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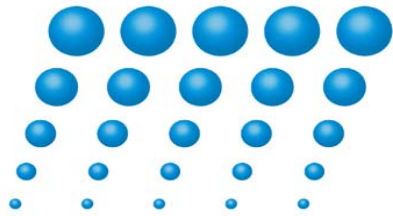
Advances in the Knowledge of Legume Inoculant Delivery Systems

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Inoculant Legume Technology – a success

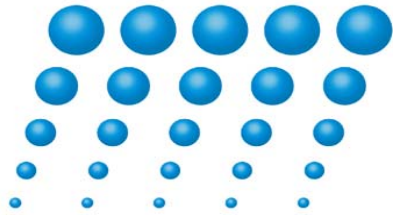


- Inoculation of legumes is one of the success stories of world agriculture
- Early attempts involved treating legume seed with air-dried soil from areas of well nodulated plants
- Presently, sterile cultures of rhizobia are the basis of quality inoculants, treating up to 44 million ha of legumes annually (Phillips; 2004)

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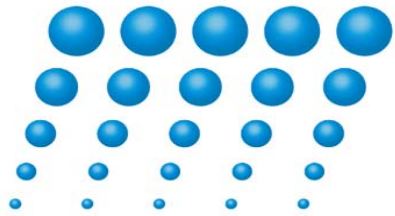
Traditional Legume Inoculant

- Peat carriers carrying Rhizobia extensively used Globally and in Australia for over 50 years
- Traditional peat-based carriers
 - Maintains bacteria in a moist state
 - Commonly used in commercial best practice
 - Cheap
 - Sterile/Non-sterile
 - Low on seed survival (sown within 24-48 hours into moist soil)
- Farming practices have changed in past 50 years
 - Chemical treated seed for pathogens
 - Dry sowing

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Development of New Inoculant Delivery Technology

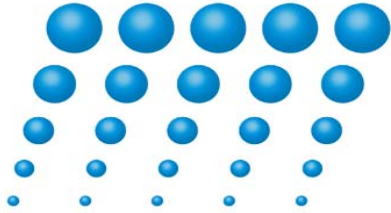


- Farmer and Commercially driven
- Streamline farm and commercial operations
- Alternative to traditional system
- Timely
- Cost effective for both the end user and manufacturer
- Rhizobium inoculants of high quality to promote growth and value in legume crops

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New Technologies

A range of technologies currently in the market place to deliver Rhizobia

On Seed Inoculation

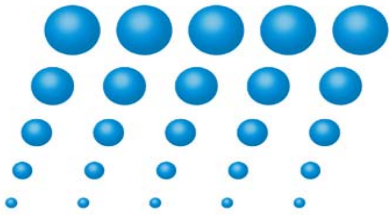
- Peat (benchmark for new technologies)
- Liquid
- Freeze-dried rhizobia
- Clay powder
- Pre-inoculants (polymers, lime, other additives)



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New Technologies

In-Furrow/Soil Inoculation

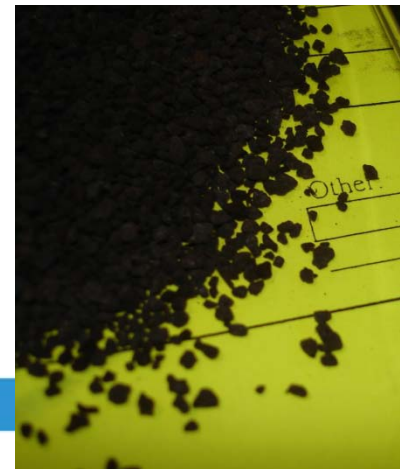
Avoids incompatibility with seed and chemical seed treatments

- Granules (clay, peat)

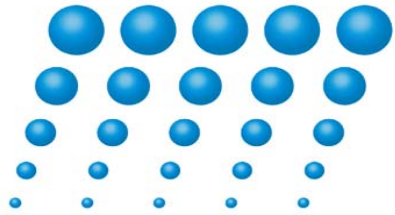
Allows for dry sowing

- Water-injection of peat
- Liquid
- Freeze-dried rhizobia

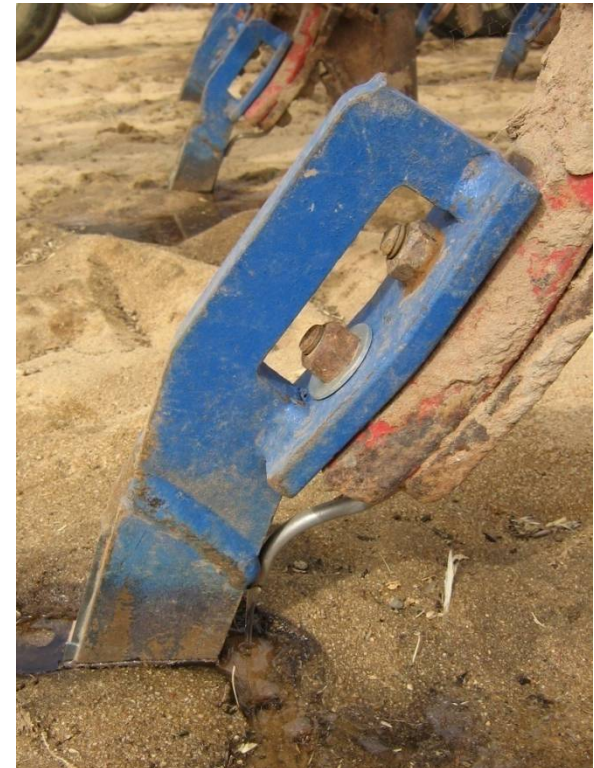
*Inoculants dispersed in water and applied
in-furrow/to soil at time of sowing*



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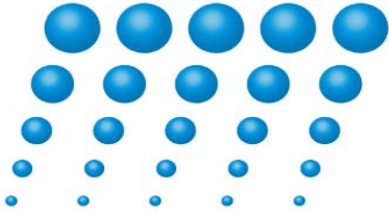
Liquid In-furrow Technique



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Technology?

Which technology to choose?

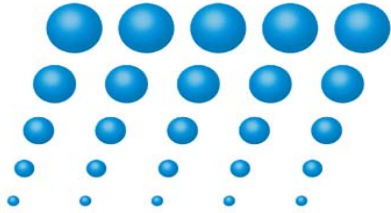
- Seasonal conditions
- Equipment
- Budget
- Storage available
- Time constraints
- Inoculant efficacy



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The Ideal Inoculant

- Maximum efficacy
- Compatible with farmer practices and chemical treatments
- Easy to use and timely (pre-inoculant)
- High Rhizobia concentrations per product (as per recommendations)
- Nodulate plant under various soil conditions
- Able to provide a good survival of the rhizobia during inoculation and after introduction into soils

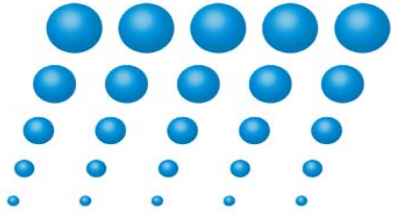
Additionally Manufacturers require:

- Extended shelf life and storage space
- Reproducible effects in production and field
- Safe for humans, animals and plants
- Cost and abundant supply of carrier

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New and Future Developments

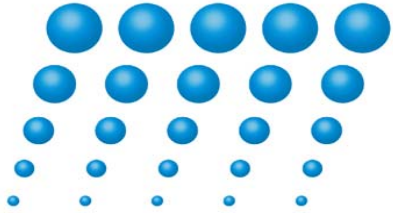
Seed Coating; Pre-Inoculant

- Release of pre-inoculant for pulse/legumes in Australia
- Previously only readily used in pasture industry in Australia
- Two part system - Peat inoculant and a special Polymer
- Offers extended Rhizobia survival on seed
- Improved compatibility with seed chemical treatments
- Developed for Commercial Seed Treaters
- Future 'One Stop Shop' for farmers

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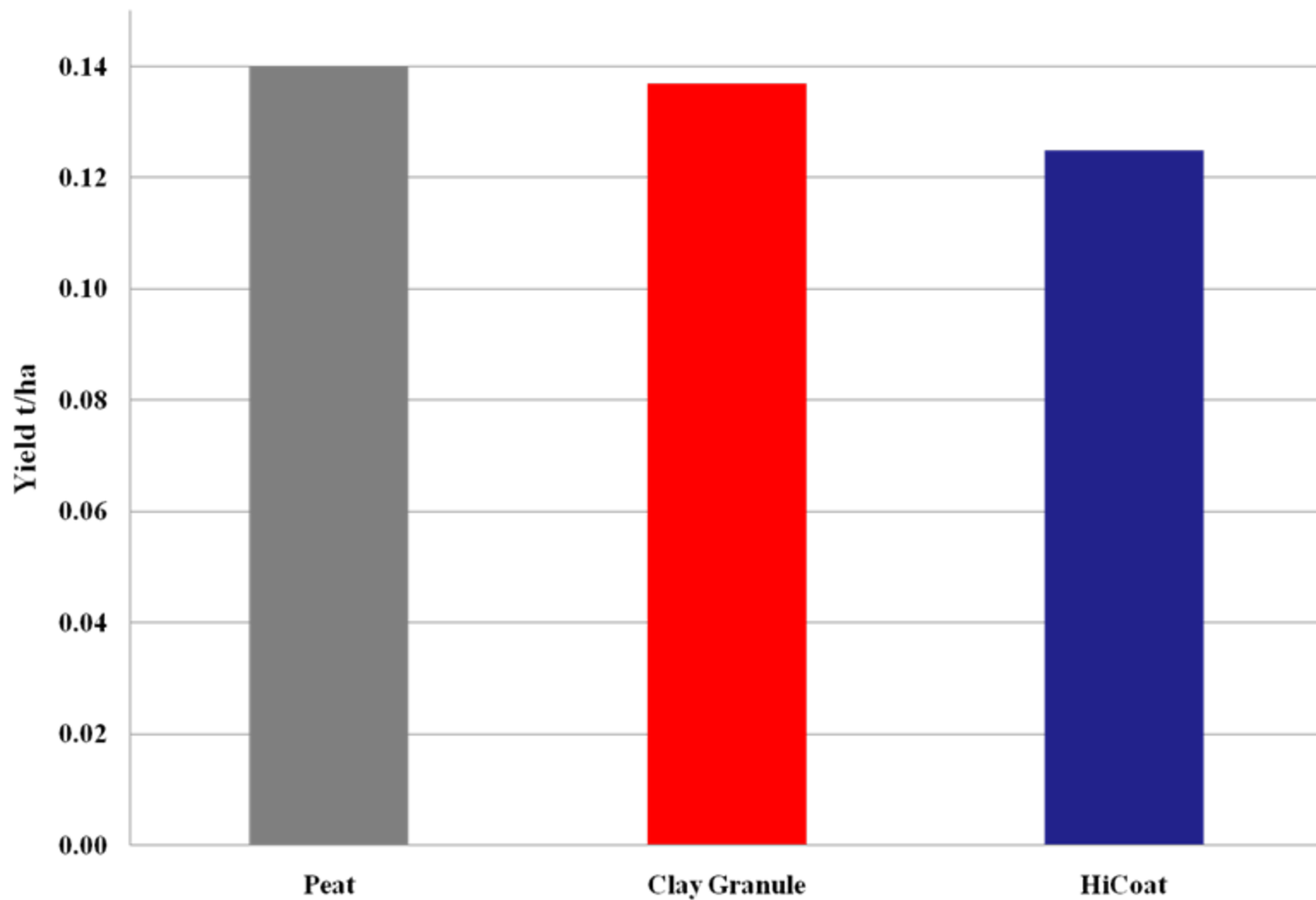
HiCoat[®]

| Group | ALIRU Standard | Days that HiCoat [®] will maintain ALIRU standard on seed |
|---------------|-----------------|--|
| E (Field Pea) | 1×10^4 | 50 |
| F (Faba Bean) | 1×10^5 | 20 |
| G (Lupin) | 1×10^5 | 90 |
| N (Chickpea) | 1×10^4 | 50 |

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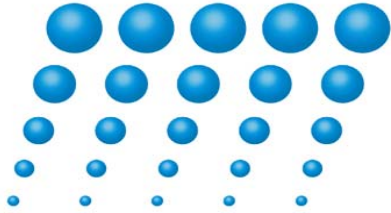
Lupin Field Trial Results - 2007



Chemical and Rhizobia compatibility using HiCoat[®] technology

| Fungicide | Groups compatible with Fungicide | | | |
|----------------|----------------------------------|------------------|--------------|-----------------|
| | E (Field Pea) | F (Faba Bean) | G (Lupin) | N (Chickpea) |
| Thiragranz | n/a | √ | √ | √ |
| P-Pickel T | √ | √ | n/a | √ |
| Rovral | n/a | n/a | √ | n/a |
| Apron XL 350ES | √ | n/a | n/a | √ |

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In Summary

- The face of global agriculture is changing, and manufacturers are developing products to embrace these changes
- A number of user friendly delivery mechanisms are being developed providing alternatives to the traditional peat method, which are both cost effective and timely
- Challenges in market to maintain high quality product for the end user in all inoculant delivery formulations – including those not rhizobia based
- Benefit the end user and provide opportunities to streamline farming and commercial practices

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