Mycorrhizal Biotechnology for production of biomass and biofuel plants

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Mycorrhiza – from Nature to technology

- Fungal mycelium spreads into the surrounding soil increasing soil volume for exploitation.
- Two major types found across the world:
- Arbuscular mycorrhizal fungi (AMF) - 90% of all plant species have this partner. 500 million years old!
- Ectomycorrhizal fungi - Host specific for tree species (e.g. Conifers and many deciduous trees)

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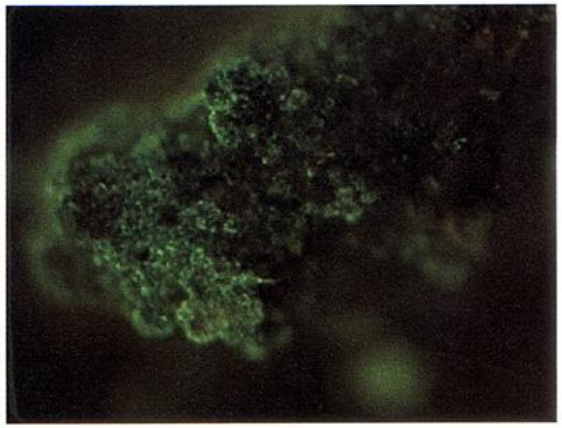
What mycorrhiza brings to the plants?

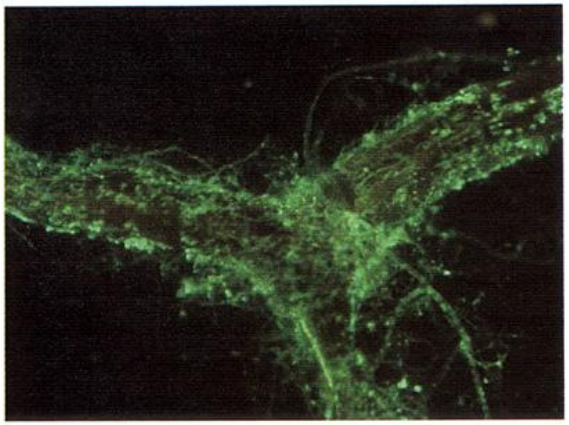
- ✓ Controlled / sustainable / eco-friendly input of nutrients !
- ✓ Natural plant health insurance (restricts the niches of possible root pathogens)
- ✓ Speeds the process of plant community development
- ✓ Improves soil aggregation
- ✓ Increased tolerance to water stress
- ✓ Reduced plant mortality /maintenance costs/more uniform plants
- ✓ Improves rate of flowering and prolongs flowering
- ✓ Stores a lot of carbon in the fungal strands in the soil

Mycorrhiza helps plants tolerate water stress by improving water uptake and helping nutrient uptake for better plant growth and yield in unfertile and arid soils

Soil aggregation anti- erosion role in deserts



Glomalin is the green material on this soil aggregate.

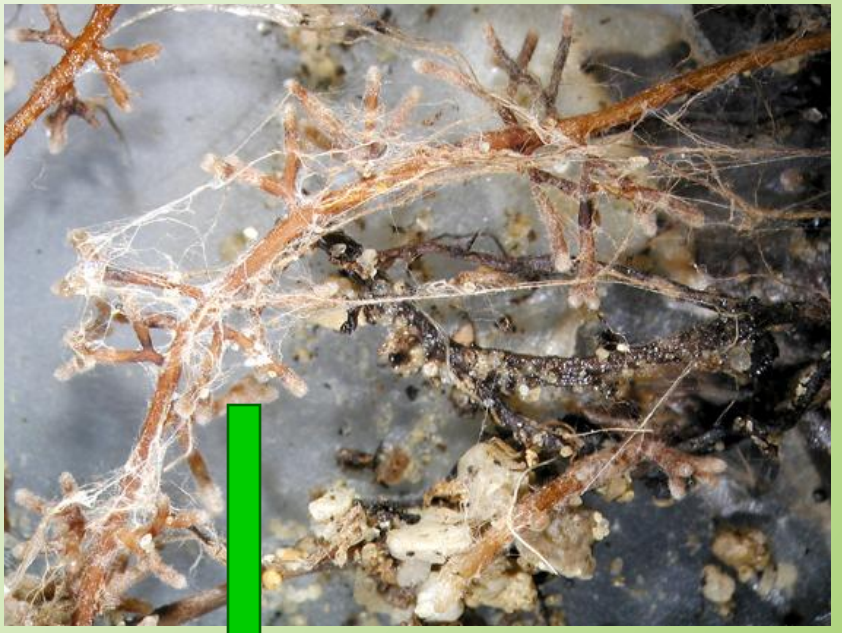


An arbuscular mycorrhizal fungus colonizing a root. Hyphae are the thread-like filaments. The green coating on hyphae is glomalin.

Binding sand particles by mycelium and glomalin

Very clearly shown in container plants

Mycorrhizas store carbon and can help to reduce negative effects of global warming



Adding AMF into a disturbed soil (above) can lead to substantial Carbon being placed below ground approx. 200 tonnes per hectare

Biotechnology and production of inocula

- ✓ Fungi are isolated from natural ecosystems
- ✓ Fungi are multiplied at industrial scale production
- ✓ Fungal inocula are formulated for target environment

PRODUCTION of AM fungi

Isolation of AM fungi spores from the Nature – obtaining pure fungal cultures

Collection of fungal isolates maintained on living plants

Mass production in greenhouse on the plant roots

Processing the inocula


Chopping machine for inoculum processing


Temperated greenhouse for fungal mother cultures


Processing machine


Mass Production of AM fungi

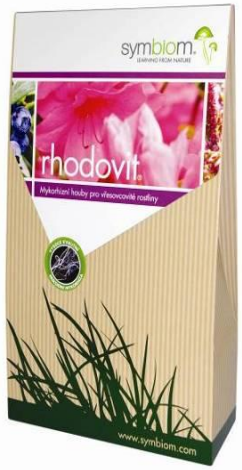
Symbiom products – mycorrhizal products:

Symbivit®

Excellent for the treatment of house pot plants, creeping plants, all flowering plants, most ornamental trees and shrubs (thuja, yew tree, juniper, cypress, maple, rowanberry etc.), herbs, fruit trees and vegetables

Ectovit®

For most evergreen trees (such as pine, spruce, fir and larch) and some broadleaved trees (beech, oak, linden, hornbeam, hazel, chestnut, alder, poplar, birch)



Rhodovit®

Compatible with all ericaceous plants (e.g. rhododendrons, azaleas, heather, blueberries, cranberries)

TurfComp®

Create a symbiosis with all species of grass

APPLICATION: dry formulation

manually

into rows by tractor sowing machine

by spreader

spreading by backsprayer

application of a dry product in cultivation substrate at container production

APPLICATION: dipping into gel form

manually

bare-root plants

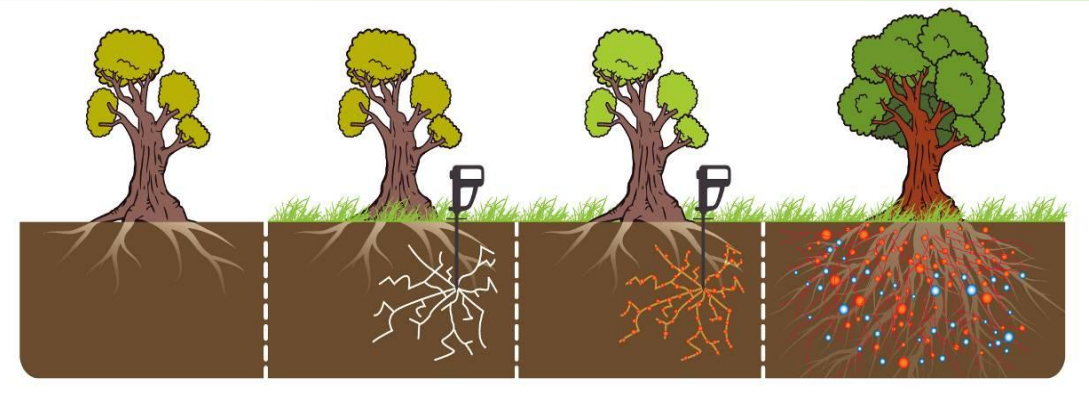
dipping the seedlings

containerized plants

pouring the inoculum

Hydroseeding

Application: injection

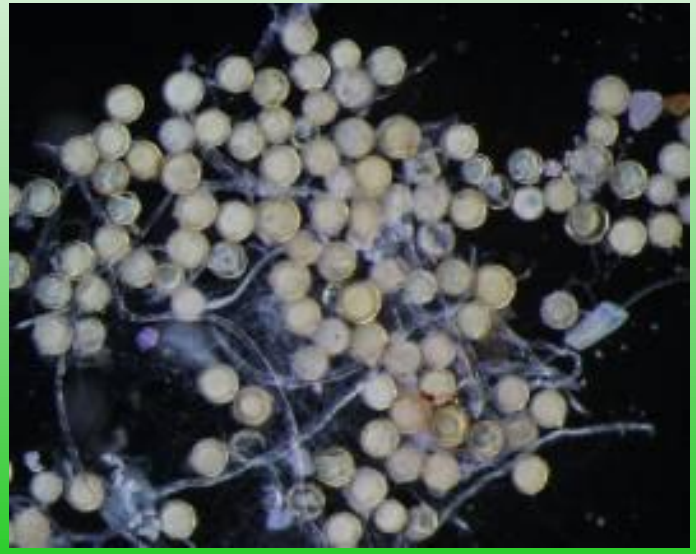


- ✓injection needle is inserted up to 60cm deep into the soil, close to the roots
- ✓a pulse of air aerates the soil, creating cavities for injecting the liquid product
- ✓the product is pumped into a large volume of soil through the cavities

NEW DEVELOPMENTS

- Seed coating and seed incrustation for extensive cash crop (cereals, grasses)

- Inoculation of AMF spore concentrate via drip irrigations systems



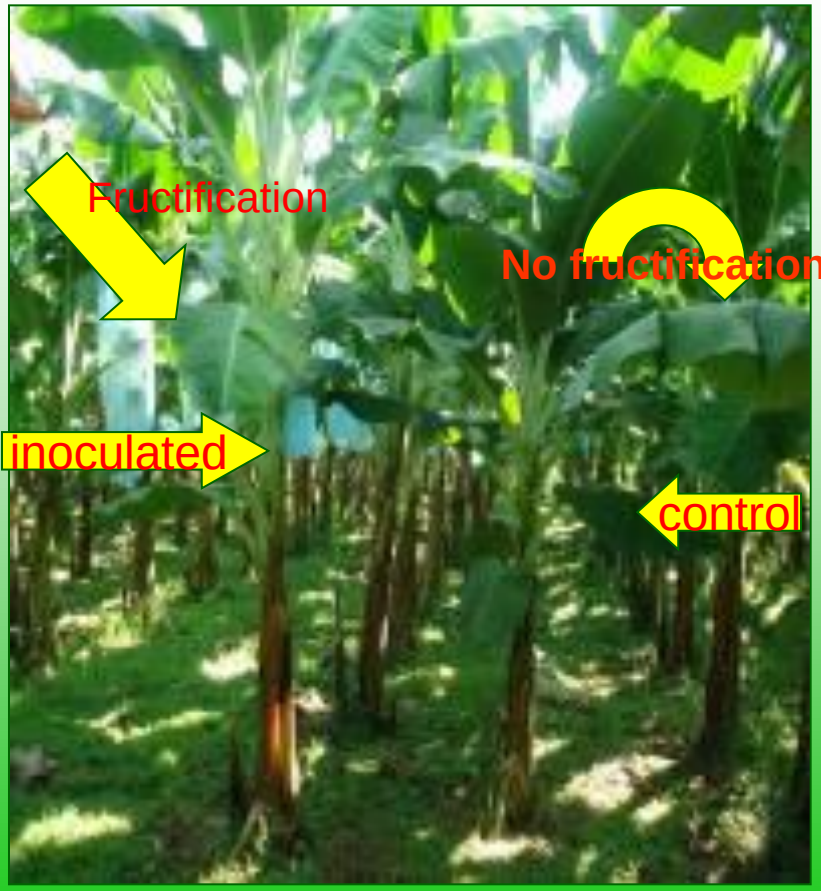
Examples of Mycorrhizal products Application

- ✓ Forestry / large-scale tree planting for biomass production
- ✓ Biofuel production / sugar cane
- ✓ Recultivation, Phytoremediation of unfavourable sites
- ✓ Oil plants production

Examples of successful use:

Inoculation of banana seedlings during 30 ha plantation establishment Colombia

✓ **Onset of fructification was 3 months earlier in inoculation plantation in comparison with control banana plants and 25% increase of banana yield**



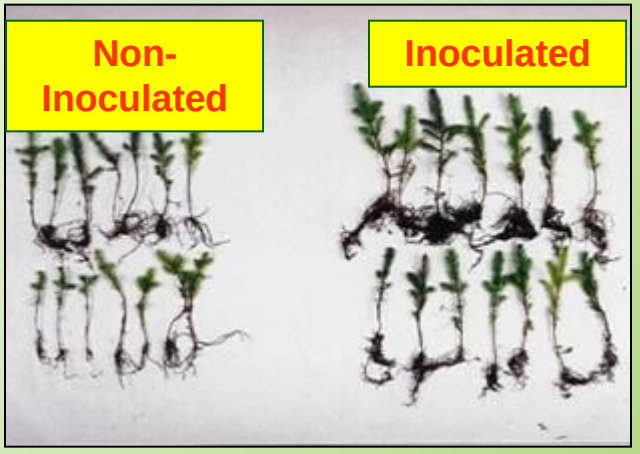
Application on forest fire sites in Portugal for pulp production

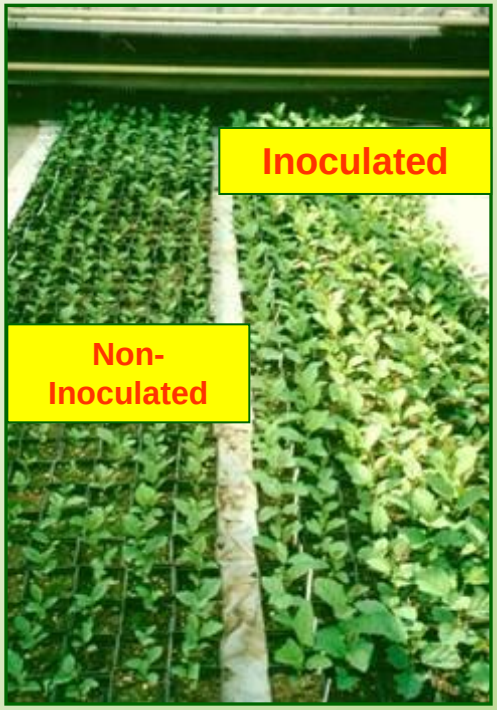
42 % higher survival of seedlings and better growth of oaks and pine

Growth of Tree Seedling in Nurseries

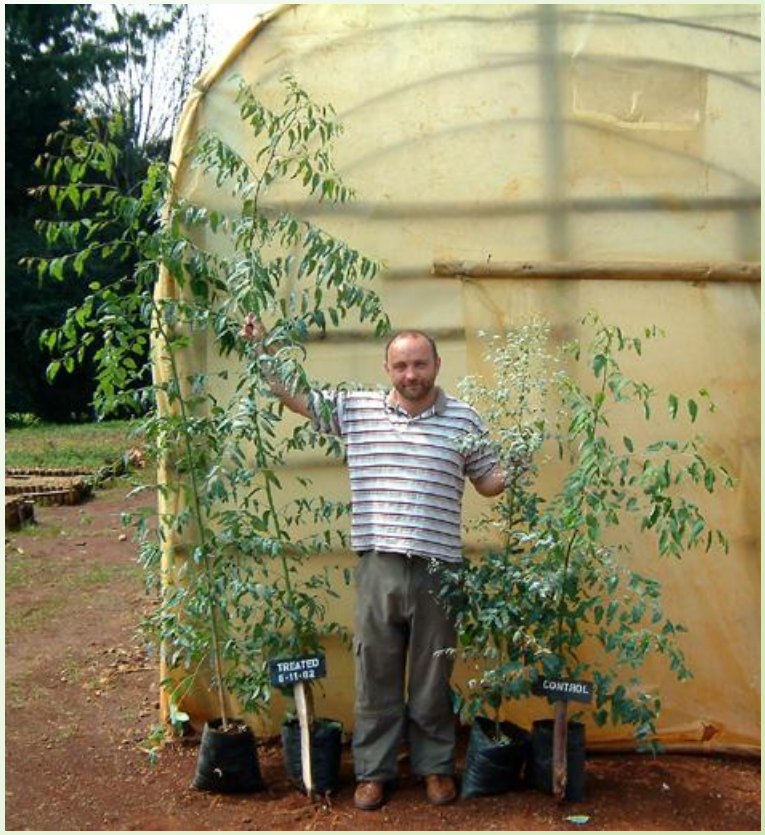
- ✓ Reducing mortality
- ✓ Improving growth

(conifers, broadleaved tree species, fruit trees, olives, palms)





Treated and untreated Eucalyptus, grown for bio-fuel in Kenya



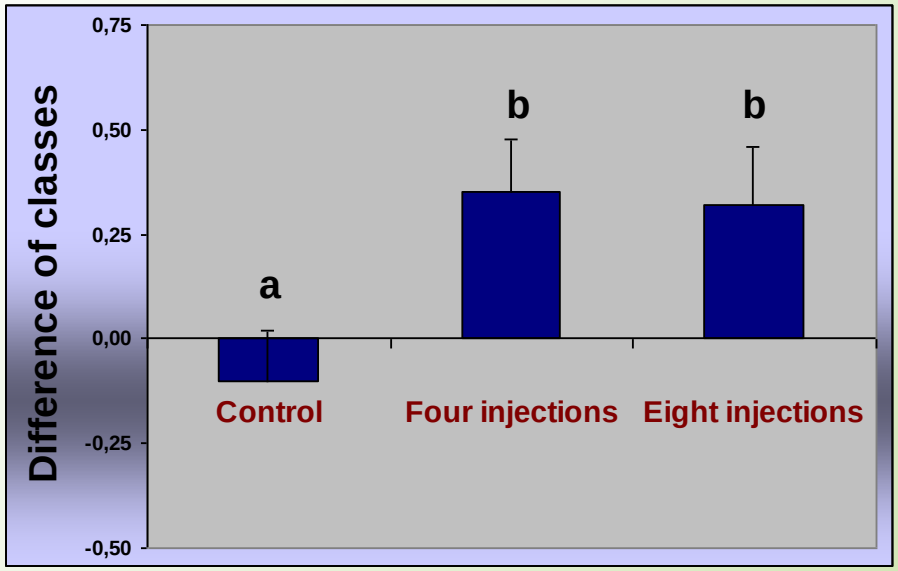
The same trees 5 years later

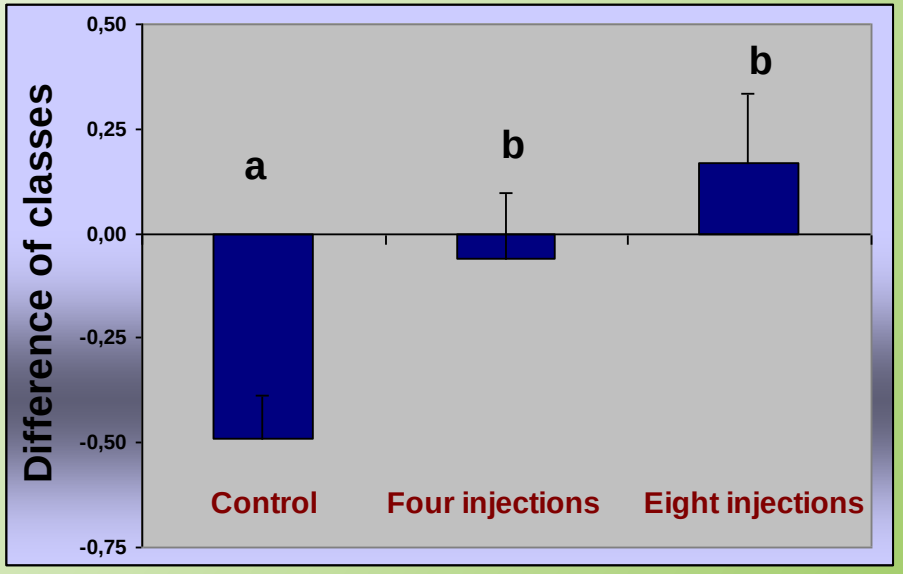
Possibilities of product injection to growing trees

Increase of yields in biofuel plantations

Revitalization of mature trees:

Reduced defoliation of cork oak after 6 and 12 months





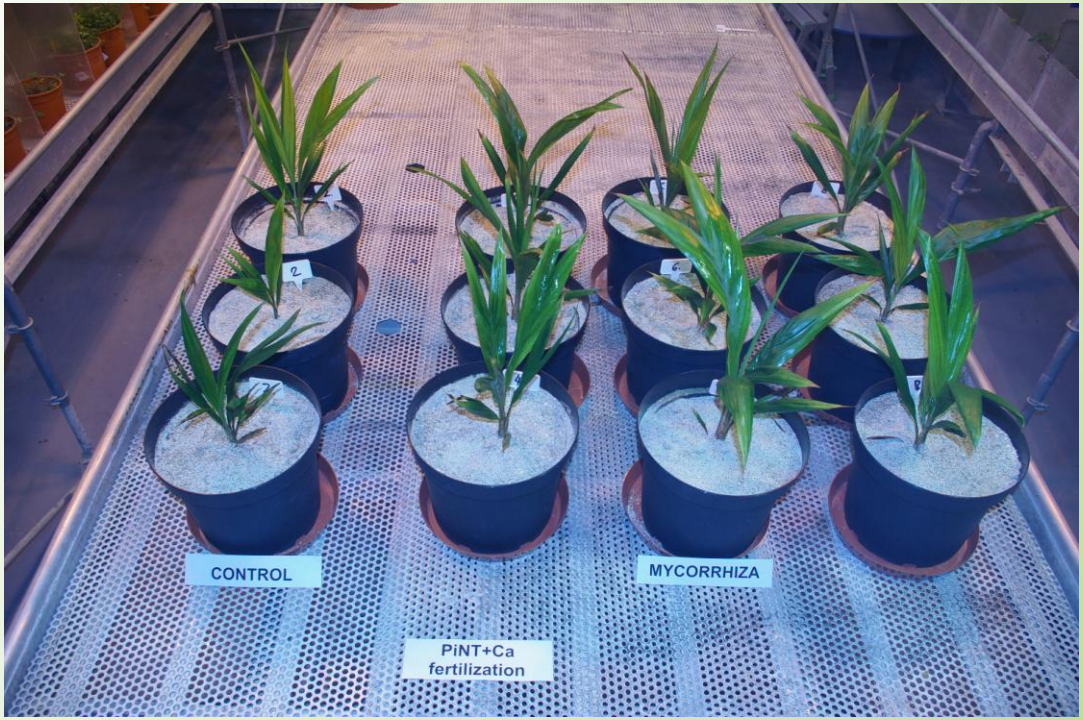
Injection effect on health state of trees

- **Figure 1. Photos of an adult tree (tree nº 91) which had a defoliation class of 2 (Table 1) in November 2007 (left) and after being injected eight times had a defoliation class of1 in November 2008 (right), showing an increase in crown foliage.**

Application of mycorrhiza in sugarcane plantation (Pakistan)

30% increase of the yield, 2% of increase in sugar content

Growth response of oil palm to mycorrhiza (Surinam application to 5 M trees)



Micromaize project
6th FWP EU

Application of mycorrhiza for cultivation of maize for biomass production

Centre for Bioindication and Revitalization

http://www.ibot.cas.cz/cbr

Cultivation of technical crop for biomass / hemp, elephant grass
Use of mycorrhizal inoculation and plant growth promoting rhizobacteria

Jatropha response to mycorrhizal inoculation

Stem diameter
Control = 7.0cm
Treated = 7.7cm

Leaf number
Control = 7.7
Treated = 9.4
Nitrogen 60% increase
Phosphorus 20% increase

Examples of successful use:

Effects of AMF inoculation on propagation of plant stock for commercial plantations of Jatropha curcas (D1Oils, India)

Cost/benefit calculations for commercial rose production (production facilities size about 100 ha)

Treatment A: 50 % reduction in P fertigation reduction N and 15 % reduction K
Treatment B: 50 % reduction in P in fertigation
Treatment C: Normal Feeding

1 Control - No AMF
2 AMF – 15 ml per plant

- Reduction in P, N and K with use of AMF does not affect stem quality
- Reduction in P, N and K with use of AMF does not affect content of these elements in leaf
- By reducing P to 50 % and application of AMF and rock phosphate at planting time, a total of Kshs. 5,637.00 is saved per hectare per month while a total of Kshs 26,677.00 is saved per hectare per month by reducing P by 50 % N by 25 % and K by 15 %.

Cost of AMF is calculated 200 Kshs per L (1Euro is about 100 Kshs)

For 100 ha in 5 years total saving is about 338,220.00 or 1,600,620.00 Euro

Conclusions

Although mycorrhiza represents a hidden part of the plant soil system, it plays an essential role in ecosystem functioning.

Microbial life in the soil is of top importance for successful plantings in particular in stressed environment.

Mycorrhizal technology is not only ecological, but also an economically sound solution for plant production

THANK YOU !

LOOKING FORWARD TO DO BUSINESS WITH YOU

Produce Happy Plant with Mycorrhizal Fungi !