



Technical Information

Planting and Establishment of Broad-Acre Summer Field Crops in Queensland

Good planting and crop establishment practices are vital to ensure suitable plant populations are achieved. Crop rotation is a useful management tool, particularly for pest and fertility management. Good management techniques early on in the life of the crop improve the likelihood of high yields and quality at harvest.

Minimum or zero tillage practices are becoming popular in many areas, with significant benefits in terms of maintaining soil structure, minimising runoff, erosion and compaction, and maximising water retention. Planting skip rows or varying row spacing in dryland areas is also increasing. Although there is no advantage in a good year, skipping every second or third row reduces the risk in a dry year, as moisture in the unplanted area is then available to the plants later in the season.

Crop selection

Profitability, risk and previous experience remain the major criteria for crop selection. The area of each crop planted is driven by market demand and likely on-farm price of the produce. While crop rotation and enterprise diversification are becoming increasingly important, the features of each crop in terms of profit, risk and management must be fully understood.

It is important to choose crops you know how to grow and grow them well. Select a known adapted variety and fertilise it adequately, establish a good stand and take care with weeds and insect control. There is potential for many farmers to increase profits by lifting yields by adapting new technology and improving property management planning.

Because marketing can affect farm profits it is important that farm managers have market intelligence to assist in crop selection. The time spent on marketing research could be as rewarding as a timely fall of rain. No longer can you plant a crop and know that you are going to get a good price for it. Crop prices fluctuate quickly and dramatically. Australia is too small to influence selling prices and is at the mercy of markets determined by others. The domestic market is sound but small.

Prices, supply and demand should be addressed in the market research whilst also looking at opportunities for direct marketing compared with industry pools and, perhaps, niche markets in some crops. Quality is also becoming an important issue as consumers set new standards for quality products (e.g. cash premiums for high grain protein).

Summer planting

Diversification away from a winter cereal monoculture to a cropping system including summer crop rotations can break weed, disease, and insect cycles, improve farm profitability, spread risk and reduce costs by spreading machinery use and time. The management requirements for successful summer crops are higher than for winter cereals. The major agronomic consideration for dryland summer crop production is stored soil moisture.

Grain sorghum is the most consistently reliable dryland summer grain crop option because it is hardier and more tolerant of dry weather than maize. It is best suited to deep clay soils with a full moisture profile at planting. Correct plant population, good weed and insect control are vital for success. The grain is used mainly for stock feeding and the stubble provides valuable grazing after harvest or from a failed crop.

Specific **maize** varieties are available for the production of grits (used in breakfast foods and corn chips). Other varieties are used for stock feed and waxy maize for starch production. As a forage crop, maize makes good silage. Maize requires more rainfall than sorghum to produce a crop and is more reliably grown with irrigation.

Sunflower is a more temperate crop than either grain sorghum or maize. Sunflower seedlings have good frost tolerance. Sunflower is a strong tap rooted crop but gives very little protection against soil erosion. Management of insects, especially Rutherglen bug is important, and birds can be a significant pest.

Summer forages

Forage sorghum is the major summer forage crop. Sorghum has greater reliability, drought tolerance and feed production than other summer forages. However, the lower feed quality of forage sorghums make 'finishing' animals difficult.

Table 1 Western Darling Downs district summer crop yields (t/ha)

| District | Sorghum | Sunflower |
|-----------------------|---------|-----------|
| Average yields | | |
| Miles | 1.5 | 0.6 |
| Goondiwindi | 1.3 | 0.6 |
| Roma and West | 1.0 | 0.3 |
| Waggamba | 1.0 | 0.3 |
| St George | | |

| | | |
|---------------------------|-----|-----|
| Better farm yields | | |
| Miles | | |
| Goondiwindi | 2.0 | 1.0 |
| Roma and West | 1.8 | 1.0 |
| Waggamba | 1.6 | 0.6 |
| St George | 1.6 | 0.6 |

Planting techniques

The benefits of conservation farming – increased fallow stored moisture, less soil erosion, opportunity cropping and lower tillage costs – have resulted in a swing away from finely worked seed beds and bare ground to less soil pulverisation and more stubble retention. Even with zero tillage or reduced tillage planting, a "seed-bed" is required in the zone into which the seed is to be placed.

In some seasons the opportunity to sow into old crop stubble where soil moisture replenishment is adequate or to sow up to six weeks after rain allows crops to be sown at their optimum time. Management decisions that allow for "opportunity cropping" include:

- Maintenance of stubble cover
- The substitution of herbicides for tillage to control weeds
- Having planting machinery capable of handling zero till and deep sowing.

Calculating a planting rate

Because each crop and the varieties within that crop have different seed sizes, a fixed quote for the weight of seed needed to plant one hectare is not always a true or accurate measure of obtaining a desired plant population per hectare. An actual seed count is required to calculate a more accurate planting rate. A two part method of calculating the planting rate of a crop in kg/ha given a designated plant population is:

1. Target plant population (plants/ha) ÷ Germination % ÷ Expected field establishment % = **SEEDS/ha**
2. Seeds/ha ÷ Seeds/kg = **PLANTING RATE (kg/ha)**

Example using sorghum:

1. $50\,000 \div 0.9 \div 0.7 = 79\,365$
2. $79\,365 \div 28\,000 = 2.83 \text{ kg/ha}$

Alternatively, to calculate planting rate use the following formula:

$$\frac{\text{target plants/ha}}{\text{seeds/kg} \times \text{establishment\%} \times \text{germination\%}}$$

Germination percentage and seeds/kg information can be found on bag labels, or you can do your own germination tests and/or seed counts. Divide 100 into the percentage rates to produce a metric fraction (e.g. 90% = 0.9).

Plant spacing

After assessing the planting rate of seed, ensure the planter is spacing seed at the right distance apart. Using data from the following tables, calculate the right seed placing distance to give the required established plant spacing and achieve a desired plant population density per hectare.

Note: 1 000 000 plants/ha is equivalent to 100 plants/m². 50 000 plants/ha is equivalent to 5 plants/m².

Summer crops

| | Planted seed per hectare (planting rate x seeds/kg) | | | | | |
|--------------|---|--------|--------|--------|--------|---------|
| | 30 000 | 40 000 | 50 000 | 75 000 | 90 000 | 100 000 |
| Row spacing | Distance between seeds in the row (in cm) | | | | | |
| 25 cm (10") | 132.0 | 100.0 | 80.0 | 53.2 | 44.0 | 40.0 |
| 35 cm (14") | 95.0 | 71.0 | 57.0 | 38.0 | 32.0 | 28.6 |
| 50 cm (20") | 66.0 | 50.0 | 40.0 | 26.6 | 22.0 | 20.0 |
| 75 cm (30") | 44.0 | 33.0 | 27.0 | 17.7 | 14.7 | 13.3 |
| 87 cm (35") | 38.0 | 29.0 | 23.0 | 15.3 | 12.7 | 11.5 |
| 90 cm (36") | 37.0 | 27.0 | 22.0 | 14.7 | 12.2 | 11.0 |
| 100 cm (40") | 33.0 | 25.0 | 20.0 | 13.3 | 11.0 | 10.0 |

Winter crops

| | Planted seed per hectare in 1,000's |
|--|-------------------------------------|
|--|-------------------------------------|

| | 100 | 150 | 200 | 250 | 300 | 500 | 800 | 1000 | 1250 | 1500 |
|--------------------|--|------|------|------|------|------|-----|------|------|------|
| Row spacing | Distance between seeds in the row (in cm) | | | | | | | | | |
| 17.5 cm (7") | 57.2 | 38.0 | 29.0 | 23.0 | 19.0 | 11.0 | 7.0 | 6.0 | 4.5 | 3.8 |
| 25 cm (10") | 40.0 | 27.0 | 20.0 | 16.0 | 13.0 | 8.0 | 5.0 | 4.0 | 3.2 | 2.6 |
| 35 cm (14") | 29.0 | 19.0 | 14.0 | 12.0 | 10.0 | 6.0 | 3.5 | 3.0 | 2.3 | 1.9 |
| 45 cm (18") | 22.8 | 15.2 | 11.4 | 9.1 | 7.6 | 4.6 | 2.8 | 2.3 | 1.8 | 1.5 |
| 50 cm (20") | 20.0 | 13.3 | 10.0 | 8.0 | 6.6 | 4.0 | 2.5 | 2.0 | 1.6 | 1.3 |

Calculating field establishment percentage

Field establishment is the percentage of seeds planted that germinate and survive. An establishment figure of 70% means that for every 10 seeds planted, only 7 will emerge to produce a plant. Establishment in the field can be affected by factors such as soil type, seedbed, moisture, planting times, disease, soil insect damage, depth of planting, seed vigour.

(a) To calculate how many **viable seeds/ha** were planted with a planting rate of 2.5 kg/ha at 30 000 seeds/kg and 95% germination:

$$2.5 \times 30\ 000 \times 0.95 = 71\ 250 \text{ seeds/ha}$$

(b) If the plant population is 50 000 plants/ha, then **field establishment percentage** is:

$$\frac{50\ 000}{71\ 250} \times 100 = 70\%$$

$$71\ 250$$

Expected establishment for summer crops planting good quality seed:

- precision planters: 60–80%;
- other presswheel planters: 50–70%;

- no presswheels: 30–50%.

Plant establishment can be improved by accurately calibrating the planter, always checking for soil insects before planting, planting at speeds of 10 km/h or less, using presswheels and narrow planting points and planting at the correct depth.

Planting depth

Optimum planting depth varies with planting moisture, soil type, seasonal conditions, climatic conditions, and the rate at which the seedbed dries. The general rule is plant as shallow as possible provided the seed is placed in the moisture zone but deep enough so that the drying front will not reach the seedling roots before leaf emergence.

Depth control

The addition of an airseeder unit will not necessarily convert an acceptable tillage implement into an acceptable planting implement. Positive depth control of planting machines in the form of mechanical depth stops or a hydraulic stop is essential to avoid hydraulic creep.

Some other compromises to minimise depth variation:

- Frame length and width affects seed depth. Flexible frames with sectional widths <3m will assist, as will large diameter tandem walking wheels.
- Planter units fitted behind tillage implements give good depth control. Depth control wheels should be as close as possible to the line of planting tines. Select planting tines on bars towards the centre of the planter rather than on the front or rear bar.
- To overcome the problem of high breakout tines driving too deep into small hills in the seedbed, some form of scraper on the tine may be useful. Flat chisel tines have some advantage in displacing surplus soil.
- In melon-hole country or in controlled traffic situations where crossing contour banks is necessary, ground following tools such as pivoting tines or parallelograms will give much better depth control and may justify the additional cost over fixed tines.
- Press wheels will often compensate for poor depth control.

Deep moisture

If planting moisture is deeper than normal, deep furrow planting techniques (using adapted scarifier or chisel ploughs or press wheel planters) will allow seed placement in the moisture zone. Wider row spacings to avoid soil coverage of adjacent rows. Avoid excessive planting speeds or excess soil will be thrown into the corresponding row. Common features of deep furrow techniques include narrow tines with high breakout pressures, narrow points to minimise soil disturbance and moisture loss and high pressure narrow press wheels (slot into the seed trench and help stabilise it) which reduce the seed-surface distance and help seed/soil contact

Seed soaking and water injection

Seed soaking

The procedure for seed soaking is to:

1. fully immerse open bags of seed in water for one hour;
2. drain off excess water (seed can be drained in bags if porous);
3. stand seed in the shade for two hours;
4. treat seed with insecticides or fungicides;
5. sow within 12 hours of soaking.

Risks include seed softening, increased susceptibility to damage in planting machinery and poorly dried seeds may clump producing uneven plant spacing. Soaked seed will swell and if left standing too long will eventually sprout and become susceptible to mechanical damage during planting. Remember to re-treat seed with fungicide after soaking.

Seed soaking is generally not recommended unless for the purpose of including insecticides or fungicides. It increases downtime and is generally impractical. As with water injection, seed soaking can increase the rate of germination, but rarely does it improve final emergence.

Water injection

Planters can be modified to include water injection equipment. Water injection speeds germination, enables seedling roots to reach moisture ahead of the drying front, allows insecticide and inoculum to be applied easily by adding to the water and may extend the planting period. Its effectiveness is improved by narrow planting tines and presswheels.

Disadvantages include reduced planting efficiency and the loss of one in five days, due to frequent water tank refills.

Whilst water injection can increase the rate of germination, rarely does it improve the final plant stand. Not only is it a costly operation in terms of equipment and downtime, the acclaimed benefits are usually more aligned with the benefits from addition of fertiliser, insecticide or fungicide. As such, water injection should only be considered as a carrier to apply fertilisers, insecticides or fungicides on precision placement planters.

Water injection rates range between 300 to 800 L/ha with an average of 500 L/ha.

Crop establishment

Factors affecting crop establishment

Poor seedling establishment occurs because of:

- inaccurate or variable seed depth
- poor seed-soil contact
- poor quality seed

- unsuitable soil temperatures
- soil insects and soil disease
- herbicide residues.

The impact of poor establishment and seedling vigour will be reduced if seedbed requirements are matched to machinery capabilities and seed quality.

Surface sealing may be a problem if heavy rains fall immediately after sowing and prior to emergence. The emerging shoot is often unable to penetrate the hard surface crust that forms as the soil dries. The problem is more prevalent on soils with declining organic matter, especially red-brown earths and grey clays. Harrowing as soon as practical after sealing has occurred will break the soil crust and allow leaf development to proceed. In many instances this has doubled the initial emergence. Gypsum application may help alleviate this problem on hard setting clays.

Low soil temperatures cause slow germination and establishment. Developing seedlings are at risk from insect and fungal attack.

| Crop | Minimum soil temperature (°C) at intended planting depth at 7am |
|-------------|--|
| Sorghum | 17 |
| Sunflower | 10 |
| Maize | 15 |