

# Germinating ideas

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As the important part of the season fast approaches, this edition of Germinating Ideas will look at the issue of defoliation and how critical it is to get it right. It will also look at how to make the decision as to when the last watering should occur.

The second part looks at boll weights and boll factors and it shows there can be large variations in yield based on boll numbers and the lint weight per boll. Many people try to assess the potential of crops by counting fruit. Fruit counts are important, but final yields are based on the weight of lint per boll as well as boll numbers.

## TIMING OF THE LAST IRRIGATION AND PREPARING FOR DEFOLIATION

Depending on where you are, sometime during the month of February, decisions will need to be made on how many more irrigations crops will need and when to time the final irrigation so that all the bolls you aim to harvest reach full maturity with adequate moisture.

The prime objective of the last irrigation is to ensure that boll maturity is completed without water stress. The broad aim is to have the soil reach refill point by defoliation. At the time of last irrigation, all bolls have been set, vegetative growth is limited and the majority of plant carbohydrates are being used to satisfy boll demands.

Once a boll reaches 10–14 days old, the abscission layer that causes boll shed cannot form and so boll numbers are not significantly reduced by late water stress. But fibre development can be affected. Crops that come under stress prior to defoliation (at 70 per cent open or four nodes above cracked boll), can suffer some yield and fibre quality reduction. The level of reduction obviously increases the earlier the stress occurs.

There are a number of methods available to accurately time final irrigation and defoliation.

Counting nodes above cracked boll (NACB) is quick and common. It is assumed that cotton will open up at a rate of about one node every three days. This will depend on a number of factors, particularly weather conditions.

When the crop reaches four NACB, the top boll will have reached “effective” maturity, where fibre development on all bolls is complete and defoliation can occur without risk of reducing yield and quality. Figure 1 explains some issues associated with measuring NACB.

### How far up the plant do you measure?

For the purpose of using NACB for timing of last irrigation and defoliation, we are

only interested in determining how many nodes from the cracked boll to the last boll that you intend to harvest.

In Figure 1 the last harvestable boll is on FB10, so you ignore FB 11–14.

### Do you count nodes without fruit on them?

Yes. All nodes between the cracked boll and last harvestable boll should be included. The maturity of the boll is dependent on its age. It takes the same amount of time for a boll to mature properly regardless of the presence of other bolls on neighbouring nodes or positions.

On the diagram, nodes 5, 7 and 9 have no fruit, but need to be included in the NACB measurement.

### Measuring/estimating crop use

When the number of days to four NACB has been determined, the amount of water the crop will require to reach that point needs to be addressed. This requires two key pieces of information:

- Soil water holding capacity (SWHC) — the difference between full and refill point; and,
- The daily crop water use. Those with moisture probes can use real time data, while those who don't may have to estimate. Generally daily crop water use will decline as more bolls open.

In our example crop, how much water would be needed and when could it be defoliated?

Current NACB is eight, so four NACB will be reached in 12 days (assuming one node every three days). If crop water use is assumed to be five mm per day and we want to be at refill point at defoliation (four NACB), this crop will require 60mm;

The number and timing of the final irrigation would then depend on the SWHC.

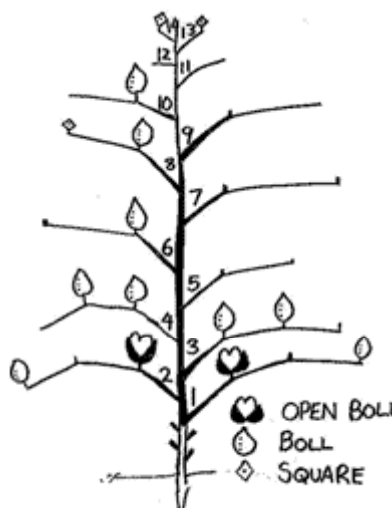
### When NACB doesn't work

There are some situations where NACB does not accurately reflect crop maturity.

- Where there has been some ‘tipping

**FIGURE 1: Nodes above cracked boll**

- Fruiting branches (FB) are numbered 1–14 in this example.
- Highest cracked boll is on FB2.
- Last harvestable boll is on FB 10.
- Nodes 9, 7 and 5 have no fruit.
- Current NACB value for this plant is 8.
- Assuming the bolls open at 1 node every 3 days, the crop will reach 4 NACB in 12 days time.





**Variations in top boll size in two varieties.**



**Picking a high yielding 15 inch cotton crop.**

out' or gappy plant stands resulting in vegetative branches with bolls younger than indicated by NACB; and,

- Where a crop has 'stopped and started again' as a result of a stress.

In these situations, it is necessary to cut all possible bolls in the crop that will be harvested to assess their maturity. This is an excellent method to calibrate NACB.

### **BOLL WEIGHTS AND BOLL FACTORS**

Usually, at this time of year as crops are around the time of cut-out, people are starting to talk about boll numbers and using boll factors for each variety (bolls/metre per bale/hectare) to get some indication of yield potential.

Boll numbers and boll weight are the key components of yield. But boll counts are famously inaccurate, and every year people report that there is very little or no correlation between boll counts and final yield of fields.

There are many reasons why this occurs.

Infield variability and representative sampling are probably the biggest reason. With the advent of yield monitors on pickers, everyone has become very aware of how much yield can vary within a field. It clearly illustrates that while boll counts on two or three random metres in a field provides a good yield prediction on those metres, it is a less than accurate measurement for a whole field.

A number of people have addressed this by using precision agriculture tools such as EM surveys and previous yield maps to identify areas in the field that are representative of the majority of the field. These

are also used for the location of moisture probes, plant tissue testing and in-season plant mapping.

Boll weights can vary greatly, and so will impact how these numbers convert into yield. A 50 per cent variation in boll weight equates to a 50 per cent variability in yield with the same boll numbers.

Boll factors (as displayed on [www.csd.net.au](http://www.csd.net.au)) provide an indication of how many bolls per metre are required to produce a bale per hectare. These figures are provided by the CSIRO breeding team who use fruit count and yield data from their research program. The boll factor is an average of several seasons and management styles. For each boll factor there may be up to 33 per cent variability from the upper and lower limits in the original data.

Boll factors provide a good indication of the comparative boll weights between varieties. If all other factors are the same, a variety with a lower boll factor will achieve a higher yield than a variety with a larger boll factor with the same boll counts.

### **Why boll weights vary**

Boll weight is determined to some degree from the time a square is initiated to when the picker reaches it.

The more seeds per boll, the heavier the boll.

The time between square initiation and flowering is 6–7 weeks. During this time the number of ovules (that may become seeds) is determined. This is largely influenced by the genetics of the plant, crop stress and nutrition. Of particular importance is a period about three weeks prior to flowering when ovules and pollen cells are being developed. The square is par-

ticularly sensitive to environmental stress at this stage.

White flowers open at dawn and are usually pollinated in less than eight hours. Fertilised ovules go on to become seeds while those not fertilised are known as motes which produce the short fibre that is removed through ginning. The number of ovules that are fertilised is heavily influenced by environmental factors, particularly hot night temperatures.

The more lint per seed, the heavier the bolls.

Larger seeds will have more lint per seed, but, other than genetics, the causes of this are not well understood. The weight of each fibre is determined by crop and growing conditions from flowering onwards. Things that can influence this are nutrition, climate, boll load and location on the plant.

Moisture stress during boll-fill needs to be severe before it will limit boll weight. Bolls are less sensitive to stress than leaves, so boll growth can still occur after vegetative development has stopped.

Crops with low boll numbers can have higher boll weights as there is less fruit to share around the plant's resources.

First position bolls are usually heavier than second position bolls and those on vegetative branches. On the main stem, heaviest bolls usually occur around fruiting branches 4–7, and decrease towards the top of the plant as there is more competition for assimilates. Bolls at the bottom of the plant often suffer from shading, which is obviously worse in rank crops. The size of a boll is proportional to the size of its subtending leaf.