MAINTAINING FIBER QUALITY AFTER PICKING

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INTRODUCTION

Cotton is the world's most widely used textile fiber, the quality of which is extremely critical for successful textile processing. The choice of the best material for various end-uses has become highly specialized and is based on three major parameters.

- The fiber technological properties
- The non lint content or waste
- The fiber impurities

All fiber technological properties are imparted during the lifetime of the boll on the plant and are already present when the boll splits open. Thereafter nothing can be done actually to improve characters such as length, strength, elongation, maturity, fineness etc. and all our efforts are due to maintain these characters in the higher level possible.

However the spinability of any given cotton is also affected by the non lint content and the fiber impurities mostly introduced into the cotton mass at the successive stages following boll opening.

The fiber quality of the open boll is affected by an array of factors, which can be grouped into two categories pre harvesting and the post harvesting ones.

This paper considers all post harvesting factors and subsequent operations involved in handling, storage, seed removal and fiber processing likely to affect fiber quality after picking. Nevertheless some factors affecting earlier stages must be discussed shortly, in terms of their possible influence on the succeeding ones.

The post harvesting practices are further discussed in sequential order along with their effect on particular quality parameters. Yet post harvesting factors can be separated in those having a direct effect on seed cotton quality and those that are affecting directly lint quality.

GROWING AND HARVESTING FOR QUALITY FIBER

Certain actions or omissions during the growing or harvesting of cotton are essential for higher performance in the following stages. We are mentioning below a series of such prerequisite actions.

- Choice of varieties that mature in short period of time (synchronously)
- Plant shape adapted to mechanical picking
- Efficient weed control
- Land preparation for harvesting
- Plant preparation by the use of defoliants and desiccants
- Moisture control by proper timing at harvesting
- Proper maintenance of picking machines for high performance
- Experienced machine operators
- Better control of production and harvesting

Improved practices and better harvesters may preserve fiber quality and lower the cost.

POST HARVESTING PRACTICES FOR QUALITY FIBER

Seed cotton handling

The gin operation should not be based on the seasonal nature of harvest and weather conditions and its efficiency has to be depended upon a steady delivery of seed cotton. The volume of seed cotton processed through the gin must be sufficient for profitable operation. Efficient handling must be involved from the harvester until seed cotton is conveyed into the gin.

Efficient handling means economical and quality preserving. The way seed cotton is handled must permit the loading, unloading, conveyance and storage with a minimum of infrastructure, equipment and energy.

Seed cotton storage

Once the crop has opened any delay in harvesting means risking quality and loosing quantity from weathering or rainstorms. It is therefore a strong motive in picking the crop faster than it can be ginned and storage is most of the times inescapable.

The form in which cotton is stored depends upon many factors. Specific warehouses are providing maximum protection however field storage is also practiced. A primary concern is the storability of seed cotton and research has shown that it can be successfully stored taking into account some limiting factors.

The most important factor determining whether seed cotton can be safely stored is the moisture content especially that of foreign matter. Clean and dry cotton can be stored indefinitely without deterioration. Cotton for storage must be picked when the ambient relative humidity is lower than 50%, while damp or not adequately dried cotton should be ginned immediately. The portable moisture meters used in the ginneries are not quite suitable but a high correlation was found between their indications and ambient relative humidity (Fig. 1).

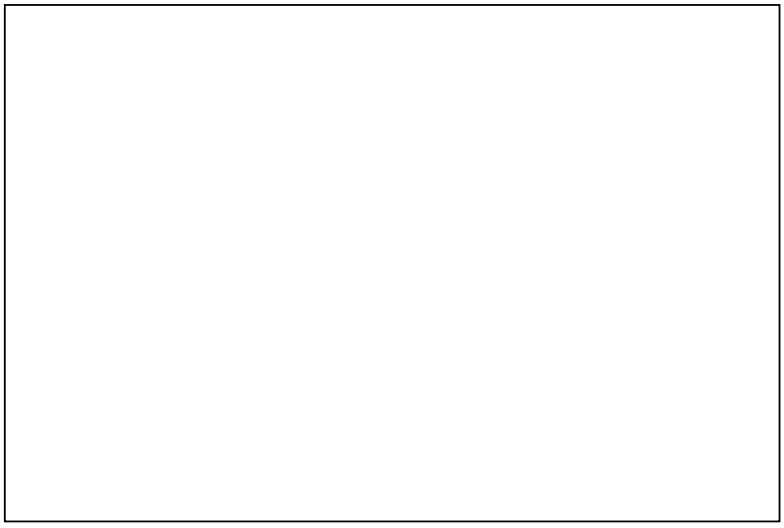

Fig. 1: Equilibrium moisture contents of cotton fiber, seed cotton and seed at different relative humidities at about 70^{o}F and 30 inches barometric pressure (From Cotton Ginners Handbook, No 503).

Other variables affecting fiber quality include length of storage, amount of high-moisture foreign matter, variation in moisture content throughout the stored mass, initial temperature of the seed cotton during storage, weather factors during storage (temperature, relative humidity, rainfall) and protection of the cotton from rain and wet ground.

Research on quality changes during storage showed that the quality parameters mostly affected is grade in its colour constituents and strength. An increase in light spotting occurs with increased moisture of stored seed cotton from 13 to 15% while no significant differences in colour were noted from 11 to 13% moisture content regardless the mode of storage.

Changes in the ambient temperature during storage have a moderate effect in yellowness. Temperature of seed cotton has to be monitored since a relative increase indicates high moisture content. Yellowness was also increased sharply at moisture levels above 13-14% when the storage exceeded 45 days.

Yellowing is accelerated at high temperatures. Both temperature rise and maximum temperature are important. Temperature rise is probably more related to the heat generated by biological activity than to heat gained from the environment.

Seed cotton moisture of 12% or less will allow safe long-term storage, assuming that production, harvesting and storage guidelines are followed. Higher seed cotton moisture can be tolerated for short storage periods. The rate of lint yellowing, however, begins to increase sharply at moisture above 13% and can increase even after the temperature of a module drops.

Biological activity at high temperatures and moisture is accelerated during storage having a direct and detrimental effect on fiber strength. The deterioration is proportional to the number and kind of microorganisms starting from a slight decrease to a more severe defect called cavitoma. Microbial defection make fibers very weak not capable to withstand ginning and spinning.

GINNING

The ginning process aiming to separate lint from seed is an unavoidable but detrimental function for fibers quality.

Cotton gins are responsible for converting seed cotton into marketable commodities ie. lint bales, cottonseed, “motes” etc. Gins although can only preserve fibers quality can nevertheless dramatically improve market value.

Assessment of the true quality of cotton cannot be completed, unless mill processing techniques and end uses are known. Current classification systems are actually encouraging ginning practices that degrade quality factors important to textile mills.

A ginner must have two objectives:

- To produce lint of satisfactory quality for grower’s classing and market system.
- To gin the cotton with minimum reduction in fiber spinning quality in order to meet the demands of the users (spinners, consumers).

Optimal ginning is the ultimate preservation of inherent quality characters and can be attained by:

- Proper selection and operation of each machine included in a ginning system
- Monitoring of the effect of each machine on weight loss and fiber quality
- Knowledge of the latest technologies in raw cotton fiber testing

- Careful assessment of each cotton lot and adaptation of the appropriate ginning practices
- Control of the ginning rates and gin stand speeds that tend to quality reduction
- Compromise between increased grade, reduced length parameters and reduced turnout
- Monitoring of moistured content and adapting ginning to the optimum fiber moisture content for any particular process in the gin

IMPACT OF GINNING IN FIBER QUALITY

The ginning practices with the higher impact on cotton quality are:

- the regulation of fiber moisture during ginning and cleaning
- the degree of gin cleaning used.

Ginning can have a large influence on some quality factors but it has very little impact on others.

Fiber length and relevant parameters are the quality characters mostly affected by ginning process. Maximum length decreases, length distribution undergoes dramatic changes and short fiber content increases. Reliable measure of short fiber content (SFC) is not possible yet although AFIS gives a close estimation. Constructing of fiber length diagrams is very tedious, nevertheless it gives the best information regarding changes in fiber length parameters during and after ginning. Deterioration is higher when damp cotton is processed while the lower strength of poorly stored cotton increases fiber breakage (Fig. 2). For each percentage point of reduction in fiber moisture below 5% the length is reduced about 1/100 of an inch and the uniformity 1% (Anthony, 1990).

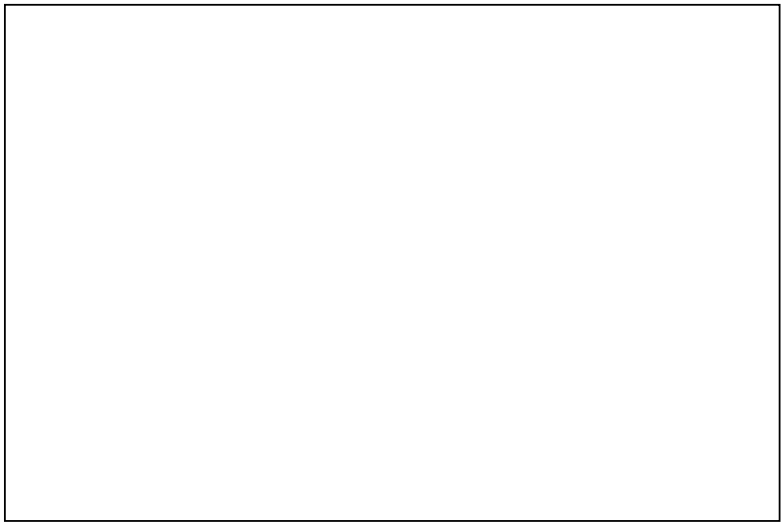

Fig. 2: The acceptable moisture content of cotton being ginned is a compromise between grade level and fiber damage (From Cotton Ginners Handbook, no 503).

Ginning affects grade in regard to preparation and foreign matter but has little effect on the fiber color except in extreme cases. However trash removal changes the perceived color of some samples. Lint cleaning is sometimes blending fibers, so that fewer bales would be classified as “spotted” or “light spotted” (Baker, 1988).

“Preparation” is mainly affected by ginning especially of wet cotton. Foreign matter or trash has its origin on the variety and is mostly affected by harvesting but proper cleaning during the ginning process may remove trash and increase cotton cleanliness. Excessive cleaning may be tolerated unless fiber breakage is too high thus decreasing length. A compromise between the two characters is the best practice (Fig. 3).

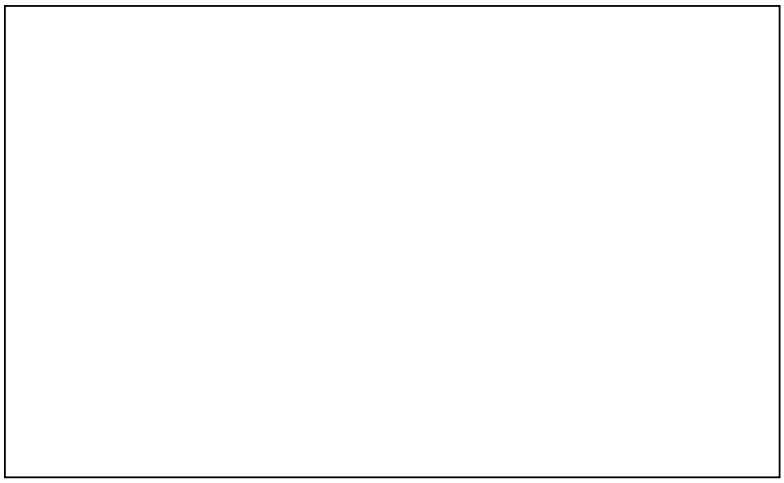

Fig. 3: Cleaning at the gin is a compromise between fiber quality and trash removal (From Cotton Ginners Handbook, no 503).

Ginning has little or no effect on micronaire although a slight decrease in micronaire values is witnessed. In fact the micronaire affects gin operation, because low micronaire cotton is susceptible to entanglement and nepping during ginning process. Parameters such as maturity or fineness are practically not affected by ginning while in cases of extreme heating strength may be slightly decreased. Neps on the other hand is the outcome of ginning. Neps are not found in the unopened boll, but their number rapidly increases during ginning. The degree of nepiness is an inherent character depended on the variety and ginning has to be adapted to the specific variety needs. The same applies for seed coat fragment. The fiber to seed attachment varies greatly in the different cotton growths but ginning efficiency may restrict or increase seed cotton fragment accordingly.

A ginner must produce a quality of lint that brings the grower maximum value while meeting the demands of the spinner and consumer. Operating gin machinery in accord once with the recommended speeds, adjustments, maintenance and sequence while ginning the cotton at the optimum moisture level will produce the best possible end product.

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