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# The Effects of Mycorrhizae on Rapid-Grow Radish, *Brassica rapa*

by John Von Drasek

## ABSTRACT

Mycorrhizae are fungi that have a symbiotic association with vascular plants. They increase nutrient absorption by plants, causing increased growth and reproduction. This study investigates the effects of mycorrhizae on the growth and reproduction of rapid-grow radish, *Brassica rapa*. The source of mycorrhizae was obtained through a mycorrhizal inoculate containing *Rhizophagus irregularis*. Germination rate and flower count were studied and recorded over a four week period to determine the effects of the mycorrhizae. Flower count of rapid-grow radish with the mycorrhizal treatment was compared to flower count without the mycorrhizal treatment. The mycorrhizal inoculum was found to have a significant positive effect on earlier growth and reproductive maturation of the rapid-grow radish. Early germinated seedlings have shown to have higher survival rates than seedlings that germinate later in the growing season.

## INTRODUCTION

Mycorrhizal fungi form a mutualistic, symbiotic relationship with vascular plants, involving the translocation of carbon from the plant to the fungus, and uptake and transport of soil nutrients from the fungus to the plant (Wilson and Hartnett 1997). Mycorrhizae are believed to spread via infective hyphae, hyphal fragments, or asexual spores (Bever et al. 2001). Many form specialized structures called arbuscules, which are the site for transfer of nutrients between the plant and the fungus (Newsham et al. 1995). Colonization by arbuscular mycorrhizae can provide multiple functions, such as increased nutrient uptake, drought tolerance, and resistance

to pathogens (Hartnett et al. 1994, Wilson and Hartnett 1997). Increased nutrient uptake includes poorly mobile nutrients such as zinc (Wilson and Hartnett 1997). The functions that mycorrhizae provide allow plants to often be more competitive and better able to tolerate environmental stresses than non-mycorrhizal plants (Varga 2010). However, there is variation in response to colonization of mycorrhizae among different plant species due to abiotic and biotic environmental factors (Ronsheim 2012). Direct interaction of arbuscular mycorrhizal fungi reduces the lethal effects of root pathogenic fungi and therefore may increase plant reproduction (Graham 2001). Mycorrhizal inoculation has also shown to have a positive effect on plant growth by improving the rate of photosynthesis and transpiration (Cho et al. 2009).

In the following study, the effects of mycorrhizae on the growth and reproduction of rapid-grow radish were investigated. The prediction was that mycorrhizae would promote growth and reproduction.

## **METHODS**

Rapid-grow radish seeds were purchased from the Carolina Biological Supply Company (Burlington, North Carolina). Four liters of potting soil was sterilized at 180°C for 3 hours. Two liters of soil were treated with 20 ml of GLOMYGEL® inoculum (MYCOVITRO SL, Granada, Spain) to serve as the mycorrhizal treatment. The remaining sterile soil was allocated as the control treatment. Soil for each treatment was dispersed among 18 50-ml cups. Three rapid-grow radish seeds were then added per cup. Both treatments were given 13 hours of light and 11 hours of darkness each day for four weeks inside a window sill on the campus of College of DuPage in Glen Ellyn, IL. Both treatments were exposed to a constant temperature of 24°C. Both the mycorrhizal inoculated treatment and the control treatment were placed in separate plastic bins to

soak up distilled water that was filled at the base. Each treatment received the same amount of distilled water.

The fraction of rapid-grow radish seeds germinating according to treatment was compared after 7 days and also 14 days after sowing seeds using a Chi-square goodness of fit test. Flower count per plant was compared between treatments using a 2-tailed t-test. Fifteen plants per treatment were randomly chosen for flower count.

## **RESULTS**

Table 1 summarizes germination rates according to treatment and the number of days that germination was determined. Seed germination of rapid-grow radish was significantly different between treatments after 7 days ( $\chi^2 = 5.09$ ;  $df = 1$ ;  $P \leq 0.05$ ), but not after 14 days ( $t = 2.863$ ;  $df = 1$ ;  $P > 0.05$ ) (Table 1). The count of flowers per plant also varied, being higher among plants inoculated with mycorrhizae (Table 2).

## **DISCUSSION**

Mycorrhizae appear to have a positive effect on earlier seed germination and the onset of flowering of rapid-grow radish. The absence of a difference in seed germination after 14 days may indicate mycorrhizae does not improve germination, but rather the speed of germination and subsequent reproductive maturation. Seedlings of many species that germinate and emerge early in the growing season have greater survival than those that emerge later (Jones et al. 1997). Early germinants often have the advantage of available resources, such as light, water, or nutrients (Jones and Sharitz 1989). Plants that germinate early may also have a greater absolute growth

than do plants that germinate later (Jones et al. 1997). The mycorrhizae may have provided nutrients for the rapid-grow radish; thereby increasing growth and reproduction.

Positive growth responses of plants to colonization by mycorrhizae fungi typically disappear once available nutrients in the soil reach concentrations that no longer limit plant growth (Jones and Smith 2004). The mycorrhizal treatment may have reached these concentrations of nutrients causing its growth to slow down toward day 14 providing an alternative explanation to similar germination counts. Meanwhile, the growth of the control treatment was able to catch up to the slowed growth of the mycorrhizal treatment. Further studies are needed to verify whether or not the mycorrhizae will support sustained plant growth and survival. Extending the time period of this study would provide better analysis of the effects of mycorrhizae on the long-term survival of rapid-grow radish.

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Table 1. Fraction of rapid-grow radish seeds germinated according to treatment after 7 days and 14 days.

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Time (Days)	Treatment	
	Mycorrhizae inoculated	Control
7	38	26
14	46	44

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Table 2. Summary (mean  $\pm$  standard error, all n = 15) of flower production according to treatment.

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Treatment	
Mycorrhizae inoculated	Control
13.3 $\pm$ 1.7	6.5 $\pm$ 1.7

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