January – a critical time in crop development

5th Jan 2018

FACTS ON FRIDAY

January - a critical time for crop development:

The aim of every grower is to maximise the yield potential of each field on the property. To do this, growers are trying to produce healthy, actively growing plants, or alternatively trying to reduce the incidence and severity of stresses on the plant. The longer the plant is growing healthily, the greater the increase in efficiencies of water use and nutrient conversion, which in turn leads to increased yield.

Table 1: Key cotton growth metrics at first flower to promote high yield potential.

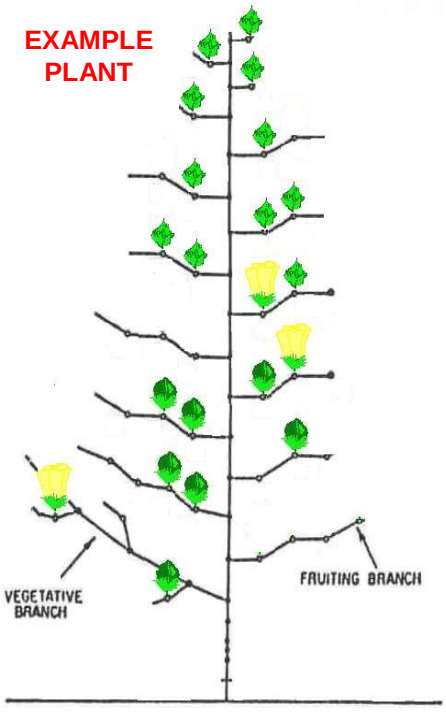
Nodes	16
NAWF	8+
1stPos Ret % (north)	80+%
1stPos Ret % (south)	90%
Growth per Node	5cm

A healthy and actively growing crop must have access to water and nutrients when it needs it from soil that is adequately aerated. The crop also needs access to sufficient heat and sunlight, and not be constrained by diseases or pests. Any one or a combination of these factors could be the limiting factor to a crop producing high yields.

As we move into the second half of the season, the aim is to capitalise on good growing conditions so far. This season's crop is on schedule and has not suffered the insect damage which characterised last season. The crop has good yield potential, but ensuring that the crop has minimal setbacks from now on is crucial in obtaining this yield potential.

January, the cotton crops' peak flowering period, is one of the most critical months in terms of determining final yield and fibre quality of a crop. The EXAMPLE PLANT below is representative of the stage that a lot of crops are at right now, demonstrating:

- Higher fruit retention early with higher on top of plant, compared to last season
- Between 6 and 8 Nodes Above White Flower (NAWF).
- Between 18-22 total nodes.



At cut-out of crop development, the crop may already have up to 90% of its yield producing fruit on it.

However, careful management is required over the next couple of months to ensure yield potential and fibre quality is achieved and maintained.

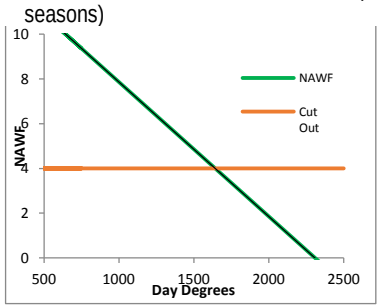
The fact that the cotton plant does not retain all the squares it produces is a positive right now. However, the aim should be to hold a many fruit from now on to ensure crop reaches its yield potential and is not maturing in late Autumn.

Nodes Above White Flower:

Analysis conducted by the CSD Team of more than 300 high yielding crops over the past 8 seasons has shown that an increase in boll number was the key changeable driver for improving cotton yield and this was achieved primarily from crops growing well and flowering for longer.

For this to occur, the plants need to be strong enough to produce and hold new flowers whilst having enough resources to fill existing bolls throughout the plant. High yielding crops did not grow excessively tall or for a long season - most were between 21-24 nodes. The difference was that they held onto later bolls at the top of the plant and in the outer positions.

Figure 1: Average NAWF decline for CSD Ambassador Network fields (3 seasons)



Ideally, in non-limiting, fully irrigated crops, aim for above 8+ NAWF at first flower or 777 Day Degrees, and try to maintain it at this level for an extended period. Having a high NAWF indicates that the plant is actively growing and will continue to retain fruit on the upper and outer fruiting branches.

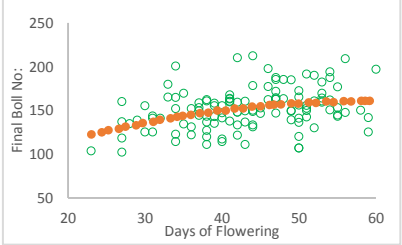
Preventing early cut-out:

Critically, the period from flowering to cut out is when up to 90% of the crop yield is set. So, ensuring that the plant/crop grows actively and is healthy through this period is paramount. Depending on the regions' season length, a major aim throughout this period is to extend the flowering period for as long as possible. Crops approaching cut-out too rapidly are stressed (cannot support the fruit load).

A crop's NAWF will always decrease to a point where it 'cuts out' (Four NAWF). This is when there are not enough resources to both mature the 'set' fruit and continue producing additional nodes. The aim is to extend the period until the crop reaches four NAWF for as long as possible, within season length constraints. There are limitations; the season length will determine the Day Degrees required in filling later bolls.

As mentioned earlier, the longer the flowering period the more potential to set more bolls, so the yield potential increases. Figure 2 shows data collected from CSD Ambassador Network sites in the past three seasons. It shows a positive trend of increased boll numbers as the flowering period is extended. In all seasons, there was a positive relationship, however, seasonal conditions and retention figures heavily influence the slope of this trend.

Figure 2: Influence of the length of the flowering period on cotton boll numbers.



Overall, to get 12.5 bales/ha the crop needs to be flowering for 40 to 50 days. This is not to say that high yields cannot be achieved in shorter flowering windows, as the level of variability in the data is quite high. On average, the CSD E&D team have witnessed 0.3 b/ha per day of

COMPILED BY THE CSD EXTENSION & DEVELOPMENT TEAM, FOR MORE INFORMATION CONTACT

James Quinn	Robert Eveleigh	Bob Ford	Jorian Millyard	Chris Teague	Chris Barry	Sam Lee	Alice Devlin	Craig McDonald
0428 950 028	0427 915 921	0428 950 015	0428 950 009	0428 950 021	0491 212 705	0427 437 236	0418 818 142	0484 513 566
jquinn@csd.net.au	roberte@csd.net.au	bford@csd.net.au	jmillyard@csd.net.au	cteague@csd.net.au	cbarry@csd.net.au	saml@csd.net.au	adevlin@csd.net.au	cmcdonald@csd.net.au

January – a critical time in crop development

5th Jan 2018

FACTS ON FRIDAY

flowering. Healthy growth of heavier bolls helps to achieve these outcomes.

It's easier to pull a crop up through late season with growth regulator management than it is to nurse it through the season with minimal NAWF.

As with fruit shed, if a crop is limiting of resources due to stress, node development will slow, the NAWF will decrease very rapidly and squares at the top of the plant will be shed. If this happens prematurely it will limit boll number (yield), and reduce the plant's leaf area which may decrease its capacity to fill bolls.

Can stress during January influence boll weight?

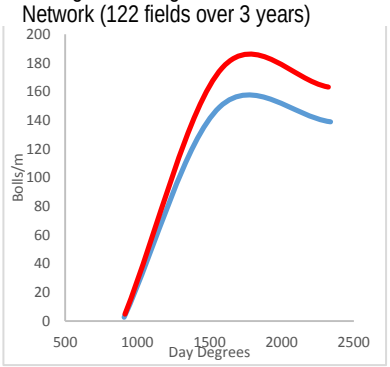
The number of ovules in a flower that are fertilised on the day of flowering is a key factor in the number of seeds per boll, and hence the amount of lint per boll. While this is heavily influenced by climatic conditions, the health of the crop at that stage is important also. Flowers fertilised during a time of crop stress may go on to become light bolls.

Boll load:

Fruit counts done through the season can be misleading and do not correlate well to yield, mainly due to final boll weight and spatial variability. However, they can offer a good indicator of how the crop is progressing. Analysis of the segmented picking by CSD has suggested most crops yielding 5 bale/acre and more had pickable fruit counts around 150+ boll/m. Crops yielding higher than this have retained more bolls/m, as shown in Figure 3.

Please note that in Figure 3, there is a rapid increase in the number of bolls from flowering through to 1500-1600 DD (approximate cut-out). This rapid accumulation emphasises how critical crop management is during the flowering to cut-out phase of growth, as well as the benefits of prolonging cut-out for as long as possible. The time period post cut-out is used mainly to fill existing bolls with minimal further accumulation in number. In conventional or heavily tipped and low retention crops the incline in the curve is not as steep.

Figure 3: Average boll accumulation in High Yielding CSD Ambassador Network (122 fields over 3 years)



Cotton plants will physiologically shed fruit if supply of carbohydrates in the plant is not sufficient to meet the demands of fruit at that particular time. These carbohydrates are directed preferentially to the development of fruit that are already 'set'.

Physiological shed can occur late in the season when the plant has cut-out, or at any time when a stress limits the carbohydrate supply. Be mindful of the effect of moisture stress due to hotter temperatures.

The fruit most susceptible to shedding are:

- Bolls less than 10 days old.
- Small squares.

Bolls older than 14 days are generally not shed.

On the EXAMPLE PLANT, the bolls immediately post flowering would be the most susceptible to shed if the crop was placed under stress, which is quite possible during a heat wave. The loss of three to five bolls per plant may constitute 15-20% of the final yield producing bolls which either needs to be compensated for with later bolls (more time) or else will result in a loss in yield.

To ensure crop stress is minimised, management of nutrition and irrigation needs to be capable and flexible. If weather forecasts indicate periods of hot weather, irrigations may need to be brought forward to make up for increased evapotranspiration rates. The irrigation system needs the capability to quickly move irrigation water to fields and the flexibility to adjust schedules to ensure plants don't suffer undue stress. Likewise, the reverse applies after in-crop rainfall or cooler conditions.

Regular plant monitoring of NAWF and fruit numbers will indicate subtle changes in crop growth. A faster than ideal decrease in NAWF should become apparent if using the CottASSIST Crop Development Tool. Crops in these situations are prone to early cut-out and it is critical that they are managed to promote growth and eliminate stress.

Boosting efficiency:

To demonstrate the boost in crop efficiency, the CSD team measured the total evapotranspiration of both irrigated and dryland CSD Ambassador Network crops, utilising the Irrisat satellite based program and derived water use efficiency (WUE) figure, kg lint per mm passed through the crop, which was then compared to the actual yield of the crop (Figure 4). This analysis showed that yield drives crop efficiency and that plant stress impacts the water use efficiency and the ability of the cotton plant to turn moisture into lint.

Figure 4: Comparing total crop water use efficiency (WUE) with CSD Ambassador Network yields (b/ha). Orange circle is those crops yielding above 12.5b/ha and the blue those field yielding between 10 and 12.5 b/ha

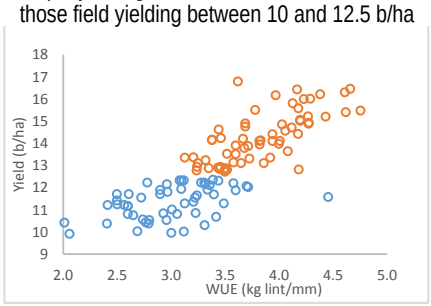
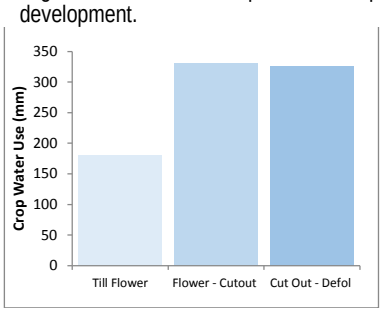


Figure 5 highlights the crop water use over three phases of crop growth. Water use per day accelerates at flowering and the crop requires approximately 3ML in both the flowering to cut-out and cut-out to defoliation periods

Figure 5: Average crop water use segmented into 3 distinct phases of crop development.



Key fundamentals:

- Monitor heavily – in addition to the usual moisture, nutrient and insect scouting schedule, regularly check for:
  - Crop growth, especially NAWF and vegetative growth rate.
  - Boll numbers/retention to determine fruit load.
- Use sound agronomic principles – Apply water, nutrients, insecticides and other inputs on time and efficiently as possible. Do not let the crop's limiting factor be something which management has control over.

COMPILED BY THE CSD EXTENSION & DEVELOPMENT TEAM, FOR MORE INFORMATION CONTACT

James Quinn	Robert Eveleigh	Bob Ford	Jorian Millyard	Chris Teague	Chris Barry	Sam Lee	Alice Devlin	Craig McDonald
0428 950 028	0427 915 921	0428 950 015	0428 950 009	0428 950 021	0491 212 705	0427 437 236	0418 818 142	0484 513 566
jquinn@csd.net.au	roberte@csd.net.au	bford@csd.net.au	jmillyard@csd.net.au	cteague@csd.net.au	cbarry@csd.net.au	saml@csd.net.au	adevlin@csd.net.au	cmcdonald@csd.net.au