Cotton moving north - where?

Dr Stephen Yeates, Principal Research Scientist
CSIRO, Ayr, Qld, Australia
Northern Australia is more diverse in climate and soils than many realise.

Reviewed in 2001 were climate, soil, water and infrastructure issues for 21 catchments/regions that may be suitable to grow cotton.
Cotton research and test farming north of 21 S since 1995

Dry or winter growing season to avoid insect pests
- March to November

Wet to early dry growing season. December to June

Many seasons of R&D was required to extrapolate from these sites to help determine the climatic and soil suitability of untested locations in the region.
Possible cotton growing seasons in tropical Australia

North of the top line = likely dry season or winter production
South of bottom line = wet season or summer production (subject to surveying of insect pests)
??? = unknown due to lack of data
North or east of the red line = likely to be too wet
Yearly rainfall pattern is similar but volumes vary between locations

![Graph showing mean monthly rainfall for Tortilla, Kununurra, and NitaDowns from January to December. The graph indicates two transition periods: wet to dry season and dry to wet season. Cool Months are also highlighted.]
Dry Season Production – Climate Issues.
Dry season climate challenges and solutions
Climate comparison between Kununurra & Narrabri 30°S

- Very high temperature early and late season in some regions which can limit crop growth – the milder the better.

- Cold minimum temperatures during flowering and boll growth are possible – the warmer the better.

- Radiation early during flowering and boll growth about 20% less than temperate Australia.

- Usually overcome by high proportion of yield is produced on later pollinated flowers when radiation and temperature increases or later planting.
Diversity in dry season minima

The number of nights < 11 to 12 C during flowering and boll growth is critical for dry season cotton production. **The fewer cold nights the better**

Avoidance is possible with later sowing (May) provided there is a late start to the wet and moderate ‘build up’ maximums.
Impact of cold nights

Short periods of sub optimal night temperatures (as low as 3C) early in flowering will not affect yield.

Cotton will produce larger bolls from flowers that pollinate when temperatures increase.

Fibre length and can be reduced by cold nights.

Alternaria leaf blight can be sever when prolonged cold night temperatures at flowering coincide with dew and rain (e.g. Burdekin).
Wet Season Production - Climate Issues

The spectres of wetter-than-average seasons and climate variability years are obvious.
Wet season cotton—similar to Brazil

Average rainfall for the Burdekin cotton season

- Sowing just prior to wet season
- Flower & boll fill as rain rapidly tails off
- Defoliate & harvest in the Dry

Rainfall (mm)

Dec | Jan | Feb | Mar | Apr | May | Jun | Jul
---|---|---|---|---|---|---|---
0  | 50 | 100| 150| 200| 250| 300| 350

Northern Australia Food Futures - Darwin 2014
Solar radiation is a major limitation for wet season cotton compared to temperate Australia.

In the tropics flowering and boll growth occurs during the autumn when daylength is falling.

Late wet season cloud (March / April) further depresses solar radiation during boll growth.

Crop compensation from cloud is greater at lower latitudes because solar radiation and temperature remain higher for longer.
Fruit shedding is a common response to cloudy, wet & humid weather

With appropriate management full yield recovery is achieved provided shedding occurs early in flowering and sunny conditions return.
Example of excellent tropical climate for cotton

La Grange Sub Basin – West Kimberley *(south of Broome)*

Light soils - drip irrigation

Dry season production

May – November

**Extremely high yields**

But

**Politically Incorrect**
La Grange Cropping Window

Late start to wet permits May planting - avoiding cold nights during flowering

Temperatures are relatively mild Sept to Nov (boll filling)
Soil Type? Tropical cotton performs better on well drained course textured soils than heavy clay soils.

Heavy Clay Soils:
• Dry Season Cotton:
  Late end to wet increases the risk of planting delay. Poor irrigation = water logging.

• Wet Season Cotton:
  Optimal timing of operations is prevented, N loss is greater, water logging common.

Clays require:
Good drainage plus permanent beds / minimum tillage.

Good irrigation application (short run times) to minimise waterlogging.
Soil Type? Tropical cotton performs better on well drained cause textured soils than heavy clay soils.

Well Drained Soils (sands/ loams):

- **Dry Season Cotton:** Usually highest yields, water use efficiency and N fertiliser recovery

- **Wet Season Cotton:** Highest Yields, very high N fertiliser recovery, timely operations, deep roots.

**Requires:**
- Appropriate irrigation delivery system
- In-crop N application
Tropical Australia where to grow cotton - Key Points

• A key objective of tropical cotton research has been to identify then find solutions to climate and other production challenges.

• Of the regions reviewed the most favourable climates are similar to the La Grange basin, the eastern Roper R., Coen in Cape York and possibly Larrimah?

• Yield is not everything cotton is an industrial crop so production must be sufficiently reliable to support profitable ginning and transport infrastructure.

• There are many areas with a slightly less favourable climate (e.g. Ord, Bains R, Gilbert R, Broken R) that have other advantages such as infrastructure, scale, rotation crop options, pest avoidance, soils and reliable water supply.

• Tropical Australia is diverse so there is much to consider and still many unknowns.
Acknowledgements

The R&D program has been a collaborative effort the following are acknowledged:


- Ag n Vet Agribusiness Services – Ayr, Ord River Co-op, Western Agricultural Industries, Cotton Seed Distributors, INCITEC, Monsanto, Colly Cotton, Queensland Cotton.

- Growers – Ord, Burdekin, Gilbert, La Grange, Katherine

- Cotton CRC, CRDC
Thank You

Further Reading:
http://www.cottoncrc.org.au/industry/Publications/Northern_Production


Extra slides follow
TABLE I: Irrigable areas reviewed and their development status. * = site of cotton R&D in 2000.

<table>
<thead>
<tr>
<th>DEVELOPMENT STATUS</th>
<th>MAP REFERENCE</th>
<th>CATCHMENT OR REGION</th>
<th>Town(s)</th>
<th>DRAINAGE AREA</th>
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<tbody>
<tr>
<td>1. Existing (non cotton) irrigated cropping and/or potential for expansion</td>
<td>1*</td>
<td>Ord River Irrigation Area</td>
<td>Kununurra</td>
<td>Timor Sea</td>
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<td>Atherton, Mareeba - Dimbulah</td>
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<td>Lakeland Downs</td>
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<td>2. New areas under development or evaluation</td>
<td>5*</td>
<td>La Grange Sub-basin</td>
<td>Broome</td>
<td>Indian Ocean</td>
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<td>6*</td>
<td>Daly Basin</td>
<td>Katherine</td>
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<td>7*</td>
<td>Flinders</td>
<td>Richmond</td>
<td>Gulf</td>
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<td>3. Undeveloped for large scale irrigated cropping</td>
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<td>Fitzroy River</td>
<td>Fitzroy Crossing, Derby</td>
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<td>Lennard River</td>
<td>Derby</td>
<td>Indian Ocean</td>
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<td>Bains/Victoria rivers</td>
<td>Timber Creek, Kununurra</td>
<td>Timor Sea</td>
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<td>Sturt Plateau</td>
<td>Larrimah, Daly Waters</td>
<td>Timor Sea, Gulf</td>
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<td>Adelaide River, Marraakal Plain</td>
<td>Darwin, Adelaide River</td>
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<td>Barkley Tableland</td>
<td>Tennant Creek</td>
<td>Gulf</td>
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<td>Roper River/north-western Gulf</td>
<td>Roper Bar, Borrooloola</td>
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<td>Cape York (e.g., Kendal, Holroyd, Edward, Archer, Colman, Watson rivers)</td>
<td>Coen, Weipa, Pormpuraaw, Aurukun</td>
<td>Gulf/Coral Sea</td>
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<td>21</td>
<td>Upper Burdekin</td>
<td>Charters Towers</td>
<td>Coral Sea</td>
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</tbody>
</table>
Wet season fibre quality

Fibre quality and colour has been best produced in Australia
But gin turnout lower (36 to 38%)

Common range: Length = 38-40, Strength 31-34 g/tex, Mic 3.4-4.3.
High and low night temperatures can reduce net photosynthesis and gin turnout
## Burdekin Gross Margins and Costs

### 1. Gross Margin (AUD) Loam soil with local gin

<table>
<thead>
<tr>
<th>Expected On-farm Price ($/bale)</th>
<th>Expected Yield (bales/ha)</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>7.50</th>
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Variable cost about $2350/ha (yield=8.5 b/ha)

### 2. Gross Margin (AUD) Loam soil without local gin

<table>
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Variable cost about $2760/ha (yield=8.5 b/ha)
# Gross Margins and Costs

## 1. Gross Margin (AUD) Clay soil following sugar with local gin

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<tr>
<th>Expected On-farm Price ($/bale)</th>
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<th>7</th>
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Variable cost about $2500/ha (yield=8 b/ha)

## 2. Gross Margin (AUD) Clay soil following sugar without local gin

<table>
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<tr>
<th>On-farm Price ($/bale)</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>7.50</th>
<th>8.00</th>
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Variable cost about $2900/ha (yield=8 b/ha)
Maximum temperatures

![Graph showing mean maximum temperatures for different locations in Northern Australia over a period from January to July.]
Example Irrigation water requirement - Ord River

Sugar requires 18 ML/ha over 12 months
Cotton requires water for 5 months
Estimate of cotton water requirement = 18 \times \frac{5}{12} = 7.5 \text{ ML}
Ord River

- Dry season production April to October-furrow irrigation

- Yield: 13 b/ha warmest seasons 6-8 b/ha coldest seasons.

- IPM research – confidence to grow in other regions + Bt registration

- But new competition from Indian Sandalwood / Chia
E. February to March
Dead Cover to cotton sowing

L. March to September
Cotton Irrigation

October to E. December
Picking to cover crop establishment

December to E. February
Cover crop growth to Kill

- Proposed cotton cropping system near Katherine NT on red earth soils.
- High potential yields and WUE’s but challenges with cool night temperatures during flowering
- Peanuts a good rotation crop
• Bauer (1985) gave three reasons for failure of large-scale commercial agriculture in northern Australia:
  • Distance.
  • Ignorance of the physical environment.
  • A reprehensible aversion to learning by experience.

“Farming practices cannot be simply transferred from traditional agricultural areas to Northern Australia. They are most likely to be unsuitable, and destined for failure.”