7TH ANNUAL COTTON CONFERENCE

COTTON QUALITY - HARVEST & MODULE STORAGE

By Robert Baird,

QUEENSLAND COTTON CORPORATION LIMITED

My niche in the Cotton Industry is fibre quality but being a realist, I know quality has to go hand in hand with quantity (yield and turnout). It was always the case that if a high yield was achieved then fibre quality would also be good. That was when two bales per acre was a high yield. My idea today, with Australian farmers achieving the highest yield in the world, is that fibre quality has to be addressed almost separately to yield. I also believe most fibre characteristics, with our current varieties, can be controlled by farm management with a thorough knowledge of plant physiology and environmental adaptation.

The manageable characteristics that are now conveniently measured, or will be in the near future, are:

Maturity (fineness & micronaire)
Leaf
Colour
Stickiness
Cavitoma
Short Fibre content
Uniformity of length

This is assuming that length and strength characteristics would be determined by both varietal selection and pre-harvest management.

My paper will address the progress to date regarding harvest of the cotton crop.

HARVEST PREPARATION

Crop preparation for harvest is the critical interphase between the crop growth and the production stage, relating to the removal of leaf for processing. It's success or failure will reflect final outcome of grade and physical fibre characteristics. Being an area of such critical importance, the decisions on product usage and timing must be carefully planned. The relative ease or difficulty of good crop preparation can be intrinsically affected by crop conditions throughout the entire season. The minimal requirement for successful crop defoliation should be physiological cut out and full fibre maturity. Preparation prior to this may lead to difficulty in leaf drop with the potential for high trash content, secondly, fibre immaturity reflected by low mic and also, in extreme cases, short fibre.

Assuming the crop has reached sufficient maturity for defoliation, a high objective within the program should be the preservation of fibre quality. Perhaps the most common and significant problem arising from poor preparation is high sample trash content. Although most commonly associated with the use of desicant defoliants it can also be the result of an aggressive approach with dropp harvade type products as well.

Seasonal conditions at the time of application can have major influence and should be considered carefully. Paralleling the choice of product and timing, is the issue of to what degree do we need to defoliate. Many producers may believe the only good leaf is one on the ground. Total defoliation objectives often require aggressive approaches and increase the potential risk of desiccated trash. Studies conducted by Queensland Cotton have indicated the ability of pickers to harvest successfully through a reasonable amount of retained leaf without compromising grade and yield. The positives to this reduced defoliation approach are the reductions in costs of products due to lower rates. One of the negatives is that leathery retained leaf contains more moisture which will be absorbed by the fibre raising the module moisture content. Therefore, picking times (to avoid dew) should be carefully adhered to.

There is a fine line between just enough and not enough which will be influenced significantly by crop physiology parameters and seasonal conditions. More research work needs to be carried out and will be conducted by Queensland Cotton research and development.

In summary then, a multitude of factors will effect the success or failure of crop preparation and harvest. All these factors need to be carefully measured and analysed in making the most appropriate decision. Certainly, crop preparation should be recognised for it's significance and it's priority within management schemes should be highlighted.

This table shows, in a wet year, two important points:

	Ginned after 8 days		Ginned after 120 days	
	Commercial	Conditioned Once	Commercial	Conditioned Once
Grade	SM	SM	GM(12.5%) SM(62.5%) SMLG(12.5%) MLG(12.5%)	SM(75%) SMLG(25%)
Increased Gross Return $/ha	0	0	1.70	0
Extra Defoliation Costs $/ha	21.00	0	21.00	0
Increased Nett Return $/ha	0	21.00	0	19.30

A) The reduced costs of defoliation outweighs the reduction of grade;

B) Module storage under marginal conditions will lower grades, in this case, a dulling of colour.

GINNING FOR QUALITY

Cotton Gins have been arguably blamed for damaging cotton fibre and this can be true if very leafy, immature and high moisture cotton is received at the gin. Therefore, the simple way to preserve fibre quality is to pick cotton in a manner that is suitable for the gin to do it's job in the least damaging way to satisfy our customers, the spinning mills. High module moisture, as well as causing staining or spotting can directly create an excessive cost in relation to ginning.

The ideal ginning moisture is between 5 1/2% to 6 1/2% moisture at the gin apron. If a module has high moisture content (above 12%), then it has to be dried to reduce the moisture level back to 5 1/2% to 6 1/2%.

I will give you an example -

Grower No. 1

Seed Cotton - Module at weighbridge	=	15000kg
Lint Cotton - after ginning	=	4500kg
Moisture in Module	=	14%
Gin turnout	=	36%

Grower No. 2

Seed Cotton - Module at weighbridge	=	15000kg
Lint Cotton - after ginning	=	5400kg
Moisture in Module	=	8%
Seed cotton less 6% moisture	=	14100
Gin turnout	=	38.29%

As you can see, grower No.1 has 6% more moisture than grower No.2, which represents 900kg of water in this particular module. We gin the cotton at 6% moisture and put 2% back in the bale at the press which is a total of 8%. As you can see there is a 2.29% difference in gin turnout.

Cost to Grower

$10.40 per 100 kg of seed cotton at 36% turnout, with a 227kg bale.

1) The cost to gin a 227kg bale for grower No.1 is $65.57
2) The cost to gin a 227kg bale for grower No.2 is $61.65

\- a saving of $3.92 per bale.

The reason is simple, grower No.1 has a 6% higher moisture level than No.2 which represents 900kg of water that is evaporated during the ginning process.

It is also well known that excessive heat in the gin will damage the fibre so a module picked cleanly or with leathery type leaf (which will be discarded with gentle pre-cleaning), and low moisture levels, will ensure a ginner can get the best returns to the farmer and not cause undue damage to the fibre.

Overheating the cotton fibre causes quality related changes within the fibre that are irreversible. Putting moisture back into the fibre will cause the fibre to be less brittle but will not bring it back to its original condition.

Fibre breakage does occur as fibre is dried, particularly below five percent moisture content. For each one percent reduction in fibre moisture content below five percent, classers staple length is reduced about one-third of a thirty-second of an inch or 1/100th of an inch.

Seed cotton can be safely stored in modules for long periods if its moisture content is kept at 12% or less. Wet cotton or cotton containing green plant material will heat during storage and quickly deteriorate. Cotton damaged in this manner produces low grades, poor quality seed and may also leave stains on the cotton fibre. Freshly built modules should be checked on a regular basis for the first 72 hours. If the temperature inside a module exceeds 44 degrees C, it should be ginned immediately to prevent further deterioration.

Modules of dry seed cotton should be carefully formed so water will run off the top and sides. They should also be placed on a well-drained, dry site to prevent water getting under the module and being absorbed into the cotton like a sponge. If this occurs, the cotton will rot and be down-graded considerably. Modules should be covered with good quality tarpaulins which should be checked for any holes or damage to prevent water from soaking into the module.

A Review on Module Moisture & Grades

Dancer et al (1987) conducted a study that showed:

- relative humidity had a direct effect on seed cotton moisture;
- Module moisture changes through a picking day in direct proportion to relative humidity;
- The level of module moisture can affect grades;
- On fine picking days, module moistures above 10 percent were usually associated with grade losses of up to half a grade irrespective of whether the cotton had been rain affected or not;
- The critical relative humidity (that is, for module moistures above 10 per cent) was 55 per cent R.H.;
- Losses of upto two grades were recorded for cotton picked before versus after significant rainfall.

This study demonstrated that grade losses associated with picking cotton under humid but fine conditions are only about one quarter of those associated with a significant rainfall event (eg 50mm rain and 7-10 delay in picking). Nevertheless, the fact that grade losses can occur when cotton is picked under fine conditions warrants consideration. Some examples of the critical times measured during these studies follow. Critical times are those at which relative humidity above 55 percent is likely to be recorded during fine weather in the regions indicated.

- Central Queensland (April): before 9.00 am; after 8.30 pm;
- St George (mid-late May): before 9.15 am; after 7.15 pm;
- Darling Downs (May-June): before 10.30 am; after 6.00 pm.

McClement and Pyke (1988) conducted a study of modules picked under marginal conditions (that is, cloudy with occasional light drizzle). They found that:

- If modules with moisture above 12 per cent were ginned less than 20 days after picking at higher than normal temperatures, grades could be improved by between one half to two grades.

. For modules with moisture above 13 percent, delaying ginning for more than 20 days could reduce grades because of colour loss or spotting.

Curley et al (1987) reported significant changes to lint colour (as measured by reflectance) in cotton taken from modules with high temperature levels. High temperatures in modules are due to bacterial activity induced by high moisture levels.

Pyke and Baird (1990) found that conditions at picking can influence grades significantly. In studies of examples from both Emerald and Theodore, cotton picked from the same field but on different days could vary by up to two grades due to the conditions at time of picking. High grades were associated with fine picking conditions, lower grades with cloudy conditions or if picking commenced too soon following a short rainfall delay.

CAVITOMA

Cavitoma, being researched by S.J. Allen, etc., has been reviewed in part by the following:

Definitions

The terms "cavitoma" and "cavitomic cotton" were coined by Hall and Elting in the early 1950's to indicate the overall effects of cotton quality deterioration during storage, which is due to microbiological action. "Cavitomic Cotton" is cotton that has undergone biological deterioration, particularly when the extent of the deterioration is not reflected in a comparable lowering of grade (Hamby, 1965).

Cavitoma = microbial damage that occurs after full fibre development rather than microbial activity that retards fibre development.
Cavitoma is characterised by bacteria and fungi inside as well as on the outer surface of the fibre (Hall & Elting, 1951).

Source of Contamination

Freshly picked bolls have the highest degree of contamination and the principal contamination by fungi and bacteria of commercial cotton is from the soil (Heyn, 1957). Plant surfaces?? dead or dying plant parts??

Dispersal

Rain splash and wind prior to harvest??

During picking and ginning??

Environmental Requirements

Moisture is necessary for the growth of micro-organisms, and more water is formed as nutrients are consumed. With some exceptions, micro-organisms flourish at high humidity and moderate temperature; 9% moisture is generally considered the minimum for growth in cotton. Hall and Elting, (1951), found evidence of fibre damage progressing in the 6% to 7% range.

Fungi need a relative humidity around 80% for good growth and bacteria do not normally multiply below 70% relative humidity. The effect of temperature is not as critical as that of humidity. Nevertheless, a temperature around 25 to 30 Degrees C is most conducive for the growth of fungi (Betrabet, 1976).

Hall and Elting, (1951), suggested that the initial fibre condition, time, temperature and moisture were the principal factors affecting cotton in storage.

Hall and Elting, (1951), reported progressive fibre damage in cavitomic cottons stored at 10 degrees C and 45% RH and 33 degrees C and 75% RH.

Schulze (1990) noted that cavitoma was a problem in bales stored over the winter months with a high moisture content (ie over 7.5% and moreso over 9%).

Steve's research "hampered" by dry picking of the last few years has forced him to assimilate wet harvests and storage which is showing once again that moisture at harvest will promote microscopic damage that can go undetected until the dyeing process where hard gained Australian cotton quality reputation can be destroyed by not following some simple rules regarding moisture.

CONCLUSION

In summary, the best way for our Innovative Australian Cotton Industry to promote the fibre quality of Australian cotton to our customers is to :

(1) Ensure the fibre is mature before finishing the crop which can be a complicated and moveable objective. Included in this phase, I must comment on Stickiness which is generally related to sugars and this can be caused by insect secretion on open bolls, immature seed getting through the gin saws or natural plant sugars, all of which cause great problems to a spinner.

(2) Defoliate with the knowledge that our present gins do a better job with clean cotton or leathery leaf than desiccated leaf that shatter with any mechanical influence including pickers. Our current marketing system also still pays on clean cotton as by far most mills still require clean cotton.

(3) Modules built on dry pre-formed beds with leakproof tarps. Modules should be built with less than 10% moisture and better still around 5% to 8%. Moisture meters should be calibrated daily to ensure accuracy and condition monitored.

At this stage I must say I am not totally convinced we have the necessary instrument which will commercially reproduce an accurate moisture reading that is both acceptable for farm and laboratory use. I believe modern technology should be able to produce a robust, easily calibrated instrument, that can test both raw cotton and seed cotton in mass.

To follow these points carefully and independently to completion of crop will ensure the farmer will have done his best to preserve the fibre characteristics of -

Good Maturity (fineness & micronaire)
Low Leaf Content
Good Colour
Absence of Stickiness
and Cavitoma
Low Short Fibre Content, and
Good Uniformity of Length

and allow organisations such as Ginners' Associations to investigate the need to revolutionise the gin, the CCAA to change the grading system to better describe and promote Australian Cotton; and the marketers to promote and change our customers' ways to financially benefit the returns on farmers efforts.

Thanks to:

Barry Wilson, QCCL - Harvest Timing & Method
Bruce Pyke, CDC - Module Moisture
David Bella - Ginning for Quality
Steve Allen, NSW Agriculture - Cavitoma
Brian Soloman - Module Storage
CCAA members.