From Forest Nursery Notes, Winter 2010

66. Infectivity and effectiveness of arbuscular mycorrhizal fungi in horticultural practices. Corkidi, L., Evans, M., and Bohn, J. International Plant Propagators' Society, combined proceedings, 2008, 58:241-244. 2009.

Infectivity and Effectiveness of Arbuscular Mycorrhizal Fungi in Horticultural Practices©

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INTRODUCTION

The interest in the incorporation of arbuscular mycorrhizal (AM) fungi in horticulture is increasing. It is constantly being reported that inoculating plants with AM fungi improves the growth of seedlings and cuttings (Carpio et al., 2003; Druege et al., 2006), increases plants' tolerance to water and salt stress (Auge, 2001; Cantrell and Linderman, 2001), increases resistance to root pathogens (Azcon-Aguilar et al., 2002), and promotes earlier flowering and fruiting (Sohn et al., 2003). In addition, mycorrhizal plants seem to be less sensitive to transplanting shock and can be produced with a smaller amount of fertilizers and pesticides than nonmycorrhizal plants (Carpio et al., 2005; Gaur et al., 2000). However, it is also known that horticultural practices influence mycorrhizal colonization. Soilless mixes components, pesticides, and fertilizers affect the infectivity and effectiveness of AM fungi (Larsen et al., 2007) and the benefits of the symbiosis are related to specific plant-AM fungi-growing media combinations (Lovato et al., 1995).

This paper provides some examples on the functioning of mycorrhizal colonization with VAM 80® at the Tree of Life Nursery (VAM 80 is a dry-pot culture material with spores, hyphae, and root fragments colonized by *Glomus intraradices* and it is used for large-scale inoculation of California native plants).

ARBUSCULAR MYCORRHIZAL FUNGI INFECTIVITY AND EFFECTIVENESS

Arbuscular mycorrhizal fungi infectivity refers to "the colonization capacity of an AM fungi species" (Dodd and Thompson, 1994). Arbuscular mycorrhizal fungal hyphae colonize plant roots producing intercellular hyphae and intracellular hyphal coils, arbuscules, and sometimes vesicles in the root cortex. Arbuscular mycorrhizal fungi infectivity is usually quantified by measuring the proportion of root length occupied by these structures (Mc Gonigle et al., 1990).

The associations between AM fungi and plants are thought to be non-host specific because most AM fungi are able to colonize a wide range of plants. However, plant growth response to mycorrhizal colonization may range from positive to neutral to negative depending on plant developmental and genetic factors, as well as on the influence of the growing environment on specific plant-AM fungi combinations (Johnson et al., 1997).

Arbuscular mycorrhizal fungi effectiveness refers to "the ability of an AM fungi to benefit plant growth" (Abbot et al., 1992), either by increasing plant nutrient uptake or tolerance to biotic and abiotic stress (Larsen et al., 2007). It is often measured by comparing the survival and growth of mycorrhizal and nonmycorrhizal plants in different treatments.

It is important to notice that AM fungi infectivity is not linearly correlated to effectiveness. High levels of mycorrhizal colonization do not always lead to better plant growth. Plant growth responses to different AM fungi isolates vary widely (Ananthakrishnan et al., 2004; Carpio et al., 2005; Gaur et al., 1998). For example, Corkidi et al. (2005) found that out of four mycorrhizal inoculants that colonized the roots of *Liquidambar styraciflua*, only three increased growth compared to the nonmycorrhizal controls.

GROWING MEDIA AND VAM 80 INFECTIVITY

We have obtained mycorrhizal colonization in a wide range of species inoculated with VAM 80 in growing media containing different combinations of sand, peat, perlite, sawdust, bark, coir, and vermiculite, using slow-release fertilizers. However, we have seen that the substrate used as growing medium influences AM fungi infectivity. Corn plants inoculated with VAM 80 showed lower percentages of mycorrhizal colonization when grown in Sunshine mix than when grown in a medium with soil/sand or in a nursery mix prepared with redwood bark, pine sawdust, calcined clay, and sand (Corkidi et al., 2004).

GROWING MEDIA AND VAM 80 EFFECTIVENESS

Arbuscular mycorrhizal fungi effectiveness can also change in different growing media. In a trial conducted with *Bloomeria crocea*, the plants inoculated with VAM 80 that were grown in a soilless mix, produced larger bulbs compared to the nonmycorrhizal plants. However, there were no significant differences in the bulb size produced by mycorrhizal and nonmycorrhizal plants grown in a mix of soil and sand (Corkidi et al., unpublished).

FERTILITY AND VAM 80 INFECTIVITY AND EFFECTIVENESS

Generally, high levels of mineral nutrients can reduce or inhibit AM fungal development, but optimum levels vary between plants, AM fungi, and growing medium (Arias et al., 1991; Sylvia and Schenck, 1983). *Glomus intraradices*, one of the most common AM fungi species in commercial mycorrhizal inoculants, can tolerate a wide range of conditions. This AM fungus species has been able to establish colonization and increase plant growth even at the high fertility levels common in commercial nurseries (Davies et al., 2000).

Our experiments have shown a wide range of plant growth responses — from beneficial to detrimental — in relation to the nutrient content in different soilless mixes. For example, mycorrhizal colonization reduced the growth of corn plants grown in Sunshine mix, a soilless mix with high nitrogen (N) and phosphorus (P) content (Corkidi et al., 2004). In experiments conducted with *Nassella pulchra*, there were no significant differences in the growth of mycorrhizal and nonmycorrhizal plants grown with 100 ppm of N. However, mycorrhizal colonization enhanced the growth of *N. pulchra* grown with 75 ppm of N (Corkidi et al., unpublished).

CONCLUSION

The variation in VAM 80 performance in different growing media and fertility levels illustrates the influence of horticultural practices on AM fungi infectivity and effectiveness and highlights the possibility of adjusting nursery practices to obtain the potential benefits provided by the association of plants with AM fungi.

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