

## 7. Crop Management for Improved Fibre Quality

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Fortunately the majority of crop management factors which increase/optimize yield will also increase/optimize fibre quality. One exception may be instances of production of high Micronaire cotton. As discussed previously in the chapter on 'Fibre Biology', fibre properties can be strong yield components and influence yield: everything else being equal, longer fibres mean more lint yield. Likewise a greater linear density (and maybe higher Micronaire) will mean more lint yield

The literature on agronomy and climate effects on fibre quality is particularly comprehensive for fibre length and Micronaire; fibre strength is more influenced by variety. 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, 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 temperature and carbohydrate limitations.

Fibre thickening is 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 fertilizer 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.

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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 Table 7.1 and will be discussed in more detail in the following chapters.



**Table 7.1: 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, fertiliser and growth regulators.	Timely harvest to avoid bad weather. Use appropriate nitrogen fertilizer rates to match crop and fertilizer cut out. Schedule last irrigation to leave soil at refill point at defoliation. Use appropriate timing, product and rate for defoliation.	Spindles and doffers maintained daily. Reduce spindle twist by not picking too wet.
Reducing the incidence of neps	Variety selection.		Adopt IPM to protect fruit, and leaves.		
Delivering clean white cotton with no stickiness	Weed management.	Weed management.		Fertilizer, 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. Weed management.	Weed management.			Farm hygiene. Picking height. Hydraulics on pickers and builders checked and maintained.

## **Fibre Quality Management and Climate – Scenarios**

FIBREpak has highlighted many principles to assist in managing fibre quality. A proactive strategic plan combined with tactical management of a cotton crop will optimize fibre quality. The following three cases are examples.

### *Fibre Length*

If fibre length is of particular concern, then cultivar choice and a general cropping system to avoid or minimise water stress should be employed to ensure more reliable fibre length. Cultivars with longer inherent fibre length will have more insurance to achieve base fibre length and avoid price discount. An irrigation strategy to avoid stress on developing fibres during flowering should be followed. For dryland production systems, soil water conservation management such as fallows; sowing date strategies to time early flowering to coincide with more reliable rainfall; and plant spacing strategies such as skip rows to reduce stress at early flowering will preserve fibre length. Dryland skip row configurations can increase fibre length by up to 0.08 inches compared with solid configurations.

### *Low Micronaire*

If low Micronaire is of concern, then cultivar choice and appropriate cultivar growth habit and crop maturity for the climate and season length are important to avoid exposure of maturing fibres to low temperature, cloudy weather and other stresses. An early maturing cultivar with inherently higher Micronaire would be desirable. Management for earliness through sowing on an appropriate date for the cultivar and climate to avoid late crops in cooler areas; pest management to have uninterrupted boll setting; growth regulator application in early to mid flowering if crops become too vegetative; optimised irrigation and fertilizer management to avoid stress and to meet desired yield targets; schedule last irrigation to have soil at normal refill point at defoliation; use appropriate timing, product and rate of defoliant to minimise immature fibres. In variable climates there is a dilemma in choosing a cultivar with higher yield potential but with greater risk of encountering unfavorable conditions during boll fill compared with an early maturing cultivar which may avoid late season problems yet yield less (up to 0.6 b/ha for every week of earliness). Under this situation, a mix of cultivars would spread risk.

### *High Micronaire*

There is a special case for high Micronaire situations. In recent years in Australia for example, a series of warm dry seasons coupled with intensive management for high yield of high retention crops such as Bollgard II® has led to many circumstances of high Micronaire. The four harvests up to 2007 average 41% of the crop above Micronaire of 4.6 and another 6% above Micronaire 5.0. Analysis has indicated that management, cultivar and high temperature have been significant components of that result. The balance between boll load and crop canopy size can be significant, with high boll loads having lower Micronaire (more desirable in this case), presumably from competition. Micronaire is definitely a complex trait but management can address the problem at least partly. A cultivar with inherently lower Micronaire (preferably lower linear density and mature) is required under these circumstances and breeders need to pay more attention to this target. Crop management to optimise agronomic inputs such as water, fertilizer and growth regulators should manage vegetative growth in balance with boll setting pattern by using a cultivar with appropriate plant type for the region and climate; and sow on the appropriate date for the cultivar and climate to avoid boll filling of early crops in hotter periods.