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Polythene storage improves lupin seed germination

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Seed storage trials indicate a practical means of maintaining sandplain lupin seed at a moisture content that limits hard seed development, leading to a commercially acceptable germination rate in the following season.

The sandplain lupin *(Lupinus cosentinii)* is well adapted to sandy soils in many districts but its potential as a crop plant is limited by a hard seed content of 80 to 90 per cent., giving germination rates below acceptable commercial levels.

The rate of germination in the year of sowing can be as low as 10 per cent. for lupin seed stored and sown under farm conditions, and is seldom higher than 15 per cent.

The permeability of the sandplain lupin's seedcoat is governed by the seed's moisture content.

If the seed is prevented from drying out below 14 per cent. moisture (wet weight basis), the hard seed formation is reversible and the seed softens and germinates in moist soil. Below 9 per cent. moisture the hardening process is irreversible and the seed coat remains impermeable to moisture until exposed to daily temperature fluctuations of about 15 to 65°C, when the impermeability gradually breaks down.

Between 9 and 14 per cent. moisture the rate of softening varies directly with seed moisture content.

The relationship between seed moisture content, the proportion of hard seeds and germination, was clearly shown in 1962 when seeds stored in polythene lined cornsacks for four months at 11.5 per cent. moisture had germination rates of 66 to 86 per cent. By contrast, poorly germinating seed had developed 80 to 90 per cent. hard seed while stored in cornsacks between December and March.

The trials described below examined the commercial implications of storing sandplain lupin seed in polythene bags to retain seed moisture and germinability. Characteristics which farmers could use to estimate the best time for harvesting sandplain lupin seed for sowing in the following autumn were sought during the trials.

Experiment 1 (1972/73)

Seed of sandplain lupin (variety CB 46) harvested in November, 1972, was placed in 50 kg jute bags,

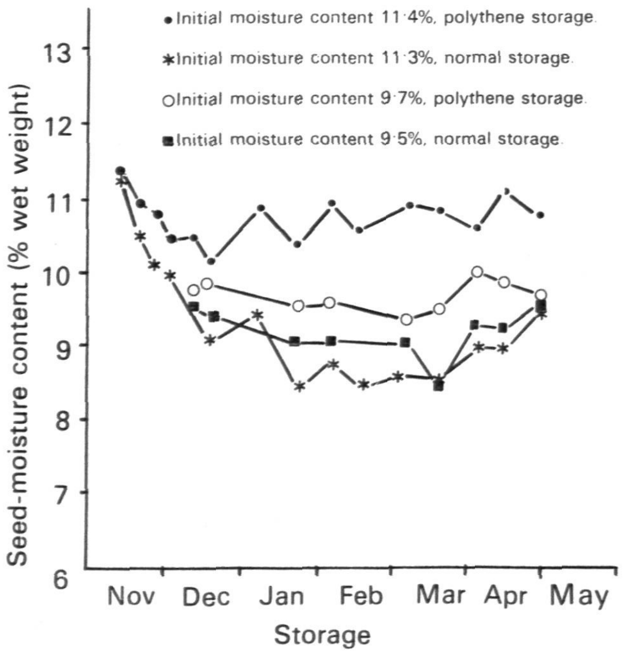

Figure 1.—Trends in moisture content of sandplain lupin seeds during normal and polythene storage, Badgingarra 1972/73.

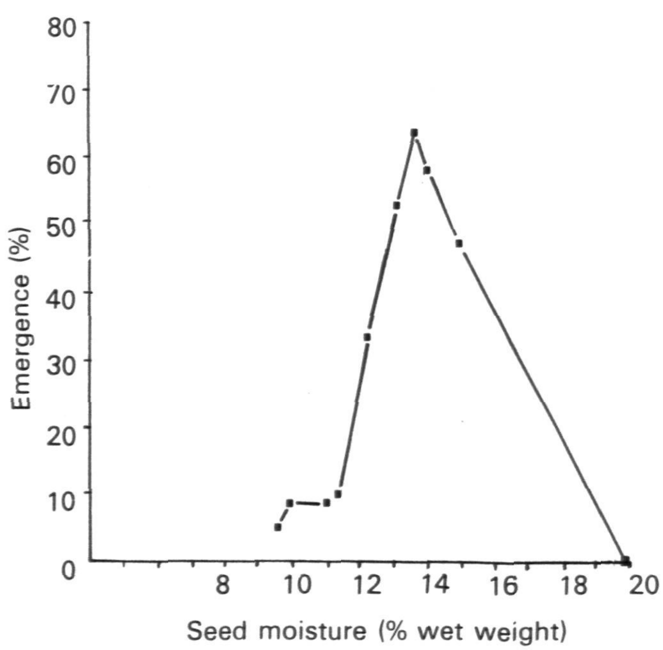

Figure 2.—The effect of seed moisture content during storage on emergence of sandplain lupin seeds.

half of which contained polythene liners. Pairs of bags (one jute, one polythene lined) were sealed as the seed moisture content fell progressively from 11.4 to 9.5 per cent. and all bags were stored in an open-fronted shed on Badgingarra Research Station. Monthly samples were taken to determine moisture content.

Sampling to determine seed moisture content showed that the moisture level of seed stored in polythene-lined bags remained reasonably stable, while the moisture level of seed in jute-only bags fell as low as 8.5 per cent. (Fig. 1).

Seed samples from all bags were planted on May 11, 1973 and germination counts made 4, 8 and 12 weeks later.

Although seed stored in polythene liners at the highest moisture contents had considerably greater germinability than those stored in unlined jute bags (24 vs 16 per cent. at eight weeks, 62 vs 18 per cent. at 12 weeks) polythene storage at the moisture levels of this experiment (11.4 per cent. and below) did not increase germination four weeks after seeding to a satisfactory commercial level.

To test the reversibility of hardseededness developed during storage, seed from three polythene-stored treatments was mixed with sufficient water to increase seed moisture content to 14 per cent. (on March 19) then resealed. Moisture content rose to 14.15 per cent. by May 4. This seed gave a 63.5 per cent. germination rate assessed four weeks after seeding on May 11.

Experiment 2 (1975/76)

Sandplain lupin (variety CB 46) harvested at Badgingarra Research Station was stored in 50 kg bags at a range of seed moisture contents.

All bags were lined with 0.076 mm polythene (except one left as a control) and stored in a brick building from December 18, 1976. On March 12, two months before the end of storage, two bags with moisture contents of 11.1 and 9.4 per cent. were mixed with sufficient water to raise their moisture levels to 14 per cent., then re-sealed.

Samples from all bags were sown at South Perth on May 14, 1976.

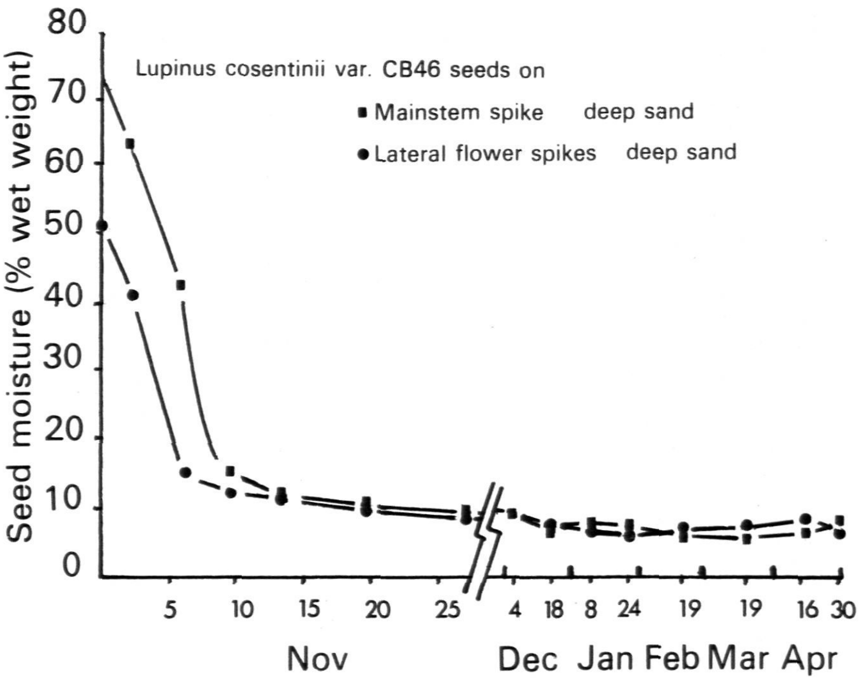

Figure 3.—Trends in moisture content of sandplain lupin seeds.

The polythene treatment prevented seed from further drying during storage. The best germination percentage, 64 per cent., was obtained with seed stored at 13.6 to 14.0 per cent. moisture. (Fig. 2). Storage with 20 per cent. moisture, or where free water was left in the bag after water treatment, allowed mould to develop and prevent germination.

Conclusions

The results suggest that sandplain lupins can be prevented from developing their natural 80 to 90 per cent. hardseededness by storing seed at 13 to 14 per cent. moisture content in polythene-lined bags.

If the seed is too dry at harvest polythene storage cannot prevent hard seed formation. If it is too moist there is a possibility of mould formation, which will also prevent germination. It is possible to mix water with seed at 11 or 12 per cent. moisture content to raise the moisture level to 14 per cent. but if free water is left in the seed there is again a chance of mould development.

Successful polythene storage will therefore depend largely on seed moisture content of the lupins at harvesting.

Plant characteristics related to seed moisture level.

Although sandplain lupin cv. Chapman usually shatters its pods when the seeds contain 20 to 23 per cent. moisture, the CB 46 variety has non-shattering pods. This improvement would allow CB 46 (and CB 49) to be harvested when the seeds contain the 14 per cent. moisture needed for successful polythene storage, as long as there are associated plant characteristics recognisable to farmers.

CB 49 is a white flowered, white seeded variety with the same general characteristics as CB 46. A grey speckling which appears on the seed coat is distinctive at 15 to 20 per cent. moisture.

To look for such characteristics a crop of sandplain lupins cv. CB 46 was examined weekly in 1972/73. Seed moisture levels were measured, and seed and pod development were monitored. The results are summarised in the Table below and Figure 3 and suggest that to harvest a seed sample of 14 per cent. moisture, harvesting must be done when lateral seeds contain 15 per cent. moisture and seeds on the main stem 12 per cent. moisture.

At this stage the pods are brown and dry, and the seeds too hard to be cracked with the teeth.

The harvested seed must be free of grass and weed seeds, and stored immediately in polythene-lined bags if the 14 per cent. seed moisture content is to be maintained and hard seed formation prevented. The thicker the polythene used, the smaller will be the further loss of water from the stored seed.

Further reading

Gladstones, J. S. (1958)—The influence of temperature and humidity in storage on seed viability and hard-seededness in the West Australian blue lupin. Aust. J. Agric. Res. 9· 171.

Quinlivan, B. J. (1962)—The effect of storage in polythene on the development of hard seeds in the West Australian blue lupin. Aust. J. Exp. Agric. Anim. Husb. 2: 209.

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RELATIONSHIP OF POD AND SEED APPEARANCE TO SEED MOISTURE CONTENT OF SANDPLAIN LUPIN, *L. cosentini,* **VARIETY CB 46.**

Stage in Figure 3	Pod and seed description	Seed moisture content (% wet weight basis)
A	Bright green fleshy kernel and seed coat	
B	Pod green and fleshy—seed kernel green with pale green seed coat	75
C	Pod beginning to yellow—seed kernel green with bluish-green speckled seed coat	50-40
D	Pod dry—seed coat bluish-brown speckled—kernel feels like dough, seed is readily cut with a kitchen knife. Seed coat easily cracked with teeth.	20
E	Pod brown and dry—seed kernel is slightly green, seed coat with intense brown speckling—seeds beginning to become saucer-shaped. Considerable pressure needed to cut or bite the seed.	15
F	Pod dry—seed coat brown speckled—seed saucer shaped. Seed cannot be cut with kitchen knife and it is not possible to bite through the seed coat.	12 or less

Residual value of manganese for split seed in lupins

by J. W. Gartrell, Plant Research Division

The split seed problem which has devastated many of the most promising sweet lupin crops on sandy country, is cured by applying manganese sulphate at 30 kg per hectare. At $8 to $10 per hectare, this fertiliser is costly.

However, experiments have shown a strong cumulative residual effect, much greater than expected, of manganese applied to previous crops.

In these experiments at the Badgingarra Research Station and Lancelin, the manganese applied two years ago remained as effective as a current topdressed application. This indicated no decline in the availability of the earlier application. However, manganese fertiliser drilled in a band with the seed, is twice as effective as topdressed manganese, or as the old application.

This means that where farmers have applied the 30 kg/ha of manganese sulphate needed to control split seed, they need to drill only half this rate with the next crop. The cost of manganese would fall from about $8 per hectare to $4 per hectare for this second crop.

When a cumulative total of 50 to 60 kg/ha of manganese sulphate has been applied, no more manganese would be needed and the split seed problem would be permanently cured.

One way of taking advantage of the residual value of manganese applied to split seed-prone soils is to crop with lupins every second year. For example, on country that has previously been treated with manganese sulphate at 30 kg/ha, 10 to 15 kg should be drilled with each later lupin crop until the total applied reaches 50 to 60 kg/ha. Further healthy crops can then be grown without spending any more on manganese.

As funds become available, all split seed-prone soils on the farm could be treated this way, and eventually the split seed problem would be eliminated.

Other soils

Unfortunately the residual effect of manganese fertiliser for cereals on affected soils along the wetter edge of the wheatbelt appears to be much less than for lupins on split seed-prone soils. However, some residual effect does become apparent after five or six applications of 15 kg/ha manganese sulphate.