# Semi Irrigated Cotton: Is it an option for you?

**14th Aug 2015**

FACTS ON FRIDAY

## Semi Irrigated Cotton - Is it an option for you?

Water use efficiency is an important aspect of Australian cotton production. Skip row irrigated cotton is being considered for use not only in limited water situations, but more widely now for a number of notable reasons.

**The practice:**

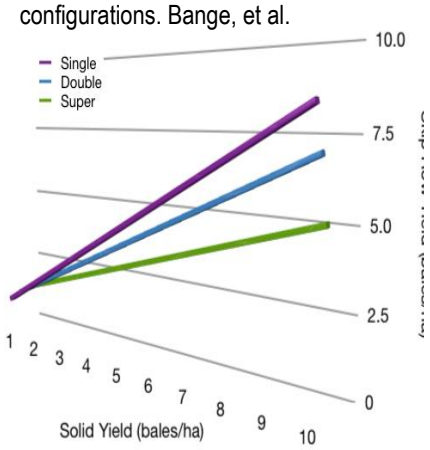
- Extends the planted area utilising full moisture profiles.
- Buys some time in which to benefit from in-crop rainfall.
- Minimises the potential of fibre quality discounts.
- Biotechnology traits allows easier insect and weed management.
- Offers significant variable cost savings over solid planting.
- Maximises returns per megalitre of water.
- Reduces fallow area and maximises productive capacity in low water years.

Skip row configurations function by increasing the volume of soil that plants have to explore, providing a bigger reservoir of available moisture and allowing the plants to hold on for longer during dry periods.

## Which Row Configuration Suits?

There is no one row configuration that suits all situations, however, choosing the right row configuration is a calculation involving yield expectations, water availability, soil water holding capacity, risk aversion, how the row configuration fits into machinery wheel spacings and available and seasonal climatic outlook.

**Figure 1:** Yield comparison between solid and skip row planting configurations. Bange, et al.




Research has shown (Figure 1) that skip row cotton does limit yield potential over solid planted cotton in full water availability scenarios. At lower yield potentials the yield difference is not that large and a combination of reduced fibre length discounts and variable cost savings in growing skip row cotton often leads to a better risk/ return proposition in limited water situations.

**Factors Influencing Skip Row Configuration Decisions:**
**Your soil moisture level - how full is the bucket?**

The concept of skip row cotton relies on the fact you are creating more soil space for each of the plant lines to access, and hence the potential soil water available for each plant, delaying the time before it will go into moisture stress. The greater the amount of moisture in the profile, the longer the crop will have before it will requires irrigation or rainfall. In situations of higher soil moisture, and higher rainfall probabilities, narrower row spacing may be considered.

- The heavier the soil type, the greater the potential there is to close in the skips, depending on all other factors, and assuming roots can explore the whole soil profile.
- In lighter, lower PAWC soils, even with the use of skip row, crops tend to stress and cut-out quickly then attempt to re-grow when irrigated.

**Your soil physical properties – how far can plant roots explore?**

It is critical to know the water holding capacity of your soil, the larger the better. Know how big the bucket is, and the physical properties which may impede root growth and exploration. If the roots can't get out into the skip row areas, you don't have the benefit of accessing this moisture. Reasons for this can include severe compaction, sodicity, hard-setting soils, or root injury from cultivation.

**Available irrigation water – and where it is:** Have an understanding of the amount of irrigation water available at planting and a estimation of losses from the system through evaporation and transmission. In limited water years, you will want to avoid moving water long distances on-farm to minimise transmission losses – whether this is from the delivery point (e.g. river, bore) or an on-farm storage.

**Quantity and timing of in-crop rainfall:**

Your district averages, weather forecasts and your attitude towards them will all impact on the row configuration set up which best suits the growing conditions of a particular year. Rainfall received in the flowering and peak boll filling period will be of greater benefit than that earlier in the pre-flowering period of the season.

**Semi Irrigated Row Configuration Decision Matrix:**

Selecting the right planting row configuration is a critical factor in the decision to plant semi irrigated cotton and, depending on seasonal factors, will impact on the final yield, fibre quality and the profitability of your crop.

There are several considerations mentioned above which may influence the selection of a row connfiguration, including soil Plant Available Water Holdnig Capacity (PAWC), irrigation water available


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

| James Quinn | Robert Eveleigh | Bob Ford | Jorian Millyard | Alex North | John Marshall |
|---|---|---|---|---|---|
| 0428 950 028 | 0427 915 921 | 0428 950 015 | 0428 950 009 | 0428 950 021 | 0428 950 010 |
| jquinn@csd.net.au | roberte@csd.net.au | bford@csd.net.au | jmillyard@csd.net.au | anorth@csd.net.au | jmarshall@csd.net.au |

# Semi Irrigated Cotton: Is it an option for you?

**14th Aug 2015**

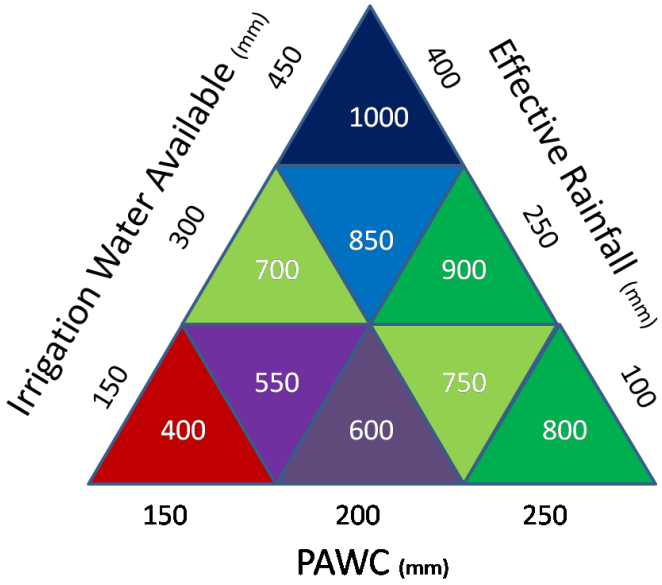
FACTS ON FRIDAY

and the seasonal forecast or risk profile. Select the optimal configuration by considering and overlaying three factors

- Understanding the water holding capacity (PAWC)
- The amount of irrigation water available and its location.
- An estimate of the effective rainfall and the confidence in the forecast or likelihood of receiving said rainfall.

Understand that the cotton plant will require access to 800 to 850 mm of evapo-transpiration or water throughout its life to reach its full yield potential. The choice of row configuration is then based on combining the various sources to achieve in excess of 800 mm over the life of the crop.

**The Semi Irrigated Cotton Decision Matrix:**




| Example 1: (e.g. Darling Downs, Breeza Plain) | Example 2a: | Example 2b (Single Skip): |
|---|---|---|
| • PAWC = 300mm<br>• 3 Irrigations = 300mm<br>• In-crop Rainfall = 400mm<br>• Avail Moisture = **1000mm** | • PAWC = 200mm<br>• 3 Irrigations = 300mm<br>• In-crop Rainfall = 200mm<br>• Avail Moisture = **700mm** (100-150mm short) | • PAWC: 300mm<br>• 3 Irrigations = 300mm<br>• In-crop Rainfall = 200mm<br>• Avail. Moisture = **800mm** |

In example 1 there is enough available moisture to potentially plant in a solid configuration to achieve a high yield potential - or single-skip if the rain forecast is not looking promising.

In example 2a, there is a deficit of 100-150 mm of available moisture and the crop will not be able to reach its full potential if planted on a solid row configuration. The one thing the grower can alter is to go out to a single skip row configuration as in example 2b which will effectively increase the amount of PAWC available to that crop.

This would give the crop enough to get through. If the growing season ends up being drier than expected or the forecast for rainfall is not high then double skip planting may be an option for risk management.

## Planting Considerations:

In limited water situations, growers may often be planting into less than ideal conditions, and possibly into uneven rain derived moisture which will make establishing a stand difficult. The benefits of establishing a stand on rain moisture is large, reducing the need for watering up. It can lead to significant savings to the water budget of the crop and frees water for more targeted irrigations later in the crops growth.

Establishing an even plant population is more critical than targeting lower plant stands than those used in solid. Anywhere between 6 and 13 plants per metre is ideal. Low or gappy plant stands reduce yield and produce big plants which don't pick cleanly and are difficult for post harvest stalk management. Yield potential loss through gappy plants stand is further exaggerated in skip row configurations as the ability for the plants to compensate for gaps is diminished.

When planting into difficult conditions, it is important to adjust seeding rates up to account for possibly higher levels of mortality.

Planting later into the window is preferable because it increases the likelihood of utilising late January and February rainfall and avoids exposing a crop with a full boll load to the potentially hot and harsh conditions of late December and January.

**Some options to consider include:**

- Slowing the planter down to around 7-8 km/hr – this will result in less bouncing and more even seeding depth.
- Disc planters are very good at pushing through heavy stubble. Instead of using trash whippers, increase the pressure on the planter unit to ensure seed is placed into moisture.
- Where moisture in the seedbed is marginal, (common in rain fall generated soil moisture profiles and variable soil types) water injection in the row can extend planting an extra couple of days.

## Irrigation Management:

The principles irrigation management do not change under a semi irrigated skip row situations. Monitoring and utilising moisture effectively and efficiently in the skip row is the obvious difference.


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

| James Quinn | Robert Eveleigh | Bob Ford | Jorian Millyard | Alex North | John Marshall |
|---|---|---|---|---|---|
| 0428 950 028 | 0427 915 921 | 0428 950 015 | 0428 950 009 | 0428 950 021 | 0428 950 010 |
| jquinn@csd.net.au | roberte@csd.net.au | bford@csd.net.au | jmillyard@csd.net.au | anorth@csd.net.au | jmarshall@csd.net.au |

# Semi Irrigated Cotton: Is it an option for you?

**14th Aug 2015**

FACTS ON FRIDAY

**Ulitise water when you will get biggest benefit:**

Irrigation strategies used in skip row cotton need to work on the principle that yield is maximised by avoiding or at least minimising moisture stress while the plant is flowering (Table 1).

**Table 1:** Yield loss (%) per day of water stress (extraction of > 60% plant available water content) (Source Yeates et al. 2010#; Hearn and Constable 1984*)

| | Past Conventional* | Bollgard II# |
|---|---|---|
| Squaring | 0.8 | 1.1 |
| Peak flowering | 1.6 | 1.7 |
| Late flowering | 1.4 | 2.7 |
| Boll maturation | 0.3 | 0.69^ |
| ^14 d post cut out | | |

Regardless of the amount of water available it should be used when it is going to give the biggest benefit. Unfortunately there is no strict rule of thumb in timing irrigations as it is influenced heavily by seasonal conditions such as temperature and rainfall. However, as mentioned above the aim should be to minimise stress on the plant (easier said than done).

Table 1 shows the effect of water stress on yield. Crop stress should be minimized during the flowering period. Periods early in the crops development and also late in the season are times where stress will have the least impact on the yield of the crop.

It is critical that monitoring of irrigation water availability, rainfall and temperature forecasts, soil moisture in the plant line and the skip area and monitoring of VGR and NAWF occurs, as these can give insight into the most opportune irrigation time to achieve the highest yield from the crop.

With this in mind, the optimum timing to get the most out of each irrigation will depend on irrigation water availability and on the field and environmental conditions your crop is enduring. Irrigation water should be targeted at generating and protecting yield. This is why it is so important that a range of monitoring techniques is used.

**Soil Moisture Monitoring:**

Knowing the moisture content status of the soil and also the extent of root exploration not only in the plant line but also in the skip area is critical management of skip row cotton.

- Ensure probes are located in the predominant soil type of the field. This can be done using your own experience or data from EM surveys.
- Position moisture probes in the skip row as well as the plant line. This will give a very accurate measure of crop water use when the plant is growing well and help predict when skip row moisture will run out.
- Using neutron probes in conjunction with capacitance probes can deliver actual daily water use – invaluable for determining correct irrigation date
- There is no substitute for double checking probe results with a spade or moisture spear to determine whether roots are accessing moisture across into skip rows.

**Plant Monitoring:**

Plant vigour can be measured using squaring nodes before flowering, Nodes Above White Flower (NAWF) during flowering and Vegetative Growth Rate (VGR) and fruit numbers throughout the season. This information can be benchmarked against 'ideal' crop growth using the Cotton CRC Crop Diagnostic Tool. This information can be used and cross referenced to soil moisture probe data to fine tune the irrigation decision and timing.

**The First Irrigation:**

The timing of the first irrigation in skip row cotton is critical. Stretching it too far can result in rapid-cut out, resulting in a restricted boll load and triggering crop re-growth when moisture eventually becomes available. This will result in a big maturity gap making the crop difficult to finish and defoliate. The decision when to start irrigating also needs to consider the capacity to water all areas to avoid being late on the last fields. Although irrigation intervals may be greater in skip row, each irrigation may use as much if not more water than solid plant.

**Where to run the water** - In double skip, watering down the middle of the planted rows can be more efficient than between in the skip area. Soil moisture will be first drawn from this area as well - as the plants grow they provide shade which will assist in minimising evaporation losses. To avoid breakouts across soft rows, furrows and wheel tracks may need to be cultivated. Breakouts can also be avoided by watering both skip and plant rows to produce an even wetting front.

**Yield is a not exactly a function of amount of water applied:**

Yield is a function of the amount of stress incurred by the plant. The aim of growing skip row irrigated cotton should be to minimise the stress applied to the crop during the critical flowering and boll filling period. If a crop suffers from a stress during this period it is going to affect yield. Applying water late in the season to try and stimulate more growth and bolls is not going to be beneficial if the crop was actively growing through the entire season.

**Some Irrigation Scenarios:**

The following scenarios are based on grower experience and their success in individual situations and will be influence by environmental conditions including in-crop rainfall and the chosen row configuration.


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

| James Quinn | Robert Eveleigh | Bob Ford | Jorian Millyard | Alex North | John Marshall |
|---|---|---|---|---|---|
| 0428 950 028 | 0427 915 921 | 0428 950 015 | 0428 950 009 | 0428 950 021 | 0428 950 010 |
| jquinn@csd.net.au | roberte@csd.net.au | bford@csd.net.au | jmillyard@csd.net.au | anorth@csd.net.au | jmarshall@csd.net.au |

# Semi Irrigated Cotton: Is it an option for you?

**14th Aug 2015**

FACTS ON FRIDAY

- **One irrigation available.** May just be used to establish the crop, and then grown as a dryland crop thereafter.
- Delay irrigating for long as possible into flowering without letting the crop go into serious stress or fully cut out – maybe 5-6 NAWF. This will limit yield potential should further irrigation water become available later on but will give the best opportunity for good fibre quality for the fruit that is already set.
- **Two irrigations available**. Target the first irrigation early in the flowering period and the second at around cut-out to provide adequate moisture to mature the set fruit. Close plant monitoring around this second irrigation is essential as growth regulator may be required to prevent re-growth and target resources into filling bolls.
- **Three irrigations available.** Use a similar approach to two irrigations. The third may help to add size to later bolls. In any of these scenarios, if the crop is looking good enough, a decision to purchase more water can be made.

## What The Trials Have Showed:

Over the past seasons the CSD Extension and Development Team have conducted numerous trials examining the irrigation of skip row planting configurations.The aim has been to gain further understanding of this management style and whether it is viable in limited or low water scenarios.

**Table 2:** Summary of 18 case study comparisons where solid and single skip row configurations were present.

| Ave. Applied per Irrigation | | 0.94 ML |
|---|---|---|
| | **Solid** | **Single Skip** |
| **Yield (b/ha)** | 9.42 | 8.11 |
| **Evapo-transpiration** | 746 mm | 537 mm (801mm in row) |
| **Applied ML** | 4.44 | 3.08 |
| **WUE (b/ML)** | 2.68 | 3.41 |
| **Kg lint/mm** | 2.85 | 3.44 |

A summary of 18 trial demonstrations shows the average yield of single skip compared to solid is 86% (with 92% in a 5 year case study in the Macintyre) and it used 70% of the irrigation water.

Within the trials we have seen improvements in water efficiencies utilising the skip row planting over solid planted crops, in both applied and evapo-trapiration efficiency measures .

**Single plant lines vs. paired lines:**

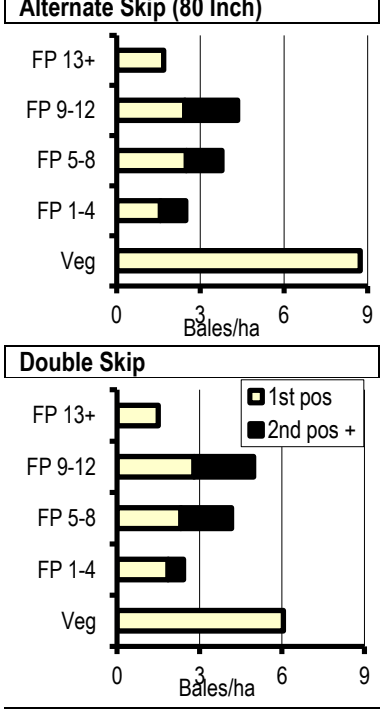
Single plant lines such as those planted on 80 and 60 inch spacings can have advantages over paired plant lines such as single and double skip. This is through better light interception, less interplant shading and less competition for water and nutrients. However, the single plant lines yielded more than paired lines in trials only when high yield were recorded. This yield increase was due to slight increases in boll numbers recorded on single plant line configuration, especially on vegetative branches. Higher boll weights were recorded in the paired row treatments however.

**Plants can get too big:**

Vegetative growth rate is required to be closely monitored to ensure plants do not get too vegetative or big. This can become a problem in

- **Wasted Energy** – as with solid planted cotton a balance should be sought between vegetative and reproductive growth. If high yields are desired from skip row planting then plants will need to be grown out to 25+ nodes to accumulate the number of bolls required to make up the desired yield.
  Defoliation can be an issue - not only are the plants bigger and therefore harder to penetrate, but also growing 25+ nodes takes time and thus pushes defoliation into temperatures which are cooler making defoliation difficult and slower.
- **Problems with Picking** – although jovial remarks like "it is a good problem to have" may mask the difficulty in harvesting the crop. Picker heads were not designed for plants with the amount of cotton or the size of plants which is possible on some of these plants. To compensate for this, speed is reduced, pressure doors are released to allow the bulk of the plant to be folded through. Blockages are more common in irrigated skip row crops. The combination of these factors results in the picking operation being dramatically slowed, picking efficiency reduced and more cotton left in the field and not the gin.
- **Lodging** – tall lanky plants have a tendency to fall over under high boll load. Also heavily loaded vegetative branches are commonly split from the main stem and thus fall to the ground. Once on the ground the likelihood of boll rots is increased and picking up branches, boll rot counts from the Macintyre in 10/11 showed minimal differences in boll rots between solid and skip row in trials due to boll contact with the ground and irrigation water.

**Figure 2:** Segmented picking results for Gwydir Irrigated Row Configuration Trial (09/10)




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


| James Quinn | Robert Eveleigh | Bob Ford | Jorian Millyard | Alex North | John Marshall |
|---|---|---|---|---|---|
| 0428 950 028 | 0427 915 921 | 0428 950 015 | 0428 950 009 | 0428 950 021 | 0428 950 010 |
| jquinn@csd.net.au | roberte@csd.net.au | bford@csd.net.au | jmillyard@csd.net.au | anorth@csd.net.au | jmarshall@csd.net.au |