



Department of Agriculture

Farmnote



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Inoculating and Lime Pelleting Pasture Legumes

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Pasture legumes form a symbiotic (mutually beneficial) association with soil bacteria (*Rhizobium* spp.) in the roots of the host legume to help meet their nitrogen requirements. Nodules develop on the plant roots and house millions of rhizobia that convert nitrogen from the air to a form the plant can use, in a process known as nitrogen fixation.

The association between the host plant and its rhizobia is very specific. Native strains of rhizobia are sometimes present in soil, although they are generally inefficient at fixing nitrogen compared with specialised strains of rhizobia. Pasture legumes should be inoculated with the correct rhizobium for optimum nodulation and maximum nitrogen fixation. Inoculum is applied as a seed coat so that rhizobia are in direct contact with the seed for nodulating the first emerged roots and subsequent laterals. When seeding mixtures of different pasture legume seeds, each cultivar should be inoculated separately using the following techniques, and then mixed together.

Inoculant

Inoculum is prepared with peat mixtures that support the rhizobia. The packet size is generally 250 grams and costs about \$5.00. Unlike grain legume inoculants, inoculants for pasture seed do not have the adhesive glue mixed with the peat, so an adhesive solution must be prepared separately before you inoculate.

Adhesive solution

An adhesive is needed to stick the inoculant and lime to the seed. Adhesives include methylcelluloses such as Methocel® and Bio-care® Pelleting Adhesive. A 150 gram packet of adhesive will cost about \$7.00. To prepare one litre of adhesive solution:

1. Sprinkle the granulated powder on to 200 mL of near boiling water, stirring vigorously until powder is dispersed. (The use of a stirrer attached to an electric drill is very effective). Mix 20 g powder for a solution of two per cent concentration and 10 g powder for a solution of one per cent concentration.
2. Slowly add 800 mL of cold water while still stirring vigorously, until an even gel is produced.
3. Allow mixture to cool (preferably overnight) before adding inoculum. Do not add materials such as alkalis to speed up the preparation of the adhesive solution.

Lime

Lime pelleting protects rhizobia against the effects of acidic fertilisers such as superphosphate. Lime pellet all pasture legume species except serradella, which have the most acid tolerant rhizobia. Do not use builders slaked or hydrated lime, as these are too alkaline and will kill the rhizobium. Use microfine lime such as ground agricultural limestone or inoculating lime. These are sold in 25 kilogram bags for about \$12.00.

The proportions of adhesive solution, inoculum and lime depend on seed size (Table 1) and the concentration of adhesive .

Table 1: Seed size of some common pasture species together with the required rhizobia group in brackets

Small seeds	Medium seeds
Lucerne (AL)	Strand medic (AL)
Biserrula (Biserrula)	Disc medic (AL)
White clover (B)	Barrel medic (AM)
Red clover (B)	Burr medic (AM)
Strawberry clover (B)	Sphere medic (AM)
Gland clover (C)	Murex medic (AM)
Balansa clover (C)	Subterranean clover (C)
Arrowleaf clover (C)	Cupped clover (C)
Persian clover (O)	Rose clover (C)
	C rimson clover (C)
	Y ellow serradella seed (S)
	French serradella seed (S)

Details of inoculation methods

General guidelines for inoculation are provided in Table 2 but we recommend preparing trial batches. Special considerations need to be made for biserrula (higher rate of inoculum) and serradella (no lime required). Serradella sold in the pod form also needs special consideration, and is explained in the next section.

Prepare the adhesive solution first, then mix inoculum with the solution, pour the mixture over the seed and stir **vigorously** until all the seed is wet. Higher rates of solution maybe required if seed is dusty or there is a residue of fine particles such as sand. When lime is required, add the limestone immediately and mix until the seeds are evenly coated. Keep the use of lime to a minimum as too much free lime can interfere with machinery at seeding. Use just enough lime to dry the seeds; less will be needed in warm weather.

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Seed can be processed in a cement mixer, by shovelling over on a cement floor, or by using a revolving drum or similar device (such as a large tractor tyre). You can also use a tarpaulin, mixing or rolling the seed by lifting alternate corners of the tarpaulin and walking forward. For bulk seed, some growers have developed systems that are based on the use of a mix-all. Auger systems have also been used but the incorporation of lime can be difficult and can cause blockages.

Table 2: Quantities of materials needed to inoculate different species of pasture. Weight of seed (kg) treated by one standard 250 gram pack of inoculum, the amount of lime required (kg) and concentration of the adhesive solution (L)	
Seed size and species	Materials required
Small seed (e.g. clover, lucerne) but not biserrula	25 kg seed, 2-3 kg lime 1 L of a 1.5-2% adhesive solution
Small seed (biserrula)	10 kg seed, 1-1.5 kg lime 4 L of a 1.5-2% adhesive solution
Medium seed (e.g. medic, sub. clover) but not serradella	50 kg seed, 4-5 kg lime 1-1.5 L of a 1.5-2% adhesive solution
Medium seed (serradella)	50 kg seed, No lime 1-1.5 L of a 1-1.5% adhesive solution
French serradella e.g. Cadiz and Yellow serradella pod	50 kg pod, No lime 6-7 L of a 1% adhesive solution

Inoculating serradella pods (French and yellow serradella)

Serradella pods absorb a considerable amount of water so higher water volumes are required. To inoculate 50 kilograms of pods, prepare one litre of a one per cent adhesive solution and add one standard 250 gram pack of inoculum group S. Add water to increase the slurry to six litres, then mix slurry with the seed. An auger system for inoculation of serradella pods is possible since no lime is required. Introduce under low pressure to ensure adequate coverage of the pods. Allow the serradella pods to dry overnight before sowing; otherwise the pods will not flow easily through seeding machinery.

Likely causes of poor lime pellets

- Powdery, soft pellets indicate either too much lime or uneven mixing, or both.
- Pasty-looking pellets with the seed surface showing indicates too much adhesive solution. Add more lime.
- Small seed clumps may be caused by excessive adhesive that may not break down after adding lime. Minimise this by rubbing the clumps against the side of the revolving drum.
- Hard, glossy, smooth pellets indicate too little lime or too much mixing after adding lime, especially when revolving drum mixers are used. Such pellets appear darkish and have a tendency to crack and flake on drying, especially when handled.

Maintaining inoculum viability

- Purchase and use viable cultures only. Discard packets past their expiry date.
- Store cultures away from direct sunlight or heat; refrigerate, don't freeze, the cultures.
- Discard leftovers in opened packets, as the inoculant will deteriorate.

- Use rainwater where possible when you are inoculating seed.
- Use clean equipment; pesticides and extremely acidic or alkaline fertilisers (other than lime) can be harmful to bacteria.

Seed preparation and sowing

Sow inoculated seed as soon as possible into moist soil, although storage in cool conditions for up to three weeks generally presents few problems. Aerial or dry sowing seed can result in poorer nodulation. Doubling the amount of the inoculum peat mix when preparing the adhesive solution can help to compensate for this. Lucerne rhizobia have a low tolerance of pH below 6, we

recommend higher rates of inoculation if lucerne is to be sown on acidic soils.

If mixing inoculated seed with superphosphate sow it immediately. Avoid using trace element superphosphate. Nodulation and nitrogen fixation can be reduced if high rates of fertiliser nitrogen are applied with the seed or there are high soil nitrate levels. Adding starter nitrogen should not exceed 10 kg N/ha for new legume sowings.

Rhizobia are rapidly killed when exposed to pesticides. If red-legged earth mites are a serious problem, omethoate or dimethoate insecticides can be applied as a seed dressing but this can seriously inhibit nodulation. See FN33/91 if you are treating seed with insecticide, apply the insecticide 24 hours before inoculating seed and sow immediately into moist soil. Apply the insecticide as a solution in water. Don't store inoculated and insecticide treated seed. There are safety concerns for the operator when handling insecticides for extended periods, so consider the use of a bare-earth insecticide treatment soon after sowing as an alternative control measure.

Pre-coated seed technology

Some seed companies have now developed technology to sell pre-inoculated seed as part of a complex seed pellet that may also include insecticides, fungicides and micro fertilisers. This technology includes Smartcote® (SGB) and Agricote® (Heritage Seeds). The main use of pre-inoculated seed is for lucerne but the technology is likely to be expanded to other pasture cultivars in the future.

Further reading

Farmnote No. 33/1991 *Le-mat and legume inoculation*.