California Agriculture. 1978. 32(4):6-7.

Mycorrhizal Fungi Increase Growth and Reduce Transplant Injury in Avocado

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Avocados inoculated with beneficial mycorrhizal fungi have up to a 250 percent greater growth rate than non-mycorrhizal avocados in sterilized soil. Mycorrhizal avocados resist transplant shock because of better water absorption.

Mycorrhizal fungi are beneficial microorganisms closely associated with the roots of most plants. These fungi enable plants to absorb more nutrients—such as phosphorus, zinc, and copper — from many soils than do corresponding non-mycorrhizal plants. Water uptake may also be increased by mycorrhizal fungi. In this way, mycorrhizal fungi increase the efficiency of fertilization.

It has been known since at least 1965 (O. Ginsburg and Z. Avizohar-Hershenson) that avocados are normally mycorrhizal in the orchard. These fungi are extremely common and under normal conditions they are present wherever avocados are grown. Mycorrhizal fungi are frequently absent from roots of avocado seedlings grown in fumigated nurseries or in sterile soil. However, it has never been shown that mycorrhizal fungi increase the growth of avocado trees.

Inoculations

Several experiments were performed to establish whether mycorrhizal fungi benefit avocados by increasing growth in sterilized soils. Avocados of the Topa Topa variety were inoculated with the mycorrhizal fungus by germinating seeds in sterilized sand which contained a layer of mycorrhizal inoculum 1 inch below the seed. Mycorrhizal inoculum consisted of soil, roots, and spores from a pot containing sudangrass which had grown for 105 days after being infected with the mycorrhizal fungus *Glomus fasciculatus.*

After the seeds germinated and visual observations of the roots indicated that roots had been infected by the mycorrhizal fungus, the avocado seedlings were transplanted to 8-inch-diameter pots containing a sterilized sandy loam soil which contained only 12 ppm phosphorus. Non-mycorrhizal seedlings were transplanted at the same time. Avocados were fertilized with the equivalent of Hoagland's solution minus P once per week. Avocados were grown for a minimum of 5 months before they were harvested and growth data compiled. Several experiments were conducted with seven to ten replications per treatment.

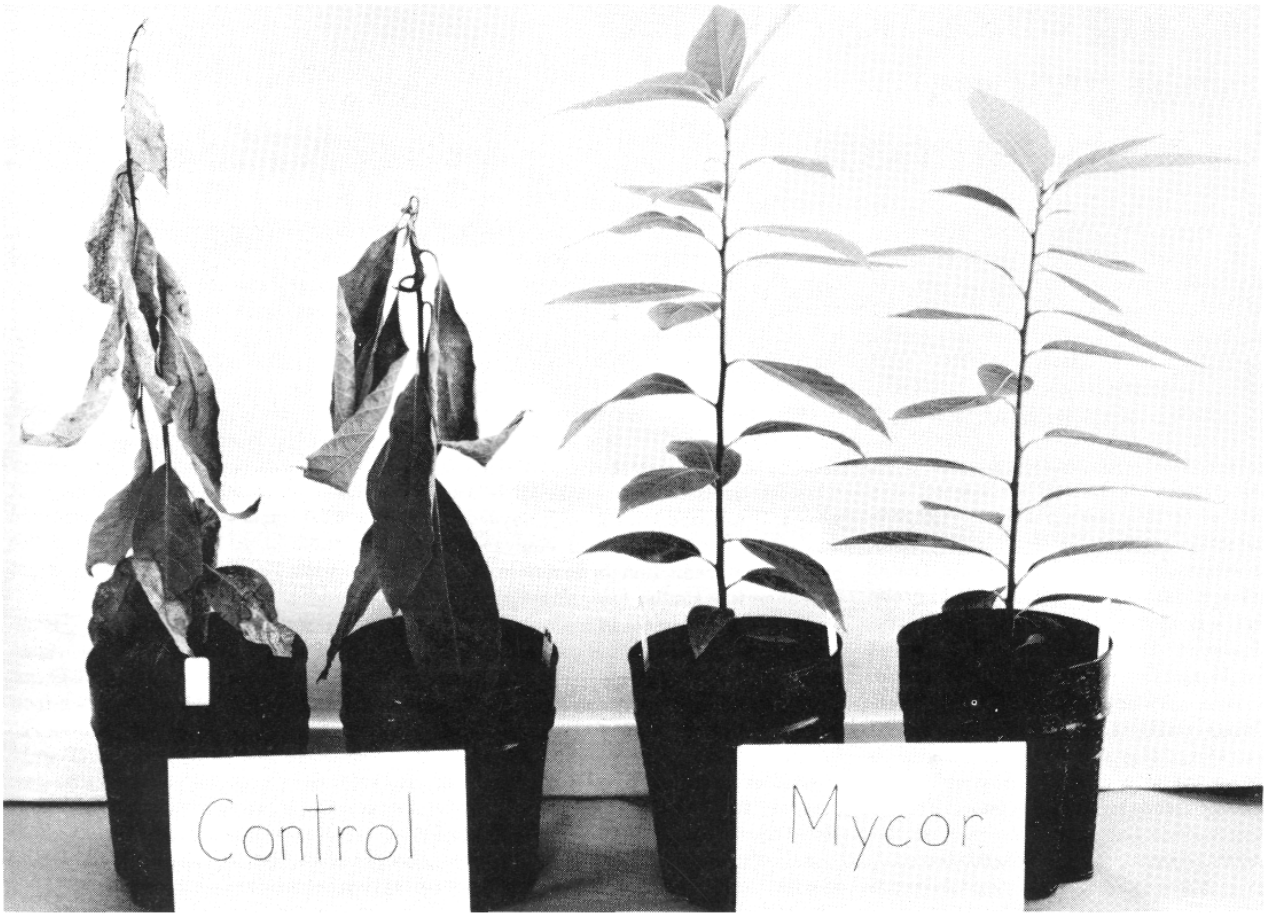

Fig. 1. Mycorrhizal and non-mycorrhizal avocado seedlings 24 hours after transplanting. Non-mycorrhizal seedlings exhibit excessive wilting.

Results

In one experiment (figure 2) mycorrhizal avocado plants grew faster and were significantly larger than non-mycorrhizal avocados 105 days after inoculation. By 129 days after inoculation, mycorrhizal avocados were 30 percent larger than non-mycorrhizal avocados and the difference between mycorrhizal and non-mycorrhizal plants continued to increase even though they became pot-bound. In another experiment (table 1), after 185 days, mycorrhizal avocados had 83 percent greater top weights, 123 percent greater root weights and were 258 percent taller than non-mycorrhizal avocado. From similar results with other plant species, it is assumed that these growth increases were largely a result of improved phosphorus, zinc, and copper nutrition provided by the mycorrhizal fungus.

During preparation of some of these experiments, it was noticed that non-mycorrhizal avocados frequently wilted and many died during the transplanting procedure. Several experiments were lost because of poor survival of non-mycorrhizal plants. (Plants from one such experiment are shown in figure 1.) Of ten replicate plants, eight non-mycorrhizal avocados were severely damaged during transplanting and were unusable

as test plants (table 2). Only two mycorrhizal plants were injured by transplanting and they recovered within two days (table 2). It is assumed that mycorrhizae improve the water absorption capacity of avocado and the mycorrhizal avocados are better able to maintain adequate moisture content than non-mycorrhizal avocados following transplant shock.

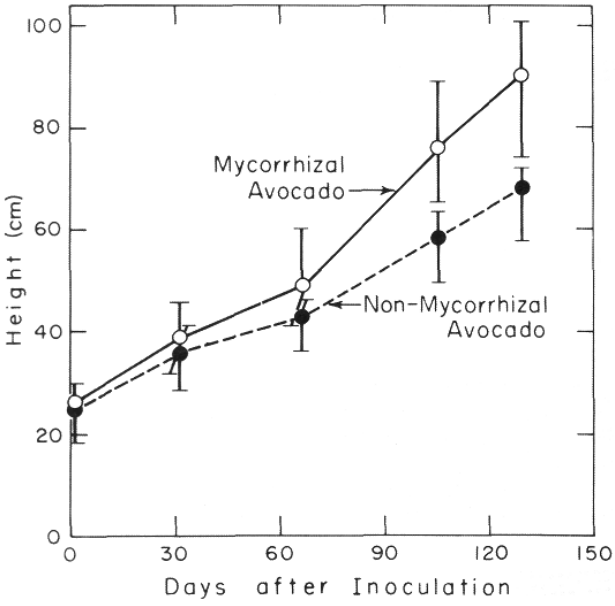

Fig. 2. Height growth curve for mycorrhizal and non-mycorrhizal avocado seedlings. Range of 7 replicate avocados is indicated for each point.

TABLE 1. Effect of the mycorrhizal fungus *Glomus fasciculatus* on growth of Topa Topa avocado seedlings.*

	Increase in height (cm)	Dry weight tops (g)	Dry weight roots(g)
Non-mycorrhizal	5.7a	17.2a	15.6a
Mycorrhizal	20.4b	31.4b	34.8b

*Avocados were inoculated with mycorrhizal fungi by germinating seeds in flats with mycorrhizal inoculum. Both inoculated and non-inoculated plants were transplanted to pots. Avocado seeds were placed in flats 11/22/75 and measured 5/27/76. Values were averages from 10 replicate plants. Values in the same column not followed by identical letters are significantly different ($P = 0.05$).

TABLE 2. Effect of the mycorrhizal fungus *Glomus fasciculatus* on transplant injury of avocado.

	Percent of plants showing transplant injury	Wilt index*
Non-mycorrhizal	80	2.6[a]
Mycorrhizal	20	0.4[b]

*Wilt index: 0 - no symptoms, 1-2 necrotic or wilted leaves, 2-3 heavy necroses or wilting, 4 meristem collapse. Values are averages from 10 replicate plants. Values in the same column not followed by identical letters are significantly different ($P = 0.05$).

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