WESTERN

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GRDC GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 3

PLANTING

INOCULATION | CROP ESTABLISHMENT | SEEDING RATES | PULSES AND HERBICIDE DAMAGE | SEEDING EQUIPMENT

Planting

Key messages

- Inoculants carry live root-nodule bacteria (rhizobia), which can die from exposure to sunlight, high and low temperatures, and chemicals. The strain of rhizobia used to inoculate faba bean is WSM1455.
- Rhizobia only fix nitrogen (N_2) when inside a legume nodule.
- This nitrogen fixation process has a national benefit of ~$4 billion annually to Australian cropping.
- Stubble retention can increase water infiltration and slow moisture loss.
- Early sowing produces the highest potential yields, but requires greater attention to disease control, particularly for chocolate spot.

FAQ

3.1 Inoculation

Pulses have the ability to fix their own nitrogen (N_2) from the air via nodules on their roots if specific N_2-fixing bacteria (rhizobia) are available (Figure 1).

Faba beans tend to nodulate freely, but agronomists will often suggest inoculation as cheap insurance against poor nodulation, especially in acid soils. Inoculating legume seed or soil at sowing provides a large number of effective rhizobia around the emerging legume root to optimise nodulation and N_2 fixation.

When the legume germinates, the rhizobia enter the plant's roots, multiply rapidly and form a nodule. Effective nodule formation and function requires good growing conditions, the appropriate rhizobia and a host plant.

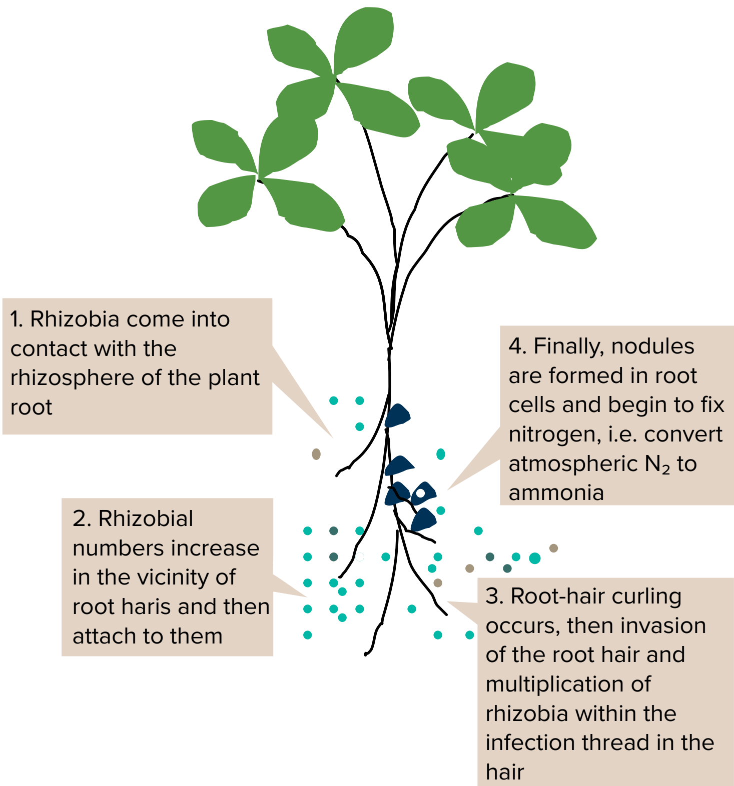


Figure 1: *Schematic representation of the process of nodulation.*

Source: D Herridge 2013

Inoculation with the correct rhizobial strain is essential for effective nodulation in some soil types and situations.

The strain of rhizobia used to inoculate faba bean, WSM1455, is common to field peas, vetches and lentils. Faba beans and lentils are in group F, which only responds to the use of WSM1455, while field peas and vetches are in group E.

Photo 1: *Well-nodulated faba bean roots.*

Source: D Herridge 2013

Rotation lengths of four to five years are recommended between successive faba bean crops as a disease management strategy (e.g. for Ascochyta blight). At this interval in some of the more 'hostile' situations (e.g. acid soils), it is unlikely that sufficient levels of Group F rhizobia will survive for effective nodulation, so inoculation is recommended.

The Group F rhizobia are regarded as 'aggressive' nodulators. This means nodulation will be successful in meeting the crop's N requirements provided:

- Inoculants are handled and stored in a manner that will ensure bacterial survival, i.e. they should be kept cool.
- Inoculated seed is planted into moisture within 12 hours of treatment—the sooner the better, as fungicide seed dressings and warm temperatures can affect the survival of the bacteria.

Group F rhizobia are extremely sensitive to the level of available nitrate-N in the soil.

While a high level of nitrate-N has no significant effect on the initial formation of nodules, and their number, it does markedly reduce both nodule size and activity.

Nodules remain inactive until the soil nitrate supply is exhausted; ineffective nodules remain white inside from the absence of leghaemoglobin. Effective N_2-fixing nodules, on the other hand, are rusty red or pink inside (Photo 2).

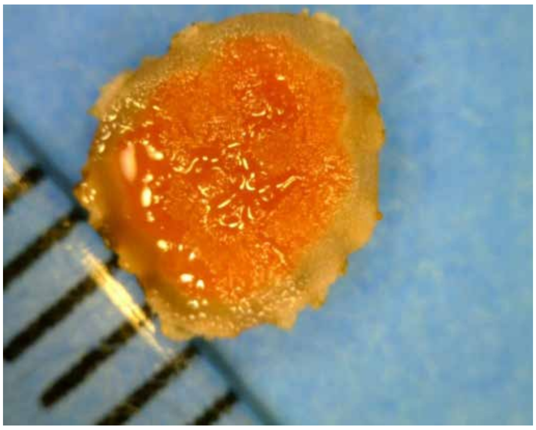


Photo 2: *Active nodules have a pink centre.*

Photo: G. Cumming, Pulse Australia

When the legume germinates, the rhizobia enter the plant's roots, multiply rapidly and form a nodule. Effective nodule formation and function requires good growing conditions, the appropriate rhizobia and a host plant (Photo 1). [1]

When purchasing inoculants:

- Choose Group F faba bean inoculum.
- Check the expiry date on packet.
- Note how it been has been stored.
  - » Packets should be stored at ~4°C.
  - » Do not freeze (below 0°C) or exceed 15°C.
- If applying a slurry, apply in the shade ad avoid exposure to high temperatures (>30°C), direct sunlight, and hot winds.
- Accurately meter adhesive slurry onto the seed. Too much water means sticky seeds and blockages in the seeder.
- Avoid high-speed mixing in augers.
- Sow inoculated seed immediately. Never delay more than 12 hours.
- Check air-seeders for excessively high temperatures in the air stream. Temperatures >50°C will kill the rhizobia. [2]

3.1.1 Inoculant types

A diverse range of inoculant products with different methods of application is available.

The inoculant type used will depend on product availability, relative cost, efficacy, ease of use and machinery availability. Granular products vary and may be dry or moist, uniform, variable, powdery, coarse or fine. [3]

1 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

2 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

3 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

Table 1: *Rhizobial inoculants available for use in Australia.*

Manufacturer	Brand	Formulation	Application
Becker Underwood	Nodulaid™	Peat	Slurry on seed; slurry/liquid in furrow
	Nodulaid™	Liquid	On seed; in furrow
	Nodulator™	Clay granule	In furrow
	BioStacked®	Peat (rhizobia) plus liquid (*Bacillus subtilis*)	Slurry on seed; slurry/liquid in furrow
New-Edge Microbials	EasyRhiz™	Freeze-dried	Liquid on seed; liquid in furrow
	Nodule N™	Peat	Slurry on seed; slurry/liquid in furrow
Novozymes Biologicals Australia	N-Prove®	Peat	Slurry on seed; slurry/liquid in furrow
		Peat granule	In furrow
	TagTeam®	Peat (rhizobia) plus (*Penicillium bilaii*)	Slurry on seed; slurry/liquid in furrow
	TagTeam®	Peat granule (rhizobia) plus (*Penicillium bilaii*)	In furrow
ALOSCA Technologies	ALOSCA®	Clay granule	In furrow
Brushmaster	Inoculeze™	Peat	'Tea extract' on seed via an applicator

Source: D Herridge, 2013.

Photo 3: *Different forms of rhizobia. Left to right: EasyRhiz™ freeze dried, Nodulator™ granules, ALOSCA® granules, N-Prove® granules and Nodulaid™ peat inoculant.*

Photo: M. Denton, formerly Vic DPI

Photo 4 shows nodule development with peat and granular inoculants.

Photo 4: *Faba beans on acid soil inoculated with peat inoculant showing few nodules (left panel), compared with those inoculated with granular inoculant (right panel). Note that nodulation is still less than would occur on more neutral or alkaline soils*

Photo: W. Hawthorne, Pulse Australia)

MORE INFORMATION

E Drew et al. (2014) Inoculating Legumes: A Practical Guide. Rev. edn. GRDC.

Injection of inoculants mixed in water is becoming more common practice. It can be used where machines are set up to apply other liquids, such as liquid N, at seeding.

In-furrow water injected inoculants

Water injection of inoculant requires at least 40 L/ha of water, and is better with more water. The slurry–water suspension is sprayed under low pressure into the soil in the seed row during seeding. Benefits of the new inoculants over peat are that they mix more readily, and do not need to filter out peat. Compatibility of the inoculant with trace elements is not yet known, but caution is advised, because water pH is critical, and trace element types, forms and products behave differently between products and inoculant groups. [4]

Photo 5: *A seeding bar setup with Atom Jet narrow points, gang press-wheels and liquid injection for either inoculum or trace element application during sowing.*

Photo: W. Hawthorne, Pulse Australia

4 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

Photo 6: *Tanks mounted on the seeding bar for liquid injection of rhizobia or trace elements during seeding. Agitation is required. Note the tubes and manifold. Inoculum must be applied under low pressure only. Some machines have their tanks set up as a separate, trailed tanker.*

Photo: W. Hawthorne, Pulse Australia

Photo 7: *A disc seeder set up with Yetter trash-clearing wheels and tubing for liquid injection of inoculum or trace elements during sowing. Note also the closer, covering the seeding slot to act like a press-wheel from the side.*

Photo: W. Hawthorne, Pulse Australia

Photo 8: *In-furrow liquid injection. Note the droplets from the liquid injection, which can be used for inoculating pulses or applying liquid trace elements.*

Photo: W. Hawthorne, Pulse Australia

Granular inoculants

Granular inoculants are applied like fertiliser, as a solid into the seed furrow, near the seed or below it. They avoid many of the compatibility problems that rhizobia have with fertilisers and fungicides. They also eliminate the need to inoculate seed before sowing. Granular inoculant may also be better where dry sowing is practiced or when sowing into acidic soils, because the rhizobia survive better than on seed. A third, small seed box is required to apply granular inoculum (Photo 9). This is because rhizobial survival is jeopardised if the granular inoculum is mixed with fertiliser. If it is mixed with the seed, then distribution of both seed and inoculum is affected, causing poor and uneven establishment and/or patchy nodulation.

Granules contain fewer rhizobia per gram than peat-based inoculants, so they must be applied at higher rates. The size, form, uniformity, moisture and rate of application of granules differ between products. Depending on product or row-spacing sown, rates can vary from 2 to 10 kg/ha to deliver comparable levels of nodulation. [5]

5 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

Photo 9: *An 'after-market' third box fitted to a Flexicoil box to enable application of granular inoculum.*

Photo: W. Hawthorne, Pulse Australia

3.1.2 Inoculant and chemical compatibility

As rhizobia are living organisms, it is very important inoculants are kept away from toxic substances, such as fertilisers, fungicides, insecticides and herbicides, that will reduce their viability. Inoculated seed should not come into direct contact with fertiliser because the latter will kill the rhizobia through desiccation and exposure to acidity. Certain pesticides can also decrease rhizobial survival and nodulation. [6]

Caution should be used when treating pulse seed with a fungicide. Some insecticide and seed treatments can also cause problems. Check the inoculant and chemical labels for compatibility of the inoculant and fungicide or insecticide seed treatments, and the planting window (time) for either sequential or simultaneous application of seed treatments and seed-applied inoculants. [7]

Inoculant companies conduct compatibility tests with registered seed treatments to ensure the viability of inoculants is not compromised by pesticides and other seed treatments. Each inoculum formulation is tested with various seed treatments using different application methods. Note the compatibilities and planting windows are specific to the individual product, and should not be used for other inoculants, whether they be from a different company or of a different inoculum group.

Read the label of both the specific inoculum and the seed treatment being used. Some fungicide labels specify that their fungicides should not be mixed in a slurry mixture with particular rhizobial inoculants, as they may decrease rhizobium survival.

If in doubt, adding the fungicide to seed and then applying the rhizobium inoculant to the dried seed is suggested to promote better results. [8]

MORE INFORMATION

Novozymes (2016) Product Guide Australia.

6 E Drew et al. (2014) Inoculating Legumes: A Practical Guide. GRDC. Rev. edn, https://grdc.com.au/GRDC-Booklet-InoculatingLegumes

7 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

8 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

3.1.3 Assessing nodulation

Plants should be gently dug from the soil and the root system rinsed in water before scoring the level of nodulation.

Obvious signs of nodulation should be visible by 6 weeks after sowing (even in high-soil-nitrate situations).

The pattern of nodules on the root system is important. Nodules on the main taproot clustered near the seed are an indication nodulation occurred because of the inoculation process. These are referred to as 'crown nodules'.

If there are no crown nodules but nodules on the lateral roots, it is more likely that they have formed from native soil bacteria which are usually less effective at fixing N_2, even in faba beans.

Nodules on both the crown and lateral branches indicate inoculation was successful and that bacteria have spread in the soil. Faba bean rhizobia are not very aggressive and do not spread more than very short distances in the soil.

Inspect nodules for nitrogen-fixation activity by assessing their internal 'pink' (leghaemoglobin) colour. The best method is to slice a few nodules open with a razor blade or sharp knife and examine their colour.

Young nodules are usually white and have yet to develop. However, white nodules can also indicate the wrong bacteria in the nodule, and these will not fix N_2. Effective nodules, which actively fixing N_2, are a rusty red or pink inside. Effective red nodules can sometimes turn green when a plant is under water, diseased or otherwise stressed, or is deficient in nutrients. These nodules do not fix N_2, but if the stress is relieved without too much damage being done they can change back to red and begin to fix N_2 again. Black nodules are usually dead or dying. These are often seen as the crop matures, or after a crop has suffered severe waterlogging. [9]

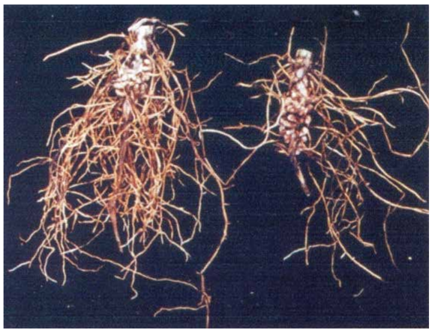
MORE INFORMATION

GRDC (2008) 'Seeding', Grain Legume Handbook.

E Drew et al. (2014) Inoculating Legumes: A Practical Guide. Rev. edn. GRDC.

9 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

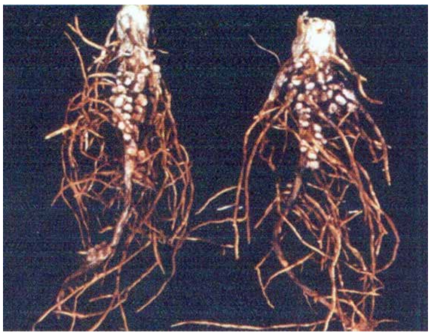
(a) Score 0: taproot, absent; lateral, absent.



(b). Score 1: taproot, few-medium; lateral, absent-few

(c) Score 2: taproot, medium; lateral, absent-low.

(d) Score 3: tap root, medium-high; lateral, low.



(e) Score 4: taproot, high; lateral, medium.

(f) Score 5: taproot, high; lateral, high.

Photo 10: *Visual key for nodulation scores.*

Source: TopCrop 'Growers guide to assessing nodulation in pulse crops'

Points to note:

- Where plant-available soil-N is low, the crop relies heavily on good nodulation for its N supply. A score of 4–5 is desirable.
- Where plant-available N is high, nodulation may be partly inhibited, and the crop will depend mainly on the soil for N supply.
- A high score indicates that the crop will yield well and conserve soil N for use by a following crop.
- A low score suggests that the crop will yield poorly and deplete soil N. [10]

10 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

3.1.4 Storing inoculants

Moist peat provides protection and energy to an unopened pack in storage. For maximum survival, peat inoculant should be stored in a refrigerator at ~4°C until used. If refrigeration is not possible, store in a cool, dry place away from direct sunlight. Granules and other forms also need to be stored in a cool place out of direct sunlight. Do not store an opened inoculum packet, as it will deteriorate rapidly.

Discard the inoculant after the expiry date shown because the rhizobia population may have dropped to an unacceptable level. [11]

3.1.5 Inoculum survival

Rhizobia can dry out and lose viability when applied to seed and not kept in moist soil. Granular inoculant forms may not dry out as quickly.

With non-peat-based inoculants, such as freeze-dried rhizobia, it is recommended treated seed should be sown within 5 hours of inoculation.

Most commercial inoculants contain an adhesive solution or 'sticker' which delays drying and increases the survival rate of the rhizobia. If inoculated seed is sown into dry soil, the sticker helps the rhizobia survive until rain.

Inoculum viability rapidly diminishes over time in warm, dry soil. It is difficult to provide guidelines to survival times; however, it is best to sow as close to the appearance of a rain front as possible. The rhizobia will survive for longer in granules than when applied to seed. Hence, when dry-sowing pulses, granular inoculant is preferred over peat and liquid-injection methods.

Nodulation failure after dry sowing of inoculated seed is more likely if the soil has no naturalised rhizobia present.

Dry-dusting the peat inoculant into the seed box is not an effective means of either applying rhizobia on the seed or retaining it uniformly on seed. Under some conditions, rhizobial death is so rapid where dry-dusting is used that no rhizobia are alive by the time the seed reaches the soil.

3.1.6 Applying peat-based inoculants

Use a peat–slurry mix within 12 hours, and sow seed inoculated with peat slurry as soon as possible or store for up to three days in a cool place away from sunlight.

When mixing the slurry, do not use hot or chlorinated water. Add the appropriate amount of the inoculant group with a small amount of water to form a heavy paste, then add to the main solution and stir quickly.

Read the inoculant label before adding any approved insecticides, fungicides, herbicides, detergents or fertilisers into the slurry (see Seed treatments). Add the inoculant suspension (slurry) to the seed and mix thoroughly until all seeds are evenly covered. A small amount of fine lime can be added after mixing is complete to help dry the seed and prevent tackiness. If adding lime use only calcite lime; agricultural lime is too coarse. Do not use builders lime, hydrated lime or slaked lime: they will kill the rhizobia. [12]

Slurry can be applied to the seed using:

1. A cement mixer. This is practical for small lots only, unless a cement truck is used.
2. Through an auger (see Figure 2). Make sure the auger is turning as slowly as possible. Reduce the height of the auger to minimise the height of seed-fall. Perhaps add a slide, e.g. tin, to the outlet end of the auger to stop seed from falling and cracking. Meter the slurry in, according to the flow rate of the auger (about a 250g packet per 100 kg seed). If the auger outlet is out of reach, e.g.

MORE INFORMATION

GRDC (2008) 'Seeding', Grain Legume Handbook.

11 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

12 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

under a field bin, then use some poly pipe to run the slurry into the auger. A clean drench pack fixed to a dropper makes a good funnel into the poly pipe.

3. Through a tubulator. The use of a tubulator reduces the risk of damaging the seed, but its mixing ability is not as effective as an auger. Apply the slurry in a similar fashion as with an auger.

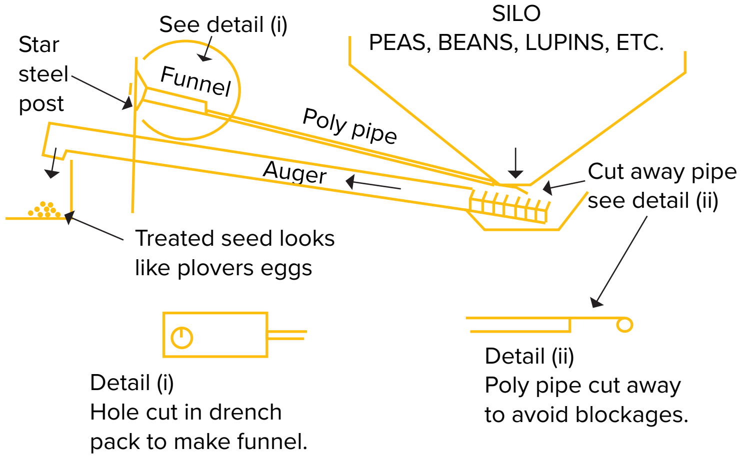


Figure 2: *Applying inoculum through an auger.*

Source: Grain Legume Handbook, 2008

3.2 Crop establishment

Successful establishment of faba beans in WA requires careful management of many factors including stubble management, seed quality, row spacing and sowing depth.

3.2.1 Stubble retention

The presence of stubble can increase water infiltration and slow moisture loss through evaporation. With standing stubble, lower wind speeds at the soil surface and cooler soil temperatures assist in reducing evaporation, resulting in increased soil-moisture storage for sowing and afterwards. Stubble retention ensures more moisture is captured and retained as stored soil moisture which benefits the pulse. Stubble retention also helps to retain some of the deeper moisture left from summer rains, provided weeds are controlled. This allows for earlier sowing opportunities.

Photo 11: *Faba beans sown into cereal stubble establish well and lose less soil moisture than those sown into bare soil.*

Photo: W. Hawthorne, Pulse Australia

By retaining stubble, combined with the ability to sow earlier, sowing into wider row spacing and achieving greater harvestable height with less lodging, growers have been able to produce a pulse crop in years that would otherwise have resulted in a failed crop.

Faba beans grown on burnt stubble have higher average disease levels (range 4.9–7.6) than those grown on slashed stubble (range 3.5–7.0). [13]

3.2.2 Time of sowing

Faba beans show a marked response to the time of sowing, with crops sown 'on time' having an excellent chance of maximising yields. Crops sown earlier or later than recommended will often give reduced yields.

Water Use Efficiency is commonly in the range 8–12 kg/mm grain for sowings made during the preferred sowing window. This drops to 4–6 kg/mm for very late or very early sowings.

Sowings made prior to the recommended sowing window tend to be more vegetative and suffer from:

- poor early pod set because of low light or low temperatures (10°C) at the commencement of flowering
- higher risk of chocolate spot at flowering and through podding
- crops pre-disposed to lodging
- increased frost risk at flowering and early podding
- high water use prior to effective flowering and earlier onset of moisture stress during flowering and podding
- increased risk of Ascochyta blight, chocolate spot and rust in susceptible varieties

Late-planted crops are more likely to suffer from:

- high temperatures and moisture stress during flowering and podding
- greater native budworm pressure
- fewer branching and flowering sites, unless the plant population is increased

13 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

- shorter plants and lower podset, which make harvest more difficult

To achieve maximum yields, critical management factors such as weed control and seedbed preparation must be planned to allow crops to be sown as close as possible to the ideal sowing dates.

Faba bean seeds can germinate in soil as cold as even 5°C, but emergence will be slow. Seedlings are tolerant of frost but can still be affected. Seedling vigour will be greater if soil temperatures are at least 7°C.

Table 2: *Sowing times for faba and broad bean varieties at different locations* [14]

Month	April				May				June				July	
Week	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**
WA – low rainfall														
WA - medium rainfall														
WA - high rainfall – WA														

Marginal area or low disease risk area
Preferred sowing time
For high disease-risk areas or more susceptible varieties
Sowing-time needs vary with the flowering date and maturity rating of each variety.
Yield loss: 250 kg/ha for each week's delay

Faba bean sowing dates are often a compromise between delaying sowing to reduce disease without severely reducing yield potential. Early sowing, even dry sowing, is a priority in some drier areas or where sowing is completed early to optimise operations and enable optimum sowing times for cereals.

Early sowing produces the highest potential yields in faba beans, but requires greater attention to disease control, particularly for chocolate spot. Late sowing produces short, low-yielding crops with less disease. The time of sowing is therefore a compromise. Added to this, some varieties, e.g. Fiesta VF⁽ᴅ, Farah⁽ᴅ respond less to early sowing because they do not set early pods under cold and shaded conditions.

In low-rainfall areas faba beans must be sown early. Hot winds in spring cause the beans to wilt, stop flowering and ripen prematurely. Compacted soils that do not allow root penetration exaggerate this effect.

Sowing also needs to be earlier:

- in wetter areas
- in areas where soils have lower fertility, or are acidic
- where excessively tall growth of beans is unlikely

Ultimately the use of varieties with resistance to chocolate spot will enable earlier sowing in most areas. In the interim, wider row spacing (skip row or wider) is being used in early sowings to delay canopy closure and so lessen disease risk. [15]

3.3 Seeding rates

Seeding rates (kg/ha) for faba beans vary with the size of the seed being sown (Table 3).

Growers of faba beans should target 30 plants/m^2.

Not all seeds are equal—some grow better than others. Before deciding on a seeding rate take a representative sample, have it sized and then germination- and vigour-tested (see Section 2, Pre-planting).

14 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

15 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

Seeding rates can have a significant effect on crop yields. Be aware of the very large differences in seed size between varieties and the impact that variable seasons can have on grain size of even the same variety.

When determining a seeding rate, consider plant populations and not just kilograms of seed per hectare: the kilogram rate should be adjusted to achieve a target population of plants based on seed size and germination percentage.

The seeding rate for the target plant density can be calculated using germination percentage, 100-seed weight and establishment percentage:

$$\text{Seeding rate (kg/ha)} = \frac{\text{(100 seed weight (g)} \times \text{target plant population per m}^2 \times 1000)}{\text{(germination\%} \times \text{estimated establishment\%)}}$$

Example:
100-seed weight = 60 g
Target plant density = 25 plants/m^2 (i.e. 250,000 plants/ha)
Germination % = 90
Estimated establishment % = 95% (90–95% is a reasonable estimate, unless sowing into adverse conditions)

Seeding rate (kg/ha) = (60 × 25 × 1000) ÷ (90 × 95) = 175 kg/ha

To determine the seed weight, weigh 100 seeds (g). A seeds per kg reading from a laboratory test can be easily converted to 100-seed weight, as follows:

100-seed weight = (1000 ÷ no. of seeds per kg) × 100

Table 3: *Seeding rate (kg/ha) required for targeted plants/m^2 for a range of faba bean varieties and sizes at 85% germination and 95% establishment* [16]

Example variety	Average size range (g/100 seeds)	Seed weight used (g/100)	Plants required per square metre*			
			10	18	25	32
Fiord⦸	35–55	45	56	100	139	178
Farah⦸, Fiesta VF⦸	55–75	65	80	145	201	258
PBA Rana⦸	80–90	85	105	189	263	337

* = targeted seeds/m^2

3.3.1 Row spacing

There is a trend towards wider row spacing with pulses, especially faba beans. Wider-row and 'skip'-row pulses (30–54 cm) must be part of an overall system, and it should not be considered in isolation. Stubble retention, preferably standing stubble, is considered essential for wide rows, where retaining soil moisture and ensuring adequate weed control are required (Photo 12). Yield comparisons in research trials can vary depending on the system and location, and there is no one solution that fits all situations.

Reasons for choosing wider rows with faba beans vary with location and operator, but key drivers are the combination of:

- yield and yield consistency
- better stubble clearance and other sowing practicalities
- drought tolerance
- minimised disease risk and easier management of diseases
- desire to sow pulses early
- weed control through minimised soil disturbance
- herbicide application options between the rows using hooded sprayers

16 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

If row spacing is doubled, the seeding rate per row must be doubled if the same plant density is to be maintained. This is significant when using seeders with one seed meter per row, but relatively unimportant in air seeders where one meter supplies all. [17]

MORE INFORMATION

Pulse Australia (2015) Wide row pulses and stubble retention. Australian Pulse Bulletin.

W Hawthorne, (2010) Wide row pulses and stubble systems. Southern Pulse Bulletin.

S Kleeman and G Gill (2008) Row spacing, water use, and yield of wheat (*Triticum aestivum*), barley (*Hordeum vulgare*) and faba bean (*Vicia faba*). 14th Australian Agronomy Conference.

Photo 12: *Wide ('skip') rows in faba beans allow easier sowing into heavy cereal stubbles, assist in weed control, promote better pod set, and delay canopy closure, which assists in disease control and fungicide application.*

Photo: W. Hawthorne, Pulse Australia

3.3.2 Sowing depth

Faba beans have a hypogeal pattern of emergence (i.e. they leave their cotyledons below the soil surface) and therefore are able to emerge from deeper in the soil than plants with an epigeal emergence pattern (Figure 3), such as lupins. Faba beans are also large-seeded and produce a relatively strong seedling, which further enable seedlings to emerge from deeper in the soil (Table 4).

17 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

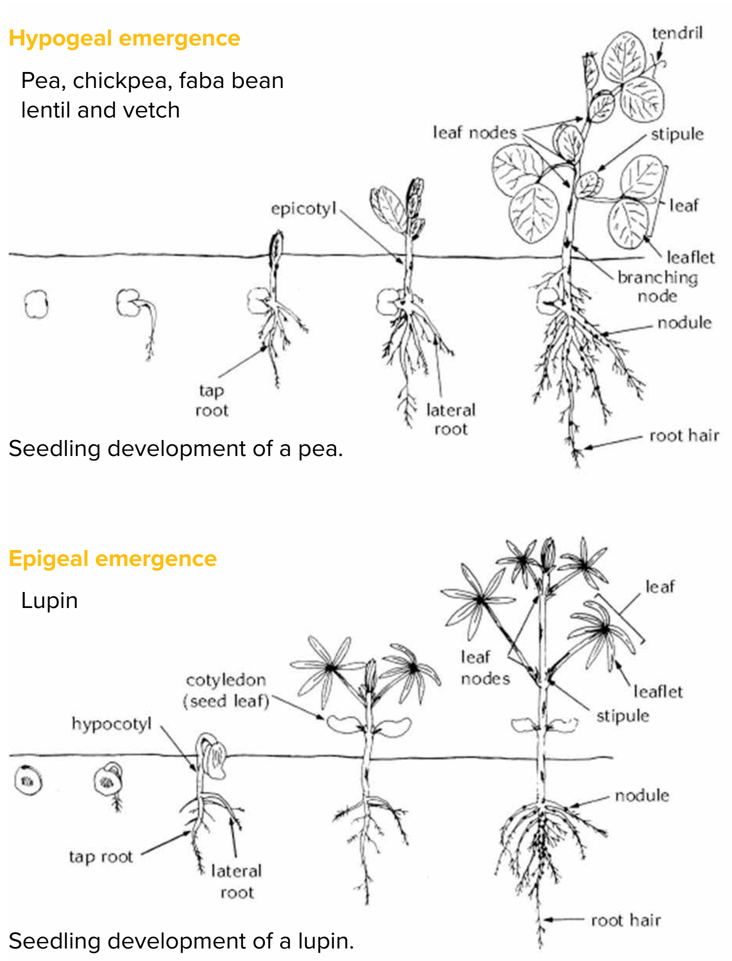


Figure 3: *Epigeal versus hypogeal emergence patterns.*

Source: Grain Legume Handbook, 2008

Table 4: *Sowing depth ranges (cm) for pulses*

Crop	General recommended sowing depth range
Chickpeas	3–5 cm
Faba beans	5–8 cm
Lentils	2–6 cm
Lupins	1–3 cm
Peas	3–5 cm
Vetch	3–5 cm

Note that if applying a pre-emergent herbicide, the greater depth should be used.

Photo 13: *Faba beans are much more tolerant of deeper sowing than are lupins, because of their hypogeal emergence. The lupins shown were sown too deep (greater than 5 cm). Note the stunted first true leaf and lack of early vigour.*

Photo: Grain Legume Handbook, 2008

Faba beans can be sown at depth to 15 cm if necessary. Deep-sowing or moisture-seeking techniques can be used to ensure timely planting when the soil surface is still dry. The large seed size makes faba beans very suitable for this type of planting system. [18]

3.3.3 Rolling

Leaving a flat, firm soil surface free of stumps, stones and clumps is essential when growing most pulse crops, including faba beans. A flat soil surface at harvest becomes even more essential when crops are short at maturity, or are tall but have lodged.

Rolling also improves seed–soil contact in sandy, non-wetting soils, although press-wheels will normally achieve this.

Rolling of paddocks sown to pulses in the past has generally occurred before crop emergence. However, some growers have taken to post-emergent rolling of their pulses. This is particularly common with field peas but faba beans can be rolled after emergence if the plants themselves are not taking the weight of the roller.

3.4 Pulses and herbicide damage

Pulses can be affected by application of some post-emergent broadleaf herbicides even when applied at label rates. Crops may have reduced plant biomass or N_2 fixation and lower yields.

18 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

Pulses grown in lower-rainfall regions with >250 mm annual rainfall and with sandy, calcareous soils are at most risk of herbicide damage. Crops with a significant reduction in N_2 fixation can mean the difference between making or losing money from a pulse crop, particularly in low-rainfall situations. [19]

When planning weed control programs in crops and fallow prior to faba beans, be cautious about the use of herbicides with damaging residues. Many of the Group B herbicides have long plant-back periods, up to 24 months for faba beans, which are prolonged on dry soils with pH ($CaCl_2$) above 6.5. [20] See Section 6. Weed control.

3.5 Seeding equipment

Success with pulses may depend on the type of sowing equipment used. The large size of pulses can make sowing with conventional seeders very frustrating.

If the seeder is not suitable for sowing a particular pulse (usually the larger-seeded types) in standard form there are several options available.

The machine may be adapted by minor modifications such as:

- modifying the metering mechanism with manufacturer-supplied optional parts
- modifying seed tubes to reduce blockages, particularly on older machines
- modifying or replacing dividing heads on air seeders

Sow a percentage of faba beans (i.e 25%) at a shallower rate through seed tubes and the remainder through deep banding tubes. This may help any blockages in the seed/fertiliser hose.

Agronomist's view

Most pulse-seeding problems are related to seed metering and the transfer from seed meter to soil. These problems are caused by the large size of some pulses and the high seeding rates generally used.

Faba beans can be sown with a standard air seeder or conventional combine, but care is needed because seeds tend to bridge over the outlets, causing very uneven sowing. This difficulty can be eliminated by filling the box to only one-third or one-half capacity or by fitting an agitator.

Faba beans can also cause problems in some combines, but air seeders with adequate metering rollers can sow them successfully if the airflow is adequate.

3.5.1 Air seeders

Air seeders that use peg-roller metering systems (Napier, Shearer) will handle grain up to the size of smaller faba beans without problems, because of the banked metering arrangement. The optional rubber star roller will be necessary for larger seeds.

Air seeders using metering-belt systems (Fusion, Alfarm, Chamberlain–John Deere, New Holland) can meter large seed at high rates with few problems.

Air seeders with large or very coarse, single-fluted rollers cannot meter faba beans >18 mm without modifications to the metering roller. Consult a machinery dealer about possible modifications.

On some air seeders, the dividing heads may have to be modified because there is too little room in the secondary distributor heads to allow seeds to flow smoothly. Figure 23 shows a standard secondary distributor head (on the left) and a conversion

19 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4–General Agronomy.

20 P Matthews, H Marcellos (2003) Agfact P4.2.7, NSW Agriculture, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157729/faba-bean-pt1.pdf

to suit Connor–Shea air seeders. The conversion head increased the bore from 23 mm to 41 mm. Four larger hoses replace the original eight, and row spacings are increased from 150 mm to 300 mm. This conversion allows large seeds to be sown easily.

Significant levels of seed damage can be caused in air seeders by excessive air pressure, so growers need to take care to use only enough air to ensure reliable operation.

MORE INFORMATION

Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 4—General Agronomy.

3.5.2 Combine seeders

Combines with fluted roller feeds have few problems feeding seed of <15 mm down to the metering chamber.

Combines with peg-roller and seed-wheel feeds will sow grains up to the size of faba beans without problems, providing adequate clearances are used around the rollers. Smaller faba beans such as Fiord(D can be metered with the more aggressive seed-wheel system, but peg rollers are best replaced with rubber stars for larger faba beans.

Combines with internal force-feed seed meters perform well on small seeds but cannot sow seed >9 mm because of bridging at the throat leading to the seed meter. The restricted internal clearance in this type of design can damage larger seeds.