

Symbiotic Mycorrhizal Fungi: Quarterback of the Microbial Herd

by Steve Diver

Fayetteville, Arkansas

©2001-2005

Introduction to Mycorrhizal Fungi

Plant roots form a symbiotic link with beneficial fungi in an association known as mycorrhizae. There are two major types of mycorrhizae fungi that surround and penetrate plant roots: ectomycorrhizae and endomycorrhizae.

Dr. Robert Linderman, the USDA Research Leader for Mycorrhizae, once explained to me that mycorrhizae are like the quarterback of the microbial herd. Whereas bacteria and other microorganisms hang out in the rhizosphere, capturing root exudates as they float by, mycorrhizae actually form a symbiotic fungal link with the vascular system of the plant. The result is an elaborate communication system which results in a feedback loop between the plants and the mycorrhizae. The mycorrhizae calls out signals to the microbial herd, which in turn acquire nutrients or antibiotics to feed back to the plant, as needed.

mycorrhiza

The association, usually symbiotic, of fungi with the roots of seed plants.

ectotrophic mycorrhiza

A mycorrhizal association in which the fungal hyphae form a compact mantle on the surface of the roots. Mycelial strands extend inward between cortical cells and outward from the mantle to the surrounding soil.

endotrophic mycorrhiza

A mycorrhizal association in which the fungal hyphae are present on root surfaces as individual threads that may penetrate directly into root hairs, other epidermal cells, and occasionally into cortical cells. Individual threads extend from the root surface outward into the surrounding soil.

Canadian Soil Information System Glossary

<http://sis.agr.gc.ca/cansis/glossary/mycorrhiza.html>

Suppliers of Mycorrhizal Inoculant

AgBio Inc.

9915 Raleigh St.
Westminster, CO 80030
303-469-9221
303-469-9598 Fax
877-268-2020
agbio@agbio-inc.com
<http://www.agbio-inc.com>

AgBio-Endos™
AgBio-Ectos™

Mycorrhizae Overview

By J.C. Meneley, AgBio Inc.

http://www.agbio-inc.com/myc_ovrvw.html

Content: A brief, information leaflet published by the company

Albright Seed Co. / S & S Seeds

5690 Casitas Pass Road
Carpinteria, CA 93013-3061
805-684-0436
805-684-2798 Fax
<http://www.albrightseed.com>

TurboStart™

Becker Underwood Biologicals

801 Dayton Avenue
Ames, Iowa 50010
515-232-5907
515-232-596 Fax
request@bucolor.com
http://www.bucolor.com/products_info/rhizanova-Tu.shtml

Rhizanova™ Mycorrhizae Products

Bio-Oregon

P.O. Box 429
Warrenton, OR 97146

800-962-2001

503-861-3701 Fax

<http://www.bio-oregon.com/flash/biovita532.htm>

BioVita™ Biological Soil Amendment

Bio-Organics

53606 Bridge Drive

La Pine, Oregon 97739

888-332-7676

541-536-1583 Tel/Fax

info@bio-organics.com

<http://www.bio-organics.com>

Bio-Organics™ Endomycorrhizal Inoculant (BEI)

Bio-Organics™ Mycorrhizal Landscape Inoculant (LA)

Bio-Organics™ Mycorrhizal Root Dip Inoculant (RD)

First Fruits, LLC

RD 1, box 156

Triadelphia, WV 26059

888-489-0162

sales@vamfungi.com

<http://vamfungi.com>

EarthRoots™

Fungi Perfecti

P.O. Box 7634

Olympia, WA 98507

360-426-9292

360-426-9377 Fax

800-780-9126

mycomedia@aol.com

<http://www.fungi.com/mycogrow/>

MycoGrow™

Plant Success™ Tabs

Mycorrhizal Management: A Look Beneath the Surface at Plant Establishment and Growth

By Michael P. Amaranthus. This article originally appeared in The

Spring 1999 issue of *Florida Landscape Architecture Quarterly*.

<http://www.fungi.com/mycogrow/amaranthus.html>

Content: Article reprint; the author worked for Oregon State University and USDA Forest Service.

Gro-Power

15065 Telephone Avenue
Chino, California 91710-9614
909-393-3744
909-393-2773 Fax
gropower@gte.net
<http://www.grolife.com>

Note: GroLife™ is joint venture of Gro-Power and Tree of Life Nursery. Mycorrhiza.com appears to be their educational web page.

GroLife™

Tree of Life Nursery

<http://treeoflifenuresery.com>

Mycorrhiza.com

<http://www.mycorrhiza.com>

Hoodridge International

6699 NW 66 Way
Parkland, FL 33067
954 340-3300
800 745-6963
954 340-3299 fax
info@hoodridge.com
<http://www.hoodridge.com/mycoroot.htm>

MycoRoot™

Horticultural Alliance, Inc.

P.O. Box 5744
Sarasota, FL 34277
800-628-6373
941-917-0670
941-917-0671 Fax
Contact: Jim Quinn
jamesq@bigfoot.com

http://www.hortsorb.com/DIEHARD_Mycorrhizal_Inoculants.htm

DIEHARD™ Mycorrhizal Inoculants

ROOTS, Inc.

3120 Weatherford Road
Independence, MO 64055
800-342-6173
sales@rootsinc.com
<http://www.rootsinc.com>

mycorrhizaROOTS™
endoROOTS™
M-ROOTS™

Mikko-Tek Labs

P.O. Box 2120
Timmons, Ontario
Canada P4N 7X8
705-268-3536
Contact: Mark Kean
mikrotek@onlink.net
[Note: This is an old listing; still in business?]

Plant Health Care

440 William Pitt Way
Pittsburg, PA 15238
800-421-9051
info@planthealthcare.com
<http://www.planthealthcare.com>
<http://www.planthealthcare.com/fungi.html>

Mycor™
Mycor™ Plant Saver™
Mycor™ Tree Saver™
Mycor™ Flower Saver™
MycorTree™ Root Dip
MycorTree™ Ecto Spore Spray
PHC™ Colonize™ VAM Stimulant

Mycorrhizal Fungi: Endo or Ecto Species Finder

<http://www.planthealthcare.com/endo.html>

Content: A handy table comparing the two types of mycorrhizal fungi

PlantHealthCare.com online magazine

<http://www.planthealthcare.com/magazine.html>

Content: Award-winning online magazine, about 32 pages each. See articles on mycorrhiza, rhizosphere, root health, rhizobacteria, biological control, organic amendments, etc.

PHC TV: Educational Videos

<http://www.planthealthcare.com/phctv.html>

Content: Award-winning video clips for Flash or RealPlayer. See *The Fungus Among Us* (7 minutes) and *Beneficial Bacteria* (7.5 minutes)

Premier Enterprises Ltd

326 Main Street
Red Hill, PA 18076
800-424-2554
215-679-4119 Fax
MycorRise™

[Note: This is an old listing; still in business?]

Premier Tech Biotechnologies

<http://www.premiertech.com/unites/ptb/products.htm>

MYKE™

MYKE™ Pro

Poulenger USA, Inc.

3705 Century Blvd. #3
Lakeland, FL 33811
866-709-8102
863-709-8102
863-644-4038 Fax
info@poulengerusa.com

http://www.poulengerusa.com/rutopiam/rutopiaM_by_poulenger_usa_inc.htm

RUTOPIA+M™

Reforestation Technologies International

341 Dayton Street, Unit G
Salinas, CA 93901
800-784-4769

831-424-1495 Fax
RTI@reforest.com
<http://www.reforest.com>

Silva Dip™
AM120™
MycoPaks™

**List of Economically Important Plants Responding to Endo- and Ecto-
Mycorrhizae**
<http://www.reforest.com/species.html>

The Tree Doctor
617 Deery Street
Knoxville TN 37917
865-633-5400
865-633-6624 Fax
treeguru@treedoc.com
<http://www.treedoc.com>

DieHard™ Injectable
DieHard™ Root Reviver

Tree Pro
3180 W. 250 North
West Lafayette, IN 47906
800-875-8071
765-463-3157 Fax
sales@treepro.com
<http://www.treepro.com>

MycorTree™

VAMTech, Inc.
3186 Pine Tree
Road, Unit D
Lansing, MI 48911
517-272-7359
<http://www.vamtech.com>

Mycoform® and Myconate® mycorrhizal stimulants

Web Resources on Mycorrhizae Fungi & Related Topics on the Rhizosphere & Soil Biology

Educational: Leaflets, Articles, Reviews

Managing Soilborne Diseases by Managing Root Microbial Communities

Dr. Robert G. Linderman, SARE 2000 Conference Proceedings

<http://wsare.usu.edu/sare2000/060.htm>

When mycorrhizae form, great changes take place in the physiology of the roots and the whole plant, and in the soil surrounding the roots, now appropriately called the "mycorrhizosphere." In this paradigm, the mycorrhizal fungus is the quarterback, and the other associated microbes are the rest of the team. Due to specific changes in the microbial community resulting from altered root exudation plus the specific chemicals exuded by the fungal hyphae that have grown out into the soil, the "team" is ready to compete with pathogens, increase the availability of nutrients derived from organic substrates, help the plant acquire water and nutrients from well beyond the range of the roots themselves, and increase plant tolerance to other environmental stresses, such as toxicity from soil salinity.

Glomalin: A Manageable Soil Glue

Sara Wright, USDA-ARS-Soil Microbial Systems Lab

<http://www.barc.usda.gov/anri/sasl/glomalin/brochure.pdf>

Content: 5-page PDF download; Educational leaflet from USDA

A strong glue, glomalin, is produced by a beneficial fungus that grows on plant roots. The glue comes off of the fungus and is deposited on soil particles. This process leads to build up and stabilization of aggregates.

Soil aggregation is a complex process that is largely dependent upon microorganisms to provide glues that hold soil particles together. These glues are carbon-containing compounds that protect microorganisms from drying out. We are beginning to understand the importance of one group of soil fungi and the glue that is produced in large amounts by these fungi. The fungi are the arbuscular mycorrhizal fungi (AMF) and the glue was named glomalin after Glomales — the taxonomic order of this group of fungi.

Glomalin—Soil's Superglue

Agriculture Research, October 1997 | USDA -ARS

<http://www.ars.usda.gov/is/AR/archive/oct97/glomalin1097.htm>

Glomalin, a fungal protein derived from mycorrhizal fungi in the genus *Glomalin*, is the glue that binds soil together. "It coats soil particles and may be what holds them together in the stable structures we call aggregates."

A Practical Guide to Mycorrhiza

<http://www.mycorrhiza.org>

Content: Articles, papers, and mycorrhizal restoration projects; largely from Ted St. John, Ph.D., the mycorrhizae researcher associated with Tree of Life Nursery for many years.

The Kinds of Mycorrhiza

<http://www.mycorrhiza.org/types.htm>

The Importance of Mycorrhizal Fungi and Other Beneficial Microorganisms in Biodiversity Projects

Ted St. John

http://www.fcnet.org/proceedings.html?article_id=162

<http://www.fcnet.org/proceedings/1992/stjohn.pdf>

Content: Ted St. John paper presented at Western Forest Nursery Associations, 1992.

Importance of Mycorrhizae for Agricultural Crops

Florida Cooperative Extension, June 2001

http://edis.ifas.ufl.edu/BODY_AG116

Soil Fungi Critical to Organic Success

By Don Comis, May 2001, *USDA Agricultural Research* magazine.

<http://www.ars.usda.gov/is/AR/archive/may01/fungi0501.htm>

What All Growers Should Know About Mycorrhizal Fungi

By Don Chapman. Article reprint, from *Rare Fruit Grower*.

<http://www.treemail.nl/eurobio/inform/mycart.htm>

Mycorrhizal Management: A Look Beneath the Surface at Plant Establishment and Growth

By Michael P. Amaranthus. This article originally appeared in The Spring 1999 issue of *Florida Landscape Architecture Quarterly*.

<http://www.fungi.com/mycogrow/amaranthus.html>

Overview of Mycorrhizal Symbioses

David M. Sylvia, University of Florida Page

<http://dmsylvia.ifas.ufl.edu/mycorrhiza.htm>

Note: Chapter from *Principles and Applications of Soil Microbiology*

Note: Also see PowerPoint slide show on Mycorrhizae on this page (requires IE browser)

Tips for the Municipal Arborist: Root Physiology

Edited by Leonard E. Phillips, Jr.; From *City Trees*, The Journal of The Society of Municipal Arborists; Vol 35, Number 4, July/August 1999

<http://www.urban-forestry.com/citytrees/v35n4a06.asp>

<http://www.urban-forestry.com/citytrees/v35n4a06.html>

Content: A practical review published by the Society of Municipal Arborists: how roots grow, morphology of plant roots, root microorganisms, mycorrhizae, tips on soil preparation.

A Practical Look at Mycorrhizal Fungi in Nurseries -- Part I

Forest Nursery Notes, April 1993

<http://www.na.fs.fed.us/spfo/rngr/fnn/apr-93/eco493.htm>

Content: Informative article in forest nursery newsletter, Part 1.

A Practical Look at Mycorrhizal Fungi in Nurseries -- Part II

Forest Nursery Notes, July 1993

<http://www.na.fs.fed.us/spfo/rngr/fnn/jul-93/eco793.htm>

Content: Informative article in forest nursery newsletter, Part 2.

The Container Tree Nursery Manual | Volume 5 - The Biological Component: Nursery Pests and Mycorrhizae

USDA Agriculture Handbook No. 674-5.

HTML Gateway:

http://www.rngr.fs.fed.us/nurseries/ctnm_vol_5.html

PDF:

http://www.rngr.fs.fed.us/nurseries/ctnm/vol_5_chapter_2.pdf

Content: A 71-page PDF download; informative summary with lots of color photos.

Arbuscular Mycorrhizal Inoculation in Nursery Practice

Ted St. John, 1996: Forest and Conservation Nursery Associations, Salem, OR. [http://](http://www.fcnanet.org/proceedings.html?article_id=103)

www.fcnanet.org/proceedings.html?article_id=103

<http://www.fcnanet.org/proceedings/1996/stjohn.pdf>

Content: A 9-page PDF paper presented at forest nursery conference.

How to Recognize and Quantify Ectomycorrhizae on Conifers

USDA Forest Service, Southeastern Area, 1979.

<http://www.forestry.auburn.edu/sfnmc/class/ecto.html>

Content: Online reprint of Forest Service bulletin.

Mycorrhiza Agriculture Technologies

Chapter 10. p. 185-203. In: *Innovative Biological Technologies for Lesser Developed Countries* (July 1985), Office of Technology Transfer

http://www.wws.princeton.edu/~ota/disk2/1985/8512_n.html

Information on Adding Mycorrhiza to the Planting Hole

By David South, Auburn University

<http://www.forestry.auburn.edu/sfnmc/hole.html>

Content: A skeptical view on adding mycorrhize to the planting *hole* in the field at the time of transplanting

Tree Roots and Their Microbial Partners

By Donald H. Marx and Rob McCartney; Article published in April 1997 issue of *Arbor Age*.

<http://www.greenindustry.com/aa/1997/0497/497treeroots.html>

Unlock Sustainability: Mycorrhizal Fungi are the Keys to Long-term Health

By Felicia Gillham; Article published in August 2001 issue of *Arbor Age*.

<http://www.greenindustry.com/aa/2001/0801/>

<http://www.greenindustry.com/aa/2001/0801/0801us.asp>

Managing Soils For Sustainability

by Felicia Gillham; Article published in June 2000 issue of *Arbor Age*.

<http://www.greenindustry.com/aa/2000/0600/>

<http://www.greenindustry.com/aa/2000/0600/0600soil.asp>

Mycorrhizae on the Horizon

By Colleen Heraty; Article published in August 1999 issue of *Arbor Age*.

<http://www.greenindustry.com/aa/1999/0899/>

<http://www.greenindustry.com/aa/1999/0899/899myc.asp>

INVAM -- International Culture Collection of Arbuscular & Vesicular-Arbuscular Mycorrhizal Fungi

<http://invam.caf.wvu.edu/invam.htm>

Mycorrhizae. pp. 324-327. In: McGraw-Hill 1997 *Yearbook of Science and Technology*, McGraw-Hill Co., NY. By Joe Morton, INVAM.

<http://invam.caf.wvu.edu/Abstracts/mcgraw.htm>

Content: Educational summary and diagram on mycorrhizae; encyclopedia entry.

Evolution of Fungi in Glomales

by Joseph B. Morton; reprint from *Evolution of Endophytism in Plants*.

http://invam.caf.wvu.edu/Myc_Info/Taxonomy/Evolution/Evolution.htm

Content: Academic chapter with interesting notes and pictures.

Mycorrhiza Information Exchange

<http://mycorrhiza.ag.utk.edu>

What is a Mycorrhiza?

<http://mycorrhiza.ag.utk.edu/what.htm>

Content: Collection of introductory articles & leaflets

Mycorrhizal IMAGE Exchange

<http://mycorrhiza.ag.utk.edu/mimag.htm>

Mycorrhizae--Essential Partners in Plant Health

By Craig Elevitch and Kim Wilkinson, *The Overstory* No. 8

<http://www.agroforester.com/overstory/overstory8.html>

Content: Special issue on mycorrhizae in agroforestry newsletter, *The Overstory*.

Troubles in the Rhizosphere

By Dr. Alex Shigo

<http://www.chesco.com/~treeman/SHIGO/RHIZO.html>

Content: Article reprint on mycorrhizae with color photos; from Volume VII, Number 10. (October 1996) of *Tree Care Industry*.

Mycorrhizas

Lecture notes from Dr Louis Chinnery; Mycorrhiza Research Group,
The University of The West Indies

<http://users.sunbeach.net/users/lec/types.html>

Mycorrhizal Images and Photo Galleries

Mycorrhizal Fungi Image Gallery, Part I

The Bruns Lab, UC-Berkeley

<http://plantbio.berkeley.edu/~bruns/fungi2.html>

Mycorrhizal Fungi Image Gallery, Part II

The Bruns Lab, UC-Berkeley

<http://plantbio.berkeley.edu/~bruns/fungi3.html>

Mycorrhizal Photos

College of Forestry, Oregon State University

<http://www.cof.orst.edu/cof/teach/for442/cnotes/sec3/myco.htm>

Endomycorrhizae (VAM)

College of Forestry, Oregon State University

<http://www.cof.orst.edu/cof/teach/for442/cnotes/sec8/endo.htm>

Ectomycorrhizae

College of Forestry, Oregon State University

<http://www.cof.orst.edu/cof/teach/for442/cnotes/sec8/ecto.htm>

Mycorrhizal IMAGE Exchange

<http://mycorrhiza.ag.utk.edu/mimag.htm>

Literature: Databases, Bibliographies, Publications

Mycorrhizal Reference Database

David Sylvia, University of Florida

<http://dmsylvia.ifas.ufl.edu/references.htm>

Note: More than 8000 literature references on mycorrhiza and related topics, since 1980.

MYCOLIT - Mycorrhiza Literature Database

Forest Mycology and Mycorrhiza Research Team, USDA Forest Service

Forestry Sciences Laboratory, Corvallis, OR

<http://mgd.nacse.org/cgi-bin/qml2.0/fslmyco/mycolit.qml>

Mycorrhiza Information Exchange

<http://mycorrhiza.ag.utk.edu>

Search Mycorrhizal Information Exchange

<http://mycorrhiza.ag.utk.edu/mycor.htm>

Search Mycorrhiza at University of Tennessee Host Site

<http://search.tennessee.edu/query.html>

Literature Search for Mycorrhizal Articles

<http://mycorrhiza.ag.utk.edu/mlate.htm>

Mycorrhizal Reviews in the Literature

Citations & Abstracts

<http://mycorrhiza.ag.utk.edu/mrevi.htm>

Mycologue Publications

Mycological Books, CD-ROMs, & Databases

<http://www.mycolog.com/index.html>

MYCOLIT Version 2: The Most Comprehensive Mycorrhiza Database

14,000 References | US\$250

<http://www.mycolog.com/mycodata.html>

The Fifth Kingdom on-line by Bryce Kendrick

20 chapters, 800 pictures and animations

<http://www.mycolog.com/fifhtoc.html>

Chapter 14 | Fungi as agents of Biological Control | (23 pictures)

<http://www.mycolog.com/chapter14.htm>

Chapter 17 | Mycorrhizae - mutualistic plant-fungus symbioses | (35 pictures)

<http://www.mycolog.com/chapter17.htm>

Mycorrhizae: Impacts on Production

Quick Bibliography from National Agricultural Library, QB 95-11.

January 1989 - January 1995. 300 Citations from the AGRICOLA Database. http://www.nal.usda.gov/afsic/AFSIC_pubs/qb95-11.htm

Mycorrhiza journal

<http://link.springer.de/link/service/journals/00572/index.htm>

Mycorrhizae Mailing List

To join, send the message subscribe micronet Your Name (e.g. subscribe micronet John Doe) to listserv@uoguelph.ca

<http://www.lsoft.com/scripts/wl.exe?SL1=MICRONET&H=LISTSERV.UOGUELPH.CA>

Content: Mainly an academic discussion list with occasional resource postings and practical discussions.

Soil Biology: Soil Biota & The Rhizosphere, Mycorrhizal Botany

Rhizosphere Diversity in Forest Ecosystems

Northern Forest Research & Extension Partnership (NFREP), BC

http://www.nfrep.org/features_june.html

Content: Educational poster, 4 sheets in html.

Soil Biota and Biodiversity: The "Root" of Sustainable Agriculture

Land and Water Development Division, FAO

HTML Source:

<http://www.fao.org/landandwater/agll/soilbiod/>

PDF:

<http://www.fao.org/landandwater/agll/soilbiod/docs/SB-brochure-sept.pdf>

Content: Educational leaflet; a 4-page PDF download.

Life Underground

By Kate Goff; article reprint from Erosion Control.

http://www.forester.net/ec_9909_underground.html

Sustainable Soil Management: Web Links to Make Your Worms Happy!

Steve Diver, ATTRA

<http://ncatark.uark.edu/~steved/soil-links.html>

Content: Web resource list from ATTRA.

Soil Biology Information Resources For Land Managers, Resource Professionals, and Educators

<http://www.statlab.iastate.edu/survey/SQI/SBinfo.htm>

Content: Web resource list from NRCS.

Possible Mechanisms of Reduction of Infection by Root Pathogens by Mycorrhizae

College of Forestry, Oregon State University

<http://www.cof.orst.edu/cof/teach/for442/cnotes/sec8/more3.htm>

- Production of Antibiotics by Fungal Symbionts
- Mechanical Barrier Created by Fungal Mantle
- Chemical Inhibitors produced by Higher Plant
- Chemical Exudation of Mycorrhizae
- Protective Microbial Rhizosphere Populations

Controlling Root Pathogens with Mycorrhizal Fungi and Bacteria

Robert G. Linderman and Marielle Hoefnagels

http://www.fcnanet.org/proceedings.html?article_id=168

<http://www.fcnanet.org/proceedings/1992/linderman.pdf>

Content: Robert Linderman paper presented at Western Forest Nursery Associations, 1992.

Arbuscular Mycorrhizae

Y.Dalpé, DSc., Eastern Cereal and Oilseed Research Centre, Canada

<http://res2.agr.ca/ecorc/fr/mycorhiz/index.htm>

Content: A researcher's page on mycorrhizae, yet quite informative as an introduction to these symbiotic fungi with links to description, organisms, morphology, function, and benefits to agriculture, with color images.

Biodiversity of Mycorrhizal Fungi

Y.Dalpé, DSc., Eastern Cereal and Oilseed Research Centre, Canada

http://res2.agr.ca/ecorc/fr/mycorhiz/bio_sols.htm

The Microbial World: Mycorrhizas

University of Edinburgh

<http://helios.bto.ed.ac.uk/bto/microbes/mycorrh.htm>

Supplementary Note and Images: Ectomycorrhizas

The Microbial World, University of Edinburgh

[http://helios.bto.ed.ac.uk/bto/microbes/ectoimag.htm#Supplementary information: Ectomycorrhizas](http://helios.bto.ed.ac.uk/bto/microbes/ectoimag.htm#Supplementary_information:Ectomycorrhizas)

Mycorrhizae in Aquatic Plants

Laura Marx's Senior Exercise, Kenyon College, 1999

<http://www.msu.edu/~marxlau1/contents.htm>

ICOM Links - International Conferences on Mycorrhiza

ICOM 1 | 1st International Conference on Mycorrhiza

University of California, Berkeley, California in 1996

<http://plantbio.berkeley.edu/~bruns/icom.html>

Abstracts Listed by Author | ICOM 1, Berkeley 1996

<http://plantbio.berkeley.edu/~bruns/icom/abstracts.html>

Effects of organic substances or extracts on VA mycorrhizae

LINDERMAN, R. G. & E. A. DAVIS

USDA-ARS, Horticultural Crops Research Laboratory Corvallis, OR [http://
plantbio.berkeley.edu/~bruns/abstracts/linderman1](http://plantbio.berkeley.edu/~bruns/abstracts/linderman1)

Organic soil amendments, especially humic-rich substances, often stimulate plant growth, possibly due to stimulation of VAM fungi.

Solid or water extracts of humic amendments greatly stimulated growth compared to the unamended controls. Addition of VAM fungi in combination with humic extracts caused further growth enhancement but without increasing the level of VAM colonization.

These studies suggest that VAM fungi can be influenced significantly by organic components of soil or growth media, but the response is both substance and fungus specific.

Contribution of microbial associates of VA mycorrhizae to mycorrhiza effects on plant growth and health

LINDERMAN, R. G., J. L. MARLOW, & E. A. DAVIS

USDA-ARS, Horticultural Crops Research Laboratory, Corvallis
<http://plantbio.berkeley.edu/~bruns/abstracts/linderman2>

A number of soil microorganisms can affect the growth and health of plants. Some of them have been shown to positively interact with VA mycorrhizae (VAM) when dual inoculation of plants is made. These findings suggest that growth enhancement of plants by VAM fungi could be the result of combined effects of the VAM and some of the microbial associates.

We investigated this hypothesis by isolating antagonistic bacteria (shown in other studies to inhibit several fungal root pathogens and stimulate seedling plant growth) from the mycorrhizosphere soil of onions.

Root rot disease was suppressed by the slurry from pot cultures inoculated with VAM alone and bacterial antagonists alone, but most from that inoculated with GI + bacterial antagonists. These results support the hypothesis that microbial associates of VAM function in tandem to enhance the growth and health of plants.

ICOM Abstract Booklet

<http://plantbio.berkeley.edu/~bruns/ftp/ICOM-abstracts.DOC.hqx>

Note: A large file (1.6 megabytes - 137 pages) ; available only in a Microsoft Word v5.1 file for the Macintosh.

ICOM 2 | 1st International Conference on Mycorrhiza

Swedish Agricultural University (SLU), Uppsala, Sweden in 1998

<http://www-icom2.slu.se>

Abstracts Listed by Author | ICOM 21, Uppsala 1998

<http://www-icom2.slu.se/ABSTRACTS/abstract.html>

Bacterial associations with the mycorrhizosphere and hyphosphere of the arbuscular mycorrhizal fungus *Glomus mosseae*

G. ANDRADE, ROBERT LINDERMAN¹ & GABOR BETHLENFALVAY¹

U.S. Department of Agriculture, Agricultural Research Service, Horticultural Crops Research Laboratory, Corvallis, OR

<http://www-icom2.slu.se/ABSTRACTS/Andrade.html>

Roots and mycorrhizal fungi may not associate with soil bacteria randomly, but rather in a hierarchical structure of mutual preferences. Elucidation of such structures would facilitate the management of the soil biota to enhance the stability of the plant-soil system.

The results indicate that the hyphosphere-specific *A. eutrophus* depended on the presence of *G. mosseae* as its AM-fungal host, but that the nonspecific *A. globiformis* did not. The mycorrhizal status of soils may selectively influence persistence of bacterial inoculants as well as affecting the numbers of other native bacteria.

Comparison of the potential functional activities of bacteria in mycorrhizosphere vs rhizosphere soils

LINDERMAN, ROBERT G., JOSEPH L. MARLOW, & E. ANNE DAVIS

U.S. Department of Agriculture, Agricultural Research Service, Horticultural Crops Research Laboratory, Corvallis, OR

<http://www-icom2.slu.se/ABSTRACTS/Linderman.html>

These results indicate that VAM induce microbial changes in the mycorrhizosphere soil that could significantly affect disease suppression and nutrient availability and cycling compared to rhizosphere soil from non-VAM plants, and therefore contribute to the positive VAM effects.

Interaction between the AM fungus *Glomus intraradices* and different rhizosphere microorganisms

FILION, M., M. ST-ARNAUD & J.A. FORTIN

Institut de recherche en biologie végétale, Jardin botanique de Montréal, Montréal, Qc, CANADA

<http://www-icom2.slu.se/ABSTRACTS/Filion.html>

AM fungi can reduce plant diseases caused by soilborne pathogens through mechanisms that are not well characterized. We used an in vitro experimental system to test the hypothesis that mycelium of AMF can interfere directly with soil microorganisms.

The results suggest that direct interactions exist between AMF and soil microorganisms which may lead to microbial equilibrium changes detrimental for pathogens.

ICOM 2 Abstract: Titles & Authors & Key Words

<http://www-icom2.slu.se/ABSTRACTS/ab-ti-au-ke.html>

Note: Large file arranged alphabetically by filename

Use Ctrl+F (Find in Page) on your browser to search for keywords

ICOM 3 | Third International Conference on Mycorrhizas

Held at Adelaide University, Adelaide Australia, July 2001

http://www.waite.adelaide.edu.au/Soil_Water/3icom.html

Abstracts: ICOM 3, Adelaide 2001

http://www.waite.adelaide.edu.au/Soil_Water/3ICOM_ABSTs/Abstracts/abstract.html

Comparison of antagonistic potential of rhizobacteria from mycorrhizosphere and rhizosphere soils against soilborne fungal pathogens

R.G.Linderman, J.L.Marlow and E.A.Davis

USDA-ARS Horticultural Crops Research Laboratory, Corvallis, Oregon <http://>

www.waite.adelaide.edu.au/Soil_Water/3ICOM_ABSTs/Abstracts/L/R.G.Linderman.html

Specific functional groups of rhizobacteria in rhizosphere soil can influence plant growth and health, and formation of mycorrhizae can alter their populations in the mycorrhizosphere.

These results indicate that mycorrhizae stimulate antagonistic rhizobacterial populations that could suppress fungal pathogens and thereby the diseases they cause.

Further Reading: Articles, Books, Chapters, Literature Reviews

Adholeya, Alok, and Sujan Singh (ed.) 1995. Mycorrhizae, Biofertilizers for the Future. Proceedings of the Third National Conference on Mycorrhiza, Held March 13-15, New

Delhi. Tata Energy Research Institute, New Delhi. 548 p.

Allen, Michael F. 1991. *The Ecology of Mycorrhizae*. Cambridge University Press, New York, NY. 184 p.

Barea, J.M., R. Azcon, and C. Azcon-Aguilar. 1993. Mycorrhiza and crops. *Advances in Plant Pathology*. Vol. 9. p. 167-189.

Bethlenfalvay, G.J., and R.G. Linderman. 1991. *Mycorrhizae in Sustainable Agriculture*. ASA Special Publication No. 54. American Agronomy Society, Crop Science Society of America. 124 p.

Table of Contents: <http://mycorrhiza.ag.utk.edu/mtbeth2.htm>

Brundrett, Mark. 1996. *Working with Mycorrhizas in Forestry and Agriculture*. ACIAR Monograph Series, Australian Centre for International Agricultural Research, Canberra, Australia. 374 p.

Castellano, M.A., and R. Molina. 1990. Chapter 2—Mycorrhizae. p. 103–167. In: T.D. Landis, R.W. Tinus, S.E. McDonald, and J.P. Barnett (ed.) *The Container Tree Nursery Manual*. Vol. 5. *The Biological Component: Nursery Pests and Mycorrhizae*. USDA Forest Service, Agriculture Handbook No. 674.

Conway, L., D. Powell, and Joseph Bagyaraj. 1984. *VA Mycorrhiza*. CRC Press, Boca Raton, FL. 234 p.

Gianinazzi, S., A. Trouvelot, and V. Gianinazzi-Pearson. 1990. Role and use of mycorrhizas in horticultural crop production. *Advances in Horticultural Science*. Vol. 4, No. 1. p. 25–30.

Gianinazzi, S., and H. Schuepp. 1994. *The Impact of Arbuscular Mycorrhizas on Sustainable Agriculture and Natural Ecosystems*. Birkhauser Verlag, Boston, MA. 226 p.

Grove, T.S., and F. LeTacon. 1993. Mycorrhiza in plantation forestry. *Advances in Plant Pathology*. Vol. 9. p. 191–227.

Ingham, Elaine R., and Randy Molina. 1991. Interactions among mycorrhizal fungi, rhizosphere organisms, and plants. p. 169-197. In: Pedro Barbosa, Vera A. Krischik, and Clive G. Jones (ed.) *Microbial Mediation of Plant-Herbivore Interactions*. John Wiley & Sons, New York, NY.

Kropp, B.R. and Langlois, C.G. 1990. Ectomycorrhizae in reforestation. *Canadian Journal of Forest Research*. Vol. 20, No. 4. p. 438–451.

Linderman, R. 1988. Mycorrhizal interactions with the rhizosphere microflora: The mycorrhizosphere effect. *Phytopathology*. Vol. 78. p. 366-371.

Mukerji, K.G. 1996. *Concepts in Mycorrhizal Research*. Kluwer Academic, Boston, MA. 374 p.

Newman, E.I. 1988. Mycorrhizal links between plants: Their functioning and ecological significance. pl. 243-270. In: M. Begon, A.H. Fitter, E.D. Ford, and A. Macfadyen (ed.) *Advances in Ecological Research*. Vol. 18. Academic Press, New York, NY.

Pfleger, F.L., and R.G. Linderman. 1994. *Mycorrhizae and Plant Health* American Phytopathological Society, St. Paul, MN. 344 p.

Table of Contents: <http://mycorrhiza.ag.utk.edu/mtpfle1.htm>

Read, D.J. et al. 1992. *Mycorrhizas in Ecosystems*. CAB International, Oxon, UK. 419 p.

Robert M. Augé. 2001. Water relations, drought and vesicular-arbuscular mycorrhizal symbiosis. *Mycorrhiza*. Vol. 11. p. 2-42.

http://ohld.ag.utk.edu/auge/am_review.pdf

Smith, S.E., D.J. Read, and J.L. Harley. 1997. *Mycorrhizal Symbiosis*, 2nd Edition. Academic Press, San Diego, CA. 605 p.

Stewart, G.G., and I. Russell (ed.) 1995. Arbuscular mycorrhizae: Biotechnological applications, An environmental sustainable biological agent. *Critical Reviews in Biotechnology*. Vol. 15, Nos. 3–4. Special Issue.

Sylvia, D.M. 1994. Role of mycorrhizae in sustainable agriculture. p. 559–566. In: *Environmentally Sound Agriculture*. Proceedings of the Second Conference, Held April 20-22, St. Joseph, MI. American Society of Engineers.

Whipps JM. 2001. Microbial interactions and biocontrol in the rhizosphere. *Journal of Experimental Botany*. Vol. 52. p. 487-511.

Mycorrhizal Books

Mycorrhiza Information Exchange

<http://mycorrhiza.ag.utk.edu/mbook.htm>

Content: Many with Table of Contents, citations only; An extensive list of academic books on mycorrhizae.

Compiled by:

Author: Steve Diver
Who: Agricultural Specialist
Where: Fayetteville, Arkansas
Email: steved@ipa.net
Updated: December, 2001
