Acid tolerant rhizobia for faba bean

"Rhizobium bacteria,
it's a numbers game"

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Poor nodulation of faba bean grown on acid soils (pH_{CaCl_2} < 5.2) is considered by industry as a major constraint to increasing both the area of faba bean grown in south west Victoria and potential yield. A promising solution to this problem is to use acid tolerant strains of rhizobia to inoculate faba beans.

In 2017, a research trial was undertaken in conjunction with collaborators Ross Ballard and Liz Farquharson from the South Australian Research and Development Institute (SARDI). The aim of this trial was to compare commercial faba bean rhizobia inoculant with new acid tolerant strains from SARDI and the Department of Primary Industries and Regional Development (DPIRD), WA. The trial was located at Chatsworth in Victoria.

The grain yield of faba bean inoculated with the acid tolerant strains, WSM 4641 (4.7 t/ha), SRDI 696 (5.0 t/ha) and SRDI 970 (6.2 t/ha) were significantly (P = 0.014) higher compared to the grain yield of faba beans inoculated with the commercial Group F strain WSM1455 strain (2.3 t/ha) (Table 1). On average, this represents a 130% increase in yield due to acid tolerant strains.

A single rate of commercial Group F inoculant 1455 failed to significantly increase faba bean yield compared to faba beans with no rhizobia (control), although there was a trend for a (1.1 t/ha) yield improvement with inoculation. Double and quadruple rates of commercial Group F inoculant WSM1455 significantly (P = 0.014) increased grain yield by 2.5 t/ha (193%) and 2.4 t/ha (202%) respectively, compared to the no rhizobia control.

Table 1. The effect of rhizobia inoculant treatment on the grain yield of faba bean cv. Samira grown on an acid soil ($pHCaCl_2$ 4.7, 0-10 cm) at Chatsworth, Victoria in 2017.

Inoculant and rhizobia bacteria treatments	t/ha	
Peat, no rhizobia – control	1.2	*a
Commercial peat Group F inoculant – rhizobia strain WSM 1455 @ single rate	2.3	ab
Novozymes Tag Team Group EF granules – rhizobia strain WSM 1455	2.6	abc
Peat inoculant – acid tolerant rhizobia strain WSM 4643	2.9	abcd
Commercial peat Group F inoculant – rhizobia strain 1455 + EasyRhiz freeze dried	3.0	abcd
Commercial peat Group F inoculant – rhizobia strain 1455 @ four times the rate	3.6	bcd
Commercial peat Group F inoculant – rhizobia strain 1455 @ double rate	3.7	bcd
Peat inoculant – acid tolerant rhizobia strain SRDI 954	3.9	bcd
Peat inoculant – acid tolerant rhizobia strain SRDI 971	4.5	bcde
Peat inoculant – acid tolerant rhizobia strain WSM 4641	4.7	cde
Peat inoculant – acid tolerant rhizobia strain SRDI 969	5.0	de
Peat inoculant – acid tolerant rhizobia strain SRDI 970	6.2	e
LSD (P = 0.05) = 2.3		

**Values followed by the same letter do not significantly differ according to Fisher's Protected Least Significant Difference (LSD)*

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Conclusion: New acid tolerant strains of rhizobia show potential to increase faba bean yield on acid soils (pH_{CaCl_2} < 5.2), however, such rhizobia options are still several years from commercialisation. In the short term, using a double rate of Group F inoculant provides a practical way to increase faba bean yields when they are grown on acid soils, which is likely linked to increasing the number of rhizobia surviving at the time of nodulation. In this trial doubling, but not quadrupling, the number of bacteria applied to the seed improved grain yield due to the probable increase in rhizobia bacteria surviving within acid soil conditions and is consistent with earlier findings by Ballard et al (2018) and Denton et al (2013).

When improved acid tolerant rhizobia become available they should not be considered a replacement for liming, as liming will remain an important practice to run in parallel with use of acid tolerant rhizobia.

Overall, this work will provide the industry with compelling information that demonstrates how acid tolerant rhizobia combined with a robust liming program can increase yield and the area available to crop faba bean on acid soils in south western Victoria.

References

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