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Use of Mycorrhizal Fungi in Horticultural Production

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BACKGROUND

The symbiosis between plants and vesicular-arbuscular mycorrhizal fungi is common in nature (Figures 1-3). Colonization of roots by mycorrhizal fungi can increase plant growth and quality by enhancing nutrient (particularly P) uptake, increasing disease resistance, and reducing senescence. Because most growers use sterile media, which lack mycorrhizal fungi, inoculation of plants by growers may allow them to reduce their use of P fertilizer, a potential source of greenhouse pollution. A major constraint to the use of mycorrhizal fungi in florticulture, however, is a lack of information on their successful and cost-effective use.

In addition to its potential effect on nutrient uptake, mycorrhizal colonization may have other beneficial effects on plant growth. For example, mycorrhizal colonization has been shown to improve vase-life of some cut flowers, but the mechanism is unknown. The possibility exists that prolonged vase-life is due to decreased ethylene production.

The objectives of the research were: (1) to determine the most practical method for inoculation of bedding plants, (2) to determine whether inoculation reduces phosphate use, and (3) to determine whether mycorrhizal colonization reduces floral ethylene production and, thus, extends the vase life of cut flowers.

Fig. 1. Spore of a *Glomus sp*.

Fig. 2. Arbuscule within the a root cell produced by a mycorrhizal fungus.

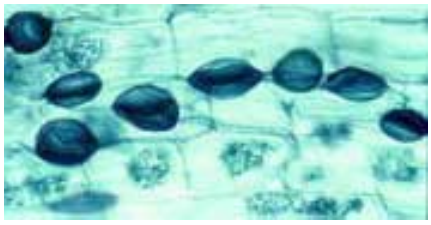

Fig 3. Internal root infection showing vesicles (dark) and arbuscules (light).

MATERIALS AND METHODS

Two basic types of experiments were performed.

Inoculation trials. In the first type of experiment, we inoculated six widely used bedding plant species growing in a peat-based medium with the mycorrhizal fungus *Glomus intraradices* Schenck & Smith using two fertilizer P concentrations (3 or 15 $\mu g\ mL^{-1}$) and three inoculation timings (inoculation at sowing, at transplanting, or at both times). We also tested the effectiveness of a commercially-available stimulant of mycorrhizal fungi, Myconate ®, a water soluble form of the flavonoid formononetin.

Ethylene production. In the second type of experiment, we determined the effects of mycorrhizal colonization on ethylene production by flowers of two cultivars of snapdragons (*Antirrhinum majus* L.).

RESULTS

Inoculation trials. In general, *Coleus*, *Petunia* and *Viola* were colonized more readily than *Impatiens*, *Tagetes* and *Salvia*. Inoculation at sowing required less inoculum than either of the other methods. Moreover, it was generally as effective in promoting colonization as a double inoculation, and was often more effective than

inoculation at transplanting. Mycorrhizal colonization, however, did not result in increased P uptake, even at the lowest P concentration. In addition, it did not improve plant growth. Mycorrhizal colonization was significantly reduced by the higher P concentration. The use of Myconate® significantly stimulated *Salvia* colonization (Figure 4).

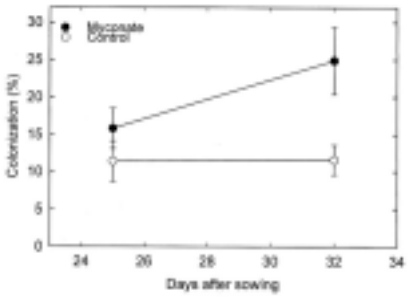

Fig. 4. Effect of 100 ppm Myconate® on colonization of *Salvia* by *Glomus intraradices*.

Further research testing the P-adsorbing power of different media suggested that the lack of benefits from mycorrhizal colonization in peat-based media is because phosphate is freely available. This makes mycorrhizal fungi superfluous.

Ethylene production.
Mycorrhizal colonization in a soilless medium (peat-based) significantly increased flower vase-life and significantly decreased flower ethylene production. For example, for the Maryland White cultivar, floral ethylene production was 1.0 nl g^{-1} h^{-1} for mycorrhizal plants, and 2.5 nl g^{-1} h^{-1} for nonmycorrhizal plants. For the same cultivar, vase life was 13.2 days for mycorrhizal plants and 12.3 days for nonmycorrhizal plants. The reduction in ethylene production caused by mycorrhizal colonization was as large as the variation in ethylene production among snapdragon cultivars. In contrast to mycorrhizal colonization, increased fertilizer P concentration resulted in an increase in ethylene production. Thus, phosphorus apparently does not mediate the mycorrhizal effect.

CONCLUSIONS

When using artificial media such as peat-based media, the most cost-effective method for inoculating bedding plant species with mycorrhizal fungi is at the plug stage with the addition of the commercially-available stimulant Myconate®. However, while inoculation can result in significant mycorrhizal colonization, it did not increase plant growth or P uptake. Thus, in peat-based media, mycorrhizal fungi may be superfluous in terms of phosphate uptake. However, mycorrhizal colonization can reduce ethylene production of snapdragon flowers in a way that is unrelated to P uptake. Thus, mycorrhizal colonization may be a viable alternative to toxic ethylene inhibitors such as silver thiosulfate.

IMPACT TO THE INDUSTRY

(1) Several companies offer mycorrhizal fungi as additives for greenhouse crops. We have shown, however, that in cases where plants are grown in peat-based media, mycorrhizal fungi can colonize plants without increasing plant P uptake or plant growth. (2) Therefore, in most cases mycorrhizal inoculants are not recommended. (3) When crops are grown in soil or other media that fix phosphate, however, mycorrhizal fungal inoculation may reduce the need for P fertilization. (4) When the goal is to increase vase-life or reduce senescence. Even in peat-based media, however, mycorrhizal inoculation may be an effective alternative to chemical strategies.

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