

## **Waterlogging highlights benefits of rhizobia in faba beans.**

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### **Abstract**

Field trials evaluating rhizobia effectiveness can be highly variable between sites and years. Trials in 2003 faba beans with rhizobia appeared more tolerant of waterlogging than those with no rhizobia. In the present trial, a site prone to waterlogging was chosen so that mild levels of waterlogging could be used to screen rhizobia for effectiveness. The trial included evaluation of different rhizobia strains; WSM1455 (Group F), SU303 (Group E) and RRI294 all applied as a wet seed dressing and within Group F applications at five times the recommended rate, as a dry seed application and in granular "Alosca?" form. Control treatments of no rhizobia (Nil) and fertiliser nitrogen were included. A second set of controls, Group F rhizobia and Nil, were planted on nearby raised beds to assess rhizobia response without waterlogging. There was a significant yield increase from rhizobia on the waterlogged faba beans but no effect from rhizobia on the faba beans grown on raised beds. Nodulation responses were present at both sites. Nitrogen applications gave yields equal to the better rhizobia treatments. All rhizobia strains yielded significantly more than the Nil, but F tended to be lower than E and RRI294. Dry and granular rhizobia treatments were not as effective as the wet seed dressing applications.

### **Key Words**

Rhizobia, faba bean, waterlogging, nitrogen.

### **Introduction**

Responses to rhizobia in Tasmania have been more apparent when autumn sown legumes experience waterlogging. Soil nitrogen, from previous crops and organic matter breakdown, may be sufficient that nitrogen stress only tends to occur after waterlogging. This trial was conducted on a flat site (without raised beds) to increase the chances of waterlogging.

### **Methods**

Faba beans (Fiesta) were sown on 27/5/05 (flat) and 30/5/05 (beds) at a sowing rate of 290kg/ha. Type F rhizobia were applied as a 1:1 ratio of rhizobia peat mix : water at the standard rate of 1.25kg/250kg seed (F wet), five times the standard rate (F wet Hi), as rhizobia peat only (F dry) and as the lime granular form (Alosca). Type E rhizobia and Rutherglen Research Institute acid tolerant strain (RRI 294) were applied as 1:1 ratio of rhizobia peat mix : water. The drill was sterilised with methylated spirits between sowing beans inoculated with different strains of rhizobia. Two uninoculated control plots were applied, without rhizobia (Nil), and with top-dressed nitrogen. The nitrogen plots had 4 applications of urea at 40 kg/ha on 20/6/05, 17/8/05, 7/9/05 and 26/10/05 totaling 160 kg. All applications were made prior to rainfall of 10mm or more in the following two days. Treatments were replicated four times and analysed by ANOVA. The trial was sown on a section of the paddock prone to waterlogging. A small trial on adjacent raised beds was used to evaluate the responses to rhizobia (F wet) and no rhizobia (Nil) on raised beds. Both sites were fertilised with 250kg 4:7:13:9 drilled at sowing. Simazine 2 L/ha, Stomp 2.5 L/ha and Astound 60 ml/ha was applied on 7/6/05 and Mancozeb 3 kg/ha and Barrack 2 L/ha on 5/10/05. Ten plants per plot were collected on 20/10/05 (plants were in early flower) and rhizobia nodules were scored on a system based on Corbin et al. (1977). Nodule score was the sum of effective nodules on the first 50 mm of taproot plus half the sum of effective nodules elsewhere.

### **Results**

Last winter/spring was particularly wet and parts of the flat area were saturated for extended periods of time and are likely to have experienced denitrification. Nodule scores were significantly higher for the F wet Hi and RRI 294 rhizobia followed by the E wet and Fwet (Figure 1). The F dry and Alosca treatments were significantly lower than the other rhizobia treatments but still higher than the Nil and nitrogen controls. Nodulation scores were similar between F wet and Nil plants grown on raised beds and on the flat, waterlogging did not affect nodulation.

The rhizobia strains F-wet, E-wet, RRI-294 all resulted in significant yield increases compared to the Nil (Figure 2). Yields from the F-dry and granular Alosca inoculated plots were not significantly different from the Nil. There was a trend for the F-wet-Hi treatment to yield more than the F-wet, though this was not significant. Nitrogen application increased the yield compared to the Nil, but produced a similar, and not significantly different, yield to the more effective rhizobia treatments. Faba beans grown on beds yielded over twice as much as the nil plots grown on the flat and 30% higher than the F-wet rhizobia treatments grown on the flat. There was no significant difference in yield between F-wet and Nil treatments grown on raised beds.

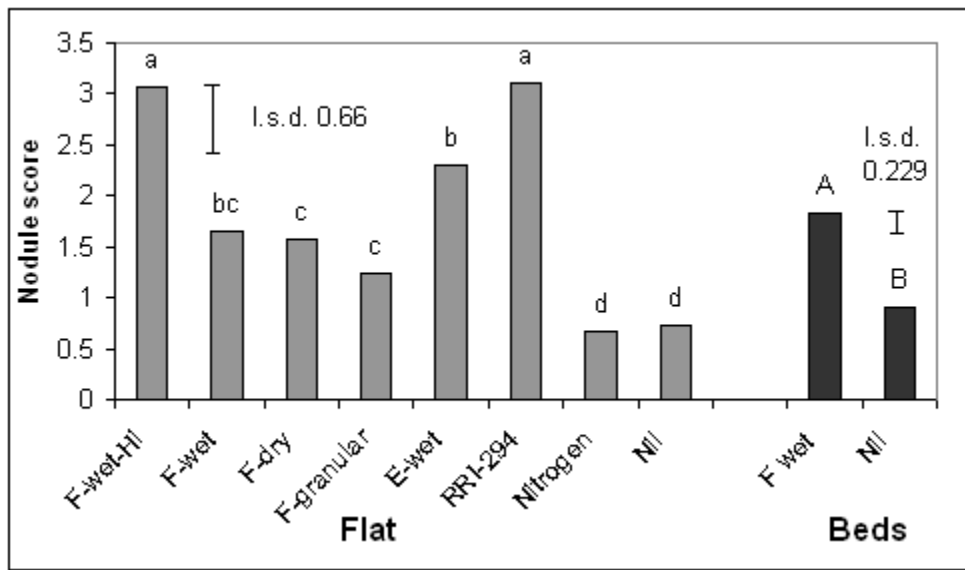


Figure 1. Nodule scores of faba beans plants on 20/10/05 from rhizobia trials on flat waterlogged site and raised bed site.

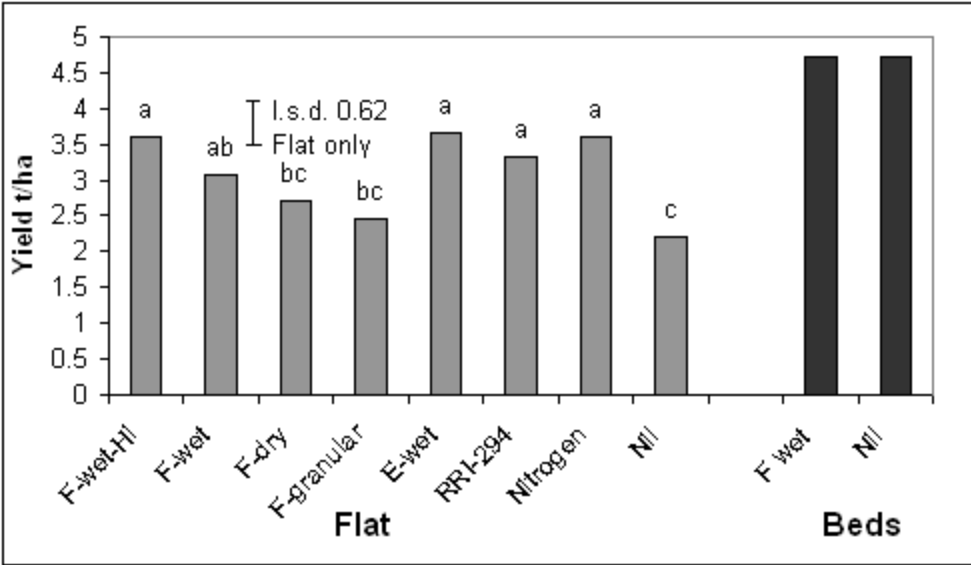


Figure 2. Yield of faba beans from rhizobia trials on flat waterlogged site and raised bed site.

**Conclusion**

The strong yield response of plants grown on the flat to rhizobia and nitrogen indicates nitrogen was limiting under the waterlogged conditions experienced (Figure 2). While there was a strong nodulation response on raised beds there was no affect of rhizobia on yield. Raised beds experience little or no denitrification so that most of the residual nitrogen and nitrogen from organic matter breakdown can be utilised by the crop. The nitrogen treatment did not increase the yield above the better rhizobia treatments. This suggests that waterlogged plants inoculated with rhizobia produce enough nitrogen that nitrogen is not limiting growth. However the waterlogged plants still yielded substantially less than those grown on raised beds and were ready for harvest three weeks earlier. Moisture stress from a reduced rooting depth of waterlogged plants may have checked their growth.

**References**

Corbin EJ, Brockwell J and Gault RR (1977). Nodulation studies on chickpea (*Cicer arietinum*). Australian Journal of Experimental Agriculture and Animal Husbandry, 17: 126-134.