Wynboer – A technical guide to wine producers from South Africa– October 2002

Arbuscular Mycorrhiza: Can it improve the survival of young vines?

Magnus van Rooyen [1] (pictured), Alex Valentine [1] , Eben Archer [2]
1. Department of Botany, University of Stellenbosch, Private Bag X1, Matiekand, 7602.
2. Department of Viticulture and Oenology, University of Stellenbosch, Private Bag X1, Matieland, 7602.

Introduction:

The poor development or dying that occurs among recently transplanted vines, is possibly the result of the plant's root system not taking up sufficient water and nutrients from the soil at this early stage of development. This phenomenon can possibly be reduced by inoculating the vines with a specific arbuscular mycorrhizal fungus (AM) prior to transplantation.

AM is a fungal group that occurs in natural association with about 80 % of all roots in the plant kingdom. The symbiotic relationship between the host's roots and the fungus is based on the fact that the fungus receives prepared carbohydrates from the host, while the host's uptake of water and nutrients is improved by means of the hyphae emitted by the fungus from the root to the soil. The hyphae extend to 8 cm from the roots of the host plant and in so doing enlarge the ground volume from which the plant can take up its water and nutrients. Plants with thin, woody root systems, such as vines, can in particular benefit from an AM symbiotic relationship. The improved underground conditions for the young vines can therefore be beneficial to greater survival and/or improved establishment during the initial period after planting.

Investigation procedure:

Commercial Sauvignon blanc/99 Richter vines were used in this trial. These vines were planted in a sand medium in pots and grown in a tunnel for 3 months. The plants were inoculated by sowing the AM inoculum in the plant hole before planting and then placing the roots in contact with it before filling the hole with sand. This has proven to be the best means of inoculation since the growth of the young roots will come into immediate contact with the AM inoculum. Plant biomass, photosynthetic gas exchange and xylem sap pressure potentials were measured in both the inoculated (+AM) and the control (-AM) plants in order to assess the water relations of the plants. The plants received a low phosphate nutrient solution once a week.

Discussion:

There was no significant difference between the growth rate and the total increase in biomass of the inoculated (+AM) and the non-inoculated (-AM) plants. Therefore at that particular growth stage the AM symbiont made no contribution to the growth of the host plants. However, there was a significant difference in the photosynthetic

rates of the +AM and the -AM plants. The AM plants maintained a higher rate of photosynthesis than the -AM plants. It seems evident that the AM symbiont enabled the host plant to produce more sugars in the leaves to feed the cost of the symbiosis, without any decrease in the growth of the host plant.

Due to the improved water relations (based on xylem water potential) of the +AM plants, they were able to maintain high photosyntetic rates at the expense of the high water loss via transpiration. The improved water relations were due to the +AM plants' improved water uptake. Since the two treatments received the same amount of water during the experiment, it would have been expected of the +AM plants to show symptoms of water stress due to their higher water requirement. This was not the case however, since the xylem sap pressure potential indicated that the +AM plants were not subjected to any water stress.

From the above one can conclude that the AM symbiont enabled the host plants to take up sufficient water enable the host plants to maintain the higher photosynthetic rates without experiencing any water stress. At the end of the experiment when the application of water and nutrient solution was stopped, the +AM plants lived longer than the -AM plants (Fig. 1). This is an indication that the +AM plants can be more drought resistant than the -AM plants.

Summary:

The plant water status of the +AM plants was higher than that of the -AM plants, despite both treatments receiving the same amount of water. This conclusion correlates well with the hypothesis that transplantation shock in vines is partly due to the plants' inability to take up sufficient water for their survival. It has been found with transplantation, that the inoculation of vines with a single species of AM fungus can improve the water relations of the host plants. Thereby, the survival of young vines can be improved.