The Benefits of *Trichoderma* and Mycorrhizas in Growing Media

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INTRODUCTION

Trichoderma and mycorrhizas have been present in natural plant ecosystems for millions of years. In its natural environment *Trichoderma* resides in the decaying plant litter and humus in the soil profile. McPherson and Hunt (1995) state: It acts as a mycoparasite or saprophyte to establish a niche for itself often at the expense of the fungi which it may use as an alternative source of nutrients. *Trichoderma* has been clearly demonstrated actively parasitising basidiomycete fungi including *Rhizoctonia solani, Armillaria mellea,* and *Chondrostereum purpureum*. Researchers in the U.S.A. have confirmed that *Trichoderma* does not interfere with either beneficial *Pseudomonas* soil bacteria nor does it upset the mycorrhizal fungi's assistance of nutrient uptake by plant roots.

Mycorrhiza is from Greek derivation "mycor" meaning fungus and "rhiza" meaning root, hence fungus - root (Jasper, 1997). Mycorrhizas form a very intimate association with plant roots of up to 80% of plant families (Brundrett, 1991) where they aid uptake of nutrients and in protection from some plant pathogens, the fungus in turn take sugars and other nutrients from the plant, the relationship is termed mycotrophy. There are wide selection of mycorrhizae, most common are either endomycorrhiza which enter the root cells to form structures known as vesicles and arbuscules. These are termed vesicular-arbuscular mycorrhizae (AM or VAM). The other common mycorrhizas are ectomycorrhiza (ECM) which form a mantle of fungal material around the root and a network of hyphae (referred to as the Hartig net) between the root cells. The growth of fungal hyphae from the colonised root increases the volume of soil from which nutrients can be absorbed for the benefit of the plant.

These beneficial properties of *Trichoderma* and mycorrhiza have led to the commercialisation of *Trichoderma*- and mycorrhiza-based formulations in several countries.

USING *TRICHODERMA* IN GROWING MEDIA

The critical things to consider when using *Trichoderma* in a commercial nursery situation are:

Formulation. The type of formulation intended for use in the medium, does it contain any type of nutriment to help enable the successful and long-term colonisation of the *Trichoderma*. Does the formulation require controlled atmosphere storage, how long is the shelf life?

Dose. The claimed activity of the commercial formulation at manufacture measured in colony-forming units (cfu) of *Trichoderma* per gram. The formulations available in Australia as soil conditioners vary from 5×10^7 to 10^8 cfu. Higher cfu measures would be expected to improve the chance of colonisation.

Application. The application needs to be targeted at the plant root zone, this may be possible with: a pellet formulation placed adjacent to the root or emerging root zone, as a granular form blended into the growing medium, or as a wettable powder used as a soil drench.

Timing. The *Trichoderma* should be applied as a preventative management treatment against soil and water-borne fungal pathogens. Addition to the growing medium after sterilisation will ensure that the *Trichoderma* will grow and occupy the vacant niche. For commercial growing media, that is not sterilised, addition before use will ensure that the *Trichoderma* becomes established. Evidence of activity may be noted as distinctive fuzzy white mycelium visible in the medium just days after application.

THE OPTIMUM GROWING-MEDIUM CONDITIONS FOR *TRICHODERMA*

Soil Temperature. Growing-media temperatures in the 5 to 27C range are required with 20 to 25C considered as ideal. At low temperatures, less than 10C growth is much slower.

Soil pH. *Trichoderma* occurs naturally in acidic soils within a pH range of 3.5 to 7.0.

Soil Water. Growing-medium moisture levels suitable for plant root growth should be appropriate for *Trichoderma* colonisation and growth.

Soil Organic Matter. Growing media should contain a component of organic material containing cellulose such as composted bark, sawdust, or peat to sustain the *Trichoderma*.

Fertilisers. Fertiliser levels applied to sustain plant growth should not be detrimental to *Trichoderma*. Fertilisers applied with a high alkaline content such as limestone, dolomite, or gypsum will discourage *Trichoderma*. Soluble fertilisers applied at high rates, causing high electrical conductivity levels, may also be detrimental.

Pesticides. Agrimm Technologies Ltd. in New Zealand have carried out numerous laboratory and field experiments testing the compatibility of various fungicides. Aerial sprays such as dinocap (Karathane), copper oxychloride, phosphoric acid, bitertanol (Baycor), and wettable sulphur are considered as compatible. Soil or growing medium drenches such as fosetyl-al (Aliette), triadimefon (Bayleton), metalaxyl (Ridomil), and phosphoric acid are considered compatible.

MYCORRHIZAS AND GROWING MEDIA

In general, mycorrhizal associations are absent in soilless growing media. The use of substrates like perlite, vermiculite, composted bark, and sterilised soilless media will not contain mycorrhizas and the adoption of the use of inorganic fertilisers and fungicidal chemicals in nurseries will deter the development of mycorrhizas. Mycorrhizas have specific soil pH requirements, they do not tolerate low light intensities or excess water and extreme temperatures in the root zone (St. John, 1994). The challenge will be to introduce them into nursery growing media and sustain their development and survival. As mentioned previously the endomycorrhiza (AMs or VAM) and the ECMs are the most common.

Hunter (1998) lists the following benefits of mycorrhizas in a nursery situation: greatly enhanced uptake of less mobile soil nutrients such as phosphorus and zinc,

particularly important where extractable nutrient levels are low; increased plant tolerance to the fungal pathogens *Phytophthora*, *Fusarium*, and *Pythium*; enhanced plant water relations; production of a glue-like exudate that stabilises the soil; and produce a network of fungal threads in the soil which provides a nutritious surface for the proliferation of a host of growth-promoting soil bacteria.

USING MYCORRHIZAS IN GROWING MEDIA

There are many similarities between the successful use of *Trichoderma* and mycorrhizas in growing media. The most significant aspects are:

Formulation. The type of inoculum formulation intended for use in the medium. If it is a commercial type, does it contain spores and mycelium, how stable is it with variation in temperature in storage, what is its shelf life, is it easily applied to the target area?

Activity. The claimed activity of the inoculum formulation to be used and the species present in the formulation will determine what plant types will be infected. Formulations containing several species of mycorrhiza are likely to be more successful infecting the target plant than those with only one.

Application. The application needs to be targeted at the plant root zone, this may be achieved by applying the mycorrhizas in a granular form directly adjacent to the root or emerging root zone or by blending directly into in the growing medium or as a wettable powder used as a soil drench. What rate of inoculum is required?

Timing. Application of the inoculum directly in the developing root zone at propagation would be ideal as relatively small amounts of inoculum would be required. Once the plant is infected the beneficial relationship will be continuous unless compromised by a change in environmental conditions. Addition to the growing medium after sterilisation will help ensure that the mycorrhiza germinates and infects the plant roots before any pathogenic fungi. For commercial growing media which are not sterilised, the addition by incorporation or direct placement at the time of use is possible.

CONCLUSION

If nurseries wish to take up the challenge of utilising *Trichoderma* and mycorrhizas in growing media situations they will have to consider more sympathetic management practices. These would encompass monitoring fertiliser inputs, soil pH, and chemical pesticides, as well as critical selection of media substrates. There are laboratories around Australia that are able to assess mycorrhizal infection in plant roots to reassure growers that inoculation has been successful.

LITERATURE CITED

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