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Real case applications of commercial mycorrhiza products in the Netherlands: "Prove us that mycorrhiza works and we will use it."

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ABSTRACT

This article describes experiences with the application of commercial mycorrhiza products under practical conditions in the following areas: sustainable management of golf greens, revegetation and urban landscaping, sustainable management of rose gardens, rose and tree nursery, bulbs, and organic raspberry production.

INTRODUCTION

In 2005 Servaplant started to introduce commercial mycorrhiza products from several members of FEMFiP (Federation of European Mycorrhizal Fungi Producers) in the Dutch market. In our vision mycorrhiza is the basis for vital plants and soils and will be increasingly used for the management of (urban) green spaces and for the production of plants in a more sustainable manner. To achieve this, mycorrhiza products must work, and this depends not only on their quality but also on the circumstances of use and the knowledge of critical environmental factors and interactions.

In this article we describe a few experiences with 'real case' application of commercial mycorrhiza products to give an impression of the challenge to "prove" that mycorrhiza works and the perspectives that it will be used.

SUSTAINABLE MANAGEMENT OF GOLF GREENS

In April 2006 half of the nursery green of golf club Stichting Duinzicht (D) was treated with a mix of *Glomus* species. Root colonization increased from 26% to 64% (July) and 59% (October) on the treated part and from 26% to 36% and 35% in the non-treated part respectively (Table 1). The treated part had visibly less drought stress and slightly less dollar spot problems. The use of fertilizer and water was reduced in the beginning to about 50% of normal but this amount was not sufficient during the warm season and had to be increased later on. The green keeper of this golf club works with organic fertilizers and without chemical pesticides.

The nursery green from another golf club (E) also has been treated on one half with a mix of *Glomus* species in October 2005. Root colonization increased from less than 2% to 24% (July 2006) in the treated part and to 4% in the non-treated part. In October 2006 on both parts colonization was declined again to < 2% (Table 2). The green keeper of this golf club works with inorganic fertilizers and chemical pesticides such as the fungicide Heritage (azoxystrobine).

Table 1 Mycorrhizal root colonization in nursery green of golf club D

Month	% root length colonized	
April 2006	26%	
	+ Mycorrhiza	- without
July 2006	64%	36%
October 2006	59%	35%

Table 2 Mycorrhizal root colonization in nursery green of golf club E

Month	% root length colonized	
October 2005	< 2%	
	+ Mycorrhiza	- without
July 2006	24%	4%
October 2006	< 2%	< 2%

These fungicides, the use of which is legally restricted to twice a year in order to avoid the development of resistances, almost completely erased the mycorrhizal fungi as well as most other soil fungi (Table 3, golf club E). This means that all natural competitors of pathogenic fungi are nearly eliminated, which makes the green much more susceptible for a new attack of a pathogen. Particularly in the colder autumn and winter season when the natural fungal population needs more time to rebuild after fungicide application, pathogenic fungi like *Fusarium nivale,* which are adapted to low temperatures, have free play.

Thus, we recommend inoculating with mycorrhiza after each fungicide treatment to accelerate the recovery of the mycorrhizal population. In contrast with fungicides mycorrhiza does not harm the other soil fungi and might even contribute to their development (Table 3, golf club D).

However, a more sustainable approach is a complete change of strategy: use mycorrhiza instead of fungicides and build up a diverse and stable population of soil fungi to keep the "bad guys" under control.

Table 3 Other soil fungi (x 1000 CFU/g fresh soil) in the nursery greens of two golf clubs before and after inoculation with mycorrhiza and treatment with Heritage (only golf club E)

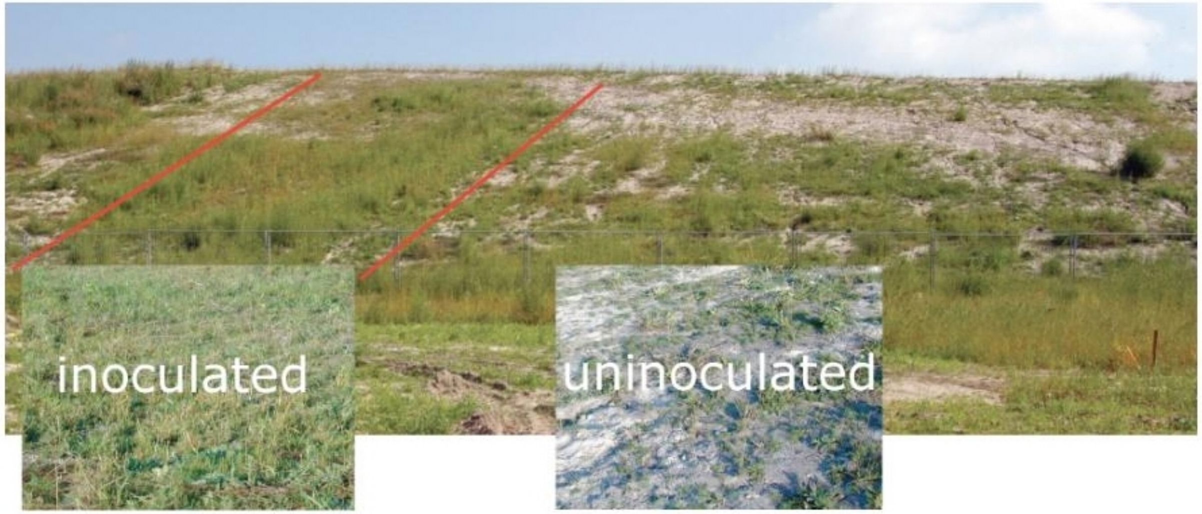
Month	Golf club D	Golf club E
April2006/October 2005 (before treatments)	12	13
October 2006 (after treatments)	30	1

Encouraged by the results in 2006, the golf club Stichting Duinzicht treated in October 2007 its old (about 20 years old) greens and two new (3 years old) greens with mycorrhiza. The green keeper reported that about one month after inoculation he could observe better, deeper growing roots in the new greens, where before mycorrhiza treatment the root development was poor.

REVEGETATION AND URBAN LANDSCAPING

In June 2005 a nine-meter broad stroke of a several meter high noise barrier build up from sand near the city of Breda was treated with a mix of *Glomus* species before sowing with grasses and herbs. In September 2005 there was a clear visible difference between the mycorrhiza treated stroke and the surrounding area on the slope (Picture 1). The soil coverage with plants was considerably higher in the treated stroke, whereas the first signs of erosion were present in the untreated area. In June 2006 erosion gaps of more than 50 cm deep characterised the untreated area (Picture 2), whereas the treated stroke was densely covered with a diverse flowering vegetation (Picture 3). However, this striking result, encouraged till now – as far as we are aware - only one public planting authority in the Netherlands to use mycorrhiza for the revegetation of roadsides and newly build urban areas.

Picture 1.
Noise barrier near Breda. The stroke between the two red lines was treated with mycorrhiza at sowing



Picture 2.
Deep erosion hole on the untreated part of the slope

Picture 3.
Closed cover of flowers on the mycorrhiza treated part

SUSTAINABLE MANAGEMENT OF ROSE GARDENS

In December 2005 during the renovation of the rosary of the city of Amersfoort all 4000 new roses were treated with a commercial mycorrhizal root-dip containing a mix of *Glomus* species. This was decided by the municipal green manager based on the positive results with the use of mycorrhiza to overcome rose replant disease in England. In June 2006 most of the roses were in full bloom with up to 60% colonized root length despite the disturbance of the soil that has been removed and refilled from another part of the park. Less than 10% of the roses were lost, which were planted again with addition of mycorrhiza.

The well-known garden architect Ineke Greve, Huys de Dohm, Heerlen, had a rose replant problem in 2005/2006 when creating new borders in the "Long Garden" of her estate. In autumn 2006 she decided to repeat the planting with new roses without changing soil but using mycorrhiza. In June 2007 when her gardens were open for visitors the young roses looked healthy with many buds and flowers and the lady was very content with the result and started to promote the product.

At Rozenhof Lottum, one of the five national rose gardens for the certification of "Toprozen" in the Netherlands, a mycorrhiza root dip was used when planting new rose cultivars in test compartments in early May 2007, actually too late for planting bare-root roses. In one compartment mycorrhiza was left out. The roses of all mycorrhiza treated compartments survived and developed reasonably, while the roses in the untreated compartment died of and were removed in August. In the planting season 2007/2008 the municipality of Lottum decided to use mycorrhiza for planting 6000 new roses on different locations (soil types) in preparation of the famous "Rozenfestival Lottum" in August 2008.

ROSE AND TREE NURSERY

In a field rose nursery in the Dutch rose growing area near Lottum a mycorrhiza trial was carried out in 2006. A batch of about 1000 one year old grafted rootstock (*Rosa corymbifera* 'Laxa') from own production was root-dipped with a mix of *Glomus* species before planting to the field in February. Rows with dipped plants were alternated with rows with untreated plants. In October the roses were harvested and root analysis was carried out on mycorrhiza-treated and untreated plants. The average root colonization (measured according to McGonigle et al., 1990) was 46% with untreated plants and 67% with dipped plants. This means that, even with a relatively high background of indigenous mycorrhiza in the rose fields, a 45% increase of root colonization could be achieved by inoculation. The growth of the roots seemed to be more vigorous with the treated plants (Pictures 4) than with the untreated plants (Picture 5). However, these results did not cause the grower to use mycorrhiza on a regular basis. Apparently they cannot compensate for the extra costs of inoculum and labour.

Picture 4.
Rose roots treated with mycorrhiza

Picture 5.
Rose roots untreated

A field trial with one-year-old tree seedlings (*Fagus sylvatica*, *Quecus robur*) was carried out at the experimental station ‘Proeftuin Noordbroek’ in 2006/2008. Two different ectomycorrhizal products, both containing a broad range of different species, were compared with an untreated control (96 trees /treatment). Product A was applied as a root dip, product B was added dry in the planting whole. The trees were planted in April 2006 and harvested in February 2008. In December 2007 the length of the trees and their diameter on ground level were measured and their quality was rated. There were no significant differences in survival rates and tree size between treatments. All beech trees were of good quality with a well-developed root system and many mycorrhizal root tips, mainly of one dominant type. The oaks, on the other hand, differed considerably in quality: 83% and 78% of the trees treated with product A and product B respectively were ranked as good (sellable) quality, whereas only 52% of the control trees fell in this category. However, the same type of white root tips and wefts of hyphal strands covered all oak roots. Apparently, the introduced ectomycorrhizal species could not compete with the indigenous mycorrhiza in this nutrient rich nursery soil, where year after year trees are grown.

BULBS

At PPO Bloembollen in Lisse a field trial was carried out with lily “Siberia” in 2005 and 2006. In the first year treatment with a commercial mix of *Glomus* species resulted in 60% more bulb yield, 60% more N uptake and 25% more P uptake compared with untreated control. In treated plots 40% less plants were lost to *Rhizoctonia* rot (Gera van Oss & Marjan de Boer, 2006). In the second year with the same cultivar and the same experimental design, treatment with mycorrhiza did not result in improved yield and more resistance to *Rhizoctonia*, though roots of treated plants were better colonized (26,5%) than those of untreated plants (2,8%). Extreme weather conditions in 2006 (extremely warm and dry early in the season, right after application of mycorrhiza) might be the reason for these differing results, which indicate the difficulty to predict (= guarantee) mycorrhiza effects. However, this is crucial for professional use, and more long-term experiments should be carried out to improve our knowledge on critical environmental factors and to increase our ability to use mycorrhiza in a more directed and controlled way.

A field lily bulb grower (impressed by the results of the experimental station of PPO Lisse in 2005) used the same commercial mix in 2006 at planting on a test area of about 100 m^2. He could not see any difference in yield or quality of bulbs compared to conventional production. The pH of his soil was relatively low (4,5) and the available phosphorus was relatively high (Pwater = 112 mg P_2O_5/L and P-ALactic acid = 37 mg P_2O_5/100 g).

In a field trial in cooperation with another lily bulb grower we applied two different commercial mixes of *Glomus* species in two concentrations (2L/m^2 and 0,5L/m^2) at planting in May 2006. Root colonization in July and in September was low (2 - 8%) and did not differ between treatments and control. It was mostly the for *Liliaceae* untypical Paris type mycorrhiza. So we consider that we did not find back the inoculated *Glomus* strains on the roots. There also was no difference in intensity of *Rhizoctonia* rot (generally low) and in bulb yield. There was no fungicide treatment carried out and available P-levels were moderate (Pwater = 27 mg P_2O_5/L).

A greenhouse grower of *Zantedeschia* flowers, who is busy to develop a more sustainable growing system to combat disease problems, has applied several commercial mixes of *Glomus* species for several times with several cultivars when planting the bulbs. However, we never could find AM root colonization on the treated plants. The soil in this greenhouse is high in pH (7,9), low in organic matter (1,6%) and high in phosphorus (lactic acid extractable P-AL = 210 mg P_2O_5/100 g). If we want to get mycorrhiza work in such a system we first would have to restore the soil conditions.

ORGANIC RASPBERRY PRODUCTION

An organic raspberry grower planted in 2006 120.000 plants with mycorrhiza. The roots were dipped with a mix of *Glomus* species. The grower is very content about the result. He says that growth and rooting are good, less need in fertilizer and watering, and more fruit (personnel communication, Carlo Peters, Raspberry-Maxx, Meijel, NL).

CONCLUSIONS

Mycorrhiza works, but not in all circumstances. We have to be realistic about that. We have to better work out for which practical applications under which conditions it is worthwhile (economical feasible) to use commercial mycorrhiza products. We have to do this in close cooperation with the customers and their practical experience. Mycorrhiza should be part of an integrated approach. Tuning of products for specific applications should be considered more. Formulation of products and application modus have to further be developed to meet the need of the customer. Mycorrhiza works, but there is still a lot to improve.

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