



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

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Pulse Point

Germination testing and seed rate calculation

The correct plant density is an important factor in maximising yield of pulse crops. To obtain the targeted density it is necessary not only to have quality sowing seed but also be able to accurately calculate seeding rates. It is surprising the difference a slight variation in seed size or germination makes to the seeding rate required to achieve a target plant density. Seed size, quality and germination varies between varieties, from year to year, from paddock to paddock and should be checked for each seed line to be used.

Quality of sowing seed

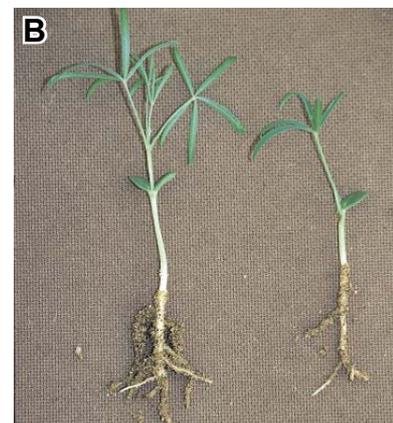
The large size of pulse seed makes it vulnerable to mechanical damage by the header at harvest and during subsequent handling. This damage is not always visually apparent. Damage can be reduced by slowing header drum speed, opening the concave, taking care when augering and reducing the number of augerings. Ideally a rotary header and a belt grain mover or elevator should be used.

Seed to be used for sowing should be treated with special care. Ideally seed to be used for next years crop should be produced as a specific seed crop and not just randomly kept from an area of the whole paddock at harvest. If this is not possible, seed should be kept from the best part of the crop where weeds and diseases are absent and the crop has matured evenly. Grain to be used for seed should be harvested first, to avoid any weed and disease contamination from other pulse crops or parts of the paddock. Store the seed, with minimal handling, separate to the bulk seed.

A seed that has been damaged will produce an abnormal seedling—the shoot, the root, or both may be damaged. If the root is damaged the seedling will germinate, emerge and then generally die. This is because the taproot is weak and cannot grow normally. If the shoot is damaged the seedling will germinate and may emerge.



Eric Armstrong



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Figure 1. A normal (left) and abnormal (right) field pea seedling (A) and narrow-leaved lupin seedling (B). Note the missing cotyledon and deformed shoot on the abnormal lupin and the multiple shoots and deformed poor root system on the field pea seedling

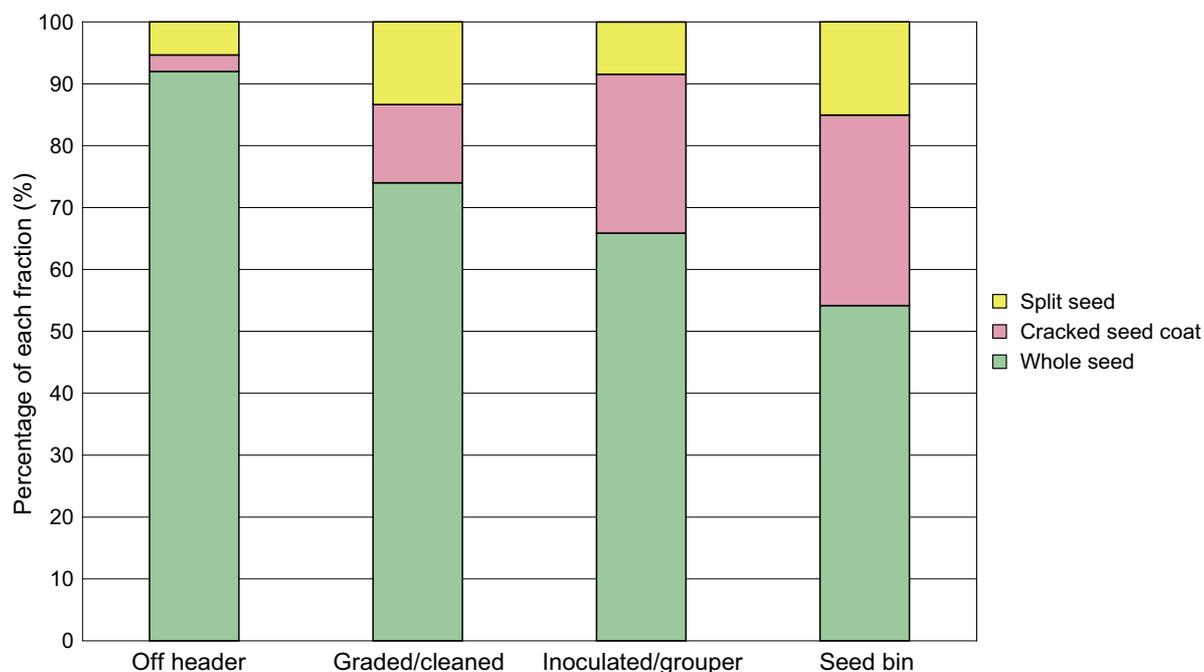


Figure 2. Whole seed, cracked seed and split fraction of field pea samples collected from a grower in southwest NSW after each seed handling operation from harvest until sowing.

Lupins will have damaged or missing cotyledons like the plant on the right in Figure 1B. In damaged field pea and faba bean seedlings, where the cotyledons remain below ground level, the shoot takes longer to emerge, looks deformed and may be yellow or pale green (Figure 1A).

Abnormal seedlings which do emerge lack vigour making them vulnerable to the rigours of field establishment. Factors such as temperature, disease, insects, seeding depth and soil crusting are more likely to affect the establishment of weak seedlings. Those that do emerge are unlikely to survive for long, producing little dry matter and making little or no contribution to final yield.

Unsatisfactory establishment of commercial crops can often be linked to poor quality sowing seed.

The quality of pulse seed should always be checked before it is sown. A visual check of the seed lot should be done for any seed coat cracking or other damage from insects and disease and a germination test carried out to identify the number of viable normal or undamaged seeds.

Testing for the presence of seed borne diseases can be conducted by specialist laboratories for a number of diseases such as cucumber mosaic virus in narrowleaf lupins, bacterial blight in field peas and ascochyta blight in chickpeas. Albus lupins should be checked by 'UV screening' for possible bitter (high alkaloid) seed contamination.

Germination testing

All pulse crop seed to be used for sowing should be germination tested. Ideally only pulse seed with greater than 80% germination should be used. Germination testing can be done in a laboratory or at home.

When to do the test

The best time to sample is at or just after seed cleaning. This minimises the number of times the seed is likely to be augered or handled after the test is done. It also provides an ideal way to get a good representative sample. However, if you think a seed lot is likely to have reduced germination, testing should be done before seed cleaning. This minimises expenses and provides time to obtain replacement seed.

When you do the test before or after seed cleaning, the germination tray or ground temperature is likely to be higher than at sowing. This does not matter as the aim is to identify the number of normal seedlings and this is not affected by temperature.

Sampling

The key to a good germination test is getting a representative sample. A test should be done for each 20 tonne seed lot. Sampling should be random and include numerous sub-samples to give the best results. Small amounts (1 cup) of seed should be taken regularly while seed is being moved (perhaps out of the seed cleaner, storage or truck) or from many different bags. Do not sample from a silo as it is dangerous and difficult to obtain a representative sample. When the sub-samples have been bulked, mix thoroughly and take a seed sample of 1 kilogram.

Home germination tests

Setting up the test

A convenient method is to use a flat tray about 30 cm square and 5 cm deep (a nursery seedling raising tray like the one in Figure 4 is ideal). Put a single sheet of paper in the bottom to cover the drainage holes and fill with clean sand, potting

mix or freely draining soil. If you do not have a tray the test can be done in any sort of self-draining container or in a cool part of the garden.

Laboratory germination tests are normally conducted at 20°C, so if the test is to be done indoors aim to conduct it at this temperature.

Count out 100 seeds (including damaged ones) and sow 10 rows of 10 seeds—the rows make it easier to count seedlings. Seeds should be sown at normal seeding depth of 2-3 cm. Place the seeds on top of the sand or soil and push them in with a piece of dowel or a pencil (Figure 4) and cover with a little more sand. Larger seeds, such as faba beans, can successfully be tested in the same trays, and should be sown as deep as possible.

Gently water! Keep moist (not wet). Over-watering will result in fungal growth on the seeds, causing possible seed rot, affecting normal germination.

If you do not have a tray, sow 100 seeds in rows in the garden at normal depth, carefully counting the number sown. Keep moist.

Counting

Seedlings should be counted after 7 to 10 days when the majority of seedlings are up. Do not wait until the late ones emerge—these are the damaged, weak ones.

Only normal seedlings should be counted. Do not count badly diseased, discoloured or distorted seedlings or, in the case of lupins, those missing a cotyledon (see Figure 3).

Remember, you want to know the total number of normal, vigorous, healthy seedlings. If you count 83 normal seedlings then your germination percentage is 83%.



Warwick Holding

Figure 3. Close up of newly emerged narrow-leaf lupin seedlings. The one circled is abnormal, missing a cotyledon. DO NOT count this one!



Di Holding

Figure 4. Setting up a germination test in a seedling raising tray. Place 100 seeds on top of the sand and push them in 2-3 cm deep before covering.

Calculating seeding rates

Seeding rate can be calculated using target density, germination percentage, 100 seed weight and establishment percentage (see equation following).

$$\text{Seed Rate (kg/ha)} = \frac{\text{Target plant density (pl/m}^2\text{)} \times \text{100 seed weight (grams)} \times 10}{\text{Germination percentage} \times \text{Establishment percentage}}$$

Step 1 – target plant density

What is the optimum plant density? This will vary depending on which pulse is being planted, the region, the rainfall, and the sowing time (on time or later than preferred?).

Consult your agronomist or refer to the *Winter Crop Variety Sowing Guide* for up to date recommendations on target plant densities for your pulse crop and variety. The example used here is :

- Kaspera field peas
- sown in 3rd week of May
- with 425 mm of annual rainfall
- in south western NSW

The target plant density for this example is 40 plants/m².

Step 2 – determining 100 seed weight

This is done by counting a set number of seeds (at least 200) and weighing them. Seeds per kilogram or seed size can also be obtained on request with a laboratory germination test. The more seeds counted the more accurate the answer. Always count each individual seed lot, never assume they are the same if from different paddocks, varieties, or years.

In this example, 100 seeds weighed 21 grams. If you have seeds per kilogram from a laboratory test this can be easily converted to 100 seed weight, as follows:

$$100 \text{ seed weight} = \frac{1000}{\text{seeds per kg}} \times 100$$

Step 3 – adjust for germination and establishment percentage

Assume that only 80% of normal germinated and emerged seeds will establish under field conditions—temperature, moisture, soil type, sowing depth, insects and disease will all affect survival. Establishment percentage can be adjusted according to your confidence in your sowing operation and field conditions. A realistic estimate of establishment is 80%.

In the example the Kaspera seed germination is 93%, target density is 40 plants per m², and 100 seed weight is 21 grams. When calculating seeding rate use the decimal equivalent of establishment percentage (0.80 for 80%).

Your seeding rate	Example Kaspera	Your seed
Step 1 target density (plants/m ²) = 40 pl/m ²		TD
Step 2 wt of 200 seeds = 42 100 seed wt (grams) = 42 ÷ 2 = 21 grams		100sw
Step 3 germination (%) = 93%		G
SR seeding rate (kg/ha) = 113 kg/ha		SR

$$SR = \frac{TD \times 100sw \times 10}{G \times 0.8}$$

Table 1. Seeding rate reference guide for pulse crops in southern and central NSW. The calculation assumes 100% germination and 80% establishment.

Target plant density (pl/m ²)	Seed size - 100 seed weight (grams per 100 seeds)																			
	Lentil			Narrow leaf lupin				Field pea and desi chickpea				Kabuli chickpea and albus lupin				Faba bean				
	3	4	5	10	12	14	16	18	20	22	24	35	40	45	50	55	60	65	70	75
20				25	30	35	40	45	50	55	60	88	100	100	113	138	150	163	175	188
25				31	38	44	50	56	63	69	75	109	125	125	141	172	188	203	219	234
30				38	45	53	60	68	75	83	90	131	150	169	188	206	225	244	263	281
35				44	53	61	70	79	88	96	105	153	175	175	197	241	263	284	306	328
40				50	60	70	80	90	100	110	120	175	200	200	225	275	300	325	350	375
45				56	68	79	90	101	113	124	135	197	225	225	253	309	338	366	394	422
50				63	75	88	100	113	125	138	150									
55				69	83	96	110	124	138	151	165									
60								135	150	165	180									
65								146	163	179	195									
100	38	50	63																	
110	41	55	69																	
120	45	60	75																	
130	49	65	81																	

For further information contact

Peter Matthews, NSW Department of Primary Industries, Temora
or
Your local District Agronomist

Diagnostic services

Commercial tests for germination, seed size and seed borne diseases are available at laboratories throughout Australia. Bitter seed screening of albus lupins is available at NSW DPI and selected grain traders. Check with your agronomist.

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DISCLAIMER

The information contained in this publication is based on knowledge and understanding at the time of writing, March 2005. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up-to-date and to check currency of the information with the appropriate officer of New South Wales Department of Primary Industries or the user's independent adviser.

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