NEW GROUP F RHIZOBIA INOCULANT FOR FABA AND BROAD BEAN

FACT SHEET

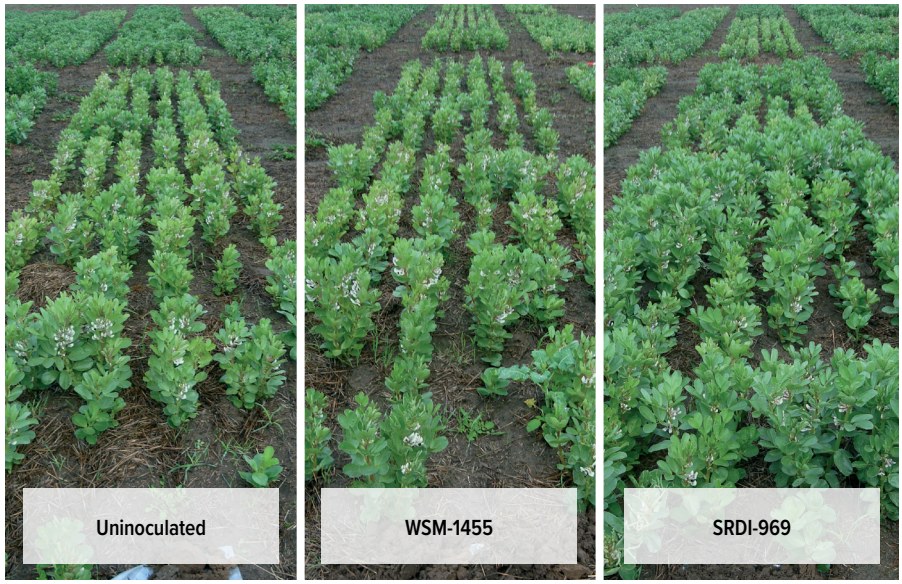
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NATIONAL
JULY 2023

Acid tolerant rhizobia improve nodulation of faba and broad bean

KEY POINTS

- Inoculation of pulses is widely recommended, particularly where the pulse is sown into paddocks with acidic soils or, where the pulse or another in the same inoculation group has not been sown for a number of years.
- A new high-performing rhizobia strain for Group F (faba and broad bean inoculant) with improved nitrogen fixation and acid soil tolerance will be available for the 2024 season.
- The new strain (SRDI-969) will replace strain (WSM-1455)
- The new strain can provide optimal nodulation down to pH_{Ca} 5.0 and improved nodulation to pH_{Ca} 4.5.



Photos: Liz Farquharson, SARDI.

Benefit of the new Group F rhizobia strain (SRDI-969) on faba bean. Wanilla, SA, 2017, Soil pH_{Ca} <4.6.

Introduction

About 260,000 hectares of faba and broad beans are currently grown Australia-wide, with 80 per cent of the total area in the southern grains region of South Australia and Victoria.

They almost always precede a cereal crop in the rotation because farmers value the contribution they make to soil nitrogen fertility and to the yield of the cereal. Based on published statistics (ABS 2023), we estimate the average bean crop (yield ~ 1.7 t/ha) will fix about 130 kilograms of nitrogen per hectare (kg N/ha). Once the grain had been harvested, the crop would leave about 115kg N/ha in the soil, of which about three quarters will be recently-fixed N.

The nitrogen fixation process requires effective rhizobia (root nodule bacteria) to be present in adequate number in the soil surrounding the legume to enable nodulation of the plant's root system. In acid soils, below pH_{Ca} 5.5 (ie. pH measured in calcium chloride), adequate numbers of rhizobia are unlikely to be present in the soil. In these paddocks rhizobia will need to be added to the seed or soil at sowing, using an inoculant. The requirement for inoculation can be estimated using the Predicta rNod test available through the South Australian Research and Development Institute (SARDI).

The rhizobia that nodulate faba and broad bean are especially sensitive to soil acidity below pH_{Ca} 5.5, as highlighted in Figure 1. Expansion of pulse sowings into areas containing acid soils is currently restricted because of poor nodulation, plant establishment and growth. With GRDC investment, an improved inoculant strain has been selected to facilitate successful establishment and improve production of beans on acidic soils, an area exceeding 50,000 hectares.

What is changing?

For the 2024 season two new acid-tolerant rhizobia strains will become available from commercial inoculant suppliers. This Fact Sheet describes the Group F strain, SRDI-969 which will replace WSM-1455 for use on beans. Details of an acid tolerant strain (WSM-4643) for lentil, field pea and vetch (shown in table 1) are describe in a companion Fact Sheet.

Table 1. Inoculant Group, legume crops covered and rhizobia strain

Inoculant Group	Crop	Strain
F	Faba and Broad Bean	SRDI-969
E	Lentil, Field Pea, Vetch	WSM-4643

P Level 4, 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T +61 2 6166 4500 **F** +61 2 6166 4599 **E** grdc@grdc.com.au

FIGURE 1. Relationship between soil pH_{Ca} (0-10cm) and the field nodulation (number of nodules per plant) of legumes inoculated with rhizobia strain WSM-1455. Value for pea at pH 7.5 (open circle) is an average of data collected from 12 sites with background rhizobia. All other values based on single sites.

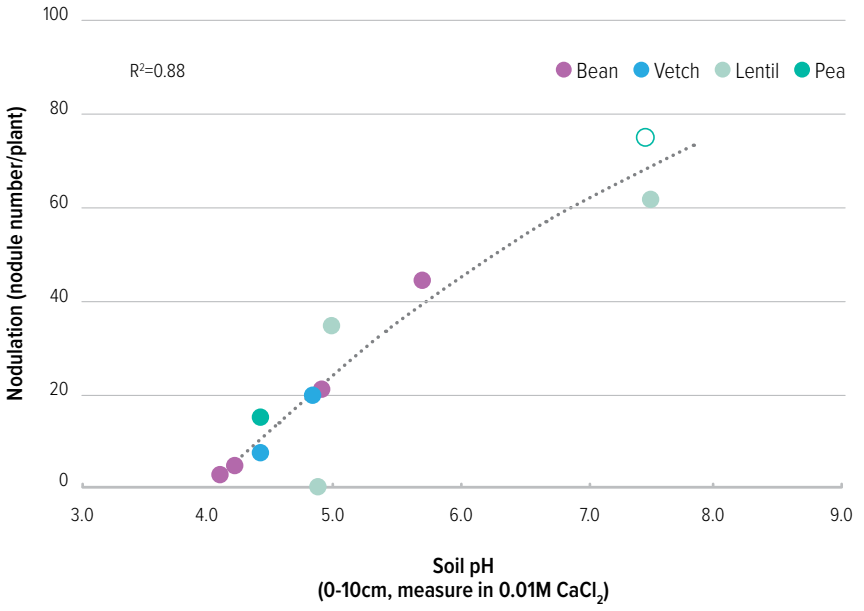
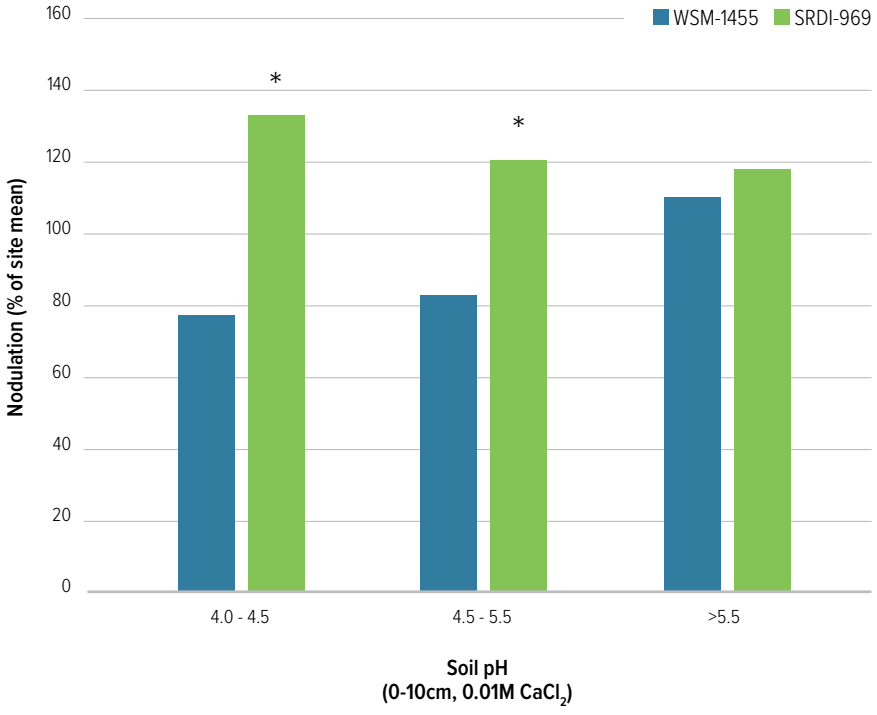


FIGURE 3. SRDI-969 improves nodulation of faba bean on acid soils compared to WSM-1455 and maintains good nodulation on soils above pH_{Ca} 5.5. *Indicates significant improvement in nodulation above WSM-1455. Results from 9 sites.



What is the benefit?

The new Group F strain, SRDI-969, has shown across multiple field trials with faba bean an average improvement of 65 per cent in nodulation and 24 per cent in nitrogen fixation (Figure 2).

At two sites where low soil pH favoured significant improvements in nodulation with SRDI-969 and the season ended favourably, yields were more than doubled.

Even where paddocks have been limed, the new rhizobia strain should improve bean nodulation in areas of the paddock where surface and sub-surface acidity persists.

The maximum benefit of the new rhizobium strain is in acid soils below pH 5.5, however SRDI-969 is equally effective as the former strain WSM1455 on neutral and alkaline soils which are suited to growing faba bean and broad bean (Figure 3).

FIGURE 2. Improvement in nodulation and nitrogen fixation with the new acid tolerant rhizobia strain SRDI-969 compared to former inoculant strain WSM-1455 on faba bean (average 7 trials).

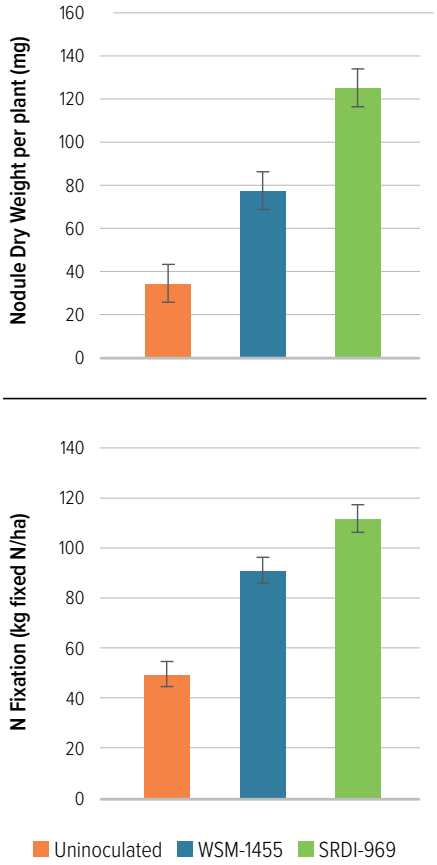
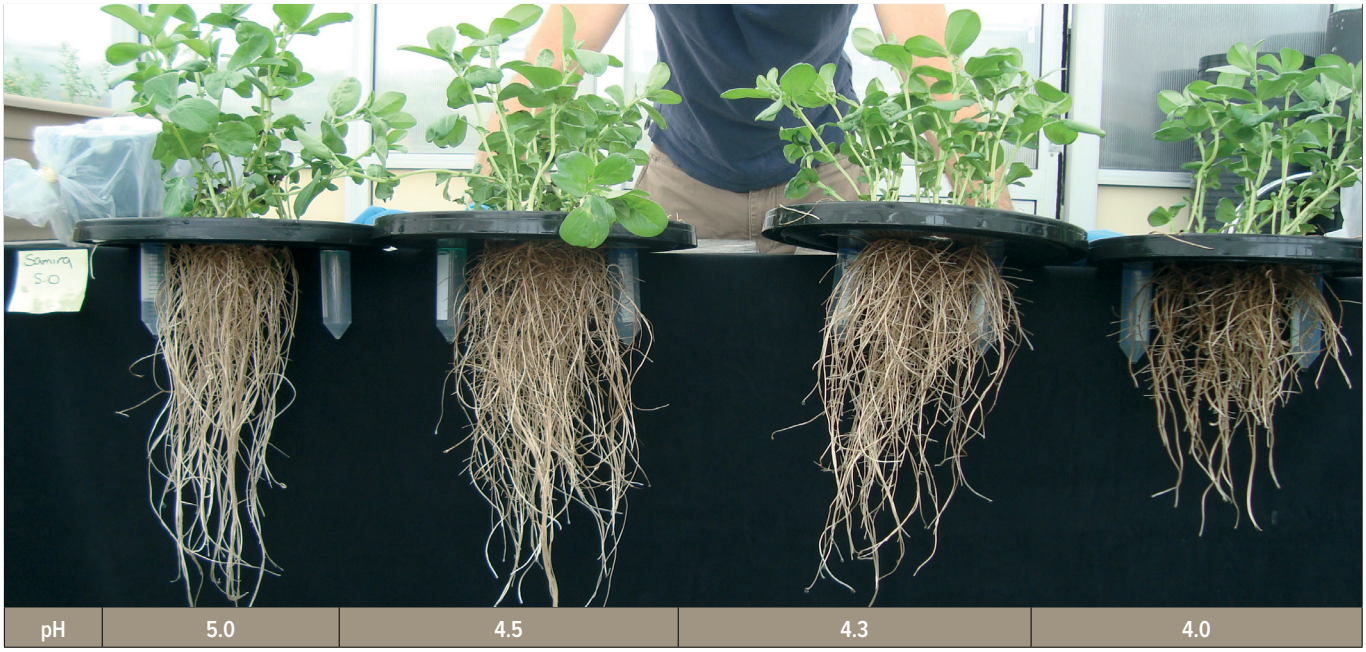


FIGURE 4. Impact of decreasing pH on the root growth of faba bean (PBA Samira) inoculated with former Group F rhizobia strain WSM-1455.

Photo: Ross Ballard, SARDI.



Soil pH – how low is too low?

Inoculation should always be used with good liming practice. Soil pH_{Ca} below 5.0 is a hostile environment for the acid sensitive species of rhizobia. These conditions can also damage plant roots and restrict availability of nutrients for a wide range of crops (Figure 4). When pH_{Ca} is 4.5 or lower, liming is essential to decrease toxic levels of available aluminium if present in the soil and to ensure good legume root growth needed for prompt and abundant nodulation. In addition, liming will benefit other crops, i.e. cereals and canola, grown in the rotation.

Optimising inoculation practice

How often do I need to inoculate bean seed if I have acidic soils?

Beans will nearly always need to be inoculated where soil pH is less than 5.5 measured in calcium chloride. Although the new rhizobia strain will improve nodulation in the year it is applied, it may not survive from one season to the next. Therefore beans will need to be inoculated each time they are sown in very acidic soils. Results from two replicated field trials (Figure 5) in acid soils shows the nodulation by strain SRDI-969 six months after the host crop was below optimal, the result of inadequate rhizobia persistence. SRDI-969 is unlikely to persist at adequate levels in very acid soils to nodulate the next bean crop in a 3-4 year rotation. In non-acidic soils, we would expect to find at least 50 nodules per plant.

When applying inoculant, growers are applying living rhizobia. The more rhizobia that survive between inoculation and plant germination, the greater the potential for prompt and abundant nodulation. Therefore, the higher the number of rhizobia applied, the greater the chances sufficient rhizobia will survive in the soil until needed at plant germination. Doubling the inoculation rate may be advantageous on acidic soils.

Care must be taken if growers intend to inoculate seed that has been treated with pesticides. Where pesticide application is necessary, peat inoculant is best applied to seed as close to sowing as possible and sown into moist soil. Alternatively, granular inoculant may provide a better option as this reduces direct exposure of the rhizobia to the pesticide.

FIGURE 5. Persistence of rhizobia strains in acid soils; Nodulation of plants sown into soil collected six months after grain harvest of an inoculated host crop (either with strain WSM-1455 or SRDI-969) or Uninoculated (Nil). Although SRDI-969 shows some improvement, it is recommended that bean crops are always inoculated below pH_{Ca} 5.5.

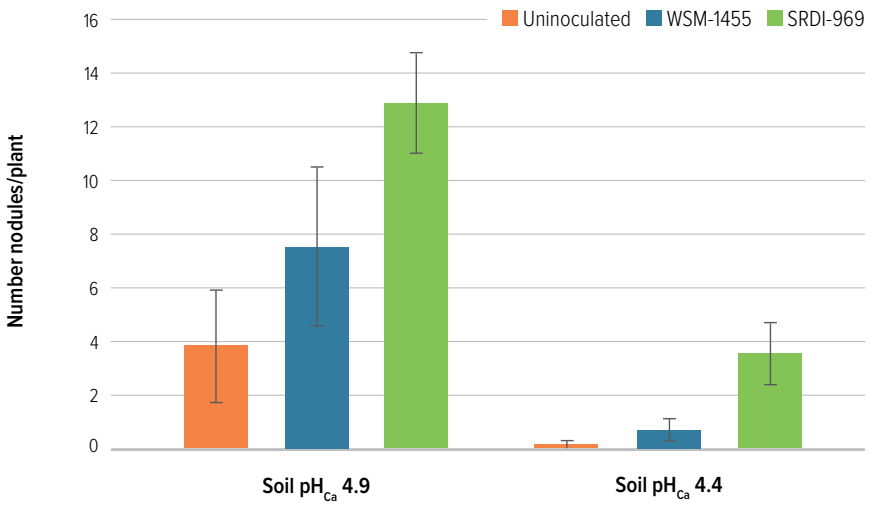


Photo by Liz Farquaharson (SARDI)

Improved nodulation and growth of faba bean inoculated with SRDI-969 (right) compared to WSM-1455 (left) on an acidic soil on Kangaroo Island in 2022.

FREQUENTLY ASKED QUESTIONS

What can I do to remediate my acidic soil?

Consider a liming and a lime incorporation strategy to increase the pH across the paddock or in very low pH areas of the paddock identified through soil testing.

Can I dry sow on acid soils?

Dry sowing into acid soils which are highly responsive to inoculation is not recommended. Dry sowing reduces the number of rhizobia that survive between inoculation and plant germination, which may compromise nodulation. If choosing to dry sow consider doubling the inoculation rate.

Can I use the group E inoculant on Faba bean or the group F inoculant on field pea or lentil ?

Use of strain SRDI-969 is NOT recommended for use on field pea, lentil or vetch. Another improved rhizobia strain (WSM-4643) , specifically selected for field pea, lentil and vetch, will also available for the 2024 season.

USEFUL RESOURCES

GRDC Podcast – The lowdown on subsurface acidity grdc.com.au/news-and-media/audio/podcast/the-lowdown-on-subsurface-acidity

GRDC Publication - Legumes in Acidic Soils – Maximising production potential in south eastern Australia grdc.com.au/resources-and-publications/all-publications/publications/2021/legumes-in-acidic-soils

Inoculating legumes in acidic soils fact sheet grdc.com.au/resources-and-publications/all-publications/factsheets/2021/inoculating-legumes-in-acidic-soils

GRDC Inoculating Legumes Practice and Science: Inoculating legumes: practice and science - GRDC

GRDC Fact Sheet - New Group E Rhizobia Inoculant for Field Pea, Lentil and Vetch Fact Sheet: grdc.com.au/resources-and-publications/all-publications/factsheets/2023/new-group-e-rhizobia-inoculant-for-field-pea,-lentil-and-vetch-fs

MORE INFORMATION

Liz Farquharson
South Australian Research and Development Institute (SARDI)
08 8429 2243
liz.farquharson@sa.gov.au

REFERENCES

https://pir.sa.gov.au/research/services/

GRDC RESEARCH CODES

DPI1901-002RTX
(Northern rhizobial improvement)

UOA1805-017RTX
(Southern rhizobial improvement)

UMU1901-002RTX
(Western rhizobial improvement)

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION