Boll Weights and Boll Factors

3rd March 2017

FACTS ON FRIDAY

At this time of year many a grower's thought turns to yield potential - boll counts and boll factors are one way to estimate the yield potential.

This season sees a diverse range of crops with climatic impacts throughout the season such as high temperatures during boll fill. Added to this variability in the different forms of planting, from fully irrigated through varying levels of row configurations and water stress through to dryland plantings.

Boll counts are famously inaccurate yield indicators. As a rule of thumb, @12-14 bolls/m equates to 1.0 b/ha in irrigated, and @16-20 bolls/ m equates to 1.0 b/ha in dryland situations.

Every year there is variability in the relationships between boll number and final yield of fields, and ***there are many reasons why this occurs:***

In-field variability and representative sampling are probably the biggest reasons. With the advent of satellite imagery, drones and yield monitors on pickers, people have become very aware of how much yield can vary within a field. While boll counts made on 2-3 m of randomly selected plots in fields provide a good yield prediction for those metres, it may not be a representative measurement of the whole field.

People have addressed this by using precision agriculture tools such as EM surveys and yield maps from previous crops to identify areas that are representative of the majority of the field. These techniques are also used for locating moisture probes, tissue testing and in-season plant monitoring.

Boll weights can vary greatly, and hence will impact on how these numbers convert to yield. The following table illustrates how 50% variation in boll weight equates to 50% variability in yield with the same boll numbers. These levels of boll weight variability have been observed within the same variety in CSD's segmented picking work over many seasons.

Table 1: Impact of boll weight and boll number on yield potential.

		Boll weight (g/lint per boll)				
		1.6	*1.8*	*2.0*	*2.2*	*2.4*
Bolls /m	*80*	*5.7*	*6.4*	*7.1*	*7.6*	*8.4*
	100	*7.1*	*7.9*	*8.8*	*9.6*	*10.6*
	120	*8.4*	*9.6*	*10.6*	*11.6*	*12.6*
	140	*9.9*	*11.1*	*12.3*	*13.5*	*14.8*
	160	*11.3*	*12.6*	*14.0*	*15.5*	*16.8*
		Yield (bale/ha)				

No greater example of this variability has been witness during the past 2-3 seasons where excellent growing and boll filling conditions have produced very heavy bolls in some cases up to 25% heavier. Table 3 shows the seasonal variability but also variability between varieties. It is a general consensus with the CSD E&D team that the boll factors witnessed in the previous two season will not be replicated again this season.

Boll factors, as displayed on www.csd.net.au provide an indication of how many bolls/m are required to produce 1.0 bale/ha. For each boll factor, there may be up to 33% 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 everything else is equal, 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.

Table 2: Sicot 74BRF example highlighting the range in yield dependent on boll factor

	Mean	*Upper*	*Lower*
Boll Factor	*13.5*	*12.0*	*16.5*
Yield (bale/ha)	*11.1*	*12.5*	*9.1*

Table 3: CSD Variety Trial Boll Factors of Popular Varieties

Variety	Boll Factor	
2014/15 Season		
	Irrigated	Previous
Sicot 74BRF	11.9	13.5
Sicot 714B3F	11.4	N/A
Sicot 746&748B3F	10.5	N/A
Sicot754B3F	12.3	N/A
2015/16 Season		
	Irrigated	Dryland*
Sicot 714B3F	13	13.6
Sicot 746B3F	12.4	12.9
Sicot 748B3F	12.5	12.6
Sicot 754B3F	12.6	14.2
Sicot 711RRF	12.4	14.5
Sicot 75RRF	13.3	13.7
Sicot 812RRF	14.2	16.4

*Dryland results shown are per linear metre, a row configuration multiplication factor is needed to estimate yield potential.
Sicot 707B3F does not have enough data at present to give a reliable figure. But, initial figures are similar to Sicot 714B3F.

Why boll weights vary:

Final boll weight is influenced from the time a square is initiated to the time the picker reaches it.

More seeds/boll = heavier bolls

The time between square initiation and flowering is 3-4 weeks. The number of ovules (that may become seeds) is determined just after the point of square initiation. The ovule number is largely influenced by the genetics of the variety, crop stress and nutrition. The square is particularly sensitive to environmental stress (eg: heat/moisture) at this stage. As a rule of thumb, healthy crops have between 30-35 seeds per boll with some bolls having up to 40.

White flowers open at dawn and are usually pollinated in less than 8 hours. Fertilised ovules go on to become seeds while those not fertilised are known as motes and these may produce a short fibre that is removed through the ginning process. The number of ovules fertilised is strongly influenced by environmental factors especially night time temperature, with high (>25°C) values as seen throughout the months of December and January this season being detrimental.

More lint per seed = heavier bolls

Larger seeds will have more lint per seed. Other than genetics, the causes of this are not well understood, but competition between seeds in a boll is likely. The weight of each fibre is determined by the growing conditions from flowering onwards. Things that can influence this include 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, hence boll growth can still occur after vegetative development (eg: new nodes) has stopped.
- Crops with low boll numbers can have higher boll weights as there is less fruit to draw on the plant's photosynthetic 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, this obviously being worse in rank crops. The size of a boll is proportional to the size of the subtending leaf.

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