BioTech Series

Mycorrhizal Fungi

Where science meets sustainability, and your farm's potential meets our passion.

How We Help

We know that understanding biologicals can be both confusing and overwhelming. Your solution should simple, measurable, and profitable. This is why we developed the **BioPlan**.

Focus on testing and data to develop the best solution.

Integrated solutions focusing on soil, nutrition, and plant health.

Simple crop and soil monitoring providing solution accountability.

Simple solutions providing agronomic, environmental, and economic returns.

The BioTech Series has been designed to answer some of the more technical questions you may have about our solutions. Or provide some extra information for inquisitive minds wanting to know a little more about biological strategies. When digesting the information in this booklet and others in our series, remember there is no silver bullet. No solution is the same. No challenge is the same. What is the same are the processes that BioHub team members and trained business partners follow under the BioPlan to try to formulate an integrated solution. This integrated solution can involve nutrition, plant health, biologicals, or soil ameliorants.

At BioHub Solutions, we fuse cutting-edge science and data with the wisdom of nature to deliver pioneering biological solutions to the agricultural sector. Our Australian heritage drives us to innovate for the unique challenges faced by local and global farmers, ensuring our products not only boost your bottom line but also safeguard the environment.

Take the guesswork out of biologicals by contacting one of our team or authorised business partners.

www.biohubsolutions.com.au

What is Mycorrhiza?

Mycorrhiza is a fungus that grows in association with plant roots, forming a symbiotic relationship whereby the mycorrhiza supplies the plant with nutrients and water and receives carbohydrates in return. Mycorrhiza plants utilise fungal hyphae and spores that germinate from a pathway and hyphopodia formation as attachment The mycorrhiza fungi then form arbuscules and vesicles inside the root from where communication and essential soil component exchanges take place. These arbuscules are considered one of the main sites for phosphorus and calcium, along with other minor elements, as exchange ports, as well as water and other required plant growth essentials. Runner hyphae exit the plant root and explore the soil to take up available nutrients and water from the soil via transporter gene mechanisms. (e.g.: phosphate uptake).

Mycorrhizae species prefer to prolificate in and on living roots whilst a plant is alive or acting as a host and can also survive some years in environment depending totally on temperature, conditions, and moisture. Once a plant root dies some mycorrhizae make spores to survive until the next crop is planted, some die and some lay in wait for the correct conditions to return.

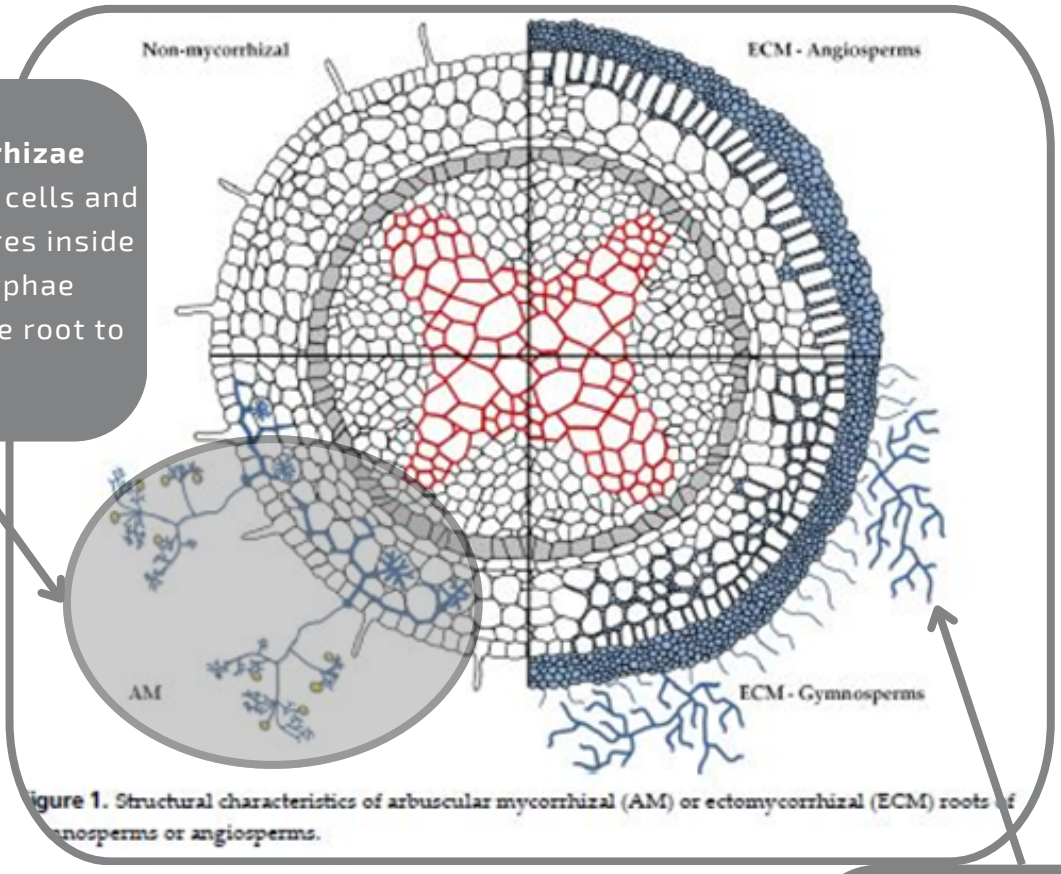
Mycorrhizae reacts to the biochemical stimulation by the host plant when it secretes a substance to let the mycorrhizae know it is needed. Once the signal is received the spores germinate and the hyphae grows toward the root and inoculation takes place.

Even though mycorrhizae and plant symbiosis relationships are as old as the mountains it has recently been emphasized how important these fungi are for today's sustainable agriculture needs.

Endo vs Ecto Mycorrhizae

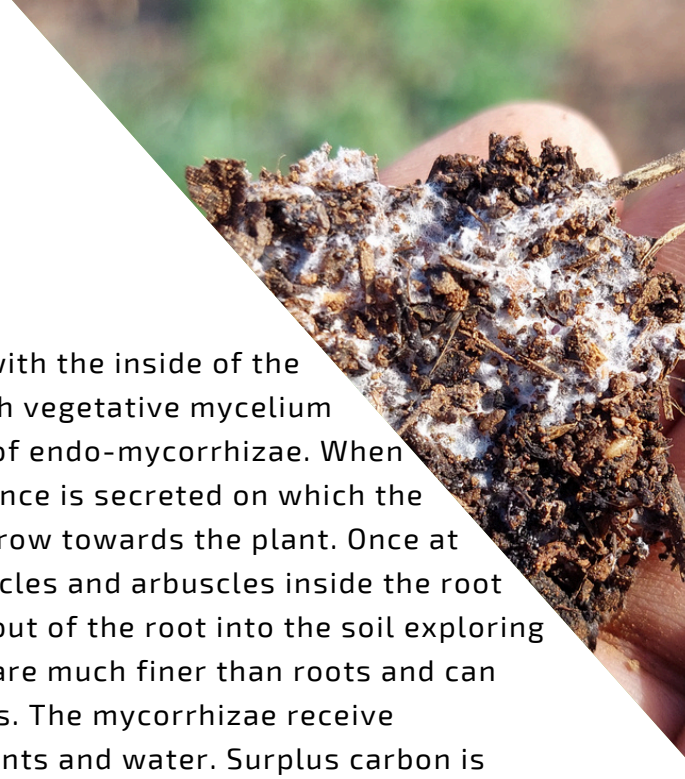
There are two types of mycorrhizae that is quite essential in agriculture today, namely: ectomycorrhizas and endomycorrhizas. The difference is mainly the way they associate with the plant root. Ectomycorrhiza remain around the outside of the root, forming a “Hartig” net that looks like a white cargo net around the root tip often bridging cortical cells. Endomycorrhizas penetrate the cell wall and form communication pods inside the root to exchange information with the plant.

Endo Mycorrhizae
Enters the plant cells and develop structures inside the cells with hyphae growing from the root to the soil.



igure 1. Structural characteristics of arbuscular mycorrhizal (AM) or ectomycorrhizal (ECM) roots of nosperms or angiosperms.

Ecto Mycorrhizae
Associate with the outside of the plant root and penetrate only into the intercellular spaces.They do not penetrate the plant cell itself.



Endomycorrhiza is a soil organism that associates with the inside of the plant's root cell and that grows out into the soil with vegetative mycelium using hyphae as branches. BioHub Endo-4 consists of endo-mycorrhizae. When the plant's roots start to grow a biochemical substance is secreted on which the mycorrhizae respond to germinate the spores and grow towards the plant. Once at the plant root, it penetrates the root and forms vesicles and arbuscles inside the root cells. Once established in the cell the hyphae grow out of the root into the soil exploring delivering nutrients and water to the plant.Hyphae are much finer than roots and can explore micropores more efficiently than plant roots. The mycorrhizae receive carbohydrates from the plant in exchange for nutrients and water. Surplus carbon is deposited from the roots and mycorrhizae, into the soil forming aggregates which improve the soil structure.

Successful inoculation with the plant root enables the mycorrhiza to greatly assist in the uptake mechanisms for phosphate and nitrogen, often delivering 90% of the phosphorus and 50% of the nitrogen required by the host plant. Reacting on the demand from the plant through the arbuscles and vesicles the mycorrhiza react to request the nutrients required and deliver when demanded by the plant, this may also be sulphur, zinc, and copper.

Diffusion of nutrients to uptake depleted zones around plant root is slow. Mycorrhizae achieves more efficient uptake by increasing the root volume though the mycelium exploration of the soil. Despite vast overall area that mycelium and extended hyphae may cover the mycelium hyphae may only be a hundredth of a millimeter which is much less than that of plant roots themselves, enabling the mycelium hypha to enter the micropores of soil aggregates, accessing nutrient often unavailable to plants.

Root,hyphae,and spores

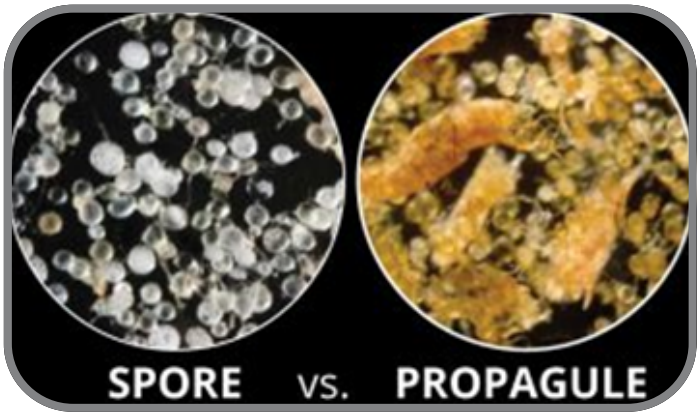
Benefits of Mycorrhizae

There are several benefits of utilising Endomycorrhizae in a cropping system. These include but are not limited to the following.

- Improved soil structure. Increased aggregation leads to improved water holding capacity and improved water infiltration.
- Improved biodiversity. The improved soil structure and increased oxygen in the root zone aids in the stimulation of beneficial microbes in the biota profile.
- Assists in solubilising nutrients such as
  - Calcium
  - Nitrogen
  - Phosphorus
  - Zinc
  - Manganese
  - Iron
  - Sulphur
- Improved germination and transplant potential through superior root structure.
- Improved crop quality due to nutrient uptake efficiencies.
- Improved resilience of weather extremes.

Difference Between Spores and Propagules

Biology suppliers tend to provide information on their products. Mycorrhizal products will often quote their counts, whether that be either spores or propagules or a combination of both. Not many people understand the difference between the two, but more importantly, understand the benefits of the two types.



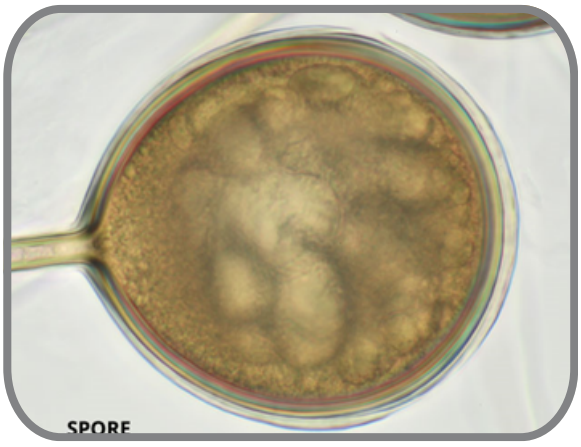
Propagules

Propagules include spores, colonised root fragments, and dry fungal mycelium from the root zone. The root fragments can contain various fungal structures including hyphae, spores, and vesicles that can be an effective means of fungal propagation and help establish symbiosis with root plants. A root fragment propagule can contain many spores within it, despite being counted as one propagule.

The advantage of propagules is that their symbiosis with plants happens faster than spores. This has the potential to provide faster results when compared to spore only products. Root fragments can infect a root within 1-2 weeks. However, the shelf life of propagules is much shorter than spores. Viability of propagules can be greatly diminished as soon as 3-4 months. Spores will remain viable after this time. Therefore, you should always ask when the propagules have been harvested. The fresher the better.

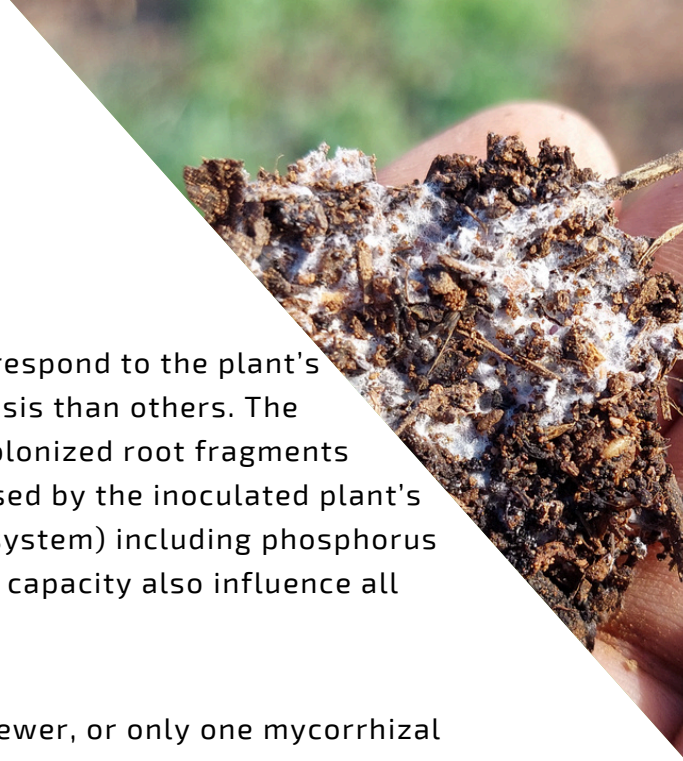
Spores

Spores are reproductive and survival structures produced by the fungi. The spores near roots germinate and colonise new roots, thereby propagating the fungal species. Spores are much more long-lived than root fragments and other propagules, but they require a much longer time to colonise roots. This is a critical point to understand, as this time frame can be four to six weeks.



So Which Is Better?

The honest answer is that both have their advantages. It is about understanding what each does and how they do it. We are often wanting the symbiosis period to happen and see results as early as possible in the production process. The response rate is also influenced by the genus and species offered in any mycorrhizal product. Some



endomycorrhizal genera and species are quicker to respond to the plant's root hormones or "exudates" and initiate the symbiosis than others. The response rate is also influenced by the amount of colonized root fragments ready for immediate action once exudates are released by the inoculated plant's roots. Conditions in the rhizosphere (root-zone ecosystem) including phosphorus concentration, soil pH, soil temperature, and soil air capacity also influence all propagule germination rates and speeds.

So, if you opt for an endomycorrhizal product with fewer, or only one mycorrhizal species and only spores, you have the potential to have the slowest response rate by the mycorrhizal inoculant because the symbiosis is dependent on fewer species of mycorrhizal fungi, combined with the slower response of the spores as propagules.

If you opt for a product like **BioHub Endo-4**, which have multiple endomycorrhizal species and contain both colonized root fragments and spores, you will have the fastest mycorrhizal symbiosis response rate based on the diversity of mycorrhizal species and propagule types offered.