

## **Is earliness really next to Godliness?**

Steve Milroy, Mike Bange and Grant Roberts  
CSIRO Plant Industry and Australian Cotton CRC. Narrabri, NSW.

**Earliness can be manipulated by choice of cultivar, insect management, water or nutrition. Early crop maturity may allow you to pick earlier to avoid quality down grades and perhaps save on late season insect protection. However, this needs to be balanced against the fact that earliness may cost you between 0.6 and 1.0 bales/ha per week in lost yield.**

**Match your cultivar choice to the desired timing of crop maturity first and tune water and nutrition inputs. This allows appropriate implementation of IPM.**

### **Introduction**

At various times, strong interest develops within the industry for early crop maturity. Earliness can allow the manager to harvest the crop in a more timely manner and thus reduce the risk of quality down grades due to weather damage. It can also mean a saving on water and late season spray costs if the period for which protection is required can be reduced. In this paper we will bring together some pieces of ongoing research which are dealing with aspects of the timing of crop maturity.

In this article we use the term 'earliness' to describe the time taken from sowing to crop maturity, defined as 60% of the bolls open. Thus, a crop which is sown ten days later than a normal crop but harvested only five days later, has greater earliness because the growth period is reduced.

### **The Mechanism of Earliness**

It is generally understood that the timing of crop maturity in cotton is not determined solely by temperature and day length as in many other crops, but by the balance of supply and demand of resources to the developing fruit and growing points. When the fruit load develops to the point where the rate of growth monopolises the entire supply rate of resources, the crop cuts out and ceases to produce new fruit. Because of this, the timing of crop maturity can actually be manipulated by altering either the supply of resources to the fruit or the demand by the developing fruit load. In terms of differences between cultivars, the biggest difference is in fruiting patterns, hence the developing demand for resources.

In experiments conducted over the last eight years, we have looked at whether there is much difference between late and early cultivars in their ability to supply resources to the fruit in an

attempt to test if this explains why early maturing varieties are early. In terms of capturing light and converting it into growth we found that there was a surprisingly small amount of variation. The cultivars had a similar capacity to intercept light per unit of leaf area. They also had a similar capacity to convert the light they intercepted into photosynthate and hence dry matter. Other researchers who have compared cotton genotypes for other purposes have also found these traits to be fairly stable, although they did not specifically compare early and late cultivars.

As expected, the characteristic that varied most between the cultivars was the way that the fruit load developed. An earlier fruit load development led to an earlier cut out and hence earlier maturity. The analysis of this data is still under way to better understand how we can utilise this principle in crop management.

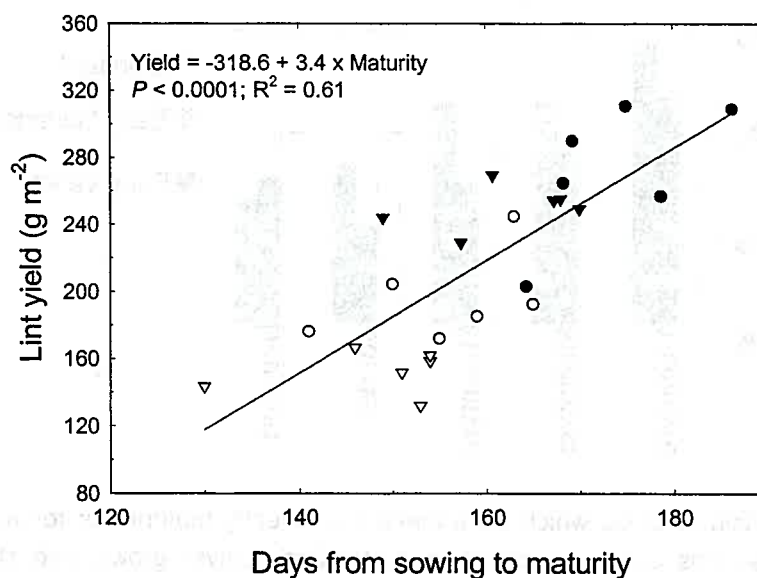
### **Manipulating Earliness**

The timing of crop maturity can be manipulated by a range of management factors. Fruit retention, and hence insect control, is a key driver. Variety, nitrogen and water are three other factors.

Varying nitrogen rate or water stress modifies the growth rate of the plant and so alters its capacity to support fruit. This means that the time taken for the supply rate to be matched by the increasing fruit demand varies. Brian Hearn and others have demonstrated this, and shown that when other factors are not limiting, it is biologically possible to generate a wide variation in crop maturity time by varying nitrogen rate, for example high nitrogen rates can extend crop maturity. However, when considering the range of inputs typical in commercial systems, the difference is far less; one week at the most.

It is far easier to generate a difference in maturity by modifying retention rates early in the season. It must be born in mind that low action thresholds early in the season work against IPM and may have little economic benefit in terms of increasing yield, however protecting the crop early in fruiting allows a rapid accumulation of boll dry matter and hence forces the crop to cut out sooner. This is seen for example in commercial Ingard® crops. In controlled experiments, early fruit retention rates (through the use of Ingard® varieties and lower action thresholds) were able to induce a variation in earliness that was three to four times greater than that caused by manipulating nitrogen, water and Pix®.

The decision to attempt to manipulate earliness may be based on a number of different factors. One might be to attempt to match harvest time to months with a lower likelihood of rain. In short season environments, early crop maturity is imperative. In these conditions, late maturity can result in high yield variability due to late crops being truncated in cooler years and a reduced average long term yield. However, in full season environments the cost of earliness should be assessed. There is a general relationship between the duration of crop growth and yield. For each day that maturity is brought forward, there is a yield loss of between 20 and 35 kg/ha per day, that is between 0.6 to 1.0 bales/ha per week (Fig. 1).

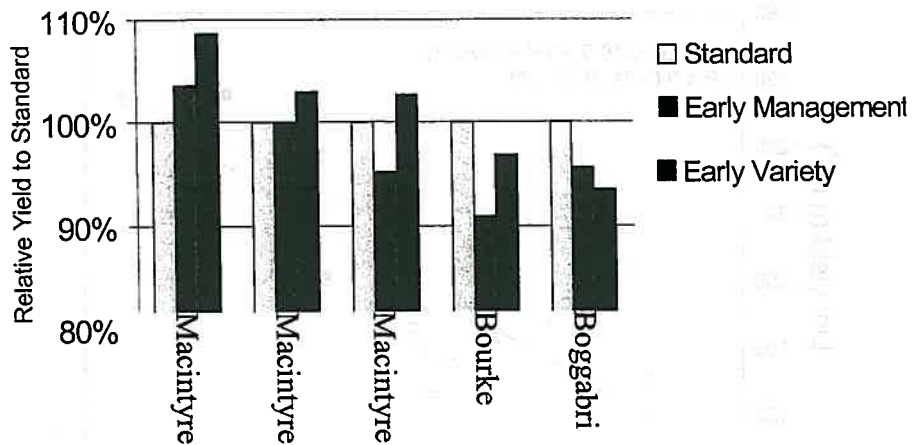


**Figure 1.** The relationship between yield and crop duration for a range of cultivars, years and sowing dates at Narrabri. For each week that the crop matures earlier yield decreased by about 1 bale/ha. Similar relationships have been found in a number of studies.

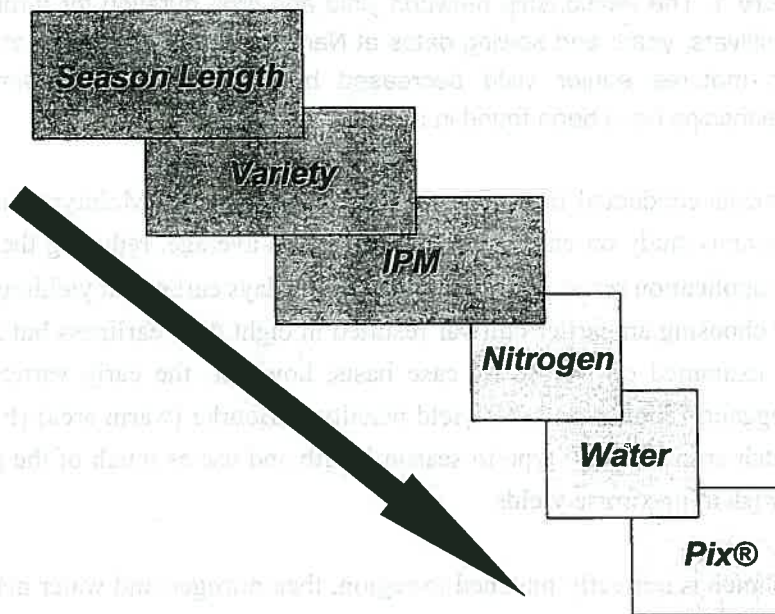
On-farm experiments conducted in the Namoi valleys, Bourke and McIntyre Valleys, as part of a CRC farming systems study on earliness, showed that on average, reducing the nitrogen rate and increasing Pix® application resulted in crops being three days earlier but yielding 0.3 bales less. By contrast, simply choosing an earlier cultivar resulted in eight days earliness but no significant loss in yield. When examined on a case by case basis, however, the early variety showed a yield advantage at Boggabri (cool area) but a yield penalty at Bourke (warm area) (Fig 2). Clearly it is important to match crop maturity type to season length and use as much of the growing season as possible if you wish to maximise yields.

When cultivar choice is correctly matched to region, then nitrogen and water management need to be optimised to ensure adequate, but not excessive, crop growth. Over supply of either can delay maturity and cause excessive vegetative growth. IPM can then be appropriately applied. Cultivar choice and pest control are the key components of managing earliness (Fig. 3). If the cultivar type is too late for the region, greater emphasis is needed on insect management to ensure high retention rates and hence earliness. However, this is likely to compromise IPM strategies and may sacrifice yield and reduce profitability.

Thus, to avoid losing yield unnecessarily, match variety to season length, whether this is based on temperature or some other parameter, and manipulate other inputs (nitrogen, water, Pix®) to match crop requirements. It is also important to ensure that an appropriate IPM approach is also adopted to achieve sensible levels of retention at flowering.



**Figure 2.** Yield of crops which were managed for early maturity, or for which an early cultivar was used, compared to a standard cultivar grown with standard management.



**Figure 3.** The level of importance of factors in manipulating earliness. Matching cultivar to season length is the first step when targeting correct maturity time without loss of yield. This allows appropriate implementation of IPM rather than striving for high retention to achieve earliness.

### Ongoing Research

Research into earliness and the mechanisms that drive the timing of crop maturity is continuing. This includes research at the farming systems scale, crop agronomy and physiology. The capacity of the crop to compensate for insect damage and the concept of determinacy are two components being examined.