

grape growing

Mycorrhizae: A Useful Tool in Vineyard Management?

Industry Divided on Whether There is Bang for the Buck

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Mycorrhizae are symbiotic associations between fungi and plant roots where both organisms benefit from the relationship. About 95 percent of all plant species form mycorrhizae naturally. Grapevines are no exception, with mycorrhizae becoming evident soon after planting.

Fungal mycelia grow between the roots and surrounding soil, acting as an extension of the plant root system. The mycelia penetrate the root cells of the plant creating an interface for movement of beneficial nutrients between fungus and plant.

Beneficial Effects

Mycorrhizal fungal mycelia spread far beyond the root zone and account for up to 20 percent of total root weight. As roots of growing plants absorb nutrients from the soil, a nutrient-deficient zone may develop. Mycorrhizal fungi penetrate beyond this depletion zone to supply the plant with water and immobile mineral elements such as phosphorous, copper and zinc. Improved plant tolerance of phosphorous-deficient soil and drought are two of the most important benefits conferred by mycorrhizae (Table 1). Mycorrhizae also provide the plant with enhanced resistance to fungal and bacterial pathogens by competing for root infection sites.

A plant's response to mycorrhizae is enhanced by specific soil bacteria, including nitrogen fixers and phosphorous solubilizers.

Beneficial relationships with other microbes, especially bacteria, are now understood to be important for optimization of mycorrhizal activity, and several companies market products that combine these organisms.

Scientific Studies

Many studies show that mycorrhizal products benefit the development of potted plants in artificial, nutrient-stressed soils, but the effectiveness of these products has not been demonstrated satisfactorily in vineyards. To date, industry suppliers are unable to provide field data derived from controlled trials, instead offering customer testimonials or unconvincing study data.

A 1980s study of several California vineyards (Menge et al., 1983) demonstrated that field grapevines are normally mycorrhizal. Pre-plant fumigation with methyl bromide caused stunting of vines and this was correlated with lack of root mycorrhizae. In one trial, yields from grapevines grown in fumigated soil and pre-inoculated with an experimental mix of mycorrhizae were 66-percent higher than those from non-inoculated vines. In a second trial, non-inoculated vines became mycorrhizal but it took nearly two years to match the growth of treated vines.

A recent Oregon study by Robert Linderman of the USDA-ARS, Corvallis, Oreg., one of the world's leading mycorrhizal experts, found that inoculated vines of all



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Potted Chardonnay vine growth with and without mycorrhizal inoculum. Vines on left were untreated while those on right were pre-inoculated with a mixture of mycorrhizal fungi.

rootstock and scion varieties examined, responded with greatly-enhanced growth under nutrient-stressed conditions.

Rootstocks MG 101-14, MG 420A and Riparia Gloire showed the greatest responses. Other studies indicate that mycorrhizae may

improve lime tolerance in vines (Bavaresco and Fogher, 1996) promoting reduced chlorosis, deeper root growth, and improved fruit quality.

Grower Reports

Mycorrhizal inocula formulated with a range of different fungal species and microbes are available from several suppliers, through local agricultural chemical stores. It is difficult to determine how many growers use mycorrhizal inocula, but it is clear that the frequency is very low when compared with items such as fertilizer.

According to Linderman (Linderman, 1988), "Plant inoculation is probably only cost-beneficial if plant growth is limited by factors or conditions that mycorrhizae can alleviate, such as phosphorus-deficient soil or prolonged drought."

There is no consensus among growers, vineyard managers, farm advisors and agricultural suppliers regarding the benefits derived from mycorrhizae. Many growers, such as Kendall-Jackson's Daniel Roberts, have used mycorrhizal products with inconsistent and disappointing results. Andy Wilson of Growers Ag Service in Sonoma, commented that vine inoculation with mycorrhizae makes sense theoretically, but that in experiments with his own vines he had not observed differences between treatments and controls.

Similarly, consultant Philip Bertoli of Santa Rosa has seen little difference in two-year-old vines treated at planting time, but was optimistic about realizing advantages as the vines matured. Paul Verdegaal, San Joaquin County University of California Farm Advisor, has generally not seen benefits using mycorrhizae in new vineyard plantings. He noted, however, that he expected greatest benefits from pre-plant mycorrhizal inoculation to be derived in

stressed vineyard sites with extremely rocky or sandy soils, or in sites with a history of multiple replanting or over-farming.

Other growers, however, report routine use of pre-plant mycorrhizal inoculants with good results. Dave DiPiero, of Artesa Vineyards and Winery, noted benefits from dipping bare root vines, or soaking potted vine flats, in mycorrhizal solutions prior to planting. Mike Vail of Vino Farms uses mycorrhizae-treated vines, especially in fumigated ground or sites with high phylloxera or fan leaf pressure. Vail soaks dormant bench grafts in solutions of mycorrhizal spores before planting. He hopes to inoculate at least some vines to create a source of inoculum for spread within the vineyard.

Pete Sweeney of Agro Tech, a Geyserville, Calif. chemical supplier and consulting firm, was perhaps most optimistic about the benefits of pre-plant inoculation of grapevine plants. In work on several vineyards, Sweeney has seen improved root and shoot growth from pre-plant treated vines. Sweeney favors the use of a 'tea bag'-type system for delivery of inoculum to the roots of trimmed dormant vines. Sweeney recommends drenching the soil of potted vines with a suspension of mycorrhizae a few days in advance of planting.

Future Developments

Mycorrhizae are undoubtedly beneficial for grapevines, but because of the ubiquitous nature of native species and their intolerance of inorganic fertilizers, it has proven difficult to conduct controlled trials to evaluate the potential of new products in the vineyard. Acknowledging this problem, Linderman is currently evaluating the effect of soils and vineyard management practices on native grapevine mycorrhizae, with the goal of opti-

mizing mycorrhizal populations through vineyard management.

Ideally, grapevine plants would be pre-inoculated with mycorrhizae by the nursery, but such vines are currently unavailable. Because fertilizers inhibit mycorrhizal development, Linderman is currently evaluating the use of soil-less media amendments and organic fertilizers to improve potted vine mycorrhizal inoculation.

Several companies now offer mycorrhizal/microbial products, which have the potential to help young vines establish a complex rhizosphere ecosystem. These products should theoretically benefit the vine and the industry awaits data supporting their use. **wbm**

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