Crop establishment

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Target plant population

To optimise yield you should aim for an evenly spaced plant population from 5–13 plants per metre. You need to avoid gaps greater than 50cm. This has been verified by many years of experiments in Australian conditions.

There are some situations where growers should target the upper or lower end of this range.

Aim for the lower end of the range when:

- Planting dryland; and,
- Where you normally grow a larger plant size that can compensate well into spaces (e.g. in wetter, warmer climates and good soil types).

Aim for the higher end of the range when:

- Early crop maturing is essential (e.g. southern and eastern regions); and,
- Where you normally grow a smaller plant size that cannot compensate well into spaces (e.g. tight soils).

BE AWARE OF

- The ideal planting time will vary between seasons and districts.
- Replant decisions should be based on good field information about the current population, its health and the cause of the stand loss.
- Remember that replanting needs to be completed within the planting windows for Bollgard II®.
- Crops planted outside the ideal planting window for your district will require special management
- A low and gappy plant stand can be very costly and difficult to manage.

Aim to avoid gaps greater than 50cm – they have a large impact on yield.

Planting rate

The key considerations when determining how much seed you need is your desired plant stand, the seed size and seed quality for the variety you are growing, and how many seeds survive.

On average there are about 10,000 seeds/kg however there will be slight differences between varieties. The average seeds/kg for each variety is printed on the bag and also available on the CSD website.

Seed quality: All CSD seed has a minimum germination of 80% at the point of sale (most are a lot higher than this). Germination percentages for individual lots are available on the CSD website or contacting CSD's lab.

Seedling survival is rarely 100% so you can never bank on seeds/ha and plants/ha being the same.

- **Bed condition**: Uneven or cloddy beds can result in uneven seed depth and seed/moisture contact, resulting in a staggered germination and gaps.
- **Soil insects**: Particularly wireworm, can attack young seedlings. Seed treatment insecticides will control them but because the insect needs to feed on the plant before it dies, some plant loss can still occur.
- **Soil temperature:** Ideal soil temperatures for cotton establishment are 16°–28°C. Temperatures below this result in slow emergence and increased chance of soil diseases.
- **Seedling diseases:** Such as rhizoctonia, pythium and fusarium can kill young plants during and after emergence. This will be more prevalent at low temperatures, where there are high levels of crop residues and in fields with a history of disease.

Many of these factors are unavoidable and the best way to manage them is to increase the seeding rate.

There are more disadvantages in having a plant population that is too low than there are to having one too high.

Planter setup

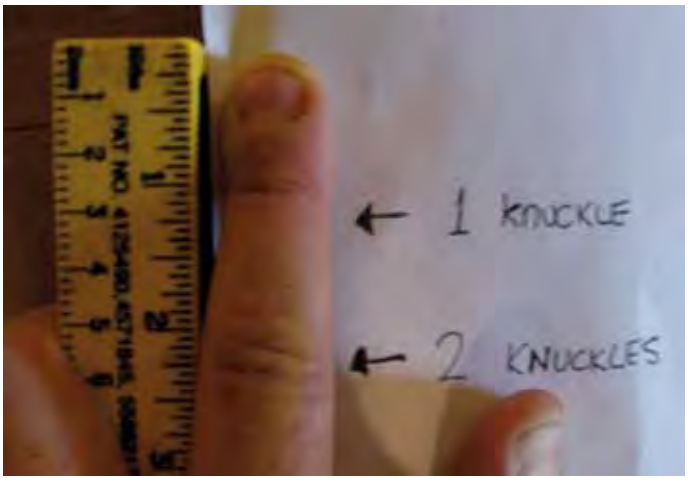
Ensure planter is well serviced and operational well before planting time because breakdowns in the field can rob you of time and allow surface soil moisture to further dry away.

- Check that monitors are calibrated and working correctly.
- Chains and cogs need to be properly adjusted and lubricated.
- Spray lines and filters should be cleaned to stop blockages when planting herbicides or when in-furrow sprays are to be used.
- During the operation, regularly check seed depth and the condition of the soil around the seed. This is especially important when planting on rain moisture where you may get some variability.
- Keep a kit of spare parts (seed tubes, press wheels, scrapers, monitor cables, chains and nozzles) in the cabin to quickly allow for quick minor repairs.
- Planter seeding rates should be calibrated as well as granular insecticide rates if used.

Planting depth

The depth you want your seed depends on the method you are intending to establish your crop. Many people like to use the 'knuckle' as a quick and easy measurement tool in the field (Figure 1)

FIGURE 1.
Checking the planting depth using your knuckles.



Establishment Method	Ideal depth
Planting into moisture (rain or pre-irrigated)	2 ½ and 4 ½cm 1 to 1 ½ knuckles

Be aware of

- If the beds are too wet at planting, you end up with a shiny, smeared slot which is very difficult for the young roots to penetrate. The result is often young seedlings dying from moisture stress, even if there is plenty of moisture down below.
- Check the consistency of the soil above the seed. If the pressure from the press wheels on the planter are set too high, you can get a compacted zone above the seed and the young seedling will have a tough time getting out.
- Some dry soil above the seed slot is useful to prevent losing moisture from around the seed, however if there is too much, a rainfall event after planting will turn this dry soil into wet soil, and increase the depth for which the young seedling needs to push through.

Particularly when planting on rain moisture, beware of uneven moisture throughout the bed which will cause variable crop development.

Establishment Method	Ideal depth
Planting Dry and Watering Up	2½cm 1 knuckle

This method has advantages in hot climates, because it cools the soil and crop establishment is rapid. However, consider pre-irrigating when:

- There is a large seed bank of difficult to control weeds; and,
- The soil is very dry and temperatures are high.

Any shallower than 2½cm and the plant doesn't have

Planting into moisture.

the chance to scrape off the seed coat at germination and growth of that plant will be quite slow until that coat is thrown off.

- When planting dry, it's very important to be aware of the consistency of the seed bed. A poorly consolidated (or cloddy) hill can collapse when the water hits it and dropping the seed down to great depths, resulting in a poor or variable strike. This is especially important for crops coming out of sugarcane or corn.
- Sowing can be followed by an over-the-top application of Roundup Ready™ herbicide, targeting newly emerged weeds.

Planting time

The ideal planting time will vary between seasons and districts.

Start Time: Planting should not occur until minimum soil temperatures at seed depth are maintained at 16ºC at 10cm depth or more for three days and rising. Planting at temperatures below this will diminish root growth, reduce water and nutrient uptake and the plants are much more susceptible to seedling diseases and insects.

History shows the incidence of replant has been much higher in situations where soil temperatures have been lower than ideal.

End Time: Agronomically, the end date is more important in short season areas where early crop maturity is essential. Shortening the length of the growing season will impact on yield, with 0.3 to 0.6 bales/ha for every week that the season is shortened. This is evident by the comparison of ideal planting times for northern, central and southern regions for irrigated cotton (see Figure 2). A sowing time response for dryland systems is presented in the chapter on dryland yield and risk at the start of this manual.

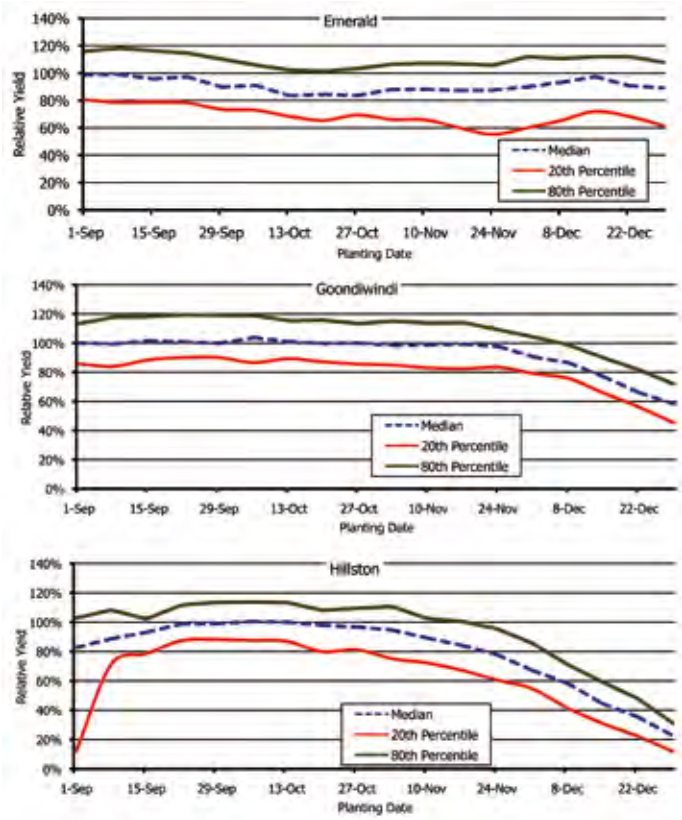
The adoption of Bollgard II® cotton has helped eliminate some of the desire for very early planting because:

- These crops tend to retain more early fruit and hence a quicker time between planting and picking.
- The season-long Helicoverpa control offered by this product diminishes the risk of high late-season insect numbers and control costs associated with conventional cotton.

Where season length allows, planting slightly later has a lot of advantages:

- It will increase the likelihood of warm temperatures at planting, resulting in increased seedling survival and vigor.
- A crop established under warm conditions has the potential to produce bigger plants, hence greater leaf and stem area to sustain boll development later in the season.
- Later planting will delay the peak flowering period past the hot conditions often associated with late December/ early January period. This can reduce the likelihood of premature cut-out, higher micronaire, and can contribute to increased fibre length..

FIGURE 2.
Irrigated cotton yield potential by sowing date for Emerald, Goondiwindi and Hillston.



Data generated by CSIRO using the OZCOT model assuming soil Plant Available Waterholding Capacity (PAWC) of 200mm (Emerald and Goondiwindi) and 150mm(Hillston), Irrigation deficit of 70mm, Water allocation for the season of 8Ml/ha.

Note: Planting 'slightly later' will mean different things in each region, depending on season length:

- In cooler areas in the south and east it may mean planting in mid October.
- In central regions it may mean mid to late October.
- In northern and western regions it may mean mid October to early November.

Other factors that need to be considered in determining planting date:

- Late maturing crops may be more susceptible to pests such as silverleaf whitefly and aphids.
- Availability of harvest machinery if a crop is much later than others in the district.

In all cases, people growing Bollgard II® cotton need to plant within the planting window for their district. This information is available in the Bollgard II® Resistance Management Plan which can be found in the Cotton Pest Management Guide.

Planting on rain moisture

Although this is what dryland growers do every year, many irrigators also aim to establish their crop on rain moisture to save water on pre-irrigation or watering up.

There are a number of factors that will improve the likelihood of success with planting into rain moisture and some cautionary points for those attempting it on irrigated country.

Cereal stubble is important in the establishment of dryland crops – it improves moisture infiltration and protects the young seedlings from sandblasting.

Stubble

The presence of standing stubble will increase the chance of seedling survival in moisture planting situations dramatically because it increases the amount of infiltration and hence moisture available to the seedling, it reduces surface evaporation and it protects the young seedling from the elements.

Bare fallows in irrigation country

This is a risky practice and often results in replants if conditions are not ideal. Fields hilled for irrigation are designed to shed water so you need to check whether moisture has infiltrated to any depth into the seed zone.

- In cloddy seedbeds the fine materials may be wet but the larger clods may be dry and may draw moisture away, drying the seed bed.
- Check across a field to see whether the rainfall has been uniform.
- When planting, check soil moisture levels in the seed zone regularly.
- In furrowed fields, rainfall will usually not fill the soil profile as well as irrigation so after emergence, soil moisture levels and the vigor of the young seedlings need to be monitored closely as an early first irrigation may be required.

Do I need to replant?

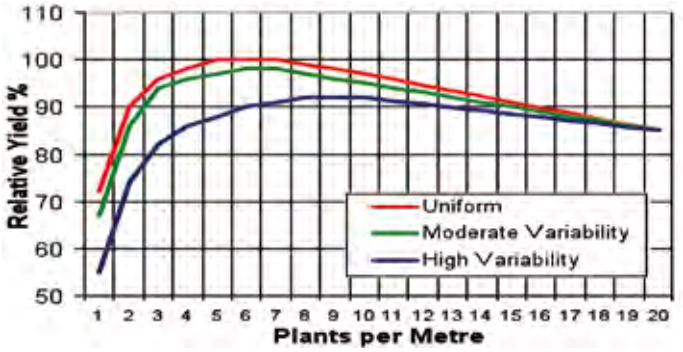
The decision as to whether to replant or not is sometimes a straightforward decision, and other times not. The obvious question is "will I achieve a better result with the plants I've got or should I start again?"

The decision needs to be made carefully, based on good field information on the current population, its health, the cause of the stand loss the implications of replanting and the implications of managing a low plant stand. Some factors to consider:

Measure your plant stand

Figure 1 demonstrates the relative potential yield of plant stands that are variable or non-uniform compared with a uniform stand. A plant stand with high variability is one having 2 or more gaps greater than 50cm in length every 5 metres of row. The data also shows that 5–10 plants/m of row has the best yield potential; variable stands will reduce yield for all plant populations.

FIGURE 3.
Relative yield potential at a range of Plant Stand Uniformities. (Source: G Constable, 1997)



Causes of the plant loss

Establishing the cause of the stand loss is important so you can determine whether further plants will die and also if you choose to replant, whether the crop will succumb to the same problem again. Often stand loss is due to a combination of factors.

- **Insect Damage:** If insects such as wireworm are the cause of plant loss assess whether they are still present and continuing to kill plants. If you replant, use an in-furrow insecticide or a robust seed treatment at a higher planting rate.
- **Diseases:** If seedling disease is the cause of the stand loss consider whether plants are still dying and likely to reduce the plant stand further. Generally higher soil temperatures will reduce their incidence when replanting.
- **Soil Characteristics:** In sodic or hard setting soils, seedlings may be slow in emerging or get stuck under a crust. Sometimes the mechanical breaking of this crust to allow the young seedlings through, maybe more effective than replanting.
- **Herbicide Damage:** If planting herbicides washing into the root zone has injured or killed young seedlings, consider whether this will reduce the population further and whether it will impact on replanted plants.

- **Fertiliser Burn:** If ammonia burn has killed young seedlings, the replant should be off-set from the original problem so it does not reoccur.
- **Hail or Sandblasting Damage:** Try and determine whether the surviving seedlings will regrow.

The implications of replant

- **Replanting Date:** Relative yields decline by late October in warmer growing regions and earlier in cooler regions (Figure 2). This reduction in yield potential should be factored into replant decisions, as a low population or gappy stand may have a greater yield potential that one which could be replanted.
- **Soil Moisture Status:** In seasons where irrigation water is such a limiting factor, the soil moisture status is a critical factor in determining whether or not a replant is justified.
  – Is flushing or rainfall going to get dry seeds up?
  – What implication does this have to the water budget for the rest of the planted acreage?
- **Dry Seeds:** Seeds can survive in soil for a long time. Consider if a stand will be improved if rainfall or irrigation geminates these dry seeds.
- **Variety Selection:** If the replant means you are planting late in the window, choose a variety which has performed well in late planted scenarios in your area. These are typically the more determinant variety with inherently longer, stronger and mature fibre as cooler conditions at the end of the season can negatively impact on fibre quality. Check variety guides for suitable varieties.

Remember, any replanting needs to be completed within the planting windows for Bollgard II®.

Avoid planting into fields with established weeds – they will draw moisture out of the profile so it's not available to the young seedlings.

The implications of not replanting

Sometimes sticking with the plant stand you have is a better option than replanting. There are some considerations of managing a low plant population.

- **Lower Yield Potential:** If possible, prioritise resources to fields with better plant populations and higher yield potentials. This is particularly relevant in limited water situations.
- **Weed Populations:** Low plant populations with gaps may encourage weed problems later in the season due to lack of competition. A plan for their management should be devised early.

Further information
CSD – www.csd.net.au