Consideration For Dryland Cotton

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Dryland Cotton Long Term Rotation Option:

The cotton price has remained at levels at $500 per bale for several months now. This price target, which for some is what they look for to consider dryland cotton as a rotational option. However, as dryland cotton growers who grow the crop year in year out have known for a while, it is the most profitable summer crop when long term rotational options are analysed.

For those considering dryland cotton for the first time, it is important to realise that there are already many growers who successfully incorporate dryland cotton into their long term farm rotational program. With access to improving varieties containing Bollgard II and Roundup Ready Flex, CSD's Dryland Industry Support Partnership and also the availability of Monsanto's End Point Royalty payment option – most of the downsides of cotton have been eroded and the upsides have been enhanced. This should lead to dryland cotton being incorporated into the long term rotational plans of many more growers and consultants.

Over time, cotton's profitability has been proven to surpass other rotational options as long as costs are kept in check and reasonable yields and quality are achieved. On a yearly basis, the profitability of any crop will rise and fall due to market forces and seasonal conditions. However dryland cotton, when examined over the full term of a rotational cycle, has proven to be consistently providing the highest gross margin return.

A Commercial Example: Table 1 shows the actual yields and returns for a dryland grower, located between Goondiwindi and Moree, who uses both cotton and sorghum as the summer crops in his rotation. Annually, the farm has areas sown to both crops, based on a five year rotation program.

Some comments about the comparisons of these two in Table 1,

- **Yield** – Actual farm averages for both crops in a similar planting window. Please note that the yield potential of cotton is 87% that of sorghum.
- **Prices** – Actual farm prices after premium/discounts. Cotton includes seed proceeds.
- **Variable Costs*** – Using CSD's Dryland Gross Margin Budgets.
- **Row Configuration** – Cotton-Double Skip; Sorghum- Solid (1m).

It should be noted that the yields, growing costs and commodity price received fluctuate from season to season. The average yield for the cotton is 3.30 b/ha with a range of 1.5-4.5 b/ha. (Higher yields when rain fell post New Year) The average yield for sorghum is 3.8% higher at 3.43 t/ha (higher yields when rain fell before the end of December).

Table 1: Average Sorghum/ Cotton Analysis (8 year)

9 YEAR AVERAGE	Cotton	Sorghum
Yield	3.30 b/ha	3.43 t/ha
Price	$473 b	$222 t
Variable Costs/ha*	$919	$430
Gross Margin/ha	**$ 668**	**$ 331**

What conclusions can be drawn from this analysis?

1. Dryland cotton in the rotational cycle is 100% more profitable than sorghum (over the past nine summer seasons)
2. It highlights the importance of having cotton in the rotational program each year to ride out the difficult years and take advantage of the years when price and seasonal conditions combine. Overall cotton had the best return, but in the 2006/07 season, it recorded a negative gross margin.
3. A mixture of both cotton and sorghum in the summer rotation program provides opportunity to benefit from in-crop rainfall – whenever it falls in a particular season. It also is an avenue for disease and weed breaks which are important in modern farming practices.

There have been marked improvements in the dryland cotton production system in the past decade or so, making it a much simpler and reliable crop to grow and manage. An increasing number of growers are also now discovering that dryland cotton is a very profitable inclusion in the rotation program.

However, reservations remain, mainly centered on the dryness of the soil profile post cotton harvest and cash flow management due to the long fallow period required to refill the soil profile.

Critically, it should be noted that soil moisture is the limiting resource for all dryland farmers regardless of what crop is grown. The profitability of a particular crop is dependent on its ability to turn soil moisture into yield and therefore returns. In essence we are farming soil moisture, exemplified by the prevalence of minimum tillage and controlled traffic farming practices. The aim should be to get the best return from every millimetre of moisture available.

Comparison of Planting and Picking Price Over Time:

Many growers and consultants weigh up the merits of various summer crop options as we move further into spring. As the previous analysis shows, cotton has the best returns as a summer crop option.

However, commodity prices at planting time have a large influence on the crop chosen. Dryland cotton growers cannot forward sell with the surety that their irrigated counterparts have, due to their reliance on the vagaries of planting and seasonal rainfall.

Australian cotton production has very little influence on the international price of cotton. Cotton prices can fluctuate largely throughout the growing season, international forces and the Australian dollar can alter the price daily.

An analysis by CSD of the cotton price on offer at

Table 2: Comparison of price at planting v final received (8 year analysis)

Planting Year	Lint Price ($/b) @ 1st Sept	Farm return post-harvest ($/b) (inc. prem/dis + seed proceeds)
2006	403	401
2007	432	435
2008	404	475
2009	400	494
2010	519	514
2011	495	491
2012	400	467
2013	502	525
2014	412	518

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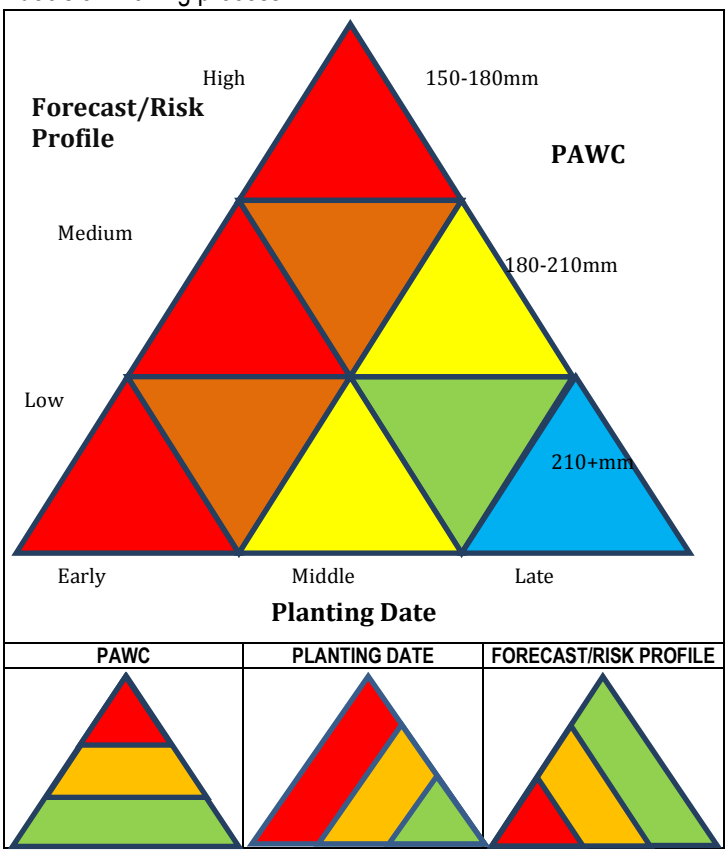
planting and picking time over the past eight years shows that it is rare that the picking price drops significantly below that at the time of planting. In 55% of years, the price in fact significantly increased.

The Row Configuration Decision Process:

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

There are several considerations which may influence the selection of a row connfiguration, including soil Plant Available Water Holdnig Capacity (PAWC), planting date and the seasonal forecast or risk profile. Select the optimal configuration by considering and overlaying these factors, but remember it has to fit into existing tractor wheel bases and picking technologies available.

Figure 1: Components of the dryland cotton row configuration decision making process.



PAWC: The amount of water a soil can hold is a critical factor in the crop's potential success and also row configuration choice. Row configuration selection is about managing the soil water bucket. In low PAWC scenarios of between 150-180cm, wider row configurations should be employed, whereas in high PAWC situations, tighter/narrower configurations are options.

Planting Date: In most regions, planting later into the planting window is better for yield potential on average. In dryland cotton your choice of planting date is very much dependant on when planting rains occur. Planting early in the window can expose dryland crops to December/January heat as well as extending the time before summer storms/rains arrive. As a general rule of thumb, wider row configurations can be employed if planting earlier to extend the bucket of soil moisture available to the crop, especially around flowering. Late season plantings can have an issue with reaching maturity before inclement weather hinders harvest, so the season length can be managed using tighter row configurations.

Forecast/Risk Profile: Regions and seasons have different risk profiles. Naturally, in hotter regions and dryer years, wider row configurations will enable the cotton plants to access more soil moisture and maintain both yield and fibre quality. Tighter configurations allow the yield potential to be maximised for wetter years and cooler regions.

Figure 1 demonstrates combining these three variables into a matrix to visually descibe the row configuration decision making process. If your situation falls within the red shaded area then a wider row configuration such as super single may be a consideration. The orange, yellow and green sections, for which the majority of dryland cotton planting occurs would higlight considerations for either double or single skip planting options. The blue area would get the best result using a solid planted configuration. The decision is ultimately based on an indivdual's attitude to risk.

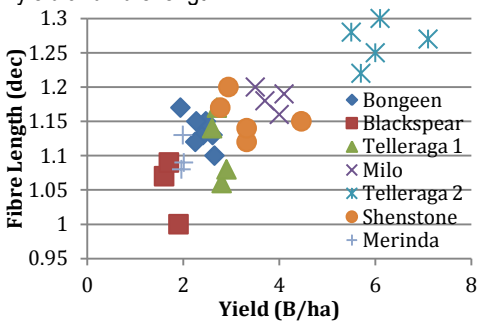
Row Configuration as a Risk Management Tool:

There is an important interaction between row configuration and yield potential and fibre quality. As the row configuration widens, inherently there is the potential for less yield in better seasons, and this difference can be quite large. However, wider configurations yield similar to tighter configurations in harder years, while maintaining base grade fibre quality.

Therefore varying row configuration is a method by which yield can be secured and quality discounts minimised.

There is also an opportunity to manage variable costs. The combination of these factors reduces the risk of growing dryland cotton.

Figure 2: Relationship between dryland cotton yield and fibre length



The relationship between yield and fibre quality in dryland cotton is shown in figure 2. This is the summary of seven dryland row configuration trials conducted by the CSD Extension and Development team since 2006. The upper points of each set of individual data are a result of a wider

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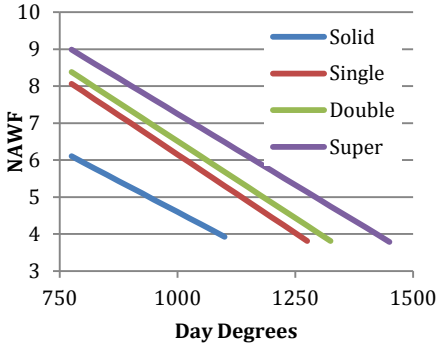
configuration.

Please note that, within many cases in these trials, the final yield was not significantly affected by the choice of row configuration.

Additionally, the use of row configuration is a method by which season length can be managed. In dryland cotton the length of the growing season, but more critically the flowering period is important. The longer the flowering period can be extended, the higher the yield potential because there is more moisture to access.

Figure 3: Relationship between dryland cotton row configuration and the length of the flowering period

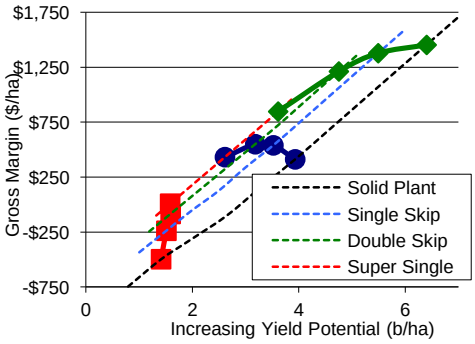


This has the added benefit of opening up more of the time in which to utilise summer rainfall. Figure 3 highlights that there was a 200 day degree difference between cut out of the single and double skip and a 340 day degree difference between the super single row configuration and solid planting scenario in these trials.

How does Row Configuration Effect the Gross Margin?

The example in Figure 4 looks at different growing scenarios, and the influence of four planting row configurations on the final gross margin.

Figure 4: Dryland cotton yield and row configuration sensitivity analysis ($500 lint & seed ex-gin)



Red Line/Squares: In this scenario, representing a very tough growing season, yields for all row configurations are very similar at about 1.5 b/ha. However, the super single configuration is still able to post a break even gross margin.

Blue Line/Circles: This represents the average growing conditions experienced over the past seven summers. As the line is very close to horizontal, this means there is minimal difference in gross margin between the four row configurations. The level of production risk is quite varied between each.

High risk is associated with the solid plant where the grower is heavily reliant on more frequent rainfall to ensure yield and fibre quality are maintained. There is less risk associated with the double and super single scenarios, as the plants would have more soil to forage for moisture, to help to maintain their yield and fibre quality. Timing of in crop rainfall would also be less critical. The financial outlay to grow the crop is also less in the wider skip configurations. Thus, for considerably lower risk, the same amount of money is returning to the farming operation per ha.

Green Line/ Diamonds: This shows the potential upside under very good seasonal conditions. Note that even as the yield of the solid plant increases it still does not give a dramatically better return to the operation as both single and double skip stay close to it.

Consequently, at yield levels below 4 b/ha, a wider skip row configuration will give the better dollar return; at higher yield level potentials, tighter configurations will be more favourable.

Dryland Row Configuration Case Studies:

The CSD Extension and Development Team have conducted row configuration trials to better understand the dynamics and the effects on yield and fibre quality of each planting configuration.

Bongeen Configuration Trial 06/07:

A replicated dryland row configuration trial was carried out on the Darling Downs in the very dry 2006-07 season. It was planted mid-November with Sicot 80BRF in a pre-watered field.. Again, minimal in-crop rainfall was recorded. (80mm in 15 falls)

Table 3: Yield, Fibre Quality and GM analysis on Bongeen Row Configuration Trial 2006/07

	Solid	S. Skip	D. Skip (9p/m)	D. Skip (5p/m)	80 in'	S. Single	2 in 8
Yield b/ha	2.65	2.41	2.25	2.47	2.61	2.27	1.94
Length	1.10	1.13	1.12	1.15	1.13	1.15	1.17
Strength	30.0	30.0	30.4	30.6	30.9	31.1	31.6
Quality Discounts	-$20	-	-	-	-	-	-
Cost Reduction	-	-$146	-$216	-$230	-$216	-$328	-$382
Net Difference	-	+$76	+$63	+$235	+$247	+$288	+$71

Tulloona Configuration Trial, 2006-07:

This trial mid-way between Moree and Goondiwindi compared Single Skip, Double Skip and Super Single configurations. Sicot 80BRF was planted into a full moisture profile in early November and there was minimal in-crop rainfall (66mm). The final yield and fibre length results reflect this.

Table 4: Yield, Fibre Quality and GM analysis on Tulloona Row Configuration Trial 2006/07

	S Skip	D Skip	S Single
Yield b/ha	1.9	1.6	1.7
Length	1.00	1.07	1.09
Strength	27.1	29.1	29.6
Quality Discounts	-$160	-$60	-$20
Cost Reduction	-	-$73	-$147
Difference	-	+$45	+$200

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Moree Row Configuration Trial 10/11:

A small plot replicated trial was conducted west of Moree in 10/11 season. The trial site received above average rainfall up to December but was stressed during the months of January and early February. Despite similar yields achieved across the different row configurations, there is a significant difference in the return to the farming operation through reduction in growing costs and preservation of base grade fibre quality (See table 5).

Fibre quality data from these three trials reinforces the fact that wider row configurations produce better fibre length.

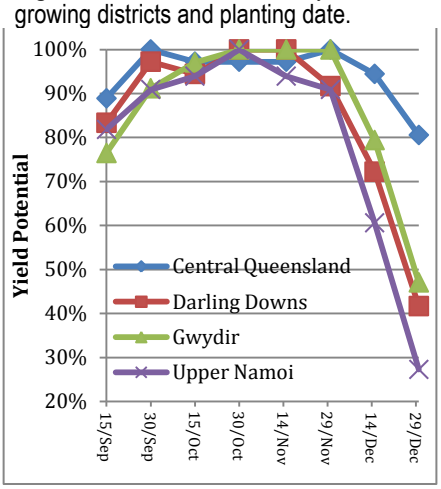
At the low yield levels produced in all of these trials as a result of adverse seasonal conditions, savings in variable costs and fewer length discounts enabled the wider row configurations to be the most profitable. At higher yield levels (when there is generally fewer fibre quality discounts), the increased yields from the narrower configurations (single skip and solid) will be more profitable.

Deciding which configuration best suits is a matter of looking at the long term yield and fibre quality potential for your region and weighing these up against the climatic outlook for the coming season.

The Best Time to Plant Dryland Cotton:

Extensions to the planting window of Bollgard II this season has a couple of benefits for dryland cotton growers. Firstly, by opening up the opportunity to plant through spring, but additionally for many regions, planting in the month of November which has the highest average yield potential. In general, planting later during the Bollgard II window generally gives better yield results, but if moisture conditions are ideal now, any delay in planting means relying on the likelihood of additional rainfall.

Figure 5: Yield Potential for dryland cotton growing districts and planting date.



There are some factors with dryland cotton relating to variety choice and row configuration which can assist growers and consultants manage risks and enhance potential returns when planting at different stages of the planting window.

Production Risks Associated with Planting Early:

Planting early can extend the growing season - the length of time the crop needs to be supplied with adequate moisture from the soil profile. For average season length (plant-maturity), crop water use of early planted crops is 10% longer/higher than those planted at the end of the planting window for the same row configuration.

Earlier planted crops will be in peak flower during the hottest months of the year, meaning peak crop water demand will coincide with peak evaporative demand. Therefore, it is critical that adequate soil moisture or rainfall is available during this period for maintaining both yield and fibre length. The season length of the crop can be manipulated through variety choice, row configuration, or a combination of both.

Choice of Variety:

Choose a dryland variety with a proven track record in yield and fibre quality over a range of seasons. There are a number of traits which make a variety well suited to dryland production.

Table 5: Yield, Fibre Quality and GM analysis on Moree Row Configuration Trial 2010/11

	Solid	S Skip	D Skip	S Single
Yield b/ha	2.8	2.9	2.6	2.7
Length	1.06	1.08	1.14	1.17
Strength	27.2	30.3	35.0	34.6
Quality Discounts	-$75	-$40	-	-
Cost Reduction	-	-$132	-$202	-$251
Difference	-	+$276	+$312	+$406

How Can Planting Date Influence Variety Choice?

With dryland cotton, variety choice should be based on three criteria, reliability of yield, inherently good fibre quality and indeterminacy. Within CSD's range, dryland cotton growers have a choice of several varieties ideal for dryland production.

1. Maintenance of Yield and Fibre Quality:

Select varieties that consistently produce the goods with yield and base grade fibre quality under a range of moisture situations.

The CSD Variety Comparison Tool, located at www.csd.net.au, allows a comparison of yield and quality data from all CSD dryland variety trials over several regions and growing years.

Table 6: Variety Performance Comparison Analysis for Sicot 74BRF and Sicot 71BRF, summary of 57 dryland trials

	Sicot 74BRF	Sicot 71BRF
Yield (b/ha)	5.25	5.25
Length	1.21	1.20
Strength	32.3	31.7
Micronaire	4.44	4.27
Uniformity	82.7	82.8

Table 7: Variety Performance Comparison Analysis for Sicot 71BRF and Sicala 340BRF, summary of 44 dryland trials

	Sicot 71BRF	Sicala 340BRF
Yield (b/ha)	4.57	4.27
Length	1.21	1.25
Strength	32.7	34.1
Micronaire	4.47	4.26
Uniformity	82.9	83.4

Improvements in Fibre Quality over time through Cotton Breeding:

With significant improvement in Australian cotton varieties yields over the past 10 years there have also been considerable improvement in the fibre quality as well, especially fibre length. However, what does that mean to growers under field conditions?

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In North West NSW the seasons of 2006/07 and 2013/14 were very similar, characterised by above average temperatures and also very minimal in crop rainfall. CSD were fortunate to have dryland variety trials on the same property in both these seasons and it provides an opportunity to compare the results of the varieties performance under very stressed conditions.

Table 8: Comparisons of variety performance in harsh seasonal conditions examining the performance of dryland cotton varieties

2006/07 (66mm rain)	Yield (b/ha)	Length
Sicot 80BRF	1.58	1.02 (33)
Sicot 60BRF	1.53	1.03 (33)
2013/14 (75mm rain)	**Yield (b/ha)**	**Length**
Sicot 71BRF	1.70	1.09 (35)
Sicot 74BRF	1.62	1.11 (36)
Sicala 340BRF	1.30	1.13 (36)

Table 8 shows that despite the minimal in crop rainfall, which was spread out over numerous small events, rendering this rainfall non effective. There was a slight improvement in yields over this time however, the yield give a good indication of how harsh the seasonal conditions were. Of interest from this comparison is the improvement seen in the fibre length achieved by current varieties over those which they replaced. There is significant improvement in the fibre length and although the Sicot 71BRF did not make base grade length the Sicot 74BRF and Sicala 340BRF did.

Sicala 340BRF is a high fibre quality variety within the CSD variety suite and to date has not gone below base grade in any CSD variety trial regardless of the seasonal conditions.

Stand-out Dryland Variety Choices:

Sicot 74BRF has performed extremely well in dryland conditions, Although its yield advantage over Sicot 71BRF is not replicated in dryland as it is in irrigated situations (see Table 1), Sicot 74BRF excelled in situations where rain occurred in the later part of the season. In these situations the later fruiting pattern of Sicot 74BRF benefited it, compared with the more determinate varieties like Sicot 71BRF. Care must be taken at planting to ensure adequate and uniform plant stand is achieved, especially with Sicot 74BRF

Sicot 71BRF family had not been considered suitable for dryland production in the past. However, improvements in the fibre quality package of Sicot 71BRF through breeding have resulted in a variety which is very adaptable to dryland conditions. With equal yields to Sicot 74BRF, the higher density seed may be an advantage in adverse planting conditions.

Siokra 24BRF displays a combination of a high yield potential, robust fibre quality characteristics, okra leaf shape and an indeterminate growth habit. It is a vigorous, full season variety which will actively explore the soil for moisture and nutrients making full advantage of good stored moisture profiles.

Sicala 340BRF has the best staple length and strength of any Australian commercial upland cotton variety. Its ELS type precursor, Sicala 350B, never produced fibre quality below base grade in a CSD dryland variety trial – even in some very harsh conditions. Although Sicala 340BRF has a slightly lower yield potential than Sicot 74BRF and Sicot 71BRF (7%), it will provide insurance against fibre length discounts even in the toughest of years. Dryland crops of this variety have won the coveted Norm Thompson Award (for outstanding Fibre Quality in a CSD trial) for three the past four seasons.

Sicot 75BRF This variety has a fit in dryland production systems due to its growth habit and fibre quality. It will give greater insurance against length discounts compared to Sicot 71BRF and Sicot 74BRF.

2. Ability to turn Soil Moisture into Cotton:

The CSD dryland variety trial program offers an opportunity to examine the WUE of varieties. This program is diverse in its geographical spread, ranging from Central QLD to the western Downs to the Upper Namoi, allowing varieties to be tested across a wide range of conditions as well as soil types over a number of years.

Table 9: WUE rankings for CSD dryland varieties (number in brackets represents number of trials)

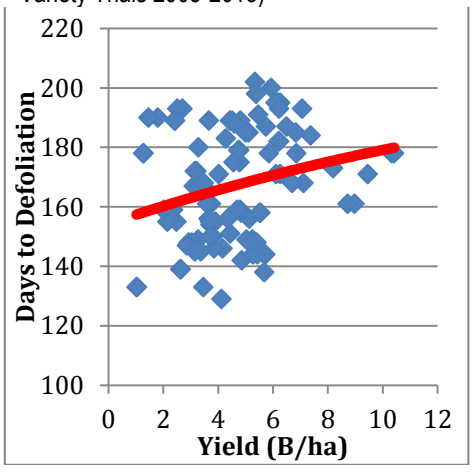
WUE*	Conventional	Bollgard II® Roundup Ready Flex®
Low-High	Sicot 75RRF (1) Sicot 71RRF (2) Sicot 80RRF (2) Sicot 43RRF (1)	Sicot 74BRF (57) Sicot 71BRF (41) Siokra 24BRF (41) Sicala 340BRF (44) Sicot 75BRF (31)

*Calculated WUE from CSD replicated variety trials using in-crop rainfall data.

All varieties within a trial have the same starting soil moisture and receive the same amount of in-crop rainfall, the final yield giving a good indication of which varieties are the most successful in converting moisture to cotton.

There is not much difference between the WUE of the Bollgard II Roundup Ready Flex® varieties, as there is only 7% yield difference between the highest and lowest yielding variety.

Figure 6: Relationship b/w season length and yield in dryland cotton. (CSD Dryland Variety Trials 2005-2013)



3. Indeterminacy

As dryland growers are dependent on rainfall to produce yield, especially during the months of January and February, a variety needs to be able to respond to favourable conditions if and when they occur. The ideal variety is a vigorous, longer

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season variety, which will be able to hang on in dry times and then rebound and quickly put on yield when rain arrives.

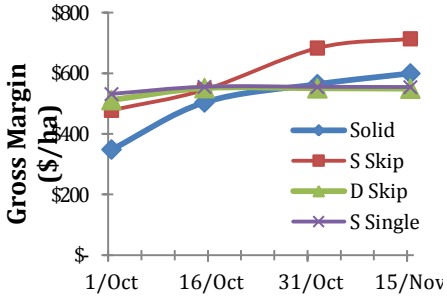
How Can Planting Date Influence Row Configuration?

Row configuration has an influence on the season length of a crop for a given planting date. For an early October plant, this can be as large as 14 days difference between solid and super single planted crops. Other row configurations fall within this range relative to the width of the skip. The difference in season length decreases to approximately 7 days in mid-November. This is particularly important to dryland growers because the wider row configurations increase the time before the crop requires in-crop rainfall. This is also of benefit in early planting scenarios in drier than average seasons.

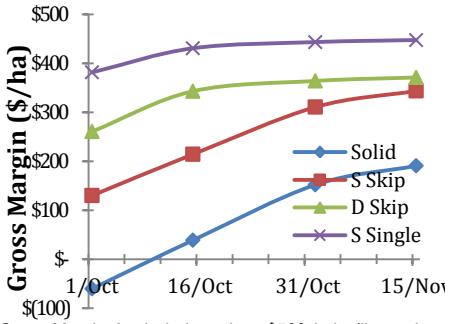
The example in Figure 7 compares gross margins of four planting configurations and four planting dates using the CSD Dryland Cotton Gross Margin analysis tool. With average seasonal conditions and yields at earlier planting dates, the wider row configurations are the most profitable. However, with November planted crops the trend is reversed and the single skip has the best gross margin. The yield figure is greater in the solid configuration but variable cost savings achieved by skip row improve the gross margin.

Figure 7: CSD Dryland Cotton Gross Margin analysis for planting date and row configuration interactions.

Average Seasonal Conditions and Yields



Bottom Third Seasonal Conditions and Yields



Gross Margin Analysis based on $500 bale (lint and seed ex gin), Moree District, 190mm PAWC and good soil fertility. Fibre length quality discounts/premiums have been factored in depending on yield potential and row configuration.

The second example using the bottom third of seasonal conditions highlights how risk can be managed using wider row configurations. This scenario is more likely to confront those growing dryland cotton in western districts where rainfall is less reliable.

Planting later in the window will generally produce better yield results. If this is not possible, using an indeterminate variety such as Siokra 24BRF and a wider row configuration can assist a crop to hold on through the entire summer and achieve the best gross margin. For crops planted later in the window, narrower row configurations may be used with varieties such as the high quality Sicala 340BRF being an ideal choice.

The 8 Golden Rules of Dryland Cotton:

1) **Use an experienced Agronomist / Consultant.**
   a) Utilise their experience to assist crop management
   b) Even long term cotton growers use consultants
2) **Know your soil type.**
   a) PAWC >180mm in the top 1.5m of soil
   b) Know the nutrient status, location and availability in the profile
   c) Understand the effect of any soil constraints
3) **Plant into standing stubble.**
   a) It creates a better environment for crop establishment
   b) Extends planting opportunities through moisture conservation
   c) Improves efficiency in capture of rainfall
4) **Have a plan for weeds.**
   a) Know your weed spectrum and have a plan for each
   b) Don't rely solely on Roundup Ready Herbicide to control weeds
   c) Where possible utilise residual chemistry
   d) Implement an IWM approach
5) **Plant on a full moisture profile.**
   a) Cotton is susceptible to adverse conditions around planting
   b) Adequate soil moisture reserves to allow crops to grow for 2-3 months without rainfall
6) **Choose an appropriate row configuration and variety.**
   a) There are many options available based on row configuration decision matrix, considering
      i) Seasonal forecast and risk profile
      ii) Plant available water holding capacity
      iii) Planting date
   b) Select variety based on
      i) Yield reliability over many seasons in your region
      ii) Quality characteristics
      iii) Growth Habit (long/short season)
      iv) Additional traits (Bollgard II/ RRF)
7) **Establish an even healthy plant stand.**
   a) Establish 6-8 evenly spaced plants/m
   b) Minimise gaps, gaps > 50cm will cost yield
   c) Account for varietal differences with establishment (eg:71BRF v 74BRF)
   d) Check planting speed, aim for 8-10km/hr
8) **Get value out of post harvest tillage operations**
   a) An essential part of Bollgard II Resistance Management Plan
   b) Effectively remove stalks to prevent ratoon cotton as they are hard to control in fallows
   c) Level out field and remove old wheel tracks
   d) An opportunity to apply deep P&K

FURTHER INFORMATION:

- Dryland Cotton Website www.drylandcotton.com.au
- Grower Information Booklet "A Guide to Dryland Cotton" – www.csd.net.au or www.monsanto.com.au
- CSD Dryland Industry Support Partnership www.csd.net.au

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