CHAPTER 20

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Managing For Fibre Quality

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Importance of Quality Fibre

Producing a quality fibre is important. Not only because Australian cotton holds a reputation of being purchased for a premium, but because the consequences of producing poor fibre quality is substantial (See table 1).

In ensuring that fibre quality is maintained, it is important to understand the nature of fibre and the interacting factors that affect its quality.

Optimising fibre quality starts with good crop management and selecting the right variety is a good start.

Crop management for improved fibre quality

Fortunately the majority of crop management factors which increase/optimise yield will also increase/optimise fibre quality. One exception may be instances of high yielding crops with undesirable high micronaire cotton.

Fibre length and micronaire are significantly affected by agronomic and climate effects, however Fibre strength is more influenced by variety choice. Fibre growth and development is affected by most factors which influence plant growth. Since the fibre is primarily cellulose, any influence on plant photosynthesis and production of carbohydrate will have a similar influence on fibre growth. Cell expansion during growth is strongly driven by turgor (the pressure of fluid in the plant cell), so plant water relations will also affect fibre elongation in the period immediately following flowering. Thus in terms of primary (direct) responses, water status (irrigation) strongly influences fibre growth and ultimately final fibre length. Fibre elongation will also be affected by temperature and carbohydrate limitations.

Here fibre elongation refers specifically to the elongation of a fibre in length during its growth. In terms of fibre quality, fibre elongation also refers to the elongation in a fibre before it breaks in a strength test.

Fibre thickening are also affected by temperature and radiation effects on photosynthesis with large reductions in fibre thickening leading to low fibre Micronaire following long periods of low temperatures or cloudy weather. Delayed sowing may expose more of the fibre thickening phase to lower temperatures and reduce Micronaire. Potassium deficiency can have a significant impact on fibre length because of the role of potassium in maintenance of cell turgor by osmotic regulation. Other nutrient deficiencies can also reduce fibre length. However where nutrient deficiencies are not the major factor in a production system, nitrogen or potassium fertiliser treatments will not necessarily improve fibre length. Early crop defoliation or leaf removal can cause substantial reductions in fibre Micronaire due to the cessation in carbohydrate supply for fibre thickening. Few agronomic or climatic conditions have been shown to consistently affect fibre bundle strength.

Severe weed competition in cotton can have strong effects on fibre properties as well as trash contamination. High density and narrow row cotton production systems have variable effects on fibre quality: from no impact to significant reductions. This varied response can be explained by the specific combination of negative direct and positive indirect effects – e.g. negative impacts of competition on fibre quality may be balanced by positive effects of avoiding later unfavorable conditions. One aim of high density narrow row systems is to compress fruiting and fibre development to a shorter time period and avoid later cool or stress conditions – to at least achieve more uniform crop fibre properties.

Cotton's indeterminate growth habit also leads to many secondary (indirect) impacts of climate and management on fibre properties. Any management which delays crop maturity can lead to reduced Micronaire due to exposure of a greater proportion of a crop to unfavorable conditions such as cooler or cloudy weather. Early stress with subsequent recovery, or higher nitrogen fertility and different tillage or rotation systems and insect damage causing compensation and later fruit production are examples. Therefore adoption of appropriate and efficient management (both strategic and tactical) for improving yield will also contribute to improved fibre quality. The issues to consider for each crop management phase are summarised in the following Tables.

For more information the following resources and tools are available at https://www.mybmp.com.au/auth_user/grower_tools_and_resources.aspx

- **FIBREpak Chapters 7 to 11**

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TABLE 1:
Consequences of poor fibre quality

Fibre trait	Trait description	Ideal range	Consequences of poor fibre quality – cotton price	Consequences of poor fibre quality – spinning
Length	Fibre length varies with variety. Length and length distribution are also affected by stress during fibre development, and mechanical processes at and after harvest.	UHML in excess of 1.125 inch or 36/32nds. For premium fibre 1.250 or 40/32nds.	Premiums can be gained for long staple length. Significant price discounts below 33/32nds.	Fibre length determines the settings of spinning machines. Longer fibres can be spun at higher processing speeds and allow for lower twist levels and increased yarn strength.
Short fibre content	Short fibre content (SFC) is the proportion by weight of fibre shorter than 0.5 inch or 12.7mm.	< 8%	No premiums or discounts apply.	The presence of short fibre in cotton causes increases in processing waste, fly generation and uneven and weaker yarns.
Uniformity	Length uniformity or uniformity index (UI), is the ratio between the mean length and the UHML expressed as a percentage.	> 80%	Small price discounts at values less than 78. No premiums apply.	Variations in length can lead to an increase in waste, deterioration in processing performance and yarn quality.
Micronaire	Micronaire is a combination of fibre linear density and fibre maturity. The test measures the resistance offered by a weighed plug of fibres in a chamber of fixed volume to a metered airflow.	Micronaire values between 3.8 and 4.5 are desirable. Maturity ratio >0.85 and linear density < 220 mtex Premium range is considered to be 3.8 to 4.2. (linear density < 180 mtex	Significant price discounts below 3.5 and above 4.9.	Linear density determines the number of fibres needed in a yarn cross-section, and hence the yarn count that can be spun. Cotton with a low Micronaire may have immature fibre. High Micronaire is considered coarse (high linear density) and provides fewer fibres in cross section.
Strength	The strength of cotton fibres is usually defined as the breaking force required for a bundle of fibres of a given weight and fineness.	> 29 grams/tex. For premium fibre > 34 grams/tex.	Small premiums for values above 29 g/tex. Discounts appear for values below 27 g/tex.	The ability of cotton to withstand tensile force is fundamentally important in spinning. Yarn and fabric strength correlates with fibre strength.
Grade	Grade describes the colour and 'preparation' of cotton. Under this system colour has traditionally been related to physical cotton standards although it is now measured with a colorimeter.	> MID 31	Small premiums for good grades. Significant discounts for poor grades.	Aside from cases of severe staining the colour of cotton and the level of 'preparation' have no direct bearing on processing ability. Significant differences in colour can lead to dyeing problems.
Trash/dust	Trash refers to plant parts incorporated during harvests, which are then broken down into smaller pieces during ginning.	Low trash levels of < 5%	High levels of trash and the occurrence of grass and bark incur large price discounts.	Whilst large trash particles are easily removed in the spinning mill too much trash results in increased waste. High dust levels affect open end spinning efficiency and product quality. Bark and grass are difficult to separate from cotton fibre in the mill because of their fibrous nature.
Stickiness	Contamination of cotton from the exudates of the silverleaf whitefly and the cotton aphid.	Low/none	High levels of contamination incur significant price discounts and can lead to rejection by the buyer.	Sugar contamination leads to the build-up of sticky residues on textile machinery, which affects yarn evenness and results in process stoppages.
Seed – coat fragments	In dry crop conditions seed-coat fragments may contribute to the formation of a (seed-coat) nep.	Low/none	Moderate price discounts.	Seed-coat fragments do not absorb dye and appear as 'flecks' on finished fabrics.
Neps	Neps are fibre entanglements that have a hard central knot. Harvesting and ginning affect the amount of nep.	< 250 neps/gram. For premium fibre <200	Moderate price discounts.	Neps typically absorb less dye and reflect light differently and appear as 'flecks' on finished fabrics.
Contamination	Contamination of cotton by foreign materials such as woven plastic, plastic film, jute/hessian, leaves, feathers, paper leather, sand, dust, rust, metal, grease and oil, rubber and tar.	Low/none	A reputation for contamination has a negative impact on sales and future exports.	Contamination can lead to the downgrading of yarn, fabric or garments to second quality or even the total rejection of an entire batch.

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TABLE 2:
Key in-field management considerations for optimising fibre quality.

Objectives	Pre planting	Sowing to first flower	First flower to open boll	Open boll to harvest	Harvest to gin
Realising the genetic potential for fibre length	Variety selection. Strategic planning for irrigation availability. Consider skip row for dryland.	Monitor soil moisture and schedule irrigation to optimise plant vegetative size.	Monitor soil moisture schedule irrigation to optimise plant vegetative size and to avoid stress on developing fibres.		
Maintaining fibre strength	Variety selection.		Maintain healthy crop.		
Producing fibre with mid range micronaire to avoid fibres that have too high linear density or are immature	Variety selection.	Monitor soil moisture and schedule irrigation to optimise plant vegetative size. Sow at appropriate date for the region to avoid early crops in hot areas or late crops in cool areas.	Management of plant vegetative size, structure and balance with boll setting pattern. Uniform boll set is achieved by having the appropriate plant type for the variety, region and climate. Optimise agronomic management such as water, fertliser and growth regulators. Adopt IPM to protect fruit, and leaves.	Timely harvest to avoid bad weather. Use appropriate nitrogen fertiliser rates to match crop requirements and assist cut out. Schedule last irrigation to leave soil at refill point at defoliation. Use appropriate timing, product and rate for defoliation.	
Reducing the incidence of neps	Variety selection.				Spindles and doffers maintained daily. Reduce spindle twist by not picking too wet.
Delivering clean white cotton with no stickiness	Weed management.	Weed management.		Fertiliser, irrigation and defoliant management as above. Refer to IPM guidelines for aphid and whitefly management.	Picker setup – avoid pin trash and bark. Follow guidelines for module placement, construction, tarping and transport. Keep good module records.
Preventing contamination	Farm hygiene to avoid contamination during harvest later. Weed management.	Weed management.			Farm hygiene. Picking height. Hydraulics on pickers and builders checked and maintained.