How Should Cotton Be Grown?

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NORTHERN AUSTRALIA CROP RESEARCH ALLIANCE

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Cotton Research and Development Corporation

How ***should*** cotton be grown?

With the worlds highest yields many would (and do) consider this question is well answered.

However, the TRUTH is that the answer depends on where you are!!!

How ***Could*** cotton be grown?

Cotton is a perennial plant that wants to live forever and we as managers place "constructs" on how it is grown.

As researchers our approach to this question has been to take what we know about the cotton plant and consider the possible interactions with

- Climate – Temperature, Radiation, Rainfall & Humidity
- Pests – Species, Ecology, Resistance
- System & Resource Considerations

Opportunity of Bollgard 3

- Less risk of Bt resistance by *Helicoverpa armigera and H. punctigera*
- Greatly improved efficacy on *Spodoptera litura*
- Opportunity to implement IPM practices for other pests in the system

Outcome of Bollgard 3 is that *How* cotton is grown is less driven by insects management compared to 15 years ago.

Wet Season Cotton Production

Climate – Is a Make or Break Factor

- Need to think about the climate from a cotton plants POINT OF VIEW
- The main drivers are radiation, temperature and rainfall.
- Many considerations – sowing, growth response, root development, shedding, boll opening, picking, nitrogen management, irrigation requirements, crop rotations, pests …….

So why plant during the wet season???

It is about envelopes of favourable weather and how to manage risk

- Cotton is at its toughest prior to flowering. Energy demand is the lowest and yield potential remains malleable.
- Mid to late wet season planting aims to confine wet weather exposure to the vegetative phase with boll setting occurring as conditions turn dry and sunny with dry season harvest.
- Most of the other sowing time options have distinct climate or system limitations.

Yield losses due to abiotic stress begin to accrue about 2 weeks after first flower

Stress	Max yield loss per day	Growth Stage
Water logging	2.4%	Flowering
Water deficit#	2.7%	Cut-out ± 2 weeks
Solar Radiation	2.1%	Cut-out ± 2 weeks
Hot Nights (>24°C)	?	Cut-out ± 2 weeks

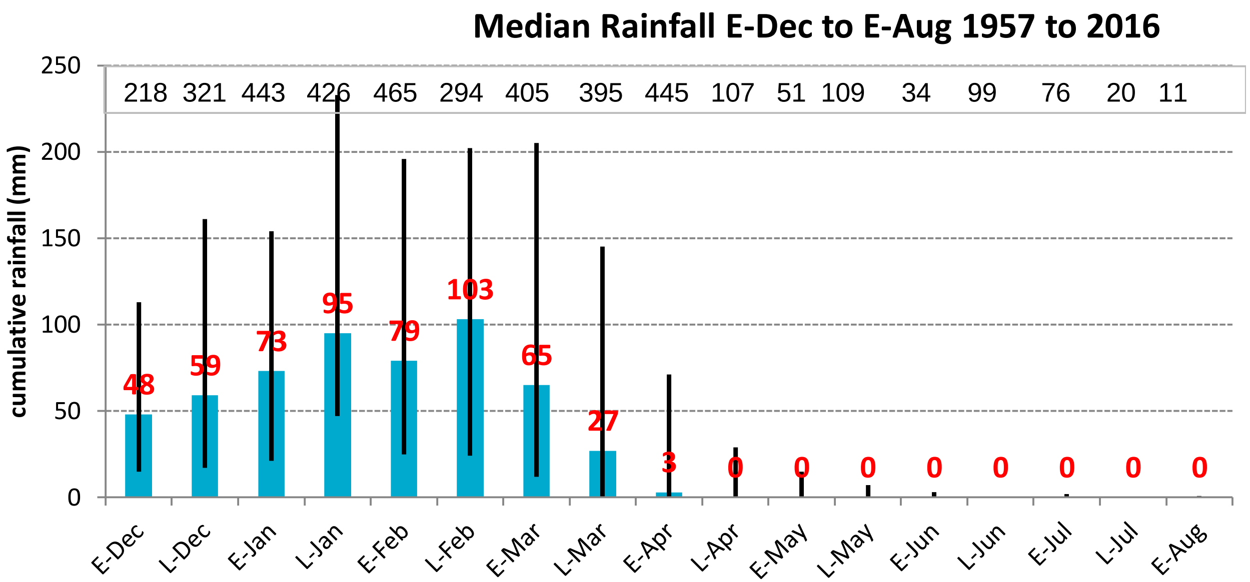
linked to high temperature

All the above stresses reduce photosynthesis

Extreme maximum and minimum temperatures can also reduce yield potential via damage to pollen and leaves (photosynthetic apparatus)

The aim is to time flowering and boll filling with good sunshine and milder temperatures

Rainfall Risks and sowing date - Ord



Sow Date	1st Square	1st Flower	Cut-Out	1st Open	Defoliation	Pick
1st Dec	L-Dec	M-Jan	M-Feb	E-Mar	L-Mar	E-Apr
1st Jan	L-Jan	M-Feb	M-Mar	L-Mar to E-Apr	L-Apr to E-May	L-May to E-June
1st Feb	L-Feb to E-Mar	M-Mar	M to L-Apr	L-Apr to E-May	E-Jun	L-June
1st Mar	L-Mar	M-Apr	L-May	M-Jun	L-Jul	M-Aug

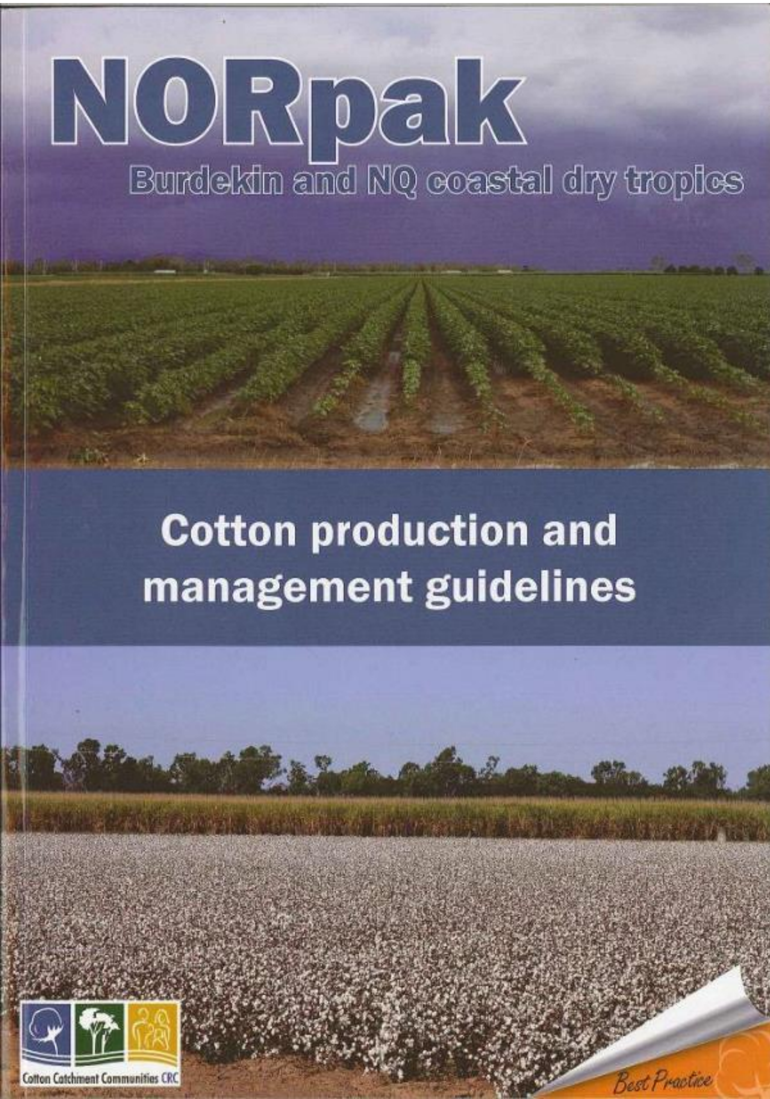
fruit shed and small Bolls	Shed & B-rot	B-rot & Colour	colour down grade

A key challenge for wet season planting is a crop that has two gears

Quick with no torque, sitting in overdrive prior to the boll filling hill climb

Crop management therefore has to aid the transition of the race car back into a load pulling machine

Striking this balance has been based on both science and commercial experience

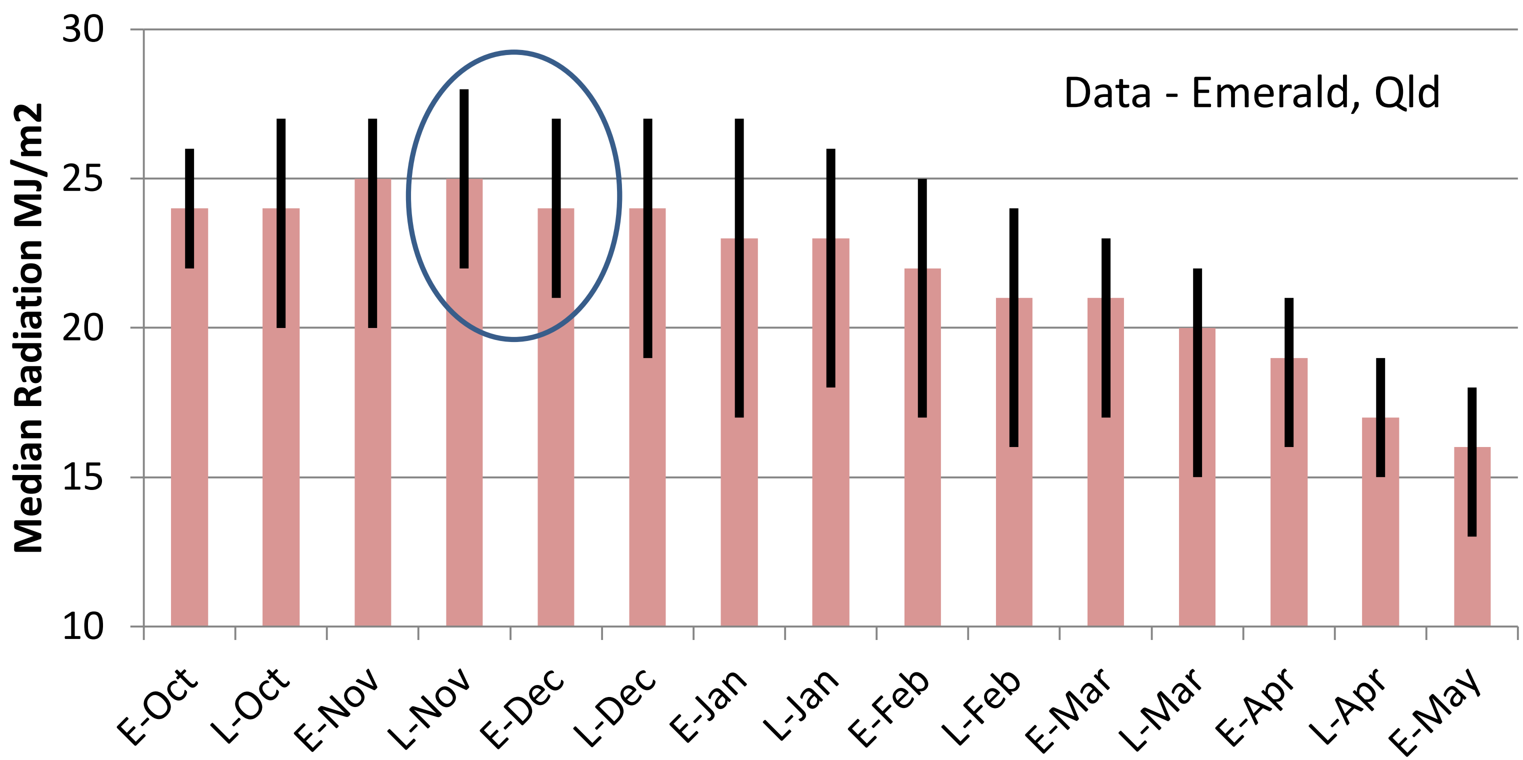


Cotton CRC & CRDC have made major investments in a feasibility study for wet season cotton in Burdekin and NQ tropics 2007-2015.

Subsequent research in Gilbert and now Ord is testing and tailoring these production principles

Recent advances in Central Qld have resulted from taking a similar approach

Climate analysis identified a narrow radiation and temperature "sweet spot" for optimal boll filling. This required re-thinking of the planting window and crop agronomy



Agronomy was tailored around targeting this climatic sweet spot

4 years of research and 2 commercial seasons have demonstrated yield increases of 20-30% simply by better matching production to the local climate.

A key learning for northern Australian is that management has to match the conditions not idealism about how a crop should be grown

Narrabri Crop @ 6 nodes

Burdekin Crop @ 6 nodes

Different growth responses to climate need to be accommodated by agronomic practice

Narrabri Crop @ First Flower

Burdekin Crop @ First Flower

Both crops produced similar yields ~ 12 b/ha but it was produced on different parts of the plant, reflecting the different in growing conditions.

Root exploration varies greatly with rainfall pattern

Wet Start to season

Dry Start to Season

Important ramifications for irrigation scheduling

Shedding squares, flowers and young bolls is a common response to cloudy & wet weather

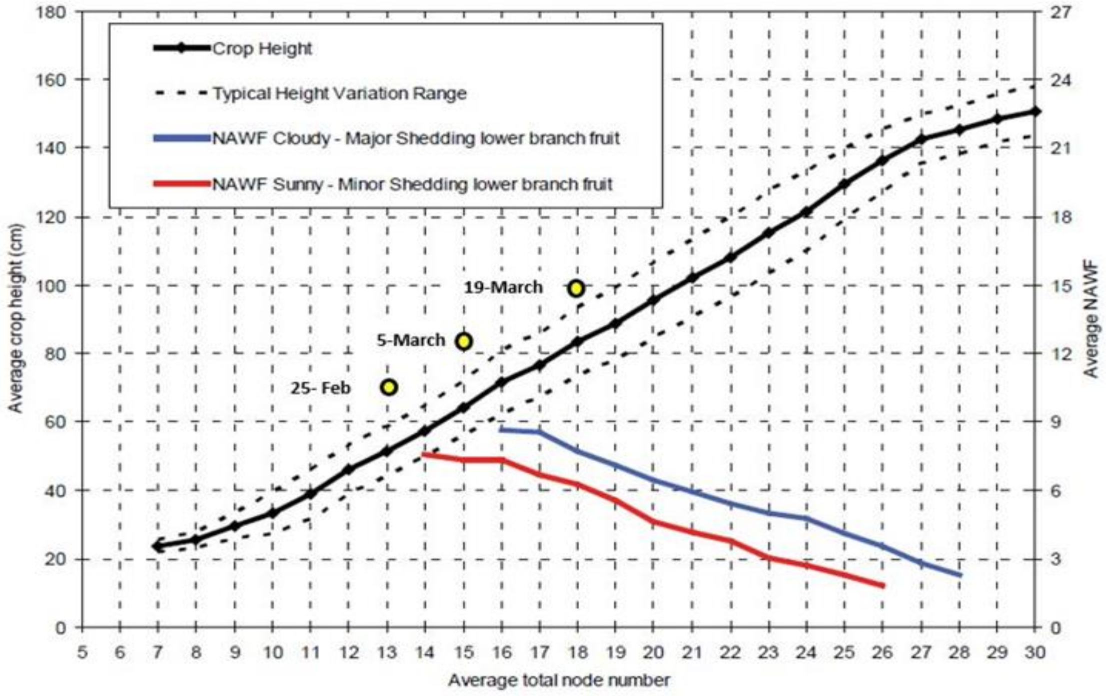
With <u>appropriate management</u> full yield recovery is achieved provided shedding occurs early in flowering and sunny conditions return

Managing for the transition to dry season

Growth & Development Happens Fast!!!!

Effective management of transition depends on being in tune with your crop, the weather and having resources ready to deploy.
What made sense last year might not be the answer this year.

Canopy Management



An example of a management practice transferred from temperate Australia that simply did not work

1. Pix
The Pix recommendations from temperate Australia based on monitoring internode length significantly reduced yields or made no difference.

Yield reductions up to 26% occurred when recovery from stress early in flowering was prevented by excessive Pix.

2. Different nitrogen, defoliation, irrigation scheduling and plant population

This strategy was applied to > 250 ha - southern consultant refused to accept local trial data!

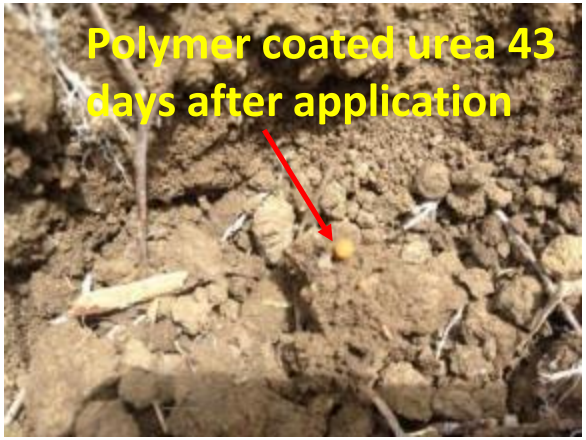
NITROGEN MANAGEMENT

- Soils are generally low in N
- N can be rapidly lost from the root zone.
- Timing and placement are significant factor for nitrogen use efficiency

Clay Soils particularly challenging - Potential solution is delayed release N fertiliser pre-planting

Percentage of pre-plant fertiliser N taken up

Year	Urea	Polymer	ENTEC
2103	25	57	39
2014	24	53	38
2015	30	50	35
Average	**26**	**53**	**37**



Then there is the farming system

- Significant opportunities to double crop.
- Need to ensure crop sequences are complimentary for soil health, pests, weeds, disease, nitrogen cycling etc.
- Many options
  - Cotton – Pulses
  - Cotton – Maize, sorghum other grains
  - Cotton - Forages

Zero till cotton – maize – cotton rotation in Burdekin

Research objectives in coming seasons for Ord & NQ sites – Northern CRC & CRDC

- Validating NORpak – Pix, nitrogen, crop responses to climate
- How does cotton fit into the system – Influence of crop sequences on nitrogen, pests, field conditions etc
- Developing appropriate IPM
- Better grasp of yield potential and variability whilst also gaining cheap experience prior to major investment decisions

Finally Its About Opportunity

- Opportunity for a new high value industry
- Opportunity to double crop
- Opportunity for economic development
- Opportunity to secure new markets
- Opportunity to leverage and capitalise on the knowledge that has been developed