetic potential, however, is a function of many environmental and production factors. Planting date, soil fertility levels, effectiveness of weed and pest control methods, and irrigation methods are production factors which can be managed to a large extent by the farmer to influence final fiber quality. Uncontrollable environmental factors, however, often have a greater influence on quality than anything under the control of the farmer. Weather during the growing season, for example, determines soil moisture availability in dryland cotton fields, available sunshine and heat units, and length of growing season. If the farmer makes good management decisions and the weather co-operates, the cotton plants produce a strong, mature fiber that will reach its maximum quality level the day the boll opens. Thereafter, there is nothing that can be done to further improve fiber quality. A number of factors can, however, begin to chip away at the fiber's inherent first-day quality. Unfavourable weather can interfere with a timely defoliation and harvest that is so critical to maintaining maximum fiber quality, and excessive rain or snow while the cotton is stored in modules in the field can dramatically lower quality expectations. The final factors that can influence fiber quality are related to harvesting and ginning methodologies. Each growing season presents a different set of challenges to the producer and ginner, requiring continual adjustment of management strategies to produce a profitable, high-quality crop.

At one time stripper cotton was thought to be of decidedly lower quality than picker cotton, but in recent years improved cultivars have been developed for stripper cotton areas that have help to close the perceived quality gaps resulting from differing mechanical harvesting methods. In addition, improvements in stripper harvesting techniques and ginning procedures have also helped to better preserve the inherent quality of these new, improved stripper cottons. This discussion will focus on these improved stripper harvesting and ginning techniques.

Results and Discussion

One very significant factor that has contributed to fiber quality improvements in many stripper cotton areas is an earlier harvest date. Since the mid 1990's, the onset of stripper harvesting has been advanced from around the first of November to the first half of October (Fig. 1). This change in harvest date has been made possible by a combination of several factors. The use of earlier maturing cultivars, greater use of harvest aid chemicals, and less dependence on a killing freeze to condition the crop for harvest are the major factors affecting harvest date.

For many years farmers in the Texas High Plains area waited 10 days to 2 weeks after receiving a killing

freeze before beginning their harvest operations. The average first freeze date for the Texas High Plains is Nov.3, but this event can occur as early as the first of October or as late as the later part of November. Waiting for a freeze to desiccate the cotton plant naturally does, of course, result in avoiding the costs of applying the required chemicals for proper defoliation and desiccation. However, the long uncertain wait required for this natural process to properly condition the plants often cause the open cotton bolls to be exposed to adverse environmental conditions that can lower per acre yields and adversely affect fiber colour as well as other important quality parameters. This loss in fiber quality may become even more acute if the plant becomes dry and brittle before harvesting. Brashears (1989) has shown that as the plant becomes dry and brittle, a higher percentage of sticks are harvested along with the cotton, and this increase in foreign material results in a higher incidence of bark in the ginned fiber. While most modern spinning systems can tolerate some bark in the cotton, most will have serious problems with heavily contaminated fiber. Generally, an earlier harvest will occur before the plant becomes completely dry and brittle. Thus, the earlier harvest takes advantage of the greater flexibility of the cotton plant's main stem and limbs and results in fewer sticks and stems in the harvested cotton and less bark in the ginned fiber.

Harvesting cotton prior to a killing freeze requires chemical defoliation and desiccation treatments to properly prepare the plants for harvest. Supak *et al.* (1994) found several chemical combinations that were effective in preparing the plant for stripper harvest. Utilization of boll openers and defoliants as an initial treatment followed by a desiccation treatment has been shown to be effective in preparing the earliest and most mature fields for harvest. As the season progresses, other more economical chemicals can be used for defoliation and desiccation. Although all cotton may not be harvested by the time a killing freeze occurs, a significant amount of the cotton can be harvested thus significantly reducing the amount of early opening bolls that may be exposed to undesirable weather conditions. One disadvantage of defoliating and desiccation during late September and October for producers on the Texas High Plains is that the days are getting shorter and cooler, and these conditions usually adversely affect the effectiveness of the chemical treatments. Further development of new defoliants and desiccants, along with improved methods of using these chemicals, may eliminate these late season problems. Recent studies, for example, have shown that paraquat, applied late in the afternoon, can significantly improve desiccation while utilizing lower rates of chemicals (Wrona *et al.*, 1996).

Modifications to the cotton stripper have been shown to reduce stick and fine trash contents of stripper harvested cotton. Changing the combination of brushes and paddles on the stripper rolls (Brashears, 1992) and spacing the stripper rolls further apart significantly reduces foreign material in the harvested cotton (Brashears, 1986). The combing pans under the stripper rolls can also be adjusted to significantly reduce fine trash levels (Brashears, 1988). Stripper harvesters equipped with bur and stick extractors have been found to be effective in removing substantial amounts of foreign matter from the cotton prior to ginning. Proper adjustment of these machines, especially the grid bars, can result in trash removal efficiencies in the range of 55% to 60% (Brashears, 1994). Cotton harvested with bur extractors may also require less drying and cleaning at the gin.

Farmers in stripper areas are sometimes asked why they use the stripper harvester instead of the more traditional picker. The lower cost of the stripper compared to the picker is, of course, one major factor. Another factor involves per acre yield advantages. Harvesting studies on the Texas High Plains have consistently shown that stripper harvested cotton usually produces higher yields due to the stripper's higher harvesting efficiency and the fiber quality of stripped cotton is approximately equal to that of once-over picker harvested cotton (Brashears *et al.*, 1995). These relationships have been confirmed for both traditional stripper and picker cultivars of cotton produced in the stripper production areas.

Improved ginning equipment for drying, and cleaning seed cotton and for cleaning lint after ginning has helped maintain fiber quality during the ginning processes. A relatively new belt drying process for wet seed cotton that allows a longer exposure time at a lower and safer drying temperature has improved drying efficiency and fiber quality (Laird *et al.*, 1995). Other significant industry improvements in seed cotton drying include wide shelf and hot shelf tower dryers, and fountain dryers. Proper conditioning of seed cotton significantly increases the efficiency of the cotton gin's cleaning equipment for stripper harvested cotton. Baker and Lalor (1990) developed a multistage bur and stick extractor that is capable of reducing foreign matter level at the gin stand from a typical level of 5.3 % to an significantly lower level of 2.1%. In general this new extraction system that is commercially available, produces cotton that contains about one-half as much trash as that cleaned by conventional machinery. Other studies have shown that seed cotton cleaning systems should feature components designed not only for large trash extraction, but provisions should also be made to remove as much of the fine trash as possible before the cotton reaches the gin stand (Baker, *et al.*, 1994). Improved fine trash removal during seed cotton cleaning reduces the amount of pepper trash that ends up in the bale after lint cleaning. While the spinning quality of fiber is not affected to any significant amount by the gin's seed cotton cleaning processes, these systems can certainly have a positive influence on ginning efficiency, lint grades,

bale values and the amount of trash that has to be removed at the textile mill.

Research has shown that improvements in lint cleaning techniques and operating procedures can offset some of the fiber damage normally associated with these necessary processes. Increased use of gentle air-type lint cleaners and a trend toward use of a single stage of saw-type lint cleaning has reduced nep levels in help preserve inherent fiber length properties. The development of specific operating guidelines for adjusting and utilizing saw lint cleaners have also proven beneficial from a quality preservation standpoint as well as from an efficiency standpoint (Baker and Brashears, 1989). Co-operative research involving both ginning and spinning considerations has identified combinations of various cotton gin and textile mill cleaning machines that provide the best cleaning results consistent with maximum quality preservation. Extensive seed cotton cleaning systems, one gin lint cleaner and 1 or 2 mill cleaners gave the best overall ginning and rotor spinning results (Baker, *et al.*, 1994). Studies by Brashears *et al.* (1997) have shown that these cleaning techniques can provide a high quality product with a minimum of foreign matter. Early season chemically defoliated stripper cotton utilizing these improved harvesting and ginning techniques produced leaf grades that averaged 1.2 while cotton harvested and ginned with the older, conventional techniques produced average lint grades of 2.7 (Fig.2). Ninety five percent of the colour grades were in the strict middling category for the early harvested cotton with improved ginning as compared to 75% of the colour grades being classed in the middling category for the freeze killed conventionally ginned and harvested cotton (Table 1). High colour grades and low leaf grades in this study demonstrates the superiority of this type of system.

Conclusion

An early harvest and improved harvesting and ginning technologies help preserve fiber quality as the cotton moves from field to textile mill. An early harvest, 3 to 4 weeks prior to a killing freeze, allows the cotton to be harvested while the cotton plant is green and pliable. These improved plant conditions leads to significantly lower foreign matter contents, particularly sticks and bark, than is obtained when cotton is harvested late in the season after the plants becomes dry and brittle. New combinations of chemicals for defoliation and desiccation have provided methods for properly preparing the cotton for stripper harvest. Modification of strippers and adjustments to bur extractors can significantly reduce foreign matter in seed cotton. Improved drying techniques in combination with new seed cotton cleaning equipment provides significantly cleaner seed cotton to the gin stand. Improved lint cleaning combinations and techniques can remove foreign matter more safely during lint cleaning at the cotton gin. Optimum combinations of gin and mill cleaning have been identified that will produce a high quality product from cotton harvested by the stripper method.

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Table 1. Colour grades for plant preparation and harvesting and ginning methods.

Plant Preparation	Harvest Ginning	Colour Grade				
		11	21	31	41	42/43
				%		
Chemical	Improved	95	5	0	0	0
Frost	Improved	0	0	80	20	0
Frost	Conventional	0	0	25	25	50

Figure1. Early and late harvest dates and average freeze date for Texas High Plains.

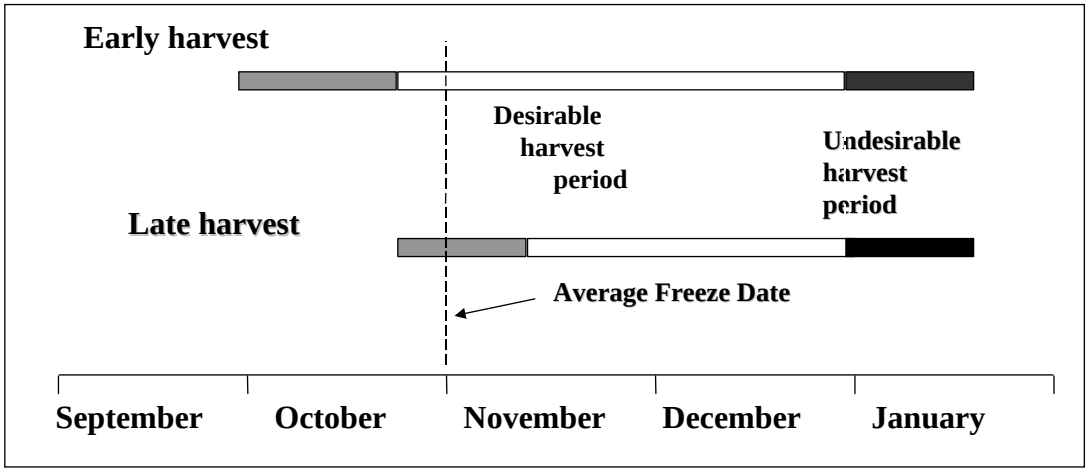

Figure 2. Average leaf grade for combination of plant preparation and harvesting and ginning sequences.