

# DRYLAND COTTON GUIDE



**Cotton is one of Australia's most important summer crops. In an average year, Australia's cotton growers produce enough cotton to clothe 500 million people. It is a major commodity, representing from 30 to 60 percent of the gross value of the total agricultural production in Australian regions where it is grown, helping to underpin more than 50 rural communities.**

Australian Grown Cotton Sustainability Report, 2014

Australian cotton growers are some of the best in the world, achieving yields well in excess of world averages and also producing some of the best fibre quality cotton. This makes Australian cotton attractive to merchants and spinners around the globe.

The modern Australian cotton industry has grown from humble beginnings with its roots in the Namoi valley of north west New South Wales, to a professional, technologically advanced industry spanning from Central Queensland into Victoria.

In recent years, the industry has seen substantial expansion into areas once thought impractical to cotton growing. At present, two thirds of Australian cotton is grown in New South Wales and the bulk of the remainder grown in Queensland. Through plant breeding and advances in biotechnology, the Australian cotton industry has been expanding into new regions, including south of the Victorian border and north into the Flinders River in the Gulf of Carpentaria and the Ord Irrigation Scheme in Western Australia.

Dryland cotton currently accounts for approximately 10% of Australia's cotton

production. However, in recent seasons the popularity of cotton as dryland summer crop has seen an increase in the area planted to dryland cotton. Current varieties, improvements in technology and trait advancements have simplified the process for growing dryland cotton, reducing production risks and allowing for greater flexibility in planting windows, pupae busting and refuge requirements. Yield potential is continually increasing with new biotech traits.

Dryland cotton offers one of the best gross margins for summer cropping. With a range of marketing options available, growing dryland cotton makes good business sense, and more and more broadacre growers are making the switch.

This booklet is an introductory guide for those who are new to growing cotton or are interested in discovering more about cotton production.

**Further information, resources and tools including a gross margin calculator are available at [www.acresofopportunity.com.au](http://www.acresofopportunity.com.au)**

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## PRE-SEASON – BEFORE YOU PLANT

Stored soil moisture is a critical factor in the dryland cotton farming system. The decision to plant cotton should be based on the level of stored moisture, not solely on the price of cotton. If the soil profile is not full then the chances of a successful crop are greatly diminished, regardless of the price.

Having an effective fallow period in the lead-up to planting (where weeds are controlled, stubble is left standing and rainfall is allowed to accumulate) will provide the basis for a successful dryland cotton crop.

It's important to complete ground and field preparation operations well ahead of planting time. Early fertilisation will facilitate a smooth transition into the planting operation, and allow the maximum amount of time to accumulate moisture into the soil profile.

Planting row configuration will vary depending on the farming operation and geographic location. It's important to consider that some dryland cotton equipment, especially pickers, have standard 2 m wheel spacing, and the picking heads are set up on multiples of 1 m and 75 cm spacings.

Planting is a critical operation in the dryland cotton farming system and every effort should be made to ensure that the young crop is given every opportunity to establish.

It's good farming practice to service all machinery to ensure it is in good condition and to avoid breakdowns. In a dryland cotton farming system, some operations are time sensitive, so there is tangible value in having machinery prepared and running for the planting season by having it serviced early. Having machinery ready to go when planting conditions are right, and having the capacity to cover the ground quickly will minimise the chance of missing the opportunity when it arises.

It is also important to investigate cotton ginning and marketing organisations for the processing and marketing of your cotton crop, prior to planting. There are many options available to market your cotton, including the opportunity to forward sell. Remember that you will produce two commodities with each cotton crop – the lint and the seed – both of which can provide lucrative returns if marketed wisely.

**A list of cotton merchants operating in Australia is available at:**  
**[www.austcottonshippers.com.au/about-acsa/](http://www.austcottonshippers.com.au/about-acsa/)**





## Neighbourhood relationships

Cotton is particularly sensitive to phenoxy herbicides (2,4-D, MCPA), suffering growth distortion, fruit loss and delayed maturity from even very small concentrations drifting onto the crop. It is important to talk to your neighbours, particularly those within a couple of kilometres, about your intentions to plant cotton.

CottonMap ([www.cottonmap.com.au](http://www.cottonmap.com.au)) allows growers, consultants and spray contractors to plot cotton fields online so you and your neighbours are aware of the location of nearby cotton fields when spraying.

It's also critical to decontaminate any spray equipment that has been used for application of phenoxy herbicides before you start the cotton season. A check needs to be made with all spraying contractors to ensure adequate decontamination has been conducted. All rubber hoses, O-rings, gaskets and seals should be replaced as harmful chemicals can be drawn back into solution by some solvents used in other chemical products.

If required, it's important to engage outside assistance to help manage the crop. This can include a crop consultant (agronomist) and contractors for time sensitive farm operations (e.g. planting, picking and spraying). Where possible, these should be organised prior to planting.

A good cotton consultant will assist you with the management of the cotton crop, from planting to picking. Their knowledge is in ensuring that the crop is managed without stresses throughout the season. Cotton consultants help with forecasting crop requirements, variety selection, planting, fertiliser requirements and application, insect and weed scouting and control, and crop defoliation. Even the most experienced dryland cotton growers utilise the services of cotton consultants.

## PRE-SEASON – BEFORE YOU PLANT

### Nutritional requirements

Cotton requires a good supply of both macro- and micronutrients to produce high yields. Dryland cotton has a similar to slightly lower nutritional requirement than sorghum. The amount required is based on the yield potential and residual nutrients in the soil. The tap root of cotton has the ability to explore the soil profile and extract nutrients from levels out of reach to other rotation crops.

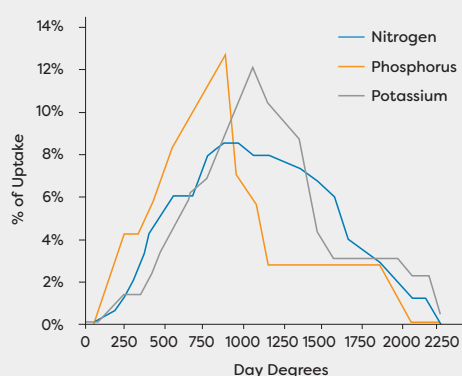
Fertiliser should be applied in a timely manner, to ensure availability for plant uptake before periods of peak nutrient demand. Regular soil testing, with accurate interpretation of the results, is valuable when assessing soil nutrient levels prior to planting.

Samples are best taken from May to August, ideally from varying depths of the soil profile. In-crop measurements should be conducted to reassess crop requirements during the season. Nutrient requirements should be budgeted on

soil and crop tests, and on crop requirements based on yield potential.

Nutrient use efficiency can be boosted through careful fertiliser application. Your cotton consultant can give you advice on the most appropriate rate, product, timing and application method.

Don't let nutrition be a yield limiting factor. Careful monitoring and management of nutrient levels is important to ensure yield potential is reached, without inefficient fertiliser application. Without regular monitoring, nutrition deficiencies may not be identified until symptoms appear - which may be too late. At that point, a reduction in yield is likely, despite remedial fertiliser applications.



Units	Nutrient	Maximum uptake rate (per day)	Percentage taken up during flowering
kg/ha			
	N	4.5	93
	P	1.3	96
	K	4.0	89
g/ha			
	Zn	2.9	100

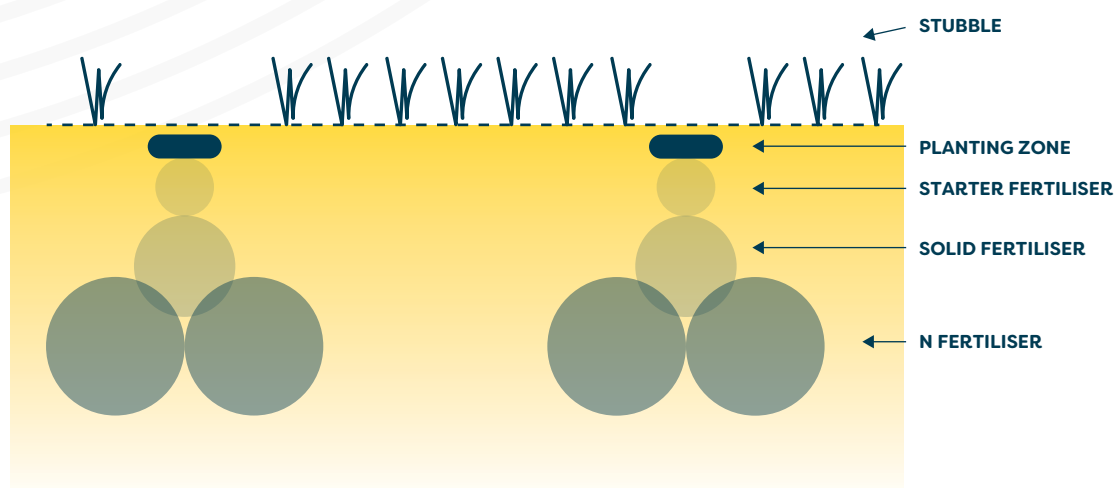
**Figure 1:** Maximum nutrient uptake rate and timing of the nutrient of the whole crop.

Source: Australian Cotton Production Manual

**Table 1.** Nutrient removal at various yield levels in bales/ha (1 bale = 227 kg). Source: Rochester (2014).

	Nutrient	Yield: bales/ha				
		2	4	6	8	10
kg/ha						
	N	5	35	65	95	125
	P	5	10	14	19	24
	K	7	15	22	29	37
	S	2	4	6	8	10
	Mg	2	5	8	11	14
	Ca	1	2	3	4	6
g/ha						
	Fe	59	85	112	138	164
	Mn	3	6	9	12	15
	B	N/A	13	28	42	56
	Zn	34	53	72	91	110
	Cu	8	12	16	20	24

Placement of fertiliser is very important, as root burn can occur if fertiliser is placed too close to the root system. It's recommended that nitrogen be applied 10 cm to the side of the plant.



**Figure 2:** Schematic placement of fertiliser

## PRE-SEASON – BEFORE YOU PLANT

### Row configuration

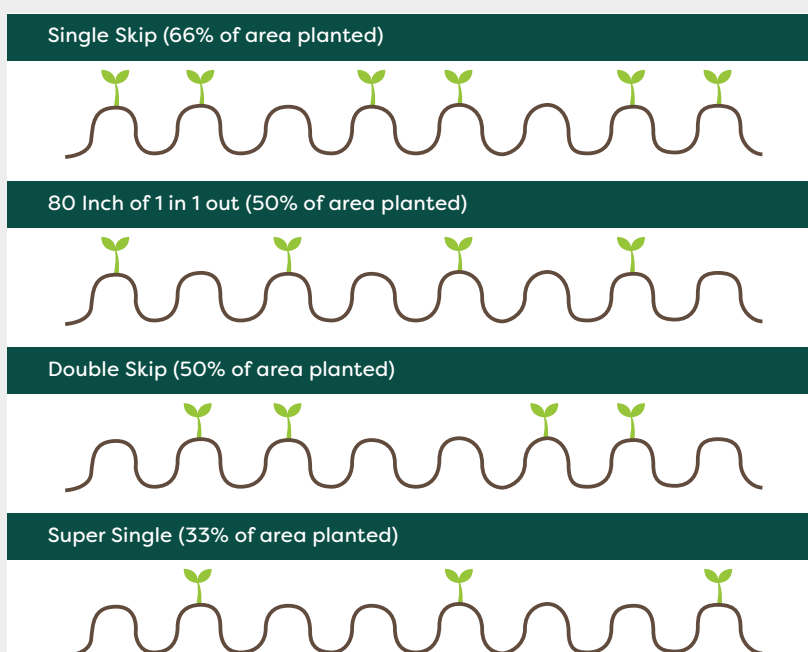
Dryland cotton growers can use planting row configuration to manage their growing costs and maintain yield and fibre quality. Decisions on what row configuration to use in different scenarios are based on:

- Potential in-crop rainfall
- Seasonal outlook
- Soil type
- Planting date
- Commercial experience in your region

There is an important relationship between row configuration, yield potential and fibre quality. As the row configuration widens, there is the potential for lower yields in better seasons, and this difference can be quite large. However, wider configurations yield similar to tighter configurations in harder years, while assisting in 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 associated with growing dryland cotton.

Discuss with your consultant which row configuration will best suit your farming operation, keeping in mind that row configuration has to match farming and picking machinery.



**Figure 3:** Row configuration guide



## Select the right variety and seed treatment

Selecting a cotton variety that has the right regional and production type fit is a very important decision. Cotton Seed Distributors (CSD) has a range of varieties available, which should be selected based on:

1. Potential yield in your area and production type
2. Disease tolerances
3. Resilience in fibre quality
4. Technology choice

**a)** Conventional : cotton is non GM.

**b)** Roundup Ready Flex®: can be sprayed over-the-top with Roundup Ready® Herbicide with PLANTSHIELD® and / or Roundup Ready® PL Herbicide with PLANTSHIELD® Technology. This technology has revolutionised cotton production by reducing the need for residual herbicides, in-crop chipping, cultivation and shielded lay-by applications.

**c)** Bollgard® 3: is the latest generation insect control technology that offers excellent control of helioverpa, the main cotton pest within Australia. It offers three different protein toxins for control and reduces the need for broad-spectrum insecticide sprays.

5. Other varietal characteristics such as determinacy, leaf shape and season length should also be considered.



## PRE-SEASON – BEFORE YOU PLANT

Your consultant or CSD Extension and Development Agronomist ([www.csd.net.au/contact](http://www.csd.net.au/contact)) will be able to assist you in making an informed decision on what variety and technology mix will suit your specific situation.

The relevant CSD Grower Agreement and Bayer (trading as Monsanto Australia Pty Ltd) Technology User Agreement (TUA) need to be completed prior to ordering and receiving seed on farm. Cotton planting seed within Australia cannot be purchased without the relevant agreements being in place as a requirement of the government regulations. The agreements can be arranged through your local cotton seed supplier, who will have further information on how to order seed. There are some accreditation processes which are required to ensure growers are aware of the crop management plans for biotech traits.

There are many pests and diseases which impact on cotton crops. Seed treatments are available to give some early season protection against disease and insects. Bion® is an additional choice that can ‘turn on’ the cotton plants’ natural defence mechanisms and provide increased resistance to some pathogens, particularly during the establishment phase of a crop’s life.

Growers should consult with their cotton consultant to select a suitable seed treatment based on expected disease and early season insect pressure. Soil-dwelling insects such as wireworm species can be particularly active in zero till fallows. An insecticidal seed treatment or in-furrow insecticide may be required for control.

Insecticidal traits such as Bollgard 3 require a small amount of refuge area to be planted as part of the Australian cotton industry’s Resistance Management Plan (RMP). The required area will vary depending on the amount of cotton grown and the technology choice selected. The aim of a refuge crop is to generate significant numbers of *Helicoverpa* moths which haven’t been exposed to Bollgard 3 or other Bts.

The types and requirements for the refuge crop can be found in the table below, and a refuge calculator too can be found at: [www.bollgard3.com.au/refuge-calculator/](http://www.bollgard3.com.au/refuge-calculator/)

**Table 2.** Bollgard 3 refuge options.\* Source: Bollgard 3 Resistance Management Plan.

Crop	Condition	% of Bollgard 3 crop area
		Irrigated & Dryland
Cotton	Sprayed cotton refuge: an area of irrigated non Bollgard 3 cotton, which can be conventionally managed for <i>Helicoverpa</i> spp. and other pests.	100%
	OR Unsprayed cotton refuge: an area of irrigated non Bollgard 3 cotton, which will not be treated for any reason with any product that controls <i>Helicoverpa</i> spp.	5%
		Irrigated & Dryland**
Pigeon Pea	Unsprayed pigeon peas which will not be treated for any reason with any products which control <i>Helicoverpa</i> spp. The pigeon pea crop is managed to ensure several cycles of flowering throughout the cotton season.	2.5%

\*Southern QLD, NSW & VIC only. Please refer to Bollgard 3 Resistance Management Plan for Central Queensland refuge options.

\*\*Subject to an approved management plan by Bayer.

## PLANTING AND ESTABLISHMENT

Precision planters are the predominant type of planter units used to plant cotton, allowing for accurate and uniform seed placement. While cotton has the ability to compensate for gaps or unevenness in the plant stand, a uniform plant establishment will contribute in easing crop management throughout the season. In dryland cotton with wider row configurations the plants have less ability to fill in the gaps and therefore yield potential can be reduced.

A successful planting operation is influenced by a number of factors mentioned below.

### Planter maintenance:

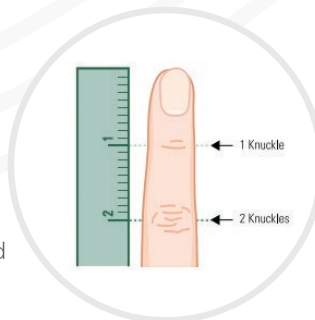
Ensure the planter is well maintained and ready to go well before planting time.

Breakdowns in the field can rob time and allow planting moisture to disappear.

### Planter depth:

Ideal depth depends on the method of establishment and the soil conditions.

A simple rule of thumb is to use the “knuckle” method as a quick and easy measurement tool in the field.



Planting too shallow (< 2.5 cm) may mean the soil dries out before the seed has time to germinate and does not allow the seed coat to be removed from the cotyledons through soil friction, which can stall crop development. Planting beyond 5 cm, even under ideal conditions, can also compromise establishment.

### Planting speed:

One of the keys to achieving a uniform seed placement is planter speed, where the aim is to plant with precision not speed. The ideal speed for planting cotton is between 8-10 km/hr. A desirable outcome of any speed is to eliminate the planter unit from bouncing, ideally having it sitting steady and stable as it moves along.

### Stubble

High levels of stubble can also impact establishment. While cereal stubble improves moisture levels and fallow efficiency it can also prevent good soil-seed contact and obstruct emergence. Trash whippers may be necessary to remove stubble from the plant line. Some growers even adjust cereal row spacing to allow cotton to be planted between the rows or use a strip till system prior to planting.





## EFFECTS OF PLANT POPULATIONS

Establishing a cotton crop is a critical operation. It sets the standard for the entire season, influencing crop growth, development and management. If establishment is unsuccessful, it is difficult to manage and costly to rectify.

Plant once and do it right. Emergence is expected to occur within 7-14 days depending on factors such as planting depth, soil

temperature and post-planting weather conditions. A faster rate of emergence is desirable, as the cotton plant emerges and starts to generate its own energy from sunlight. Cool temperatures will diminish root and shoot growth, reduce water and nutrient uptake and make seedlings more susceptible to attack from seedling disease and early season insect pests.

**Table 3.** The effect of temperature on cotton seedling survival and growth rate.

Source: Constable and Shaw, 1988.

Minimum soil temperature at 10 cm at 8am (AEST)	Seeds emerging and survival	Days to complete emergence
10°C	56%	29
14°C	73%	17
18°C	90%	5

It is important to monitor the soil temperature and air temperature to find an appropriate planting window. It had been an Australian cotton industry guideline that cotton planting should not begin before soil temperatures reach 14°C or above at 10 cm depth, at 8.00 am. In some regions, it can be difficult to obtain such temperatures in early October and therefore a forecast for a rising air temperature

is utilised in conjunction with soil temperatures, in order to time planting to provide seed with the best chance of emergence. There may be a FastStart soil temperature monitor station located near you ([csd.net.au/soil\\_temperatures](http://csd.net.au/soil_temperatures)). Always be sure to check the soil temperature before you plant.

### HAVE YOU GOT THE GREEN LIGHT FOR COTTON PLANTING THIS SEASON?

Planting the cotton crop is one of the most important operations on the farm. It sets the standard for the entire season. There are some key considerations that will help ensure that it is a once-only task.

- ☐ Soil temperature at 10 cm depth above 14°C at 8am (AEST).
- ☐ Forecast average temperatures for the week following planting on a rising plane.



RED LIGHT



STOP!



AMBER LIGHT



STEADY!



GREEN LIGHT



GO!

## High soil temperatures

There has been a lot of research into the effects of cool temperatures on seedling establishment. As the planting window for Bollgard 3 cotton is widened, so too is the possibility of planting into summer temperatures in Central Queensland, west and south west Queensland and north west New South Wales. High temperatures can reduce seedling establishment and in extreme conditions, can kill the seed and seedling.

## Seed quality

All CSD seed has a minimum germination test rating of 80% at the point of sale (majority are a lot higher than this). Germination percentages for individual Australian seed lots are available on the CSD website ([www.csd.net.au](http://www.csd.net.au)) or by contacting CSD's laboratory operations on (02) 6795 0000.

Seedling survival is rarely 100%, so growers should never rely on seeds planted per hectare and plants established per hectare being the same.

## Seed density

Some cotton varieties have lower seed density which means that when conditions are less than ideal, the variety will have lower seedling vigour and in turn, establishment.

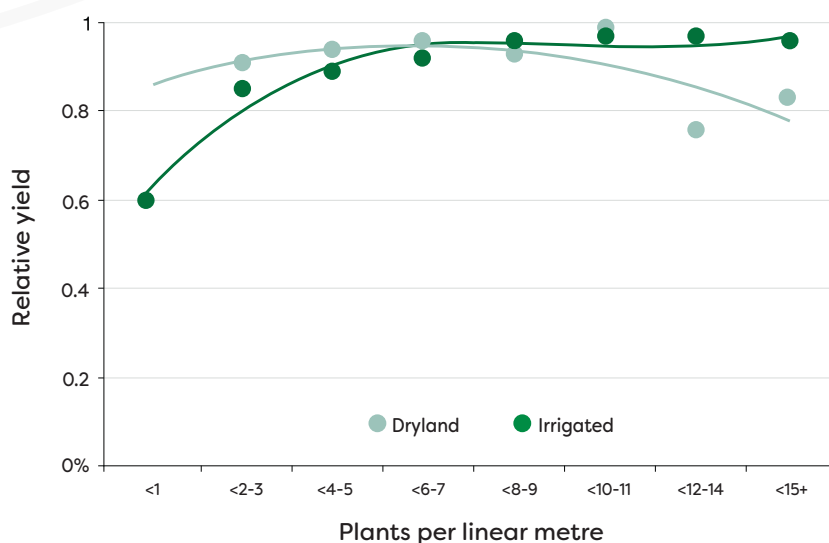
When planting varieties with lower seed densities, growers should take extra care and attention to detail with both land preparation and planting operations to ensure adequate establishment is achieved.

## Plant populations

The overall aim is to establish a healthy and uniform plant population of 6-10 plants per linear metre.

The number of seeds that should be planted is determined by several factors:

1. Soil type and seed bed condition
2. Stated germination percentages of seed
3. Anticipated seedling mortality through disease or insects
4. Temperature conditions



**Figure 4**  
Summary of  
CSD plant  
population trials  
from the past  
9 seasons.  
(21 irrigated and  
9 dryland trials)

## EFFECTS OF PLANT POPULATIONS

### Impacts of low and high plant populations on crop management

**Table 4.** Impacts of low and high plant populations on crop management

Low plant populations (below 6 plants/m)	High plant populations (higher than 10 plants/m)
Pre-flowering crop water use will be lower	Higher pre-flowering water use requiring early season rainfall.
Plants will be larger as they spread out and grow into gaps.	Plants will be taller, although more compact and with more even fruit distributions.
Plants may start fruiting earlier, but be later in maturing.	Plants will start fruiting later, putting on more vegetative nodes delaying fruiting.
More fruit is concentrated on vegetative branches closer to ground level.	More fruit is concentrated on main stem fruiting branches and in first position.
At very low populations, plant cut-out will be delayed	No delay or improvement in maturity.
Decreased picking efficiency due to blockages and difficulties in picking large plants.	Picking efficiency will be improved.
More difficulty in controlling plants in post harvest operations (e.g. root cutting).	Easier to control plant in post picking operations.

### Plants per metre of row, plants per hectare

**Table 5.** Plants per metre of row, plants per hectare

Row spacing				
Plants/m	Plants/ha			
	40 inch (1 m)	Single skip or 60 inch (1.5 m)	Double skip or 80 inch (2 m)	Super single or 120 inch (3 m)
4	40,000	26,800	20,000	13,333
6	60,000	40,200	30,000	20,000
8	80,000	53,600	40,000	26,666
10	100,000	67,000	50,000	33,333
12	120,000	80,400	60,000	40,000

### Seeding rate calculator example

**Table 6.** Seeding rate calculator example

Example (double skip or 80 inch)		
Your desired plant stand	8 plants/m 40,000 plants /ha	
Divide by the estimate of survival	80%	$40,000/0.8=50,000$
Divide by germination % of seed	95%	$50,000/0.95=52,632$
Your seeding rate		52,632 seeds/ha 10.5 seeds per linear m
Divide by the seed/kg for the variety	Sicot 748B3F 11,795	$52,632/11,795=4.46$
Seed/ha required	4.46 kg/ha	



## PEST CONTROL

### Insect pests

Cotton, like most field crops, can be attacked by a range of insect pests during the season. For this reason, it is very important to employ an experienced crop consultant/agronomist to regularly monitor the crop and help you make pest management decisions.

While there are numerous products registered for the control of various cotton pests; many insecticides, if used at the wrong time, can cause more problems than they solve by disrupting the balance of natural pest enemies ('beneficials'), which can subsequently flare secondary pests, requiring further, harsher control.

**Table 7.** Common cotton pests

Pest	Crop stage	Where found	Does Bollgard 3 control
<i>Helicoverpa</i> spp. (Heliiothis)	All season	Attacks fruit and terminal buds	Yes
Soil pests - True wireworm ( <i>Agrypnus</i> sp.) False wireworm ( <i>Gonocephalum</i> spp.) <i>Pterohelaeus</i> spp.) Black field earwig ( <i>Nala lividipes</i> ) Symphyla ( <i>Hanseniella</i> spp.)	Planting and emergence	Underground feeding on emerging seedlings	No
Thrips (various species)	Emergence until squaring (are also a beneficial insect)	'Rasps' leaves of young seedling	No
Silverleaf whitefly ( <i>Bemisia tabacci</i> )	All season but mainly concentrated late season	Underside of leaves, secretes honeydew	No
Green mirid ( <i>Creontiades dilutus</i> )	Flowering and boll fill	Attacks fruit and terminal buds	No
Cotton aphid ( <i>Aphis gossypii</i> )	All season	Underside of leaves, secretes honeydew	No
Green vegetable bug ( <i>Nezara viridula</i> )	Flowering and boll fill	Attacks fruit and terminal buds	No
Two spotted spider mites ( <i>Tetranychus urticae</i> )	All season but mainly concentrated in late season	Underside of leaves	No
Solenopsis mealybug ( <i>Phenacoccus solenopsis</i> )	All season	Underside of leaves or grouped on stems	No

If you want to know more about pest management in cotton:

- Cotton Pest Management Guide [www.cottoninfo.com.au/publications/cotton-pest-management-guide](http://www.cottoninfo.com.au/publications/cotton-pest-management-guide)
- Integrated Pest Management Guidelines for Cotton Production in Australia [www.cottoninfo.com.au/publications/integrated-pest-management-guidelines-cotton-production-australia](http://www.cottoninfo.com.au/publications/integrated-pest-management-guidelines-cotton-production-australia)

## PEST CONTROL

### Disease pathogens

In dryland cotton production systems, the risk of disease is not as prevalent as it is in irrigated production systems. However, this is not to discount the impact of disease if conditions are right.

A disease occurs when a pathogen is exposed to a susceptible host variety and the environment is favourable for an infection to take place. A disease can be controlled by excluding or eliminating the pathogen, growing a resistant variety or by modifying the environment.

### The pathogen

If pathogens are not present in an area - then don't introduce them! Several of the worst diseases of cotton are caused by pathogens that can be carried in dirt and crop residues attached to vehicles and machinery. Always practice good farm hygiene. Insist that vehicles and machinery, and even boots, are cleaned before leaving a farm - so that they are clean when arriving at the next farm.

**“COME CLEAN - GO CLEAN”.**

**Table 8.** Common cotton diseases

Disease	Crop stage	Crop symptoms
Seedling diseases	Germination and emergence	Pre-emergent seed rot, post emergent damping off, slow early season growth, lesions on roots
Black root rot	Emergence	Stunted, slow early season growth, blackening of the roots
Verticillium wilt	All season	Yellow mottling of the leaves, stem vascular discoloration, plant death
Fusarium wilt	All season	Yellow mottling of the leaves, stem vascular discoloration, plant death
Alternaria leaf spot	After canopy closure	Brown or grey spots on leaves and bolls with purple margins
Boll rot, seed rot and tight lock	After boll opening	Rotting of the boll or cotton not fluffing once opened
Cotton bunchy top	All season	Pale green angular patches on leaves, small or short leaves, internodes and bolls

The only fungicides registered for use on cotton in Australia are seed treatments for the control of the seedling disease complex that causes pre- and post-emergent ‘damping off’ of seedlings. All cotton seed in Australia is supplied with a standard fungicide seed treatment.

## The host

All Australian cotton varieties are resistant to bacterial blight and have high tolerances to Fusarium wilt, Verticillium wilt and Alternaria leaf spot. Nematodes and many of the fungal pathogens can also attack cotton. Seed treatments are available that can 'turn on' the cotton plant's natural defence mechanisms and provide increased resistance to some pathogens.

Crop nutrition is also important. Cotton plants that are deficient in potassium are very susceptible to Alternaria leaf spot.

## The environment

The environment can be manipulated by adjusting the planting date so that boll opening and cotton picking occur at the driest time of the year and fibre damage and down-grading are minimised. Good crop management to prevent tall rank growth can significantly reduce the incidence of boll rots that thrive in the humid environment of a dense canopy.

Wet weather is usually a significant factor in disease development. There are several leaf pathogens that can infect cotton and cause various leaf spots, and even defoliation, when a maturing crop is exposed to an extended period of wet weather.

## Weed control

Summer weeds are aggressive competitors to young cotton seedlings, robbing moisture, nutrients and light. It is therefore important to start the season from a clean fallow and to control early season weeds. Consideration should be given to any herbicide plant-back restrictions, as some may require rainfall to assist with the breakdown of these chemicals.

Roundup Ready Flex has revolutionised weed control in the Australian cotton industry, however, the technology is one tool and should be used as part of an overall integrated weed management system. This is particularly the case in high weed density situations. Utilise residual herbicides and inter-row cultivation or manual weeding where required.

Using alternate modes of action has the additional benefit of minimising the risk of herbicide resistance.

Consult the Roundup Ready Flex Cotton Weed Management Guide for clear recommendations for weed control practices in a Roundup Ready Flex cotton crop. The guide includes a range of herbicides which offer different modes of action throughout the season, reducing the risk of glyphosate resistant weed populations developing on your farm and saving you time and money in the future.

The Roundup Ready Flex cotton Weed Resistance Management Plan details strategies that can be implemented to minimise the risk of glyphosate resistance developing in weeds on-farm.

Both of these guides are available from [www.bollgard3.com.au](http://www.bollgard3.com.au)

Ensure cotton plants are fully destroyed post harvest, as they become woody weeds which can host pests and diseases in between seasons. Effective control of volunteer and ratoon cotton will help to achieve resistance management, disease prevention and insect population control objectives. If volunteers are left uncontrolled in fallow areas, they can cause significant drying down of the soil profile reducing the available moisture being carried over for subsequent crops

Your weed management strategy should be an ongoing discussion with your consultant/ agronomist.

For further information visit the WeedSmart website. WeedSmart is an industry-led initiative to enhance on-farm practices and promote long term sustainability of herbicide use. [www.weedsmart.org.au](http://www.weedsmart.org.au)

Additional information is also available from Bayer on volunteer and ratoon cotton management. Visit [www.bollgard3.com.au](http://www.bollgard3.com.au) to download copies of the Roundup Ready Flex Cotton Weed Management Guide and Roundup Ready Flex Cotton Weed Resistance Management Plan.



## MONITOR TO MANAGE THE CROP

Utilise your consultant/agronomist to monitor crop growth and progress, as well as insect pests and disease, and to prescribe methods of control, if required. A consultant/agronomist can provide a fresh set of eyes and will also have an understanding of where the crop should be up to based on their knowledge of other crops in the district. Critical aspects which your consultant can assist with are growth rates, plant height management and fruit retention.

Cotton is a responsive crop to manage, so growers are able to monitor and manipulate the cotton plant to maximise yield and ease of management. As mentioned earlier, the rate of growth of a cotton crop is determined by temperature and thus depending on the temperature, follows a specific pattern.

Due to this predictability, it allows for management and monitoring to influence crop growth and development. Using the relationship between the rate of development and temperature, a measure of crop progress is described as Day Degrees.

Day Degrees calculation:

$$DD = \frac{(\text{max. temp} - 12) + (\text{min. temp} - 12)}{2}$$

When the temperature is below 12°C, the cotton plant processes cease, and the plant experiences what is termed as cold shock, where the cotton plant's development is retarded. To ensure good early season growth, it is vital to limit the number of cold shock events to which young cotton seedlings are exposed.

**Table 9.** Day Degrees

Crop phase	Day degrees	Days
Sowing to emergence	80	7-14
Growth of one node	40	3-4
Sowing to first square	505	30-40
Sowing to first flower	777	60-70
Open boll	1530	110-130
Sowing to 80% open	2050	150-180

Aim to have the crop achieve the following key parameters (developed from CSD's Ambassador Network).

## Establishment

**Table 10.** Establishment

Soil temperature	Forecast temperature	Established plants
14°C at 8.00 am	Rising	6-10 plants/m

## First flower

**Table 11.** First flower

Total nodes	Nodes above white flower (NAWF)	1st position retention - north	Vegetative growth rate (per internode)
16	8+	80%	5-6 cm

## Cut-out

**Table 12.** Cut-out

Total nodes	Squaring nodes	Plant height	Bolls/m	Vegetative growth rate (per internode)
25	18	100-105 cm	180+	5-6 cm

## Plant growth regulation

Utilise plant growth regulators to manage excessive growth. Excessive rank growth is inefficient, and can lead to boll rots, increase defoliation costs and reduced penetration of insecticides and fungicides.

Generally, there are two times when growth regulators are applied in cotton.

1. In the lead-up to flowering to ensure a balance between the reproductive and vegetative growths. Applications at this time to correct excessive growth have shown improvements in yield.

2. At cut-out to shut down any excessive growth late in the season down. The main purpose is to even the crop up and to direct the plant resources towards filling the later set bolls.

Application of growth regulators to dryland cotton must be carefully considered. Moisture stress can increase the impact of mepiquat on cotton plants.



## FLOWERING TO CUT-OUT IS A CRITICAL TIME

Critically, the period from flowering to cut-out is when up to 90% of the crop yield is set. It is therefore paramount to ensure that the plant/crop grows actively and is healthy through this period. Depending on the regional season length, a major aim throughout this period is to extend the flowering period for as long as possible. Crops approaching cut-out too rapidly are stressed and cannot support the fruit load.

A crop's Nodes Above White Flower (NAWF) will always decrease to a point where it 'cuts out' (four NAWF). This is when there are not enough resources to continue producing additional nodes because the "boll load" is taking most of the plant's photosynthate. The aim is to extend the period till the crop reaches four NAWF for as long as possible within season length constraints. There are limitations; the season length will determine the Day Degrees required in filling later bolls.

The longer the flowering period, the more potential to set more bolls, so the yield potential increases. Studies have shown a positive trend of increased boll numbers as the flowering period is extended.

To extend the flowering period it is important to host a "happy plant" through good crop management. The key is to keep the plant happy through minimisation of:

- Moisture stress (e.g. wider row spacing or full moisture profile)
- Nutritional stress
- Weeds, insects and disease

Crop monitoring through this period should include tracking crop water use and irrigation scheduling, monitoring of nutritional requirements through petiole testing, and ensuring fruit retention and accumulated boll numbers are tracking to the desired target.





## HARVEST/PICKING

Do not defoliate too early – time defoliation to ensure the crop and fibre is mature. Defoliating too early can lead to immature cotton fibres, which can cause problems in the dyeing of the fabric later in the processing chain. Your consultant can assist with the timing of the defoliation operation through one or more of the following methods:

1. 4 Nodes Above Cracked Boll (NACB).  
Physiologically, the last harvestable boll is mature when the boll four nodes down has begun to open up (cracked).
2. When the crop reaches 60% open. This is determined through simply counting the number of open bolls compared to the total number of bolls on a representative number of plants.
3. Cutting bolls and looking for mature seeds. Bolls should be firm to cut even with a sharp knife; the contents of the seed should be fully formed and the seed coat turned from translucent to tan or black.

Defoliation of moisture stressed crops can be difficult and take much longer than expected.

### Nodes Above Cracked Boll (NACB)



Immature

Mature

Harvest is a good time in the Australian cotton industry, but it is also a time when long hours, tight schedules and heavy machinery mix. Safety is paramount, so it is important to ensure procedures and protocols are put in place to minimise the risk of injury. All staff, including contractors, should be made aware of powerlines, especially with tall and unfolding machinery.

Pick on time and without delay. Cotton has the ability to weather some adverse climatic conditions but can be prone to downgrades in fibre quality. Soil compaction is an issue associated with wet picking, due to the size of the machinery. Impacts can be minimised by timing the last irrigation to assist with drying the soil profile down, as well as not re-entering fields too early post rainfall.

Do not pick if seed cotton moisture is greater than 12%. This can cause ginning fibre quality issues which could lead to discount penalties for your cotton. Some signs that cotton is too wet to pick are:

1. If moisture is evident on your vehicle
2. If you can feel moisture on the bolls
3. Seeds inside the lint do not crack if bitten
4. You are experiencing picker head door blockages or the picker is throwing cotton out the front
5. It is after 9.00pm - good picking conditions are rare in the late evening

The aim is to have good quality cotton post-ginning, free of downgrades and to have the highest turn out possible. This is achieved through a proper defoliation and picking under the right conditions.

Consider using a stripper rather than a picker when yields are low and the cotton bolls are tight.

## POST HARVEST CROP CONTROL

Ensure all cotton plants are destroyed post picking. Note: All Bollgard 3 crops must be slashed and mulched within 4 weeks of harvest. As a perennial crop, cotton can regrow into ratoon plants post defoliation/picking, and can:

1. Act as a weed, robbing moisture and nutrients
2. Act as a bridge to host insect pests and diseases
3. Lead to resistance build up
4. Be costly to control

Conduct a pupae-busting operation, if required under your resistance management plan. This pass can be utilised for additional purposes such as planting another crop or remedial action to repair soil constraints such

as compaction, or to place immobile nutrients such as potassium and phosphorus deep into the soil profile.

If a pupae-busting activity is not required, growers should undertake additional tactics, such as root cutting, to prevent and control any ratoon cotton growth.

The Resistance management: control of volunteer and ratoon cotton biotech topic is a helpful reference and is available at [www.bollgard3.com.au](http://www.bollgard3.com.au)



**Please visit [www.acresofopportunity.com.au](http://www.acresofopportunity.com.au), to find your local CSD Extension and Development Agronomist or your Bayer Territory Business Manager.**





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