



Getting the most out of skip  
row irrigated cotton

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# Introduction

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Skip row configurations have long been successfully used by dryland cotton growers as a tool in achieving the best balance of yield, fibre quality and cost management under uncertain climatic conditions.

These techniques have on occasions been 'borrowed' by irrigators as a 'one off' in a low water year and subsequently there has not always been the same degree of planning as to how to get the best out of skip row options.

With significantly reduced water allocations over the last five years or so, some growers have not had the opportunity to swing back into full irrigation.

In limited water years, growers will weigh up a range of options when determining what area of irrigated cotton to grow:

- 1 Plant a large area to capitalise on in-crop rain.** This scenario runs the greatest risk of significant losses in yield, suffering fibre quality discounts and failing to break even if the area is not reduced sufficiently; however, it has the greatest upside if a favourable break occurs. Growers adopting this strategy are punting on good in-season rainfall, future high-flow events or options to purchase water during the season to finish the crop.
- 2 Plant a reduced area and aim for higher yield.** Reducing the area of cotton proportional to the reduced allocation ensures there is adequate water for the crop to reach maximum potential. While this is the optimum strategy for maximising the returns per hectare, other strategies may provide better returns per megalitre of water. There is also the risk of a lost opportunity if subsequent in-season rain is adequate to grow a larger area.
- 3 Combinations somewhere in between.** This strategy takes into consideration that every season is different and making the most out of limited resources requires planning and prioritisation. Some fields might be planted solid on a full water basis, some fields may be planted solid or in skip row configuration on a partial water budget and some may be ear-marked to be ploughed out before first irrigation if no water becomes available.

Because many growers face this dilemma every season, there have been significant improvements and innovations in techniques on how to best prepare their farming operation for uncertain water supply. Some of these new and improving technologies available to growers include machinery guidance systems, Electromagnetic (EM) surveys, soil moisture monitoring equipment, Bollgard II and Roundup Ready Flex Technology in cotton, and varieties with improved yield potential and fibre quality.

# Why grow skip row irrigated cotton?

In recent seasons many growers have faced the dilemma of trying to work out what area of cotton to plant with limited water allocations at the start of each season.

Skip row cotton is being considered for use in limited water situations more widely for a number of reasons. The practice:

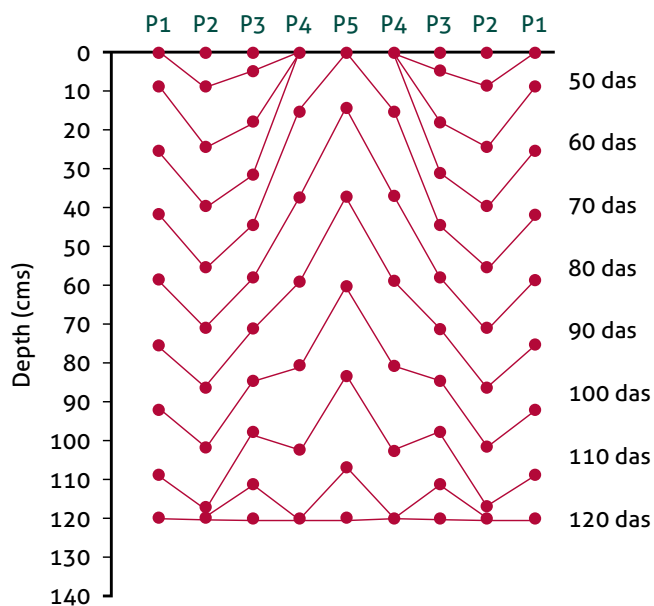
- Extends the planted area utilising full moisture profiles
- Buys some time in which to benefit from in-crop rainfall
- Minimises the potential of fibre quality discounts
- Allows easier insect and weed management with biotechnology
- Takes advantage of marketing options and upside with growing cotton
- Offers significant variable cost savings
- Maximises returns per megalitre of water

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.

Skip row cotton provides an 'in between' option for increasing the area of cotton which can be grown, allowing some upside in production if conditions improve and far less downside in potential fibre quality discounts if the season deteriorates.

In some cases, inherent growing characteristics such as soil type and location may mean there is minimal advantage in adopting skip row practices. These considerations are discussed in the following section.

Waco Soil - Double Skip 1998/99  
Position of extraction front



**Figure 1a** An example of the pattern of root extraction in a double skip situation. Experiment carried out on the Darling Downs where neutron probes were positioned in the plant line and across the skips. For example at at 50 days after sowing (das) plants were extracting at 25cm depth in the plant line and not extracting in the centre of the skip. At 80 days after sowing (das), plants were extracting at 70cm in the plant line and 15cm in the centre of the skip. Data courtesy of Dr Phil Goynne, QLD DPI.



**Above** Tony Taylor of Norman Farming, Toobeah (right) pictured with Auscott's Rod Gordon, likes to use low two metre beds to allow the option of planting solid on the hills or in an 80 inch configuration, planted in the small furrow between the beds – as pictured here

# Selecting the right row configuration

## Row configuration

There are a range of different configurations being used by growers across the cotton industry in semi-irrigated situations. These include single skip, 60 and 80 inch, double skip, super single and some non-uniform configurations. The positive and negative features of each configuration including the relative water use efficiencies depend on the individual situation. What works best in one farming system may not in another due to differences in soil type, environment, cropping history, available equipment, water availability and other factors.

### Growers contemplating:

- A. whether they would benefit from using skip row configurations, and
- B. which skip row configuration they would use ...should consider the following points.

## The yield/ cost/ fibre quality mix of each configuration.

Extensive research has shown that while skip row cotton does limit yield potential. The combination of reduced fibre length discounts and variable cost savings in growing skip row cotton often lead to a better risk/ return proposition (Figure 1a).

The row configuration choices are shown in Figure 1b, growers need to consider their yield potential, based on all the factors discussed later in this chapter.

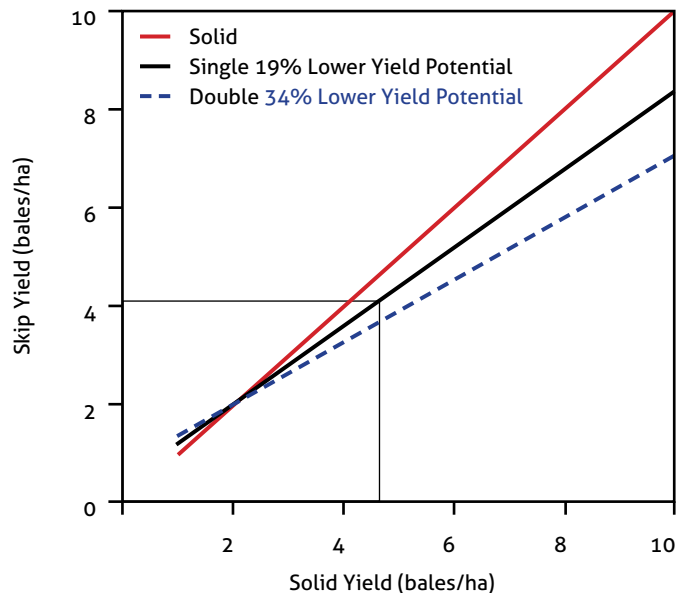
**Single Skip** has the highest upside yield potential of these configurations averaging 19% decline from solid plant. It will however also use its moisture profile the quickest. Having a plant row 50cm one side and a one metre skip row to the other, this configuration will enjoy some benefits of 'partial root zone drying.' It is best suited to situations on heavier soil types with high PAWC and more irrigation water availability.

While **one-in-one-out (or 80 inch)** cotton has not been included in these comparisons, grower experience and some trial work has shown its yield potential to be slightly higher than double skip but possibly more prone to fibre quality discounts because it does not have the advantage of partial root zone drying. A more uniform growth habit in 80 inch cotton can reduce lodging, allow better spray penetration and defoliation processes when compared to double skip.

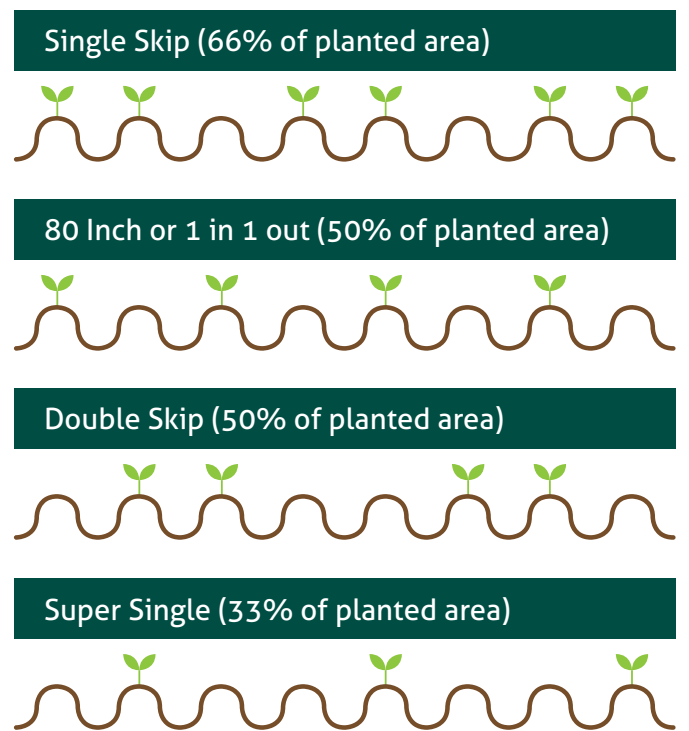
A couple of advantages perceived by some double skip growers compared to 80 inch are:

- gaps in stand are better compensated for.
- growth management easier due to partial root zone drying.
- double skip is easier for cultivation, especially if the 80 inch row is in the middle of a 2m bed.
- When watering up it is more difficult to sub to the centre of the bed.

**Double skip** has an average yield potential about 39% less than solid plant. Having a plant row 50cm one side and a 1.5m skip row to the other, this configuration provides the benefits of 'partial root zone drying' which toughens the plant up. Plants can be prone to lodging, especially vegetative branches, which take advantage of the extra light available in the skip area. It is best suited to drier profiles and hotter environments.



**Figure 1a** Comparison of average solid and skip row yields in dryland systems across several seasons and regions. Collated by Hearn (1999) and including some semi-irrigated treatments. Compiled by M. Bange (CSIRO 2006)



**Figure 1b** Row configuration guide

continued from page 05



**Pictured Right** Choosing the right row configuration is a calculation involving yield expectations, water availability, risk aversion, machinery available and seasonal outlook.

Some growers have tried **Super Single** (one-in-two-out) in semi-irrigated situations. The widely spaced plant rows 2 metres apart means the yield potential and potential upside in a good season is severely limited. However, it may be an option with a full soil moisture profile at planting and minimal irrigation water resources. This configuration allows growers to minimise growing costs as well as limit the likelihood of fibre quality discounts.

**Non uniform configurations** have been tried in some circumstances but can lead to variability in maturity, and subsequent difficulties in management.

### Cost Management

Using skip row configurations offers significant savings from various field operations (Table 2).

### Your plant available water holding capacity (PAWC) – the size of the bucket.

The concept of skip row cotton relies on the fact you are creating more soil space for plants to access, and hence the potential soil water available for each plant, delaying the time before it will go into moisture stress.

- The heavier the soil type, the greater 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-rows, crops tend to stress and cut-out quickly then attempt to regrow when irrigated. This can create a 'stop- start' crop with large gaps in maturity in the fruit, creating management problems, and usually resulting in disappointing yields. In these situations, growers would be best either avoiding these fields in water-short years or reducing their area to what they have sufficient water for solid plant.

While most growers have a good understanding of changing soil types across fields from previous crop experiences, using EM surveys is an excellent way of identifying soil types and variability across a farm – data which is invaluable for prioritising fields during water limited times.

**Your soil physical properties – how far can plant roots explore?** 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, or hard-setting soils. These fields should be treated the same as those with low PAWC - avoid them in water-short years or reduce their area to what there is sufficient water for solid plant.

**Your soil moisture level - how full is the bucket?** This can be best determined by a combination of methods including decision support programs such as "Howwet" which estimate soil moisture levels from on-site rainfall and evaporation data. This can be ground-truthed by push probes, spades and soil cores.

	Single Skip			Double Skip			Super Single		
<b>Planting</b>									
<b>Operation</b>	100			100			100*		
<b>Fertiliser - Starter</b>	@10kgs			@8kgs			@3kgs		
<b>Herbicides</b>									
<b>Fallow</b>	100			100			100		
<b>Planting</b>	Band	Row	Total	Band	Row	Total	Band	Row	Total
	40	66	26	40	50	20	40	33	13
<b>In Crop</b>	Band	Row	Total	Band	Row	Total	Band	Row	Total
	30	66	20	30	50	15	30	33	10
	50	66	33	50	50	25	50	33	16
	70	66	46	70	50	35	70	33	23
	100	66	66	100	50	50	100	33	33
<b>Technology Fee (%) for Bollgard II, Roundup Ready Flex and Liberty Link</b>									
<b>All Technologies</b>	66			50			33		
<b>Plant Conditioners</b>									
<b>Growth Regulators</b>	Similar			Similar			May require more product		
<b>Defoliant**</b>	66%			50%			33%		
<b>Picking</b>	Fill			Full to 2/3			2/3		

**Table 2** Anticipated variable cost savings per hectare compared with solid planting

\* Equipment modifications required if 8m swaths

\*\* Bigger plants may require higher %

This table is assuming the field is minimum tillage, herbicide and insecticide applications made by ground rig.





**Pictured Right** Many growers in the past have utilized fallow fields and planted into flat ground to ensure emergence. Furrows are then pulled into shape post emergence prior to first irrigation.

The greater the amount of moisture in the profile, the longer the crop will have before it will require irrigation or rainfall. In situations of higher soil moisture, and higher rainfall probabilities, narrower row spacings may be considered.

**Available irrigation water – and where it is.** 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 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.

Growers should consider, the district temperature and rainfall averages, long range weather forecasts and you attitudes towards the reliability of these. Skip row configurations lose a lot of their value without in-crop rainfall, so much so that in some cases growers may be better off planting smaller areas of solid planted cotton to match available moisture.

While predicting summer rainfall is difficult, the best information we have available is long-term rainfall records and long range weather forecasting tools such as Southern Oscillation Index. Each individual’s attitude towards these tools and averages will play a big role in which configuration to choose.

**Evapo-transpiration.** In very hot conditions, plants will use a lot of water just to keep the canopy cool – this is water that is not actively contributing to yield. There is a significant difference in summer temperatures between Australia’s cotton growing regions (Table 3). In regions with inherently higher summer temperatures, this needs to be taken into account, possibly resulting in the use of wider skips.

**In-crop ground cover in skip.** Stubble cover will significantly improve a field’s ability to capture rainfall in the fallow and in-crop. This is particularly useful during early summer when a lot of in-crop rainfall can come via short, intense storm events. Stubble cover will also lead to more uniform distribution of moisture across the field and the seed bed because there will be less run-off.

**Variety.** Variety selection will be discussed in more detail later in this document but yield potential, staple length and growth habit are key considerations. If choosing a variety which has inherently very long staple (similar to Sicot 75), growers may be able to consider a narrower configuration.

**Planting Date.** An effort should be made to time the planting of the crop to manoeuvre the critical period of plant development away from the intense summer heat and coincide with when summer storms are more prevalent. For many Bollgard II crops this will put the ideal planting date later into the planting windows than normally would be the case in a fully irrigated situation.

**Table 3** Average October to March rainfall (mm) and average November – February mean daily temperatures across most Australian cotton growing areas.

	Average October – March Rainfall (mm)	Average November – February mean Daily Temperature °C
Emerald	460	27.1
Theodore	500	26.1
Dirranbandi	310	26.7
St George	330	26.7
Mungindi	320	26.4
Bourke	205	27.0
Walgett	275	26.2
Goondiwindi	385	25.7
Dalby	450	24.3
Moree	355	25.2
Narrabri	390	25.0
Gunnedah	395	23.8
Narromine	275	24.7
Hillston	180	23.8
Griffith	195	23.1

**Equipment.** Often a major part of a configuration decision is based on what can be done simply and cheaply with the machinery growers have available on farm. Planter set-up for each configuration and tips with other in-crop operations are covered in more detail in other sections;

- For growers with 6 and 12 row gear, most configurations are easily adapted.
- Double skip is the most easily adapted configuration for those with 8 row gear.

See page 10 for more information on setting up a planter for the various row configurations.

Ultimately it is not so much a question of which is the most ideal row configuration but rather which row configuration will work best in a given farming system and environmental conditions. Growers need to be able to switch easily between solid and skip row as conditions change without disrupting the whole operation.

# Planting Solid with the option to remove some rows later

The benefit of this practice is maintaining the very high upside of solid planted cotton if water availability increases early in the season, but after the cotton planting window has closed. The success of converting some area of cotton to skip row will obviously vary greatly, depending on rain or increased allocation for the rest of the season.

Before deciding to plant a field with this intention, the grower should use all the considerations mentioned in the previous section about whether skip row will be an advantage in your system and which configuration to use.

There are a range of experiences from growers who have used this option – not all of them good. These experiences have led to the following guidelines.

- The decision as to whether to convert some area to skip needs to be made very early – around 40 days after planting, or at the time of first square. If the soil profile is relatively dry, particularly in the skip rows or the crop is in stress when the skip rows are removed then roots may not move out into the middle of the skip row – negating any potential advantage.
- Use this practice as one component of your whole planting operation. For instance, have some fields with adequate water and one with the plough-out option.

**Note:** If people decide to abandon or skip row Bollgard II cotton, consideration needs to be given to the impact that this will have on their refuge requirements for Bollgard II cotton. Contact your local Monsanto representative for further details.



**Above** Removal of cotton plant rows should be viewed as a last resort.



**Above** The decision whether to convert solid plant to skip row needs to be made early.



# Planting considerations

In limited water situations, growers may often be planting into less than ideal conditions, and possibly into uneven rain derived moisture. This opportunity may be the only one in which to establish the cotton crop. Therefore the planting operation becomes one of the most important operations during the life of the crop.

The benefit of establishing a stand on rain moisture, reducing the need for watering up can lead to significant savings to the water budget of the crop.

As with any crop, a poor plant stand starts yield limitation. Below are a few tips on making the best of this situation.

## Dealing with difficult planting conditions.

There are no rules that apply to all situations other than having an experienced operator who regularly checks the job they are doing and adjusts the machine accordingly.

Some options to consider include:

- Slowing the planter down to around 7-8 km/hr – this will result in less bouncing. Those using planting contractors may have to pay them more. The planting is slower and they may need to check their progress more often.
- 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, water injection in the row can extend planting an extra couple of days if conditions are drying out. However balance up whether the more frequent stopping / refilling caused by using water injection slows the operation down to a point where it is negating any benefit.

## Plant Populations

Establishing an even plant population is more critical than targeting lower plant stands from 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. When planting into difficult conditions, it is important to adjust seeding rates to account for possibly higher levels of mortality.

## Planting Time

For those wanting to plant on rain moisture, planting time is when it rains, However, later planting 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. Beware however that the planting conditions in November can be harsh with hot dry winds, and may result in minimal opportunity to replant within the Bollgard II planting window.



**Above** By slowing the planter speed down and carefully checking seed placement and depth, cotton can be successfully established through thick stubble layers.



**Above** Above Establishing cotton into previous crop residues offers many benefits to the emerging crop in shelter from environmental elements, reducing soil moisture loss and a habitat for beneficial insects.

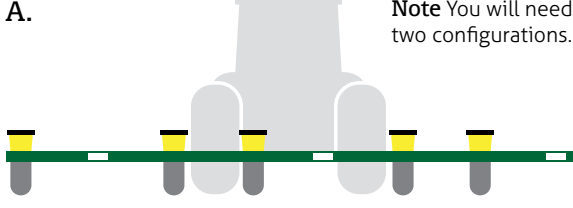
# Planter Set-up - Eight Row Planter

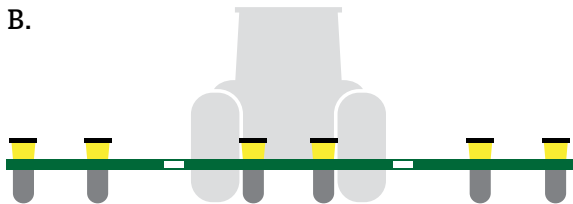
## Planter setup for various row configurations

In most cases, growers can plant all configurations using their existing planter – whether that be eight-row or twelve-row gear. The following diagrams show a variety of planter set-ups and planting patterns to achieve these configurations. For growers with six-row planters, the set-up and patterns are the same as twelve-row.

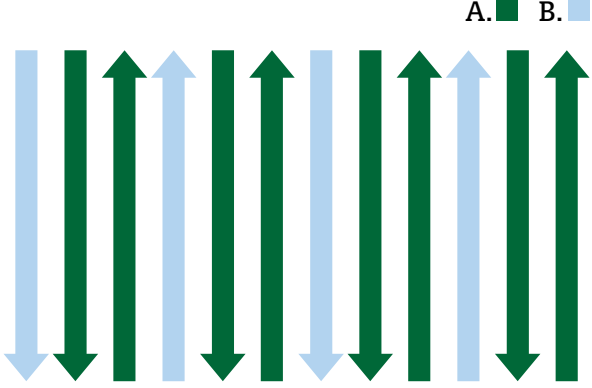
### Single Skip - Staying in the wheel tracks

**Planter Configuration**

A.  **Note** You will need two configurations.

B. 

**Field Planting Pattern**

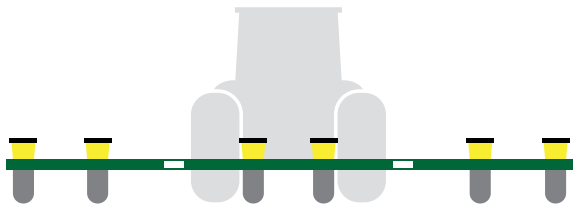
A. 

**Note** Plant "A" first then fill the gaps with "B"

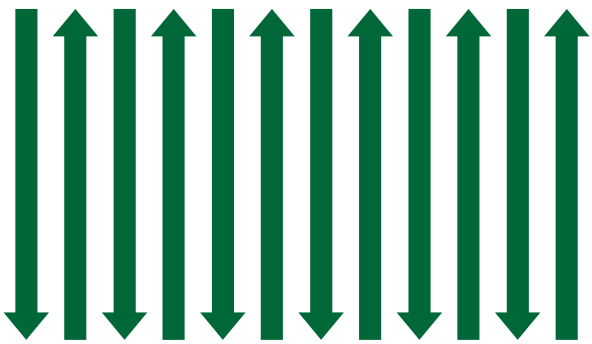
### Single Skip - 9m Swath

**Planter Configuration**

**Note** This configuration will require GPS marked hills, as you won't be planting on existing wheel tracks.



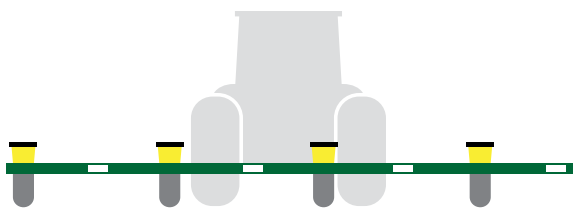
**Field Planting Pattern**



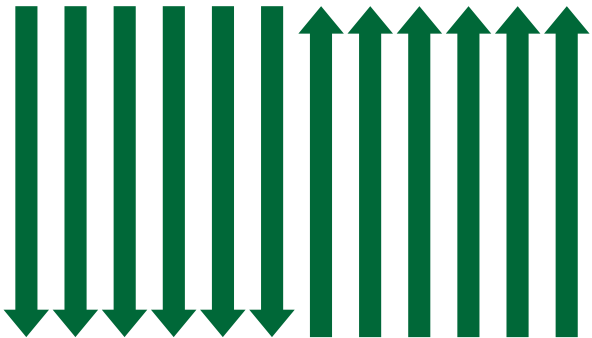
**Note** Include a 1m gap between each set of eight.

### 80 Inch or 1 in 1 out - Staying in the wheel tracks

**Planter Configuration**



**Field Planting Pattern**

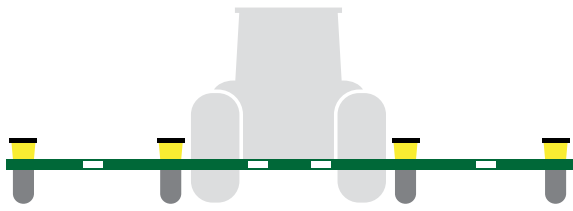


**Note** In the centre of the block there will be two rows planted side-by-side and a double skip on the outside of each block. This is reversed if the planter is set up the opposite way around

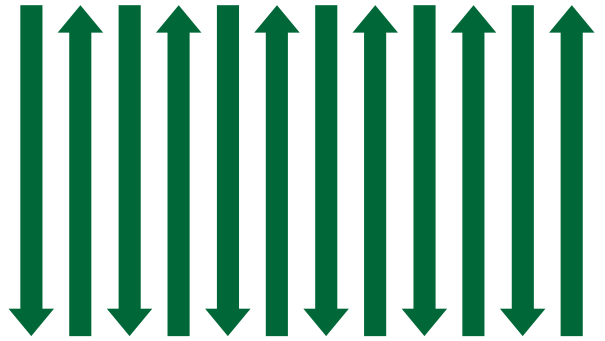
## 80 Inch or 1 in 1 out - 9m Swath

Planter Configuration

**Note** This configuration will require GPS marked hills, as you won't be planting on existing wheel tracks. Using this method 44% of the field is planted.



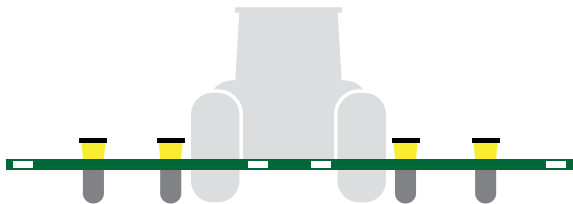
Field Planting Pattern



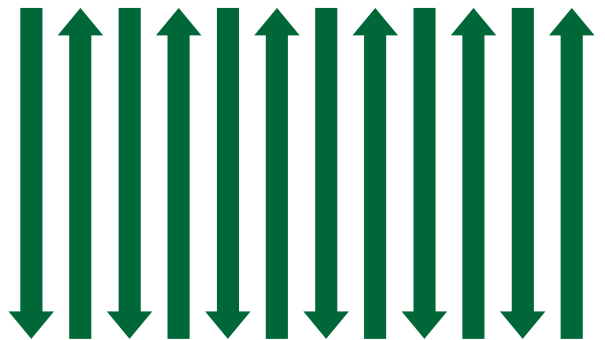
**Note** Include a 1m gap between each set of eight.

## Double Skip

Planter Configuration

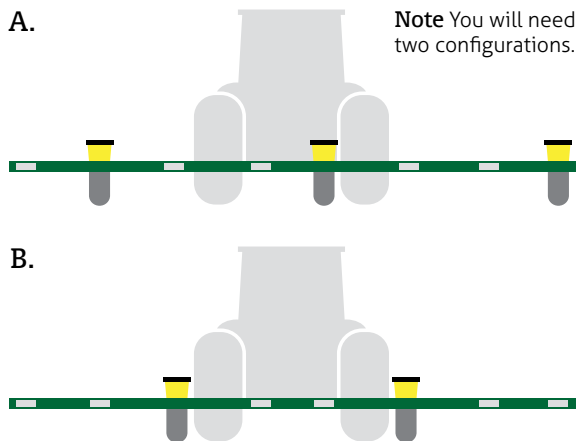


Field Planting Pattern



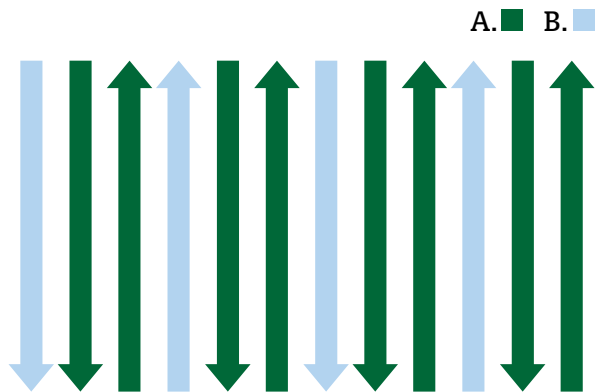
## Super Single

Planter Configuration



**Note** You will need two configurations.

Field Planting Pattern

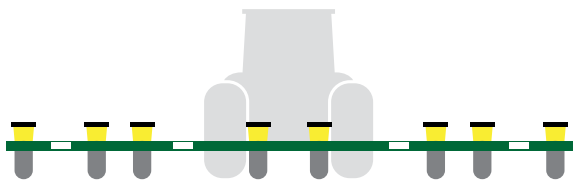


**Note** Plant "A" first then fill the gaps with "B"

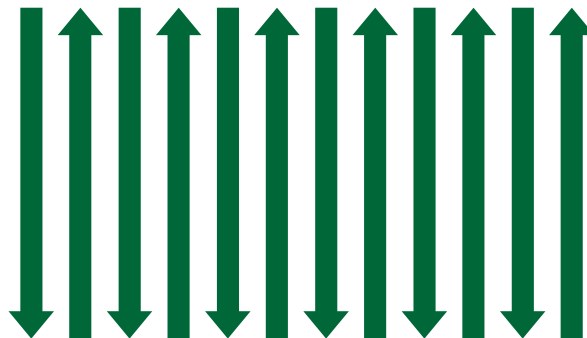
# Planter Set-up - Twelve Row Planter

## Single Skip

Planter Configuration

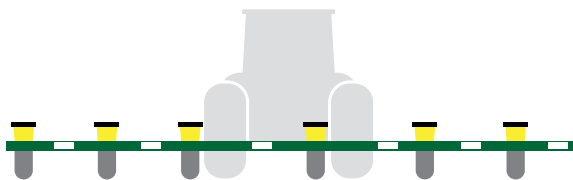


Field Planting Pattern

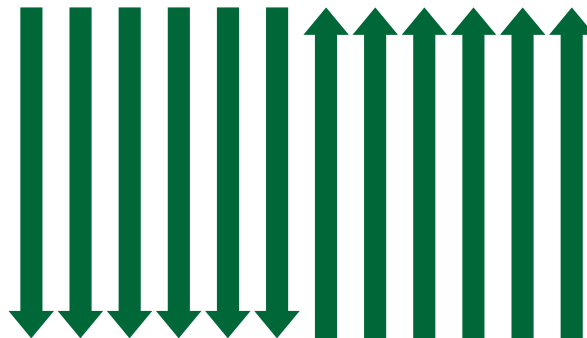


## 80 Inch or 1 in 1 out - Staying in the wheel tracks

Planter Configuration



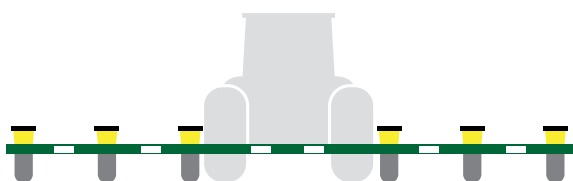
Field Planting Pattern



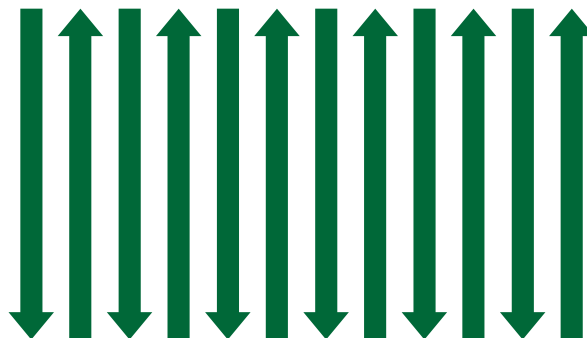
**Note** In the centre of the block there will be two rows planted side-by-side and a double skip on the outside of each block. This is reversed if the planter is set up the opposite way around

## 80 Inch or 1 in 1 out - 13m Swath Variation

Planter Configuration



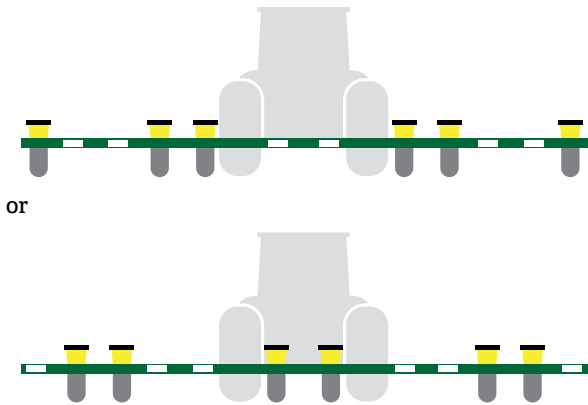
Field Planting Pattern



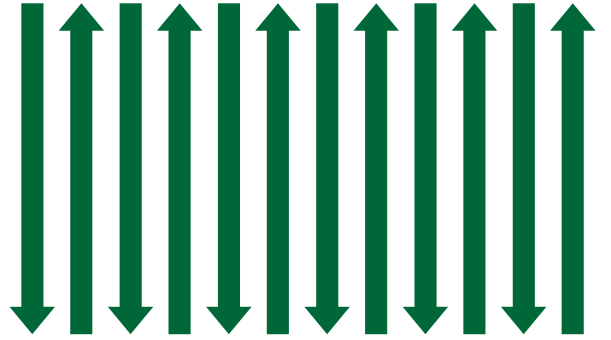
**Note** Include a 1m gap between each set of eight.

## Double Skip

Planter Configuration

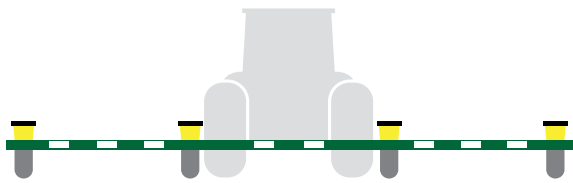


Field Planting Pattern

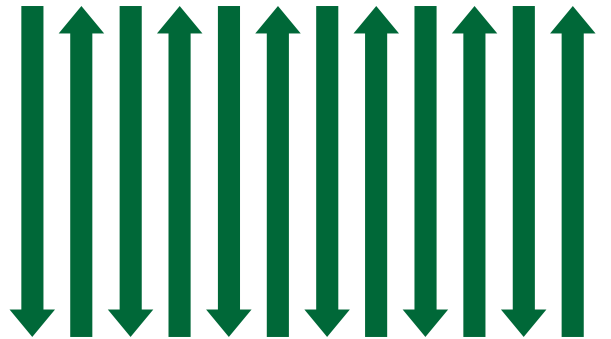


## Super Single

Planter Configuration



Field Planting Pattern





# Bed configuration

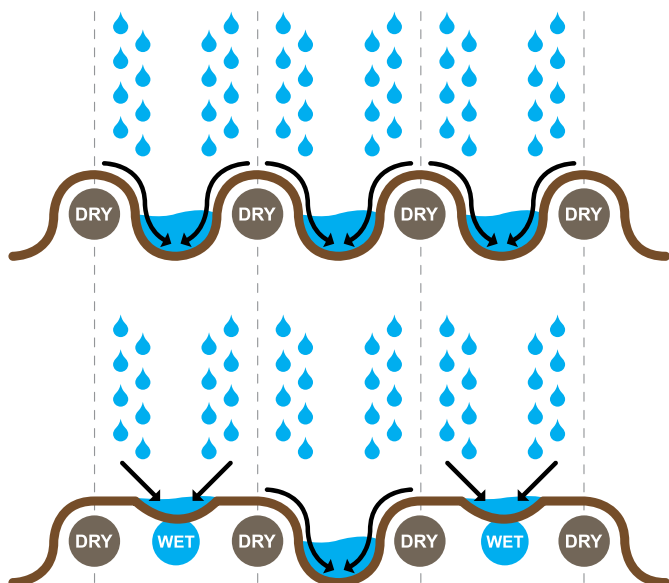
There are a range of bed configurations used across the industry including 1m hills, 2m beds, 75cm hills and 1.5m beds. Growers utilising the bed system are able to add flexibility to their operation and allow for greater use of fallow rainfall to get a planting opportunity. Depending on irrigation water availability, these systems allow for both solid or skip row planting with minimal alteration of existing equipment.

Many growers who have set up their system for semi-irrigated cotton with the option to move back to solid plant in years with higher water availability use beds – either 2m or 1.5m.

Most aim to prepare the beds with a very flat or low “m” structure bed shape. Coupled with the retention of cereal stubble this assists in retention and infiltration of rainfall moisture during the fallow months.

The advantages of beds include:

- Both in fallow and in crop they tend to capture moisture rather than shedding, producing an even soil moisture profile especially in the planting zone, which can be difficult to wet fully in 1 m hills due to the tendency of water to run to the furrow.
- Planting opportunities may be presented after smaller amounts of rainfall are received, especially if planting into the shallow trench in the centre of the bed, even in situations where moisture is marginal in the hill where traditional solid planting would occur.
- Although not ideal, the top of 2m beds will carry a ground-rig a few days earlier than the furrow if a spray needs to be applied in a hurry.



**Above** Tyne, Sweep and Alabama set up utilized by one grower to develop an “m” profile bed.



**Above** The “m” shaped bed as a result of the cultivator setup in the top image.

**Left** In conventional one metre hills the fallow rainfall sheds from the top of the hill to the furrow and out of the field. With the “m” designed hill of a 2-metre bed, water falling on the top of the bed is held and infiltrates into the centre of the hill creating a planting opportunity which may not have been realised in the traditional single hill bed configuration.

# Irrigation

“This is a \$300 per hectare decision involving your only finite resource – it needs to be done properly.”

John Norman, Toobeah.

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 4).

With this in mind, the optimum timing to get the best out of each irrigation will depend on the field and environmental conditions your crop is enduring. This is why it is so important that a range of monitoring techniques is used.

## Soil Moisture monitoring

- 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
- Double check probes with a spade or moisture spear to determine whether roots are getting 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 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 to validate soil moisture probe data.

## 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 regrowth 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 skip can be more efficient than between the rows, because this can take an excessively long time to get through. To avoid breakouts across soft rows, wheel tracks may need to be worked out. Breakouts can also be avoided by watering both skip and rows to produce an even wetting front.

## Some Irrigation Scenarios

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

- One irrigation available. Delay 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 on the fruit that is 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 regrowth 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.

	Yield Loss (kg/ha/day)
Squaring	9
Peak Flowering	19
Late Flowering	16
Boll Maturation	4

**Table 4** The impact of one day's water stress varies with the growth stage. From Milroy et al. (2002). (Figures may be higher now as yield potential increases)



**Above** A trial area of Sicot 71BRF grown in a single skip configuration produced a yield of 3.0 bales/acre at Moomin last season from three in-crop irrigations despite hail and three herbicide drift events.

# Crop Nutrition

As crop yield potential is not as high as solid plant with full irrigation, the requirement for nutrients and fertiliser is going to be less. However, the nutrient availability to the crop will impact on the crop's growth. Too much and the plant will grow excessively vegetative, too little and the plant will stress and this will lead to premature cut-out. Both scenarios represent cases where the plant will use the moisture available to it inefficiently, leading to a reduction in yield potential.

There are a couple of things to consider when determining the nutritional strategy for skip row

- Don't make assumptions based on previous crops or fallow - conduct pre season soil tests to ascertain the level of nutrients available, allow for the fact that the crop will probably draw on deeper nitrogen reserves.
- There will be more soil for each plant to explore, and therefore a bigger pool of nutrients available.
- Ideally in-crop fertiliser should be applied prior to or during early flowering.

A strategy which allows for flexibility is a basal amount of N, P, and K pre plant, with the ability to apply further fertiliser as a side dress or with irrigation water as crop conditions and water availability dictate. If growing double skip on beds, consider only fertilising the beds being planted.

When side dressing, it is important to minimise the amount of root pruning, as this could hinder the plant's ability to forage for water and nutrients in the skip row area. Side-dressing in between the rows, in single and double skip configurations, is one method employed to avoid pruning feeder root in the skip area.

In limited water situations, high rates of pre-plant nitrogen fertiliser, applied with the intention of planting solid, can produce excessive vegetative growth with incorrect timing of irrigation or good rainfall. Crop monitoring especially of the vegetative growth rate is one method to help with judicious use of growth regulators to contain excessive vegetative growth which crops facing this scenario will be prone to. Application rates of growth regulators may need to be adjusted upwards to contain plants with ample water and nutrients available to them.



# Weed Management

The availability of herbicide tolerant cotton varieties containing Roundup Ready Flex® and Liberty Link® technology has opened up many more opportunities for skip row cotton. The ability to apply broad spectrum herbicides to control weeds quickly and efficiently across the cropped and non cropped area has changed attitudes to growing skip row cotton.

Using herbicide tolerant varieties has led to the reduction in the use of residual herbicides at planting. This has provided two benefits:

- 1 Improved seedling vigour and fewer problems establishing a plant stand especially if planting conditions are not ideal.
- 2 Allowing flexibility with the crop rotational program with opportunities to plant alternate crops if the cotton planting opportunity does not eventuate.

A lay-by application of residual herbicides into the skip area is still an option and can be effective where there is less crop competition. This can provide some insurance against continual weed flushes in the event of frequent rainfall events. Lay-by application especially in heavy crop stubble can be difficult, as stubble can damage shields, break off nozzles and droppers. If a lay-by application is planned it may be practical to knock over or lay down the standing stubble during an earlier pass to ensure effective coverage with the lay-by application.

There also may be an overall need to cultivate, to allow for irrigation water to progress down the furrow and ensure hill/bed integrity to minimise water break outs and to control problem weeds especially fleabane and volunteer cotton plants. In the absence of crop stubble, a roughened surface makes a better catching surface for rain moisture.

## Crop Stubble

The moisture retention benefits of stubble do create other challenges especially in terms of practicality of other cultural operations.

These include:

- planting into heavy stubble,
- cleaning out water furrows through cultivation
- lay-by operations for problematic weeds such as fleabane and volunteer cotton,
- tie up of nutrients in decaying organic matter
- blockages to picker heads.
- potential for trash in the cotton sample.

None are insurmountable with planning.

**Left** Fleabane management is a challenge in no-till farming systems.



# Defoliation, Picking and Ginning

For both defoliation and ginning the basic principles involved do not differ greatly from what would be considered normal practice in a fully irrigated scenario. However, growers who have had experience in producing irrigated skip row cotton, have made the following comments on ways of improving the operations.

## Defoliation

Limited water crops that have experienced varying levels of stress up until crop maturity are often more difficult to defoliate than a supple, fully irrigated crop.

- To assist in defoliation of these crops:
  - Increase water rates and use droppers to improve coverage.
  - If crops are dry at time of defoliation, increase rates of defoliant. A desiccant may need to be used to drop leaves.
- On single and double skip with generally bigger plants, more leaf tends to get caught up between plants, in the paired rows leaving more leaf in the module. While this doesn't always translate to a reduction in grades, it can result in a lower turnout value.

## Picking

Depending on the skip row planting configuration, efficiencies in the picking operation can be achieved (See Table 1 on Page 6.)

## Tips

- Pull the drive gears and block the grease and air hoses off on un-used picker heads. This reduces excessive wear of parts and grease etc through heads you're not using, and the extra air may be needed for the management of bigger plants.
- To pick big plants, slow the ground speed down but maintain head speed. Newer pickers can facilitate this, but the older models can not. However, it's better if plant height is managed in crop. Through planting uniformity and stand and growth regulators.
- Back off the front pressure doors on the picker, allowing for ease of passing bulk through the front of the picking head with more cotton going into back set of spindles.
- Crop lifters will need to be adjusted to accommodate low lying fruit on vegetative branches in furrows or out in the skip area. Tilting the picker heads forward may also assist in collecting low fruit as well as minimising the collection of trash and dirt in the bottom of the head.



**Above** Graham Davis, 'Springfield', Goondiwindi uses double skip because it fits in with their 8-row gear on 2 metre beds.

## Ginning

Communication is the key to ensuring the gin is able to produce the best sample of cotton from the modules provided. If the gin has prior knowledge of the condition of the seed cotton they are likely to receive then adjustments can be made to ensure a quality sample.

A couple of key points to discuss with the gin are;

- 1 The effectiveness of the defoliation process and the amount of leaf and its condition contained in the modules.
- 2 Whether or not standing stubble has made its way into the module.
- 3 The likelihood that moisture levels of individual modules will vary greatly. As the yield potential is not as high, it takes longer to manufacture a module resulting in a higher proportion of modules made at varying moisture during the picking day than in a fully irrigated field. In fact, it is a good policy to pull up earlier, not picking once seed cotton moisture is above 10%. Individual testing of each module moisture level may be required at the feeder bay to fine tune the ginning process.

# Post Crop Management

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Some consideration must be given to post harvest crop destruction. This encompasses both pupae busting requirements and ratoon cotton control. Managing plant size in season to avoid large stalks will improve ease of management post-harvest as controlling bigger plants in gaps in the plant line is very difficult. The Resistance Management Plan for Bollgard II cotton requires the full soil surface to be disturbed to a depth of 10 cm, including skip row areas. Ratoon cotton control is important for avoiding the continued selection for Bt resistance in *Helicoverpa spp.* post harvest, as well as preventing the build up or over-wintering of other insect pests.

The importance of achieving a good even, uniform stand without gaps carries right through to post harvest management. Managing plant size in season to avoid large stalks will improve ease of management post-harvest, as controlling bigger plants in gaps in the plant line is very difficult. Root cutting is generally achievable and correct operation can greatly reduce the potential for cotton regrowth. Another advantage of root cutting is that it removes the burred up section of stalks after mulching so that they do not ball up when ripping roots out of the ground.

Ripping operations are best carried as soon as possible after picking to avoid moisture loss and the potential for soil smearing and compaction later on. Centre busting aims to rip the root systems out of the ground. Blade ploughing the rows can also be very effective, providing there is a few inches of soil moisture for operation. Blade ploughs are relatively easy to pull and only require crops to be mulched.

Grower experience has shown that it does not pay to cut corners in ratoon cotton control, particularly in wider configurations. The cost of crop destruction operations can save multiple passes with herbicides which are generally less effective. Weed detection sprayers used in combination with other management options can be highly beneficial in controlling ratoon cotton by allowing higher rates of herbicide to be used while minimising overall cost.

# Variety Selection

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Variety selection in skip-row irrigation situations should use similar principles as for dryland – select a variety with good yield potential to capitalise on the moisture you have available, and good inherent fibre quality so that penalties can be minimised in tough conditions.

Each season CSD conducts a series of semi-irrigated trials as part of its large-scale, replicated variety trial program. The trials cover a range of regions, season, configurations and growing conditions. Analysis of the data from these trials will give you a good indication on the best varieties for skip-row irrigation.

This data is available from:

- The annual CSD Variety Trial Results Book.
- The CSD Variety Performance Comparison Tool located at [www.csd.net.au](http://www.csd.net.au). This allows you to compare varieties from a range of regions and seasons.

If you have any questions relating to selecting the right variety, please contact any of the CSD extension and development team.



# Notes

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We would like to thank the following growers and industry personnel for the input in pulling the information for this publication together.

Peter Winter, Bill Arthur, Tony Taylor, John Norman, Graham Davis, Brendan Griffiths, Dr Mike Bange, Rob Holmes and Michael Josh .

# CSD Extension & Development Team



## WEE WAA

Rob Eveleigh

**Mobile** 0427 915 921



## WEE WAA

Bob Ford

**Mobile** 0428 950 015



## DALBY

John Marshall

**Mobile** 0428 950 010



## GOONDIWINDI

David Kelly

**Mobile** 0428 950 021



## MOREE

James Quinn

**Mobile** 0428 950 028



**Cotton Seed Distributors** "Shenstone" Culgoora Road, Wee Waa, NSW 2388  
**Phone** (02) 6795 0000 **Fax** (02) 6795 4966 **Web** [www.csd.net.au](http://www.csd.net.au)