

# Comparison of chickpea inoculant methods and the interaction with seed applied fungicide

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## Key Messages

- Peat-based inoculant methods (slurry or granules) had more root nodules than nil and ALOSCA® with fertiliser treatments
- There were no biomass differences measured between any of the treatments at any stage in the season
- Nodulation differences did not lead to yield differences, likely due to good growing conditions through most of the season

## Background

Chickpeas are a well suited break crop option for the Dalwallinu region. Good root nodulation from symbiosis of rhizobia and plant roots is required to get the most out of growing chickpeas. This improves crop growth and provides nitrogen benefits to following cereal crops. It is recommended that all chickpeas are inoculated prior to sowing to ensure good nodulation. Whilst reliance on background soil rhizobia from previous crops may be suitable for other legumes, such as lupins, this is not the case with chickpeas. Paddocks generally do not have enough of a history of chickpeas or adequate soil pH to ensure survival of rhizobia over the recommended 4-year break between chickpea crops.

Traditionally, grain legumes have been inoculated using a peat slurry product. Rhizobia are sensitive to both temperature and desiccation; therefore, peat needs to be stored in the fridge until it is ready to be used, and once inoculated seed should be sown within 6-24 hours to prevent drying out. Seed inoculated with peat slurry is best suited to sowing into moist conditions, as the rhizobia has no protection from drying out when sown into dry soil and rhizobia death can occur in high numbers quite quickly.

Recently, peat based granules such as Tagteam® have become available to inoculate pulses. These are a 'wet granule', which are used in a similar method to clay based granules, however they retain the high rhizobia number of peat slurry products and the need to be refrigerated prior to inoculation of seed. Clay based granules, such as ALOSCA®, can help overcome sowing in to dry/drying soil as the clay is better able to protect rhizobia from both drying out and heat. The clay may also provide more protection from potentially acidic conditions, such as exposure to fungicidal seed dressing or fertiliser. These granules require no special treatment (such as refrigeration) and can be mixed with seed into the cart, so they are easy to use, however they usually require higher application rates due to a lower number of rhizobia per gram of inoculant.

With some pulses, in situations where sowing conditions are not ideal, i.e. pH lower than 5.5 or marginal soil moisture, the recommended rate of peat slurry is doubled or a single rate of peat slurry is combined with ALOSCA® granules as an insurance policy. In these situations, it is known that some rhizobia death is likely to occur due to the imperfect soil conditions. Using either the double peat or combination of peat slurry and clay granules can ensure that there is still adequate surviving rhizobia numbers even after some death has occurred.

In addition to inoculation with rhizobia, it is recommended that all chickpea crops are treated with seed applied fungicide to manage seed borne Ascochyta risk, however it is also known that fungicide based seed dressings can impact on survival of rhizobia due to their acidic nature. It is recommended to sow as soon as possible after inoculation to minimise the time that rhizobia are exposed to the fungicide on seed. Another method that growers commonly use to avoid fungicide impacting on rhizobia survival is to place clay based granules with fertiliser at seeding, therefore achieving separation of the fungicide and rhizobia.

## Aim

We plan to demonstrate a range both peat and granular inoculant options for chickpeas, placement of these products with seed vs. with fertiliser, and the interactions of these products with seed applied fungicide.

**Table 1: Trial Details**

<b>Trial Location</b>	Matthew Hyde, Dalwallinu
<b>Plot size &amp; replication</b>	10m x 1.54m x 3 replications
<b>Soil type</b>	Heavy red loam
<b>Paddock rotation</b>	2019 barley, 2020 chemical fallow
<b>Sowing date</b>	11 May into wet soil
<b>Sowing rate</b>	CBA Captain, 103kg/ha
<b>Fertiliser</b>	Superphosphate 100kg/ha, (9.1P, 10.5S, 20.0Ca)
<b>Herbicides, Insecticides &amp; Fungicides</b>	Seed treatment, as per plot treatment: 200mL/100kg seed thiram (360g/L) + thiabendazole (200g/L) At seeding: 860 kg/ha terbuthylazine (875g/kg) + 1500mL/ha fomesafen (240g/L) + 1kg/ha propyzamide (500g/kg) + 500mL/ha chlorpyrifos (400g/L) & bifenthrin (20g/L) 16 June: 880mL/ha tebuconazole (400g/L) & azoxystrobin (20g/L) 5 Aug: 330mL/ha clethodim (360g/L) + 180g/ha butoxydim (250g/kg) + 500mL/100mL water non-ionic surfactant 30 Aug: 600mL/ha prothioconazole (150g/L) & bixafen (75g/L) 4 Oct: 160mL/ha alpha-cypermethrin (100g/L) 11 Oct: 875mL/ha tebuconazole (200g/L) & azoxystrobin (120g/L)
<b>Harvest Date</b>	1 Dec

**Table 2: Treatments**

Treatment #	Inoculant method	Seed dressing
1	Nil rhizobia	None
2	Nil rhizobia	P-Pickel T
3	Peat slurry	None
4	Peat slurry	P-Pickel T
5	Double rate peat slurry	None
6	Double rate peat slurry	P-Pickel T
7	Peat slurry + ALOSCA® with seed	None
8	Peat slurry + ALOSCA® with seed	P-Pickel T
9	Peat slurry on seed + ALOSCA® with fertiliser	None
10	Peat slurry on seed + ALOSCA® with fertiliser	P-Pickel T
11	ALOSCA® with seed	None
12	ALOSCA® with seed	P-Pickel T
13	ALOSCA® with fertiliser	None
14	ALOSCA® with fertiliser	P-Pickel T
15	Tagteam® with seed	None
16	Tagteam® with seed	P-Pickel T

Seed dressing: 200mL/100kg seed of P-Pickel T (360 g/L thiram + 200g/L thiabendazole)

**Table 3: Soil Composition**

Depth (cm)	pH (CaCl <sub>2</sub> )	Col P (mg/kg)	Col K (mg/kg)	S (mg/kg)	N (NO <sub>3</sub> ) (mg/kg)	N (NH <sub>4</sub> ) (mg/kg)	EC (ds/m)	OC (%)
0-10	7.4	41	752	2.6	5	2	0.093	0.97
10-20	7.6	8	418	2.6	1	<1	0.196	0.58
20-30	8.1	5	303	1.5	2	<1	0.234	0.45

**Table 4: Rainfall up to and including 12 December from BOM Dalwallinu station (8297).**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Apr-Oct	Annual
2021	1	33	115	39	80	34	114	26	5	35	44	2	306	529
Average	22	15	28	14	36	35	51	40	22	13	11	12	211	299

## Results

This trial was sown into wet soil following 40mm of rainfall in the week prior to seeding. Plant establishment was excellent, with all treatments close to or exceeding the target density of 45 plants/m<sup>2</sup>. Neither seed dressing nor inoculant treatment had any impact on plant density. The wet soil at seeding in combination with sowing occurring within 24 hours of inoculation provided excellent conditions for root nodulation to occur. Ideally, sampling of plants to assess root nodulation would occur 8-12 weeks after a trial is sown.

Unfortunately, in 2021, the very heavy soil and wet winter combined to make the plants extremely difficult to sample without destruction of the roots or the surrounding plants. Therefore, sample collection for nodulation assessments in this trial was done on 24 August, 15 weeks after sowing. Despite sampling occurring later than ideal, we were still able to make an accurate assessment of nodulation. The below scale was used to assess 20 plants from each plot. Nodules were also opened to check internal colour as a guide to their effectiveness.

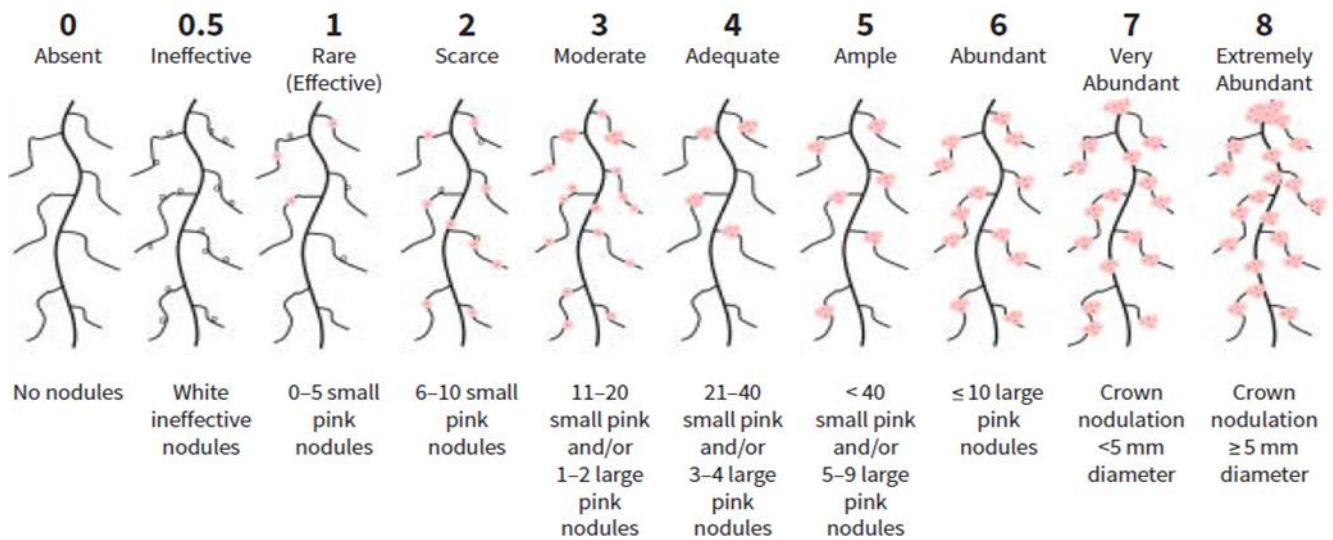


Figure One: Nodulation rating scale used to assess samples from this trial. Taken from Howieson, et al. (2016)

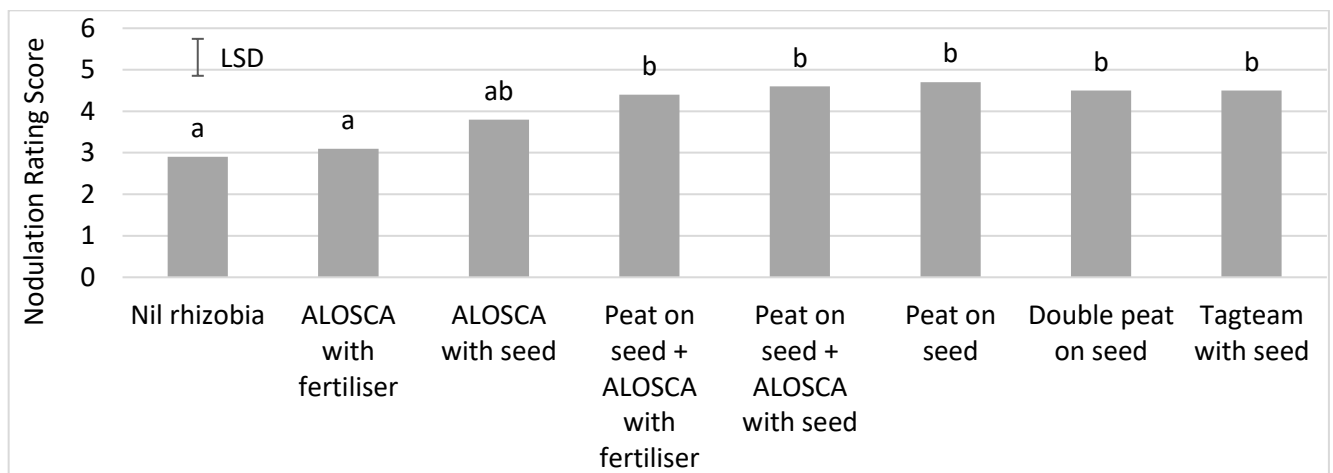


Figure Two: Average rating for each rhizobia treatment from samples taken on 24 August,  $p = 0.003$ . Treatments that share a common letter are not significantly different.

In this trial there was a significant difference in the nodulation rating score when treatments were separated by the rhizobia they were inoculated with (Figure Two). Despite the acidic nature of seed applied fungicide treatment, it did not affect root nodulation in this trial and all treatments achieved the same nodulation when sown with seed dressing as they did when sown without.

The nil rhizobia treatment in this trial did have some effective nodules present on plant roots, despite cleaning machinery with ethanol between seeding each treatment. This suggests that there may have been some contamination between treatments or that there were background rhizobia present in the soil. All treatments that were peat based, whether they were applied as a slurry or granule, at single or double the recommended rate, or in combination with ALOSCA<sup>®</sup> granules, had significantly more nodules than the nil and ALOSCA<sup>®</sup> with fertiliser treatments. The peat-based products achieved adequate nodulation, whilst the nil, ALOSCA<sup>®</sup> with

fertiliser and ALOSCA® with seed treatments had moderate–adequate nodulation. Root and shoot biomass were also measured at the time of nodulation ratings, however neither of these measures showed differences between any of the treatments.

There was no extra benefit to nodulation when the double rate of peat slurry was used, nor was there an added benefit when peat slurry was combined with ALOSCA® granules. This trial was sown into wet soil after 40mm of rainfall in the week prior to sowing. The soil pH was also well within the acceptable range for chickpeas. Hence, the peat-based products, which would likely have suffered more rhizobial death if left sitting in dry soil or lower pH, were able to nodulate better than the ALOSCA® based treatments. As mentioned above, ALOSCA® granules can perform very well when sowing in to dry or drying conditions and we may have seen different results if this trial was sown into dry soil.

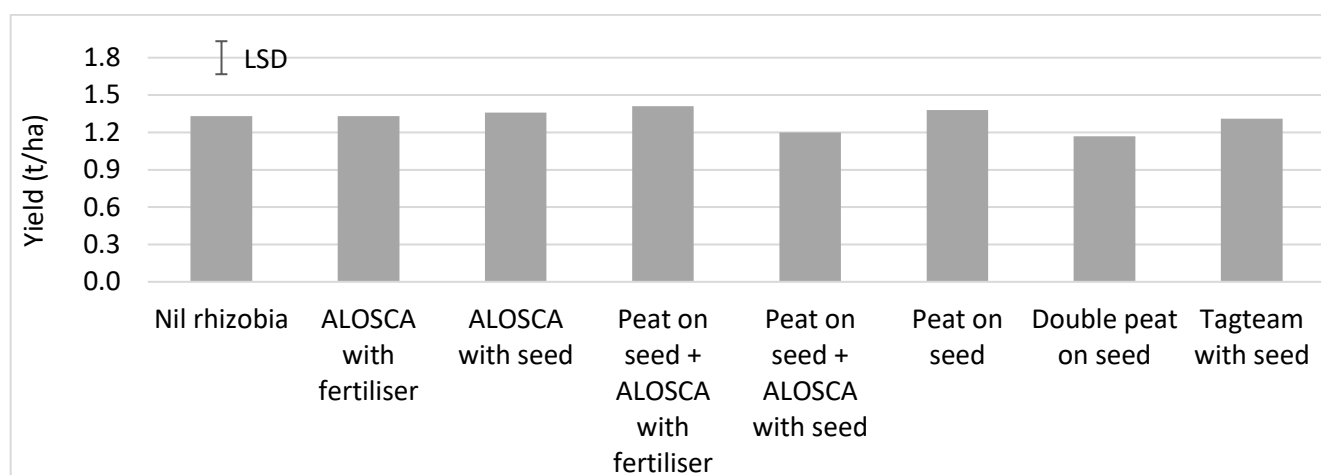


Figure Three: Seed yield at Dalwallinu in 2021. Rhizobia  $p = \textit{not significant}$ .

As mentioned above, the site was extremely wet throughout winter after 114mm of rainfall fell in July (Table 4). Chickpeas are sensitive to waterlogging at any stage of growth; with their most sensitive stages being flowering and podding. Fortunately, waterlogging receded in early August, and it did not appear to hamper seed yield. Yields were quite good, with a site average of 1.3t/ha (Figure Three). Despite the differences in nodulation between treatments, they all yielded the same. In a season such as 2021, after sowing into wet soil and with regular rainfall throughout the season, the subtle yet significant, differences in nodulation did not translate to differences in seed yield. This was expected in 2021 given the lack of differences in biomass both at the time of nodulation ratings and at harvest time. In a more difficult season, the improved nodulation achieved by using peat-based products may have resulted in yield differences between treatments.

### Comments

Seed dressing did not have any impact on plant density or nodulation success in this trial. This is reassuring, given fungicidal seed dressing is recommended on all chickpea crops as a first line of defence against *Ascochyta* blight and other fungal diseases, such as *pythium*. Plots that were inoculated with a peat-based product had significantly more nodulation than those that did not have a peat-based product. Yields across the trial were satisfactory and all rhizobia and seed dressing treatments yielded the same despite differences in nodulation, likely due to the wet soil conditions at seeding and good spring growing conditions.

While chickpeas can grow without adequate nodulation, they will fix less atmospheric nitrogen. This can cause yield loss in the year the pulse is grown, as well as deplete soil N reserves and minimise the N benefits to the following cereal crop. Many factors can impact on rhizobia survival and ability to form nodules. These can include storage conditions prior to seed application, such as not refrigerating peat inoculant, interaction with seed applied fungicide or fertiliser, low soil pH or moisture and crop stress soon after sowing such as waterlogging. It is important to handle and apply inoculants as per the manufacturers instructions to maximise crop nodulation and nitrogen fixation.

Using the scale in Figure One, it is easy for growers to assess nodulation in their own pulse crops. The scale can be used for all pulses. Samples can be collected following the instructions in the GRDC video Legume Nodulation: sample preparation <https://www.youtube.com/watch?v=0VL7CIY-K9w>.

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**References**

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