8. Pre Sowing

Pre sowing decisions for fibre quality are mainly concerned with variety selection and preparation of fields to ensure effective weed control early in crop growth to enable early crop vigour and reduce potential contamination in later stages of growth. The choice of which variety to sow is a major decision each grower must make. Although the investment in seed is relatively small in comparison with other costs many more dollars are influenced in yield, quality, crop maturity, and pest susceptibility of the crop.

Management considerations prior to sowing include:
- *Variety selection*
- *Appropriate weed control*
- *Crop nutrition management*
- *Optimising sowing date for yield and quality*
- *Establishing uniform crops at optimum plant density*
- *Skip rows in dryland production*

Variety Selection

If you start with a variety with poor fibre quality, there is nothing that can be done with management and processing to make the quality better. However, if you start with a variety with good fibre quality traits, there is some insurance against unfavorable conditions, but careful management and processing are still required to preserve quality.

Growers should use published seed company data to evaluate relative fibre properties of candidate varieties to ensure they will be optimising yield and fibre properties to avoid discounts and even attract a premium price. Discussion with seed companies on COMPARATIVE data (not only absolute values) of fibre properties for varieties and standards grown in your region will assist with these decisions.

Specific considerations for variety selection include:
- Strategic planning for irrigation water availability (including dryland) – crops with limited water availability may be more likely to encounter stress during fibre elongation, so a variety with inherently longer fibre to lessen the likelihood of fibre length discounts should be considered.

- Selecting premium fibre types – Varieties that have premium fibre attributes sometimes yield less. Growers should ensure that market premiums are negotiated and are in place to offset any potential yield reductions. Breeding material is already in the pipeline that has premium fibre traits and similar yields to current varieties.

- Crop maturity – Selecting a variety with a long growing period in a cooler shorter season region is likely to create delayed crop maturity and lower Micronaire because there is a chance of immature bolls being harvested. In some instances this may be

Photo: Adam Kay

desirable to lower the overall Micronaire of a crop but this is not advisable as it may increase the level of neps. Late maturing crops may be exposed to increased chances of cotton being downgraded from weathering. Choice of variety can impact time of sowing decision. In short season regions varieties that are earlier maturing should be chosen. This offers as added insurance in ensuring the crop will mature and be harvested before the onset of cold wet conditions. In long season regions there is more flexibility. If a variety is earlier maturing (or more determinate) there is more opportunity to sow later in long season regions.

- Achieving optimum Micronaire – If crops (including Bollgard II®) in your region are susceptible to producing higher Micronaire, consider varieties that have inherently lower Micronaire. Similarly for short season areas, higher Micronaire varieties help to minimize low Micronaire discounts as a result of cool, cloudy, or stressed environments during boll maturation.

- In variable climates there is a dilemma in choosing a variety with higher yield potential but with greater risk of encountering unfavourable conditions during boll fill compared with an early maturing variety which may avoid late season problems, yet yield less (up to 0.3 to 0.6 bales/ha every week of earliness). Under this situation, a mix of varieties would spread risk.

Other issues to consider in variety choice that can impact fibre quality include:

- Disease that will affect healthy growth and reduce fibre maturity (lower Micronaire).
- Insect tolerant varieties (e.g. Bollgard II®) under high Helicoverpa pressure or environmentally sensitive areas. In some regions Bollgard II® may be predisposed to higher Micronaire as a result of the earlier and higher fruit retention leading to more fibres thickening in warmer conditions. In addition there is less fruit maturing in cooler conditions at the end of the season thus lowering the fibre maturity of fibres which would lower (dilute) crop Micronaire.
- Herbicide tolerant varieties e.g. Roundup Ready Flex® in weedy fields.
- Okra leaf versus normal leaf types - Okra leaf varieties are known to cause an increase in trash content as the leaf shape stops the leaf from falling easily to the ground. Approximately half a grade decrease can result. Okra leaf varieties are also more resistant to silver leaf whitefly and may have less risk of honeydew contamination (see open boll to harvest chapter).

Delayed crop maturity

Throughout FIBREpak reference is made to the fibre quality consequences of delayed crop maturity. This box summarises those effects:

There can be severe consequences of delayed crop maturity (later date of 60% bolls open) on fibre quality. These will include:

- A delay may mean more of the crop will be developing and maturing during cooler weather. The slower fibre thickening will result in reduced fibre maturity and risk of discount for low Micronaire. Immature fibre may be more prone to neps and is inferior for dyeing.
- The crop will be more attractive to late season pests such as aphids and whitefly which may produce honeydew, a serious contamination problem for fibre quality at the ginning and spinning stages.
- The crop may be more difficult to defoliate. This delay increases the risk of weather damage to fibre and grade reductions.
- Later maturing crops may be at increased risk of Verticillium and Fusarium Wilts, and Alternaria leaf spot if they are present. These diseases may affect yield and quality. See integrated disease management guide.

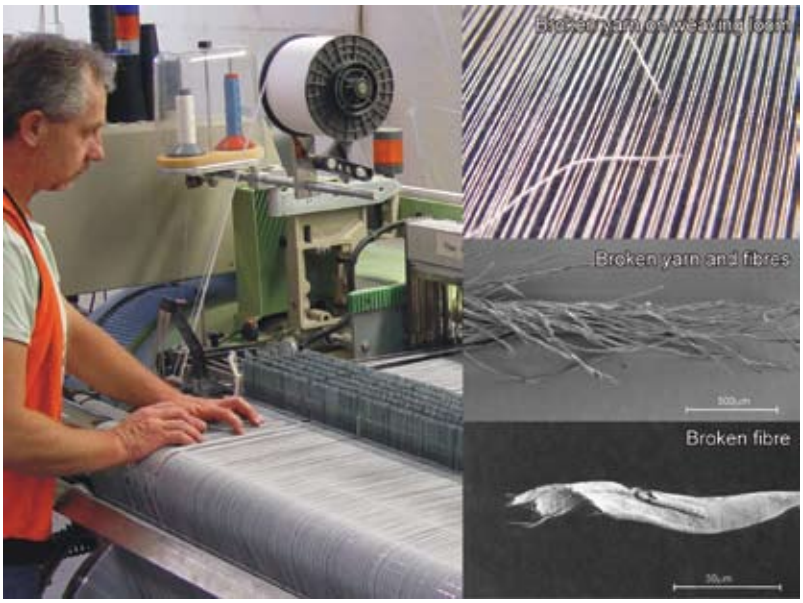

Figure 8.1: Strong fibres resulting from appropriate variety selection and by avoiding situations which delay crop maturity (which may result in more immature fibre that weakens the fibre) will avoid broken fibres which lower yarn and fabric quality. (Photos: CSIRO).

Weed control

Effective control of weeds at this time and throughout the season is important as competition from weeds for water and nutrition will reduce both yield and quality, and there is also little that can be done at harvest time to reduce the consequences of poor weed control. Weeds at harvest have the potential to:

- Reduce harvest efficiency by clogging or damaging picker heads. Vines, large weeds and bulky weeds in the picker-head zone can particularly cause problems. Vines can wrap around picker spindles and bulky weeds can reduce harvest efficiency by up to 31%. Large weeds, such as large sesbania, thornapples or noogoora burrs can damage picker spindles, requiring expensive repairs and down-time
- Contaminate lint with their leaves, stems, bark and bracts, lowering grades and returns to growers (Figure 8.2). This can increase the amount of (lint) cleaning in the gin, again exposing the lint to further damage. One large mature grass plant every 6m can reduce cotton by one grade.
- Reduce the effectiveness of leaf desiccant applications which may lead to increases in boll rot and a reduction in the rate of boll opening.
- When weeds are still actively growing there are increased chances of the lint being stained. These weeds can also harbour insects that contaminate or stain the lint (e.g. aphids, pale cotton stainer and whitefly).

Figure 8.2: This Roundup Ready crop was damaged by late exposure to glyphosate which resulted in the loss of most early bolls. The crop was low yielding, very late and had reduced fibre quality. Parrot-beaking (malformed bolls) is another common consequence of herbicide damage. (Photo: Graham Charles).

Controlling grass species is especially important as some grass parts when crushed have similar characteristics to cotton fibres and are difficult to separate, which in turn affects the spinning quality of the fibre. Some grasses also have dark seed coats that cannot be bleached and cause disfigurements in fabric.

Another aspect of weed control is the potential for the weed control inputs themselves to damage the crop and affect boll retention (Figure 8.3). Ideally, weeds should be well managed throughout the season. However, aggressive early season weed control with residual herbicides and inter-row cultivation can damage cotton plants and may thin the plant stand and delay crop maturity. Later in the season, many of the residual herbicides still have the potential to damage cotton plants if poorly or too aggressively applied. Herbicide damage can cause square and boll loss. The crop will normally compensate for this damage by setting additional late bolls, but there will be a delay in crop maturity and fibre quality may be reduced.

See WEEDpak for detailed information on appropriate weed control strategies and the possible consequences of herbicide damage to the crop.

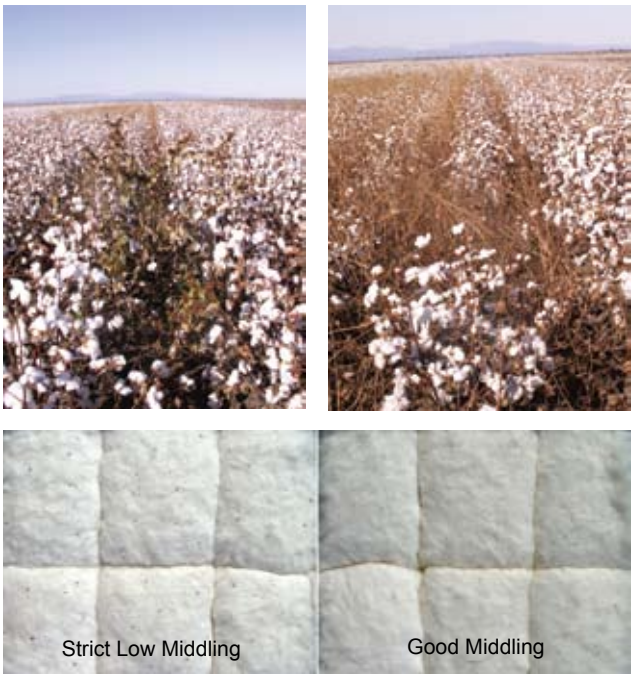

Figure 8.3: Lint harvested from weedy crops can have significant impact on classing grade which affects discounts to growers and can lead to imperfections in yarn and fabric appearance. (Photos: CSIRO).

Crop Nutritional Management

Meeting the nutritional requirements of the crop is important before flowering as it is very difficult to correct nutritional deficiencies later. Nitrogen and potassium nutrition can have a significant effect on fibre quality. Excessive nitrogen nutrition affects fibre quality indirectly by causing crops to produce excessive vegetative growth, which can shed fruit or promote late fruit, delaying crops leading to more immature bolls at the time of harvest. These crops are also prone to reduced insecticide penetration and are more attractive to insects (such as aphids and whitefly). The fibre quality of crops with nitrogen deficient conditions will be affected less as the crop compensates to support the growth of fibre on only those fruit that are present. The crops have less leaf area and less fruit overall.

Potassium deficiency can have a significant and direct impact on fibre length because of the role of potassium in maintenance of cell turgor pressure needed to expand the fibre. Low potassium can also cause premature senescence of leaves especially in crops with high boll loads. Leaves photosynthesise and provide carbohydrate for fibre secondary wall thickening so if they are senesced or lost, fibre maturity and thus Micronaire, may be reduced. Where nutrient deficiencies are not the major factor in a production system, potassium fertilizer treatments will not necessarily improve fibre length. Potassium deficiencies can also be exaggerated by water stress.

The best approaches to meeting the nutritional needs of a cotton crop to maintain quality are similar to that to optimise yield which include:

- Making soil nutrient applications the foundation of meeting the crop needs. This particularly relates to nitrogen, phosphorus and potassium.
- Determine residual soil nutrients from pre-season soil tests (or in the case of nitrogen estimate what has been provided by a legume crop).
- Monitoring crops using petiole and leaf analyses to peak flowering (approximately 1000 day degrees) to determine if crops are deficient or adequate in nutrition.
- Minimise pre sowing applications of nitrogen prior to May to avoid denitrification losses from the soil.
- Splitting applications of nutrients prior to flowering based on crop needs, especially when high fertilizer rates are required. Avoid high rates of nitrogen during late flowering as this may promote late season growth, delaying boll opening and inhibiting the effect of defoliation. For potassium, supplemental applications of potassium nitrate (KNO_3) can be applied as a foliar spray prior to cutout.
- Ideally completing all fertilizer applications before peak flowering.
- Considering past experience in the particular field with either rank or insufficient growth and adjust rates accordingly.

For specific crop nutritional information see NUTRIpak or utilize the NutriLOGIC decision aids on the CottASSIST website to assist with determining crop nutritional requirements (http://cottassist.cottoncrc.org.au/NutriLOGIC).

Optimising sowing date for yield and quality

Choosing the optimal sowing date for a particular region is important for both yield and fibre quality. Sowing too early can affect crop establishment during cool weather and expose the crop to disease, reducing early crop vigour. Sowing too late can mean that yields are reduced as the length of season to grow cotton is reduced as well as delaying crop maturity.

Considerations for establishing the optimum sowing date for your region include a number of factors:

- Season length - This should be considered as it helps to determine how long a crop can be grown and whether there is flexibility in changing sowing date. Short growing seasons such as those experienced in southern and eastern growing regions should consider sowing as early as feasibly possible to avoid crops maturing and being harvested in cold wet conditions. Current recommendation for sowing a crop that avoids emergence and establishment problems is to aim to have soil minimum temperatures above 15°C at 10cm depth for three consecutive days prior to planting and no cool weather predicted for 2 to 3 days. In regions with longer season lengths

there is some flexibility to sow later, but consideration of some other factors described below is needed. In short season areas it would be advisable that crops be sown by mid October regardless of soil temperature. Significant variation exists across the industry when comparing temperatures at both the start and finish of the season (Figure 8.4).

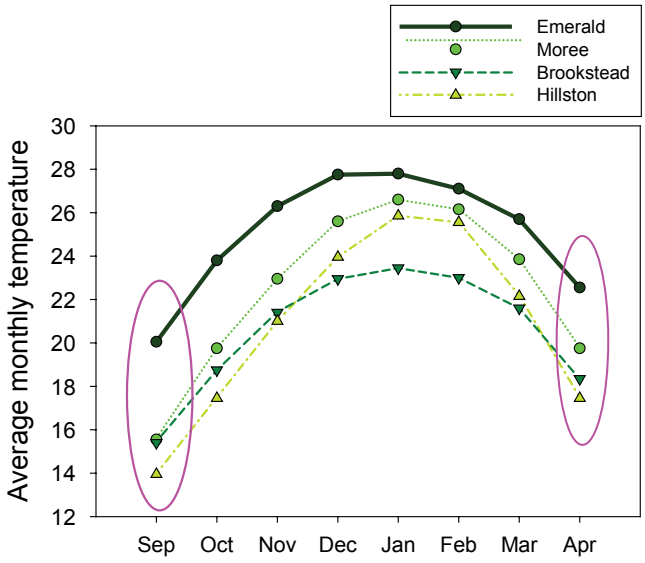

Figure 8.4: Temperatures vary considerably across the industry both at the start and the end of the season. These differences can impact crops when sown and harvested. (Source: Bureau of Meteorology).

- Climatic conditions experienced during fibre development – a number of climatic factors (predominantly temperature) will affect fibre length after flowering and fibre maturity during the period mid to late boll filling. Changing the time of sowing will influence the time and thus the climatic conditions experienced during fibre development. High temperatures after flowering have the potential to reduce fibre length. During boll filling, long periods of hot conditions will predispose the crop to high fibre Micronaire; conversely long periods of cool temperatures may lead to low Micronaire. Changing the sowing date in some regions (e.g. those with a long growing season) may offer some insurance against these situations occurring (Figure 8.5).

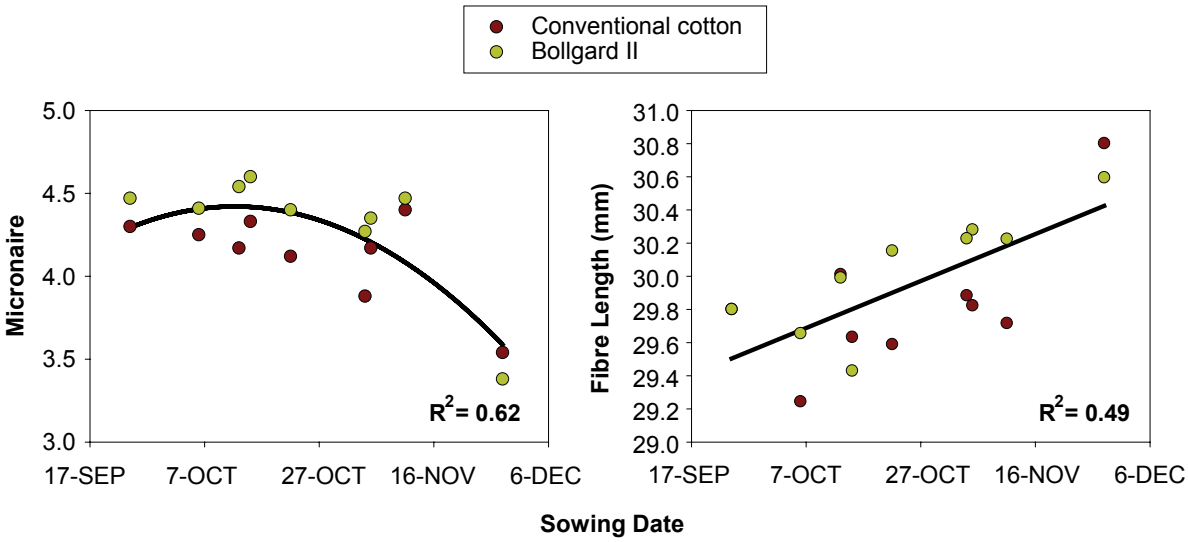

Figure 8.5: Effect of sowing date on fibre quality of Bollgard II® and non-Bollgard II varieties. Data from three seasons at Narrabri. (Adapted from Bange et al. 2008).

- Fruit Retention – recent research has shown that changes in fruit retention that results from the use of Bollgard II® can influence the time of sowing response. Results showed that Bollgard II® maintained its yield through the shorter fruiting cycle (because of its consistent and higher earlier fruit retention) allowing time to support growth of the same number of bolls as earlier sowings. In comparison, non-Bollgard II varieties had lower yields with later sowings. Improvements in fibre quality were also recorded with later sowings for both varieties (see Figure 8.6). With the advent of Bollgard II® with its higher fruit retention, sowing date needs to be reviewed for all long season growing regions that offer an opportunity to maintain yields while improving fibre quality.

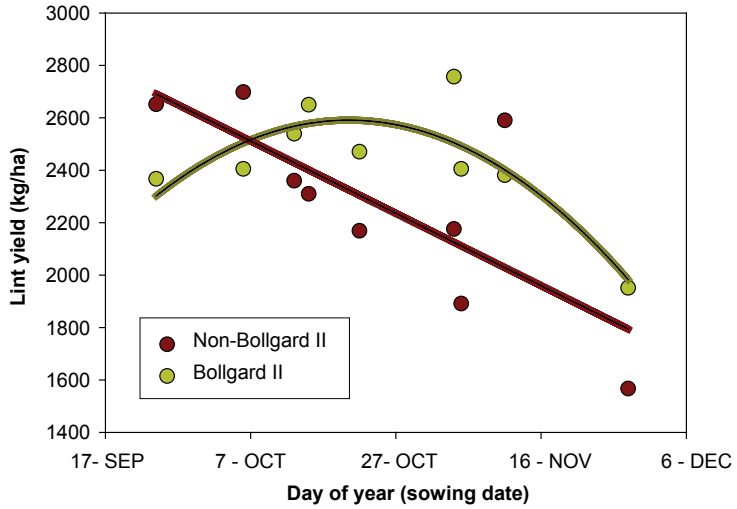

Figure 8.6: Effect of sowing date on lint yield of Bollgard II® and non-Bollgard II. Data from three seasons at Narrabri. (Adapted from Bange et al. 2008).

Establishing uniform crops at optimum plant densities

Low plant densities (especially non-uniform densities) can delay crop maturity and contribute to variable fibre properties. Uniform establishment is achieved by preparing an adequate seed bed, choosing the appropriate sowing date to optimise soil temperatures, avoiding disease and herbicide damage, and fertiliser toxicity (such as anhydrous ammonia placed too close to seed line) of young seedlings. Use of good-quality seed will also assist with uniform establishment.

Extremely high plant densities may aggravate fruit shedding of squares and subtending leaves, affecting crop maturity. In addition lower bolls also become vulnerable to shedding due to excessive shading. It is not uncommon for some plants in very high densities to be barren of fruit. Even bolls that are retained will not develop properly and will be undersized which will affect yield and fibre maturity. Thick stands are also vulnerable to boll rot. If these instances can be predicted, a growth regulator can be used (see chapter sowing to first flower).

Specific sowing considerations include:

- Narrow row production systems (including 75cm and 38cm row spacings) have not shown any advantages in terms of fibre quality.
- In irrigated cotton, target 8 to 10 plants per metre of row except where soil type restricts plant size. In these situations a density of 12 plants per metre of row is suggested. Research has shown that irrigated cotton has the flexibility of producing similar yields from 4 to 16 plants per metre provided the plants are distributed uniformly. Recent local research also showed that there was no difference between non-Bollgard II® and Bollgard II varieties in plant density requirement.
- In dryland production the recommended plant population in all row configurations is 7 to 8 plants per metre of row.

- Evenness of stand is more critical than absolute population achieved. A gappy stand is considered one that has an average of two or more gaps greater than 50cm in length every 5 m of row. A gappy stand is difficult to manage due to the large range in plant size especially with large vegetative branches - and yield reduction and delayed crop maturity may result. Consider re-sowing if the cost is less than the loss of yield potential of the replanted crop.
- Assess factors that influence plant establishment so that appropriate sowing rates can be estimated. Factors that influence final establishment include: watering up vs. pre watering, soil type, stubble type and amount, soil tilth, sowing equipment, presence of insects (such as wireworm and cutworm), weeds, disease history, soil temperature, seed vigour and expected weather conditions post sowing.

Consider skip row configurations in dryland and limited water situations

In situations where there is a high chance of a sustained dry period early in flowering, the use of skip row configurations is a viable option to maintain fibre length (Figure 8.7). Research has shown that this result is the same for higher fruit retention crops such as Bollgard II® compared to non-Bollgard II crops.

Photo: (Warwick Stiller, CSIRO)

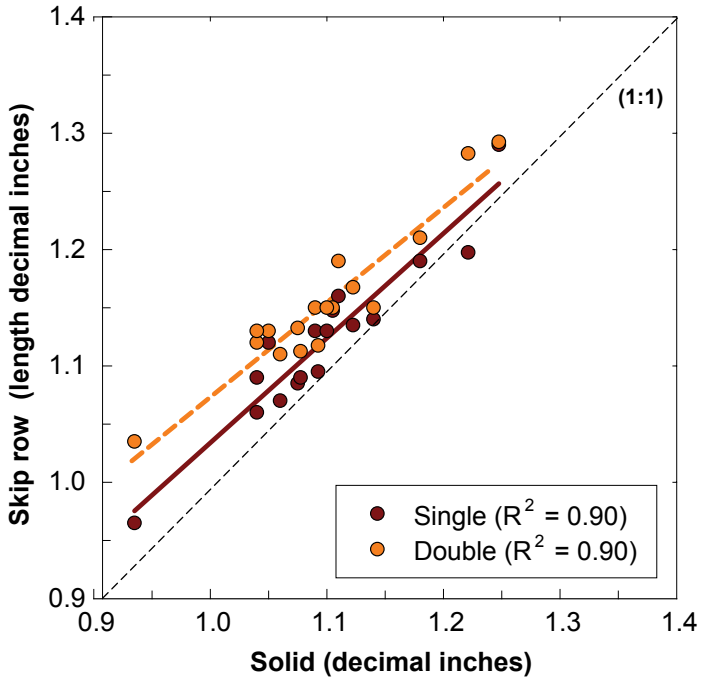

Figure 8.7: Fibre length of skip row configurations compared with solid row configuration in dryland cotton systems. As points approach the 1:1 line fibre length of the skip configurations equals that of the solid configuration. (M. Bange, CSIRO).

Further Reading

Allen SJ, Nehl DB, Moore N (2002) 'Integrated Disease Management for Australian Cotton' (Australian Cotton Cooperative Research Centre: Narrabri, NSW).

Bange MP, Roche R (2008) Do sowing rules change for high fruit retention transgenic cotton? In Proc. 14th Australian Agronomy Conference, 22-24 September 2008, (Adelaide, South Australia).

Bange MP, Caton SJ, Milroy SP (2008) Managing yields of high fruit retention in transgenic cotton (*Gossypium hirsutum* L.) using sowing date. Australian Journal of Agricultural Research 59, 733-741.

Bange M, Milroy S, Roberts G. (2006) Managing for crop maturity. The Australian Cottongrower. 27(7). 53-56

Charles G, Johnson S, Roberts G, Taylor I (2002) 'WEEDpak' (The Australian Cotton Cooperative Research Centre: Narrabri, NSW).

Colwick RF, Lalor WF, Wilkes LH (1984) Harvesting. In 'Cotton' (Eds RJ Kohel and CF Lewis). Agronomy: a series of monographs No. 24. (American Soc. of Agron., Crop Sci. Soc. America, Soil Sci. Soc. America, Madison, Wisconsin, USA).

Rochester IJ, Rea M, Dorahy C, Constable GA, Wright P, Deutscher S, Thongbai P, Larsen D (2001) 'NUTRIpak – a practical guide to cotton nutrition'. (Australian Cotton Cooperative Research Centre: Narrabri, NSW).