SEED MICROBIOME

RAY SOUTH

SEED MICROBIOME
What is it?

- All living organisms have a suite of associated microbes called a microbiome. The microbiome may contain bacteria, archaea and fungi.
- Each part of an organism may have a different collection of microbes for example, in a plant, the stems, leaves, roots, flowers and seeds all may have different microbiomes.
- The microbiome make up may change over time as the needs of the plant change.

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What does it do?

- The seed microbiome (SM) sets up the initial inoculum i.e., the initial microbial community in and on all parts of the new plant.
- Microbiome interactions have been shown to aid in germination, improve nutrient acquisition and promote resilience against attack and abiotic stresses such as drought.
- Research suggests that the first two weeks of a plant’s life are crucial in determining its lifetime health potential, so a strong, diverse SM is important.

SEED MICROBIOME

How does it get there?

- Both mother and father (via pollen) contribute the initial, internal microbiome i.e., the base endophyte community (endo - in, phyte - plant).
- Other microbes arrive on the seed surface while it is developing, or on passing through an animal’s gut and of course once it hits the soil. This is called its epiphyte community (epi - on, phyte - plant).
- The distinction endophyte versus epiphyte is arbitrary as endophytes can move to the outside and become epiphytes and epiphytes can move inside becoming endophytes.

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Loss of microbiome

Numerous factors may work against a plant's microbial community:

* Soil disturbance
* Use of herbicides, pesticides, fungicides etc.
* Use of chemical fertilisers

The above affect the mother plant directly and her progeny indirectly.

The seed microbial community is directly affected by how it is treated.

* Poor storage, especially large swings in temperature and humidity.
* Storing too long. It appears that the demise of a seed's microbial community is an important factor in its loss of viability.
* Seed treatments e.g., heat, bleach, acid.

SEED MICROBIOME

Supporting the microbiome

How can we support and even help improve the seed microbiome?

- Adopt the best seed storage practices that we can and endeavour to keep the seed as fesh as possible i.e, regular, timely grow outs.
- Avoid seed treatments if possible.
- Inoculate seed at sowing. We like to use worm compost extract to water seeds in.
- When growing for seed (or food) grow in as diverse a mix of botanical families as you can sensibly manage.
- Research suggests that a minimum of four distinct botanical families grown together supports a strong and diverse soil microbial community.

EXAMPLE

There are two seed crops in this bed: barley and peas. We also have California poppy, fathen, frilly mustard, Ethiopian mustard, lettuce, sunflowers, phacelia and one or two ring-ins.

The botanical families:

Amaranthaceae - fathen

Asteraceae - lettuce, sunflower

Boraginaceae - phacelia

Brassicaceae - the mustards

Fabaceae - pea

Papaveraceae - California poppy

Poaceae - barley

The diversity of plants encourages a diversity of microbes giving each plant the opportunity to broaden its microbiome.

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Further examples

There are numerous possible combinations:

* A bush bean (Fabaceae) seed crop grown with sorghum (Poaceae), flax (Linaceae), beetroot (Amaranthaceae)
* A lettuce (Asteraceae) seed crop grown with oats (Poaceae), chia (Lamiaceae), leeks (Amaryllidaceae)
* A tomato (Solanaceae) seed crop grown with sweetcorn (Poaceae), silverbeet (Amaranthaceae), rockmelon (Cucurbitaceae)

Note that you can grow food along with your seed crop, or even double up on seed crops.

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Further possibilities

A slightly different approach to broadening a plant's microbiome is to grow it along with some of its wild relatives, if available.
For example, grow some prickly lettuce in among the lettuce crop. Cut them before they flower to prevent accidental crosses. This is something we intend doing at some point.

Based on a practice called Indian Corn Medicine, used by the Iroquois among others, a collection of wild relatives can be ground/mashed up and seeds soaked in a solution of this material before sowing.
The Iroquois would collect wild grasses, roots and all, mash them up, heat this in some water then soak their corn seed in it before sowing. This practice gave noticeable improvements to crop health and yield.

SEED MICROBIOME

Going further

Dr James White of Rutgers University in the US is one of the leading researchers in this area today. He has put together a free, layman's course on plants and microbes called How Microbes Help Local Adaptation.
This is available on the Going To Seed website at goingtoseed.org.

Dr Christine Jones is a regenerative farming consultant with a major interest in adapting the latest research findings to on-the-ground farming strategies.
There are a number of excellent talks by her available on YouTube.

SEED MICROBIOME

Thank you everybody.

May your gardens be ever bountiful.