



Pasture establishment for groundcover and productivity

Landholders may consider pasture establishment to be a high risk operation.

Research trials and landholder experience have shown that the pasture establishment process can be made much more reliable if some **basic guidelines** are followed.

Basically, a **pasture should be treated like a crop**.

Pasture establishment is the sowing of seed to achieve a plant population able to **maximise groundcover and productivity** in as short a time as possible.

Pasture establishment is a 'numbers game', and is based on the germination, seedling emergence, growth and survival of the seeds that are sown.

Landholders can increase their chance of successful establishment by ensuring optimum conditions for germination, emergence and early growth, **via practices such as seedbed preparation and sowing**.

Pasture establishment is best considered as a **three-phase process**:

1. a seed **germination** phase;
2. a seedling **emergence** phase; and
3. a seedling **growth** and **survival** phase.



Perennial grass pasture, five months old, after zero tilling into wheat stubble.

Pasture establishment — at a glance

- Select species **suited to the soil type**, climate and conditions.
- Get a **germination certificate** and sow only **good quality** seed.
- Fallow seedbeds to control weed seed banks and accumulate soil moisture. Aim for **30-50cm depth of good moisture** at planting.
- Sow small pasture seeds into the soil but not more than 10-15mm deep; **press wheels** will improve soil-seed contact and speed germination.
- Alternatively, if necessary, drop seed on top of a **freshly cultivated** rough surface but never on an uncultivated or sealed surface.
- **Harrowing or rolling** to cover surface-sown seed and improve soil-seed contact will further improve establishment.

Seed germination

The two most important factors determining whether a seed will germinate are the **quality of the seed** and the **amount of water** the seed is able to take up (or imbibe) during a given time period.

Seed quality

The ability of a seed to germinate depends on whether it is alive or dead, fully mature and free of dormancy factors. Grass seed can contain a high proportion of dead or immature seed. Additionally, the seed can often contain chemicals that inhibit the germination of otherwise good seed. Freshly harvested grass seed is more likely to be affected by dormancy factors, which generally decline with storage time.

Many legume seeds have a hard impermeable seed coat that prevents entry of the water required for seed germination. Legume seed that has greater than 50% hard seed content may need **scarification** treatment before sowing.

The best indicator of seed quality is a current **seed germination certificate** (less than 12 months old). Germination certificates should be available for all seed that is sold. Always get a current certificate from your seed merchant for every seed lot purchased. Seed of low germination often has poor seedling vigour as well.

Do not purchase low quality seed even if it is cheaper!

Uptake of water by the seed

To germinate, a seed must take up water faster than it loses water during a critical period of time that is sufficient to stimulate the germination processes. Depending on species, this can take from **one to six days**. This means that the soil must remain wet enough for long enough to maintain the moisture content of the seed. The faster the seed takes up water the sooner the germination process begins.

Speed of water uptake by a seed depends on how wet the soil is and the degree of contact between the seed and moist soil. Seeds imbibe water through the area of seed that is in contact with moist soil. **Seed placement** therefore has a big effect on seed germination. Placing seeds into the soil increases the rate of water uptake and reduces water loss from the seed.

On the other hand, seeds placed on the soil surface can only take up water from that part of the seed that is **in contact with the soil**. The remaining part of the seed actually **loses water by evaporation** at a rate that is dependent on the microenvironment surrounding the seed. Seed placed on the soil surface by broadcasting or aerial seeding is therefore in a hostile environment unless conditions remain moist for an extended period of time.

Pressing the soil around the seed with either rollers or press wheels improves soil-seed contact, further **improving moisture uptake** and enhancing germination, while **surface cover** reduces temperatures, evaporation and drying at the soil surface.



Zero tilling small-seeded pasture grasses into wheat stubble using press wheels improves soil/seed contact and speeds up germination. This young perennial grass pasture (inset) at the six week mark has already improved surface cover. Also note the absence of weeds.

Seedling emergence

Seedling emergence is dependent on factors such as **depth of seed placement**, **rate of drying** of the soil and the **presence or absence of surface crusts**. Once a seed germinates, it must emerge and grow before the soil dries or it will be desiccated.

Depth of seed placement

From a soil moisture viewpoint, the **deeper** seeds are placed below the soil surface, **the better** the soil moisture status, the faster the moisture uptake by the seed and the slower the drying of the soil.

Sowing seed below the soil surface can increase germination and emergence by up to **10-fold** compared to broadcasting on the soil surface.

However, depth of seed placement is limited by the **size** of the seed. Most pasture seeds are relatively small and **must not** be placed more than 10-15mm deep otherwise they will not come up. While the surface 10-20mm of soil is still very prone to drying, this is slowed by the presence of **surface cover**.

Surface crusting

Hot conditions accompanied by rapid drying of the soil surface often leads to the **formation of crusts**, especially on soils that are low in organic matter, have a high sodium content, or lack **surface cover**. The crust can form an impenetrable barrier to emerging seedlings and lead to **establishment failure**. Surface cover will shade the soil surface and reduce the rate of drying and development of crusts.



The liverseed grass in this paddock indicates the weed seed bank is still too high for pasture planting.

Seedling growth and survival

Seedling growth and survival depends on an adequate supply of **soil moisture** and **nutrients** and freedom from **weed competition** within the root zone of the young seedling.

The surface layers of the soil that have no protection from **surface cover** dry rapidly under sunny, hot conditions, especially if soil moisture is limiting.

It is therefore recommended that at least **30-50cm depth of good moisture** be present in the seedbed **before planting takes place**. Seedling root growth must also exceed the rate of drying of the soil otherwise they will die. Adequate soil nutrients are necessary to achieve this.

Weed control

Surface cover protects the soil surface and the young seedlings from hot drying conditions. Live plants actively **compete for nutrients and water**, not only reducing the growth of pasture seedlings but also resulting in their death.

Vigorous annual grasses and broadleaf weeds — such as liverseed grass (*Urochloa*), barnyard grass, button grass, mint weed and amaranths — can easily smother young pasture seedlings and lead to **establishment failure**.

Prior knowledge of the level of **soil seed banks of annual weeds** in a paddock is particularly important when planning for pasture establishment. Where soil weed seed levels are high it may be necessary to delay planting for one to two years in order to control the weeds by reducing their seed banks. The weed species must not be allowed to set seed during that period.

Soil nutrients

Many soils are deficient in one or more of the important nutrients that are necessary for seedling growth; this varies from species to species. Grasses such as buffel grass, Gatton and green panic have a **high nutrient demand**, while Rhodes grass, Bisset Creeping bluegrass and Premier digit grass have a **moderate fertility requirement** and most native species have a **low fertility requirement**. Most legumes require reasonable levels of phosphorus and sulphur in the soil. A soil test is the best way of determining soil nutrient levels. If nutrients are inadequate for the species being sown, fertiliser will need to be applied or a lower-fertility demanding species sown.

Putting it together

How to sow

The principles of pasture establishment are similar to those for establishing a crop. One needs to establish a **base population** of plants that develop into a productive pasture with good groundcover. For most tropical tussock grasses, this means achieving a population of at least **6-8 mature plants per square metre** one year after sowing.

Years of research and commercial experience have shown that there is a need to **sow 2-4kg of grass seed per hectare** to achieve, or preferably exceed, this population. Seeding rates for coated seed should be increased to compensate for the lower number of seeds per kilogram (the ratio of coating material to seed varies from type to type).

Best establishment is likely to be achieved by sowing the seed into a dry soil surface that has at least **30-50cm depth** of good moisture within **5-7cm** of the soil surface, rather than broadcasting it on the soil surface.

A **zero tillage** approach where stubble or dead grass is left standing to provide protection for young seedlings, as well as slowing the drying of the soil surface, is recommended.

Tine-based zero tillage planters fitted with narrow points and press wheels have been used to successfully establish sown grass and legume pastures. These planters can also be used to sow into a cultivated seedbed. However, **great care** must be taken to ensure that the seed of small-

seeded pasture species is **not sown deeper than 10-15mm**.

When to sow

Pastures should be sown at a time when there is **greatest chance** of success. Such principles are based on building a profile of soil moisture, weed control and seasonal temperatures.

It is best to sow pastures at a time of year when temperatures are favourable for growth and there is greatest chance of getting **follow-up rain within 5-10 days**. This generally occurs during the summer months in southern Queensland.

All tropical pasture species are **susceptible to frost** and seedlings need to reach a critical size before being frosted. Sowing after the end of February in southern Queensland means sowing in a time of lower rainfall probability and also runs the risk of smaller plants being frosted, especially if early frosts are experienced.

There is little point in sowing pasture species and varieties that are not adapted to the environment and soil type as they will fail to persist. Select species that are suited to the soil type, climate and conditions.

Grazing management

Exclude stock until pastures are a well established by allowing all species in the pasture mix to set seed before the pasture is grazed. This allows the young plants to develop sturdy root systems and build up root reserves so that they can withstand stress, including frosts and drought.

Further reading

- *Pastures for protection and production on marginal cropping lands*: this publication, available from QMDC or Landcare offices in southern Queensland, includes a species selection chart and other useful information.
- *Pasture establishment in old cropping country in southern Queensland*: this paper by Dr Sid Cook is available from the Tropical Grasslands website (www.tropicalgrasslands.asn.au) in the journal archive section. Tropical Grasslands Journal, Volume 41, pp 191-199.



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