NEW GROUP E RHIZOBIA INOCULANT FOR FIELD PEA, LENTIL AND VETCH

FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NATIONAL
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Acid-tolerant rhizobia improve nodulation of pea, lentil and vetch

KEY POINTS

- Inoculation of agricultural legumes is strongly recommended, particularly where legumes are sown into paddocks with acidic soils or where the legume in the same inoculation group has not been sown for a number of years.
- A new high-performing rhizobia strain for Group E (field pea, lentil and vetch inoculant) with improved nitrogen fixation and acid soil tolerance will be available for the 2024 season.
- The new strain (WSM-4643) will replace existing strains (WSM-1455/SU-303).
- Lentil has moved from Group F to Group E.
- Strain WSM-4643 will provide optimal crop nodulation down to soil pH_{Ca} 5.0 and improved nodulation down to pH_{Ca} 4.6.

Photo: Ronald Yates, DIPIRD.

Benefit of the new Group E strain (WSM-4643) on lentil. Goomalling WA, Soil pH_{Ca} 4.6.

Introduction

In 2022, approximately 200,000 hectares of field pea, 600,000 ha of lentil (ABARES 2023) and more than 400,000 ha of vetch were grown throughout Australia (estimated).

In general legumes 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. Importantly, it has been estimated that the resulting nitrogen fixed per hectare from these plantings is on average more than 100kg N/ha. However, the nitrogen fixation process requires effective rhizobia to be present in adequate numbers in the soil surrounding the legume to enable nodulation of the plant's root system. In acidic soils, below pH_{Ca} 5.5 (i.e. 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 field pea, lentil and vetch are particularly sensitive to soil acidity below pH_{Ca} 5.5, as shown 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 production of field pea, lentil and vetch on acidic soils.

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 new Group E strain, WSM-4643, which will replace WSM-1455/SU-303 for use on field pea, lentil and vetch. Lentil has moved from Group F to Group E. Details of the new acid tolerant strain (SRDI-969) for faba and broad bean (shown in Table 1) are described in a companion Fact Sheet.

Table 1. Inoculant Groups, host crops covered and rhizobia strains

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

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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.

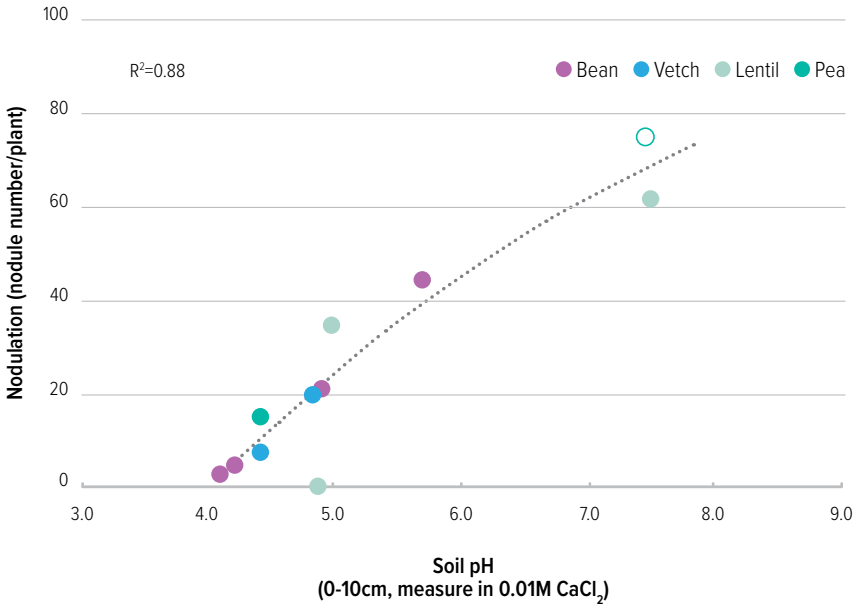


FIGURE 2. Improvement in nodulation with the new acid tolerant inoculant strain WSM-4643 compared to the former strain WSM-1455 on lentil, field pea and vetch (data are averages from experiments at 10 locations across WA and NSW). Nodulation was measured as a score between 0-5, where 0 is poor and 5 is high.

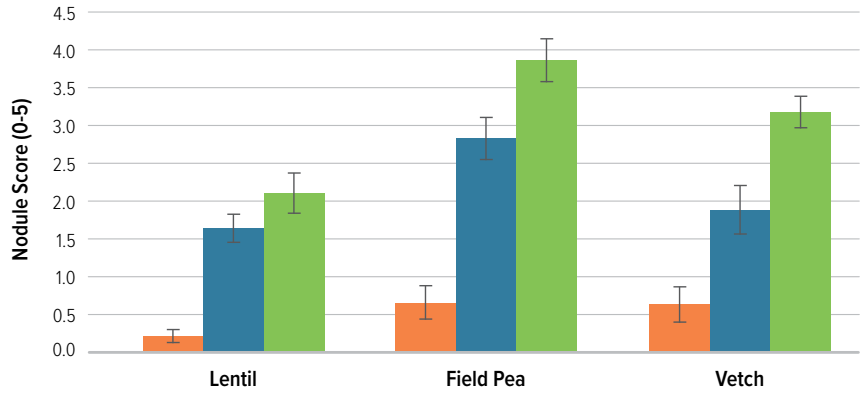
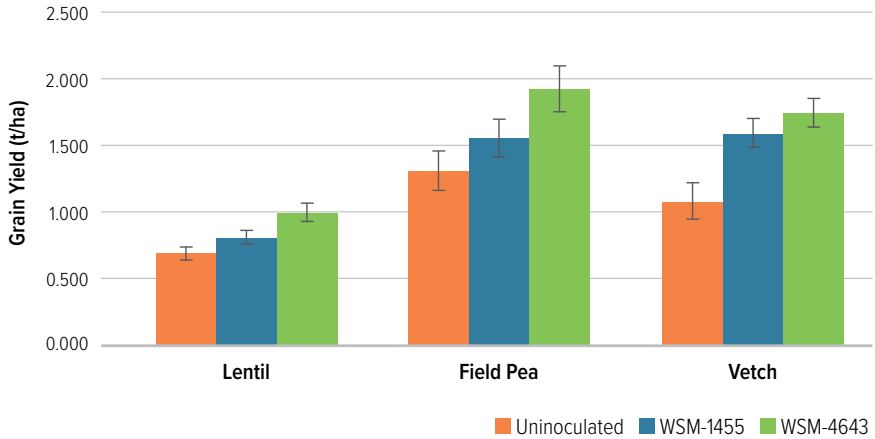


FIGURE 3. Improvement in grain yield with the new acid tolerant inoculant strain WSM-4643 compared to the former inoculant strain WSM-1455 on lentil, field pea and (data are averages from experiments at 10 locations across WA and NSW).



The new Group E strain, WSM-4643, has shown across multiple field trials (in surface soils below pH_{Ca} 4.9) with field pea, lentil and vetch an average improvement of 30 per cent in nodulation and 15 per cent in grain yield (Figures 2 and 3). Yield responses with WSM-4643 were observed at one-third of all sites across NSW and WA. Even where paddocks have been limed, the new rhizobia strain should improve crop nodulation in areas of the paddock where surface and sub-surface acidity persists. The maximum benefit of the new inoculant strain is in acid soils below pH_{Ca} 5.5. However, WSM-4643 is equally effective as the former strain WSM-1455 on neutral soils which are suited to growing field pea, lentil and vetch.

Soil pH – how low is too low?

Strain WSM-4643 will provide optimal crop nodulation down to soil pH_{Ca} 5.0 and improved nodulation down to pH_{Ca} 4.6. Soil pH_{Ca} below 5.0 creates 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 in soils where present and to ensure good legume root growth needed for prompt and abundant nodulation. In addition, liming will benefit other crops grown in the rotation, such as cereals and canola.

Photo: Ronald Yates, DIPIRD.

Well-nodulated vetch plants with WSM-4643, Esperance, WA.

FIGURE 4. Impact of decreasing pH on the root growth of field pea (cv. Kaspa) inoculated with former Group F rhizobia strain WSM-1455.

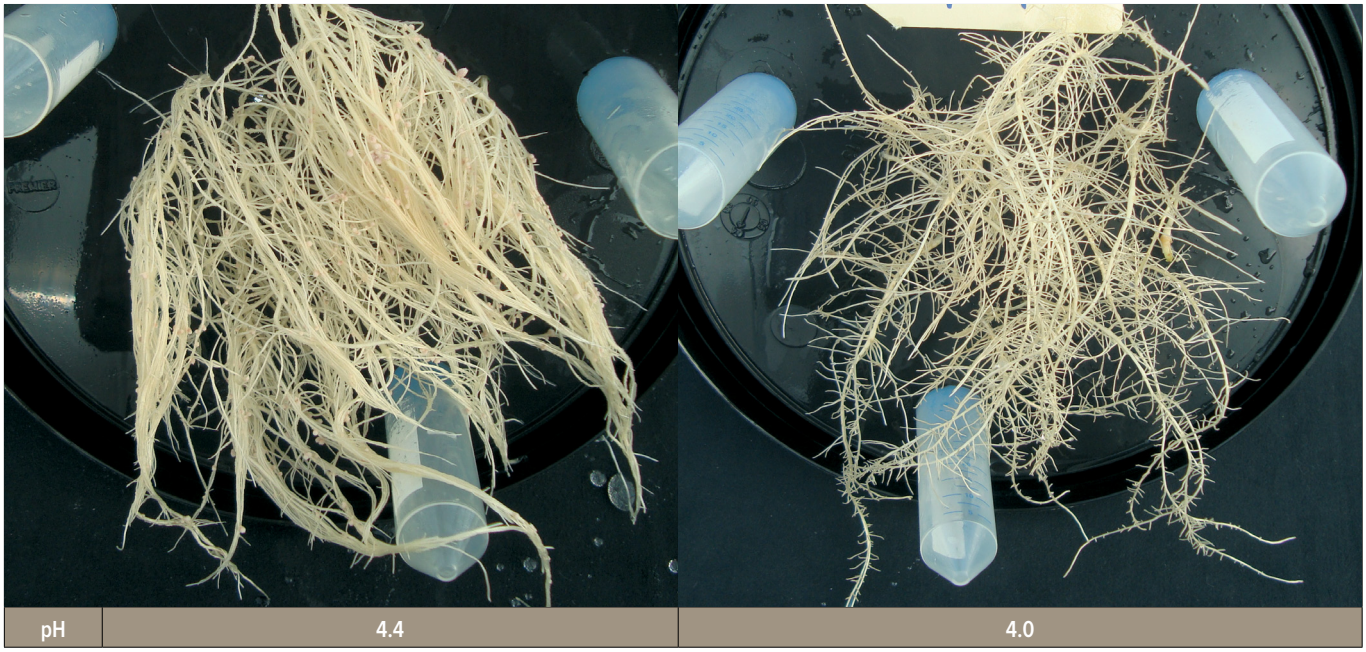


Photo: Ross Ballard, SARDI.

Optimising inoculation practice

How often do I need to inoculate field pea, lentil and vetch seed if I have acidic soils?

Field pea, lentil and vetch will mostly need to be inoculated where soil pH_{Ca} is less than 5.5. Although the new inoculant strain will improve nodulation in the year it is applied, it may not survive from one season to the next. Therefore host crops 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 persistence of strain WSM-4643 six months after harvest of the host crop is below optimal (more than 50 nodules per plant). Therefore, WSM-4643 is unlikely to persist at adequate levels in very acid soils to nodulate the next lentil, field pea or vetch crop in a 3-4 year rotation. However, in non-acidic, i.e. neutral-alkaline, soils we would usually expect to find adequate plant nodulation in that time frame.

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 e.g. fungicides. Where pesticide application is necessary, peat inoculant is best applied to seed as near 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 inoculant strains in acid soils. Graph shows nodulation of vetch sown into soil collected 6 months after grain harvest of an inoculated host crop, either with strain WSM-1455, strain WSM-4643 or not inoculated (Nil). Although WSM-4643 showed improvement, it is recommended that field pea, lentil and vetch crops are always inoculated when grown in soils below pH_{Ca} 5.5.

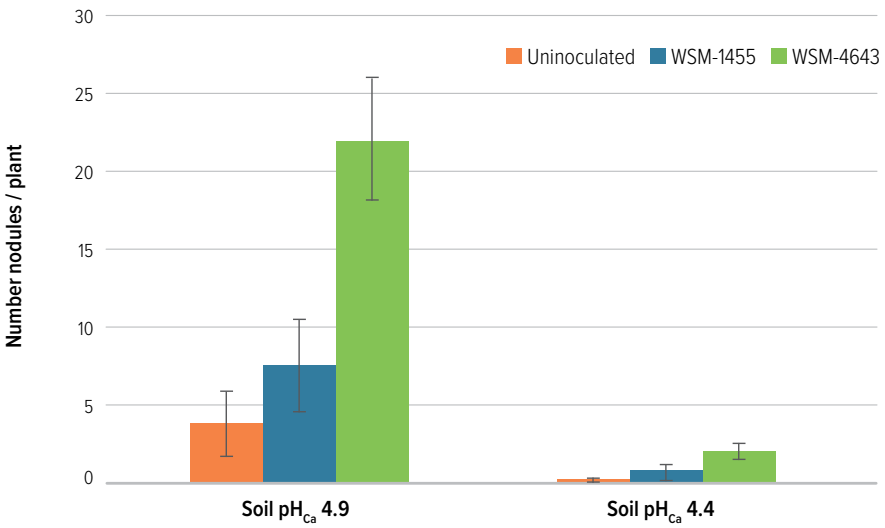


Photo: Ronald Yates, DPIRD.

Improved nodulation and growth of field pea inoculated WSM-4643 (right), compared to WSM-1455 (left) and uninoculated (middle).

FREQUENTLY ASKED QUESTIONS

What can I do to remediate my acidic soil?

Consider a liming and lime incorporation strategy to increase the pH across the paddock identified through soil testing.

Can I dry sow on acid soils?

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

If I have product left over from last season, is it still ok to use?

Provided the inoculant has not exceeded its expiry date (usually found on back of packet) and has been stored according to the manufacturer's recommendations, you can use product left over from last season.

Can I use the Group F inoculant on field pea, lentil and vetch or Group E on faba bean?

Use of Group E (WSM-4643) is NOT recommended for use on faba bean. Another improved rhizobia strain (SRDI-969), specifically selected for faba bean will also be 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 F Rhizobia Inoculant for Faba and Broad Bean: grdc.com.au/resources-and-publications/all-publications/factsheets/2023/new-group-f-rhizobia-inoculant-for-faba-and-broad-bean-fs

MORE INFORMATION

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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)

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