

Přednáška na houby:

- Využití mykorrhizních hub v ovocnářství

Aleš Látr
Symbiom s.r.o.



Co je houba?



Co je houba?



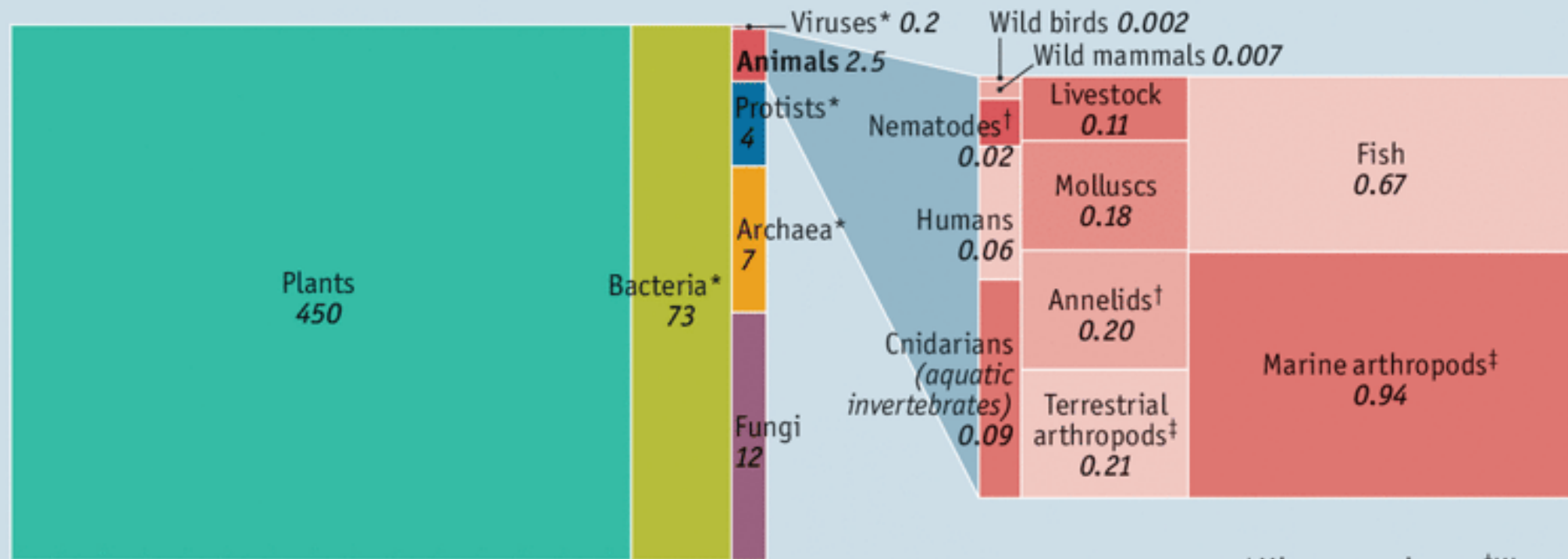
X



Kolik je na světě hub?

Life as we know it

Estimated global biomass of selected taxonomic groups, gigatonnes



Source: "The biomass distribution on Earth" by Bar-On, Phillips & Milo, *PNAS*, 2018

*Micro-organisms †Worms
‡Invertebrates with hard exoskeleton

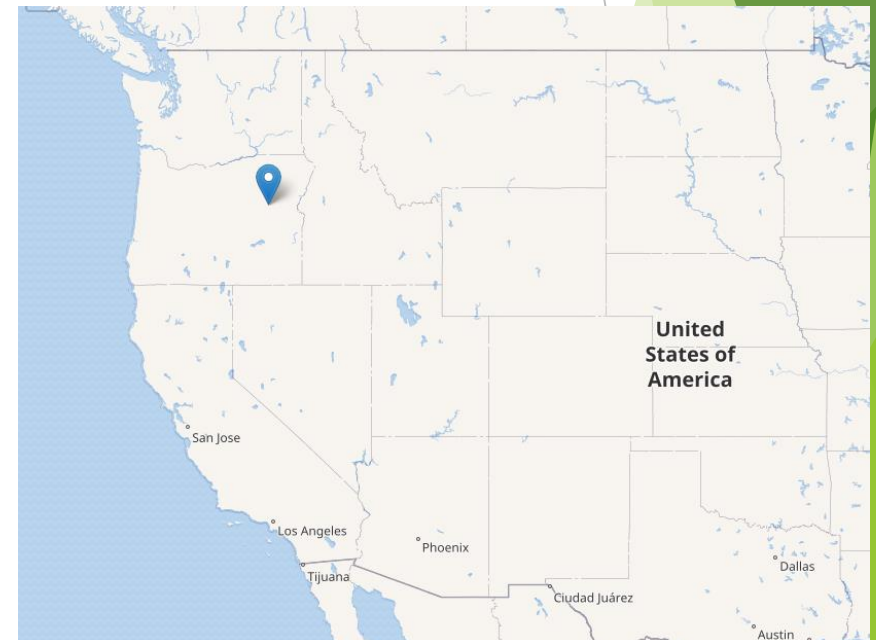
Jaký je rozsah podhoubí?

Václavka smrková (*Armillaria ostoyae*)



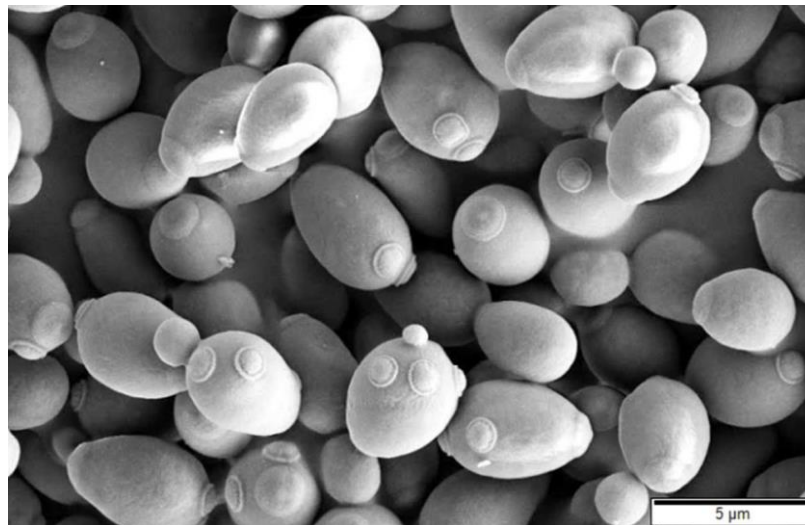
Největší organismus na světě

- Plocha: 8,9 km² (~ 1 250 fotbalových hřišť)
- Stáří: 2 400 let
- Hmotnost: 35 000 tun?
- Blue Mountains, Oregon, USA



Význam hub

Saccharomyces cerevisiae - kvasinka pивní, vinná...

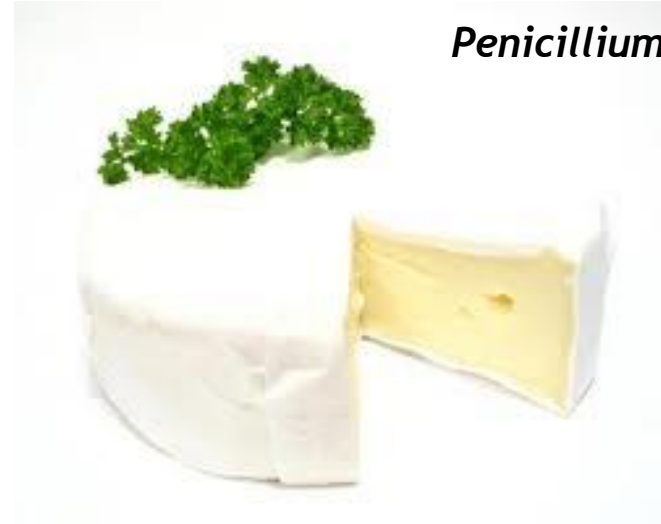


Význam hub

Penicillium chrysogenum



Penicillium camemberti



Penicillium roqueforti



Význam hub



Význam hub

Patogeni - *Monillia* sp.



Rozkladači



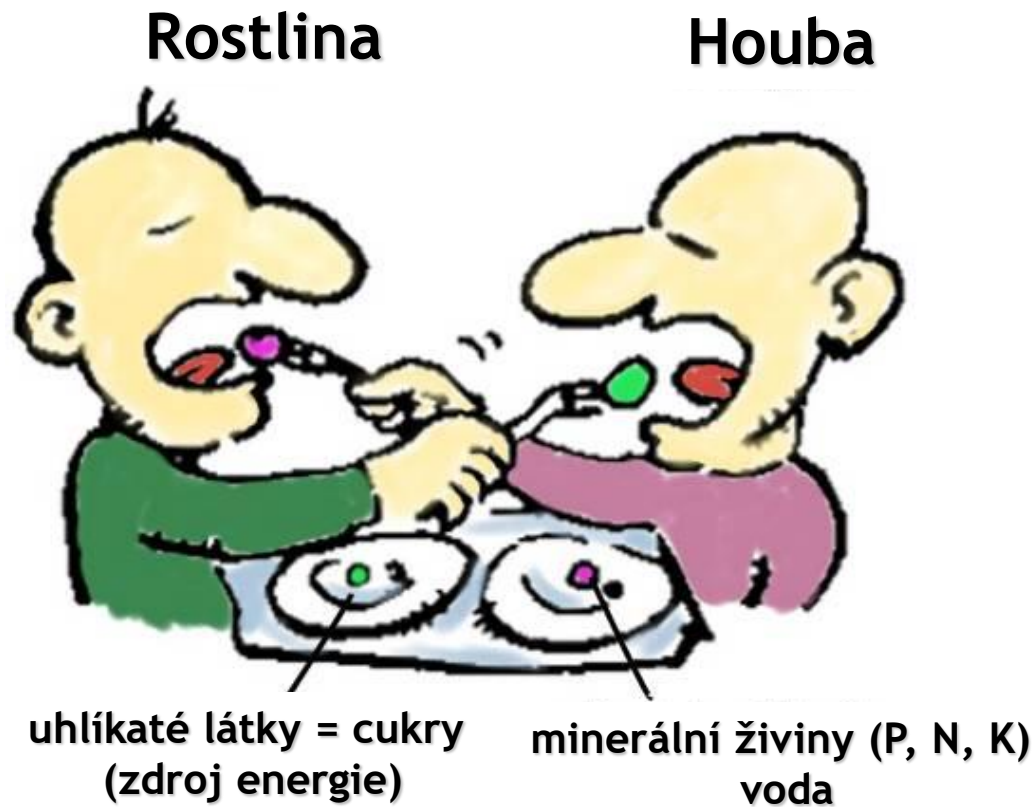
Symbionti



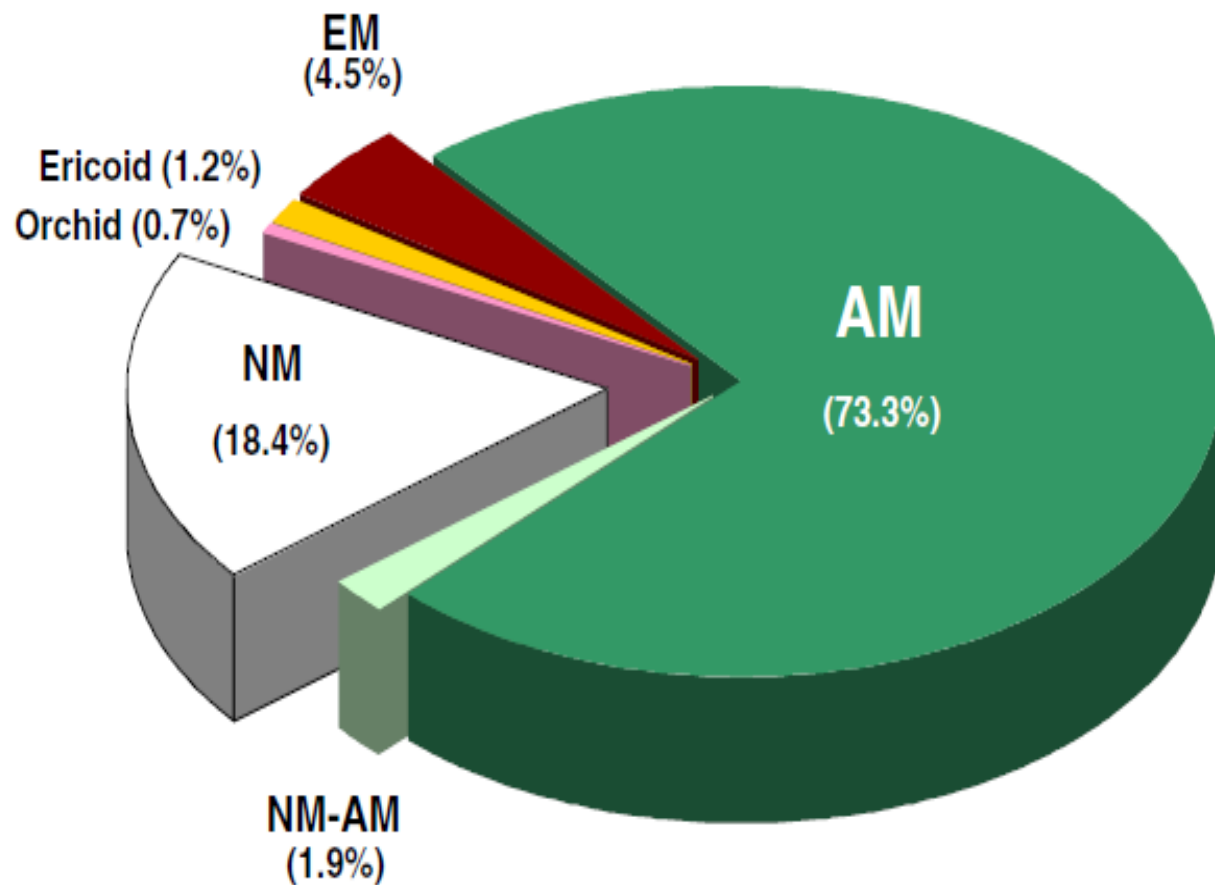
Co je mykorrhizní symbióza?

Mykos = houba, rhiza = kořen

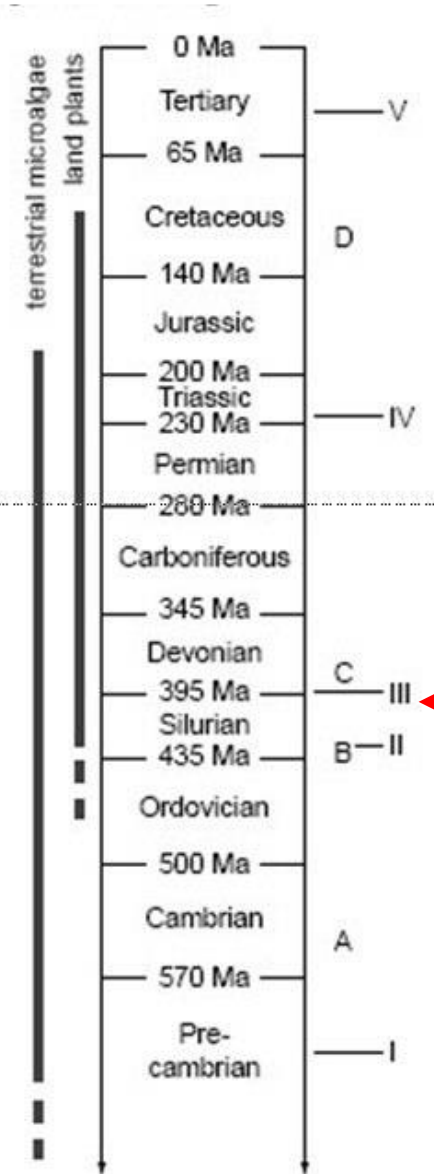
Přirozená symbióza mezi kořeny rostlin a půdními houbami



Typy mykorrhizních symbióz:

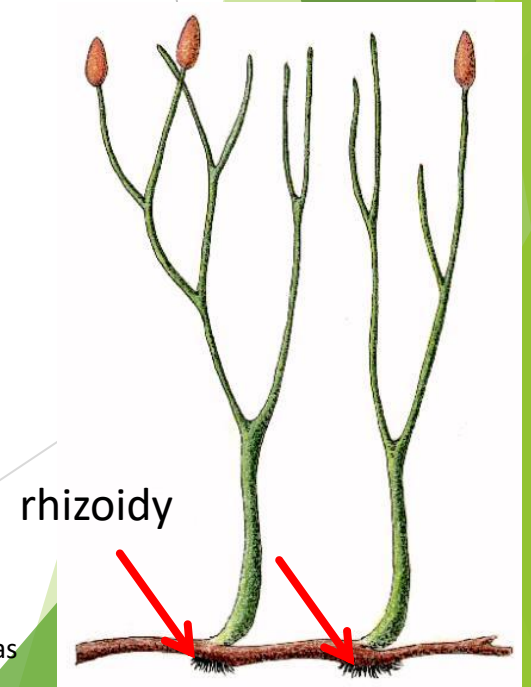
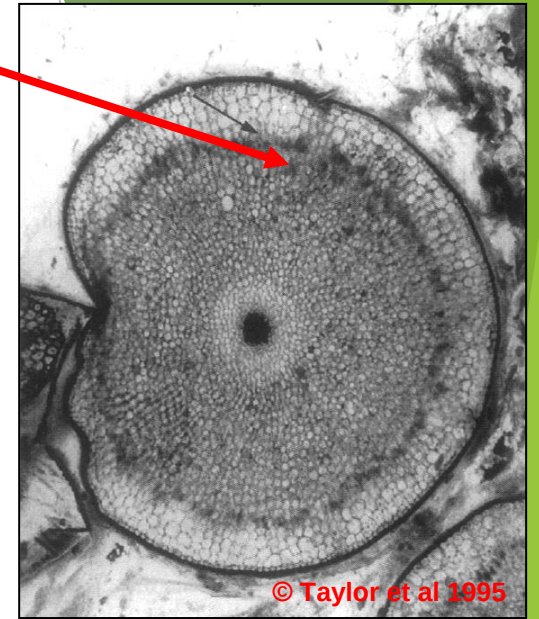
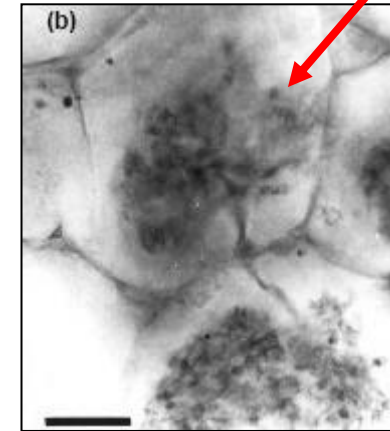


Arbuskulární mykorrhiza

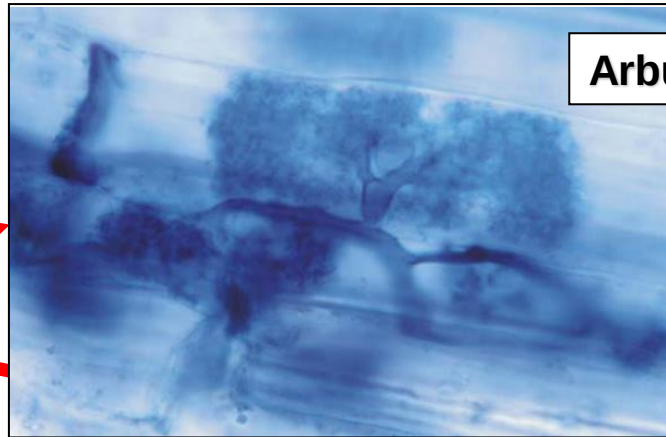
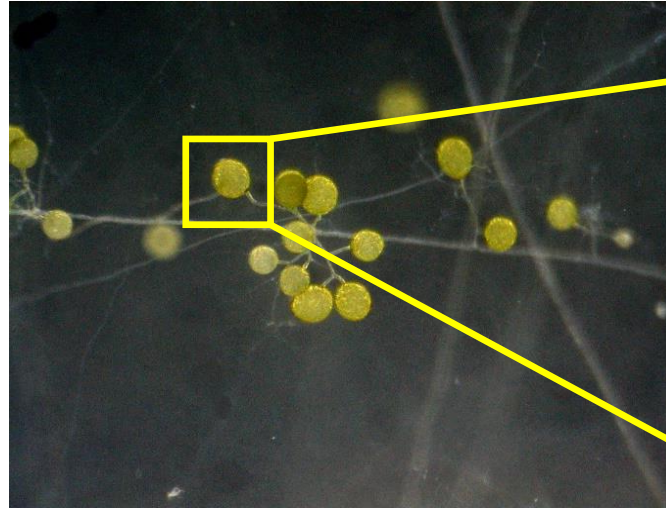
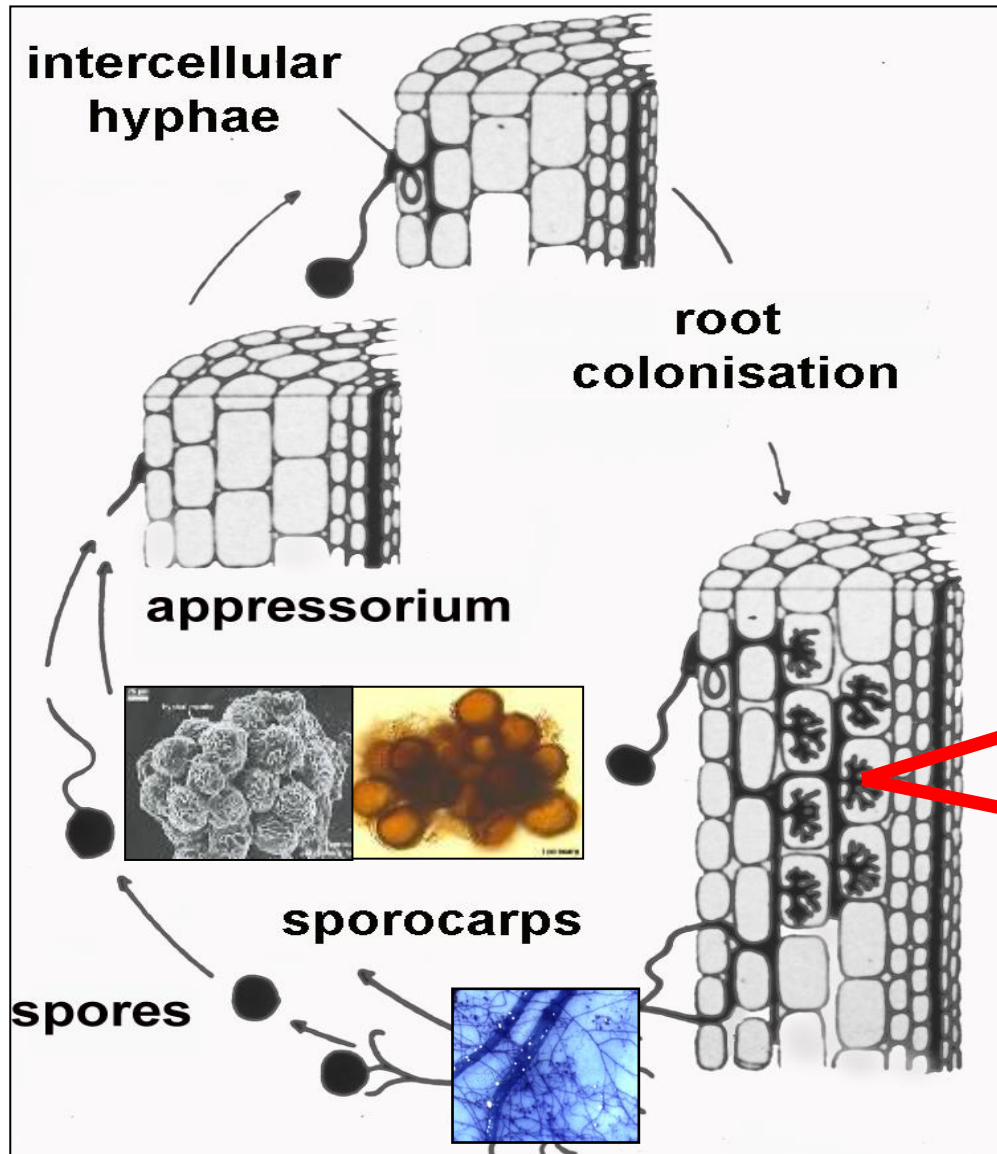


Fosilní záznamy AM struktur

- stáří 400 mil. let (spodní devon)
- druh *Aglaophyton major*
- devonské rostliny opustily vodu a rhizomy s rhizoidy sloužily pouze pro uchycení v půdě
- rostliny limitovány fosforem



Arbuskulární mykorrhiza

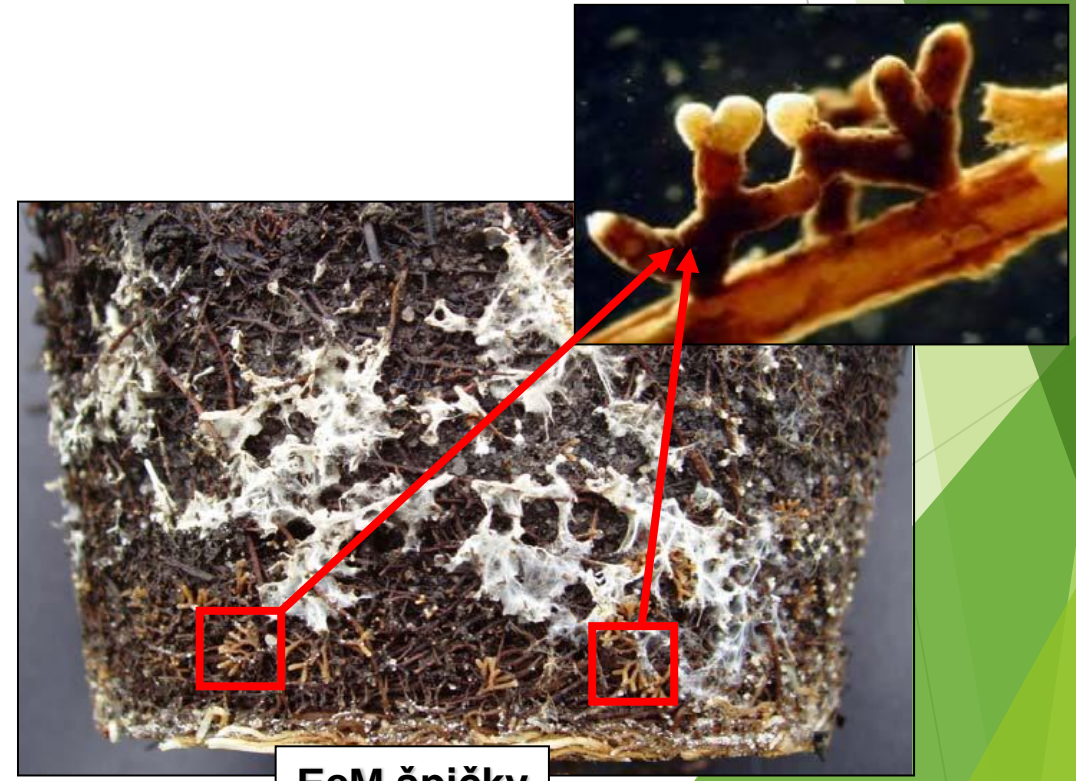
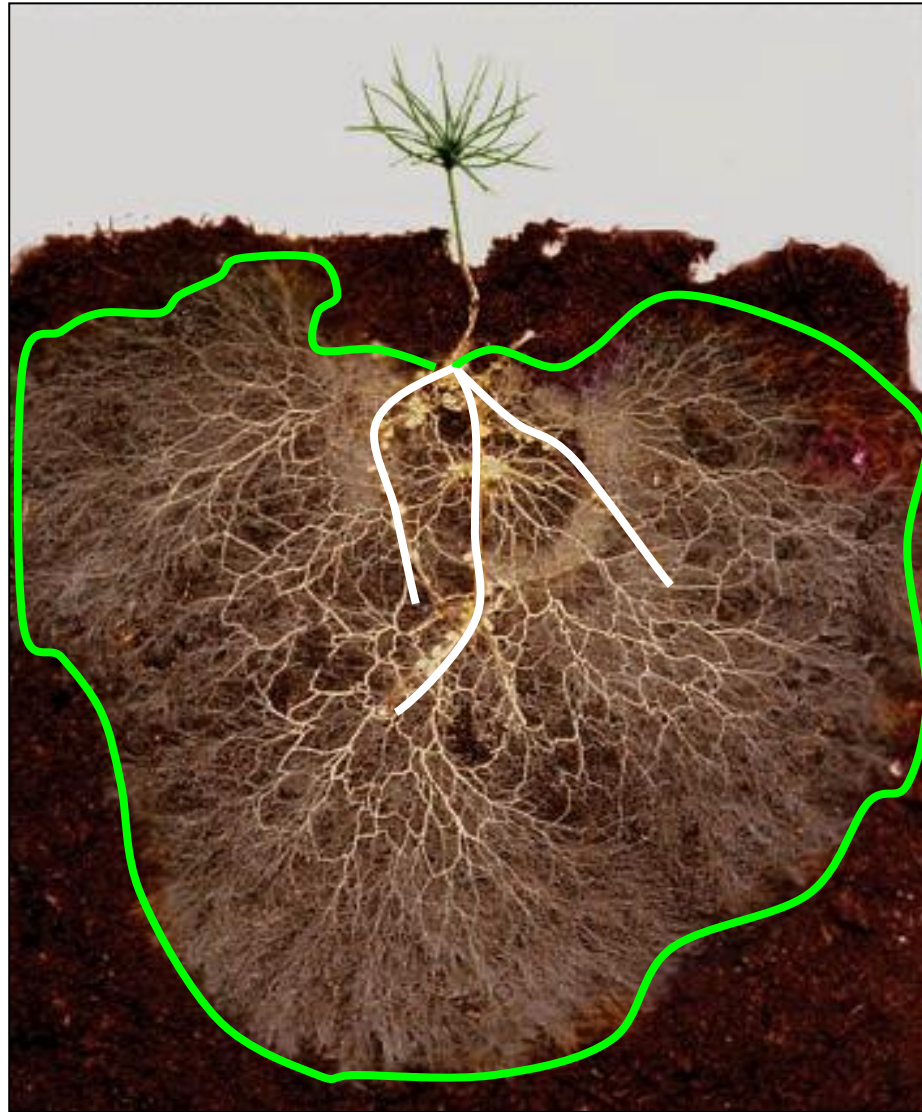


Arbuskuly



Vezikuly

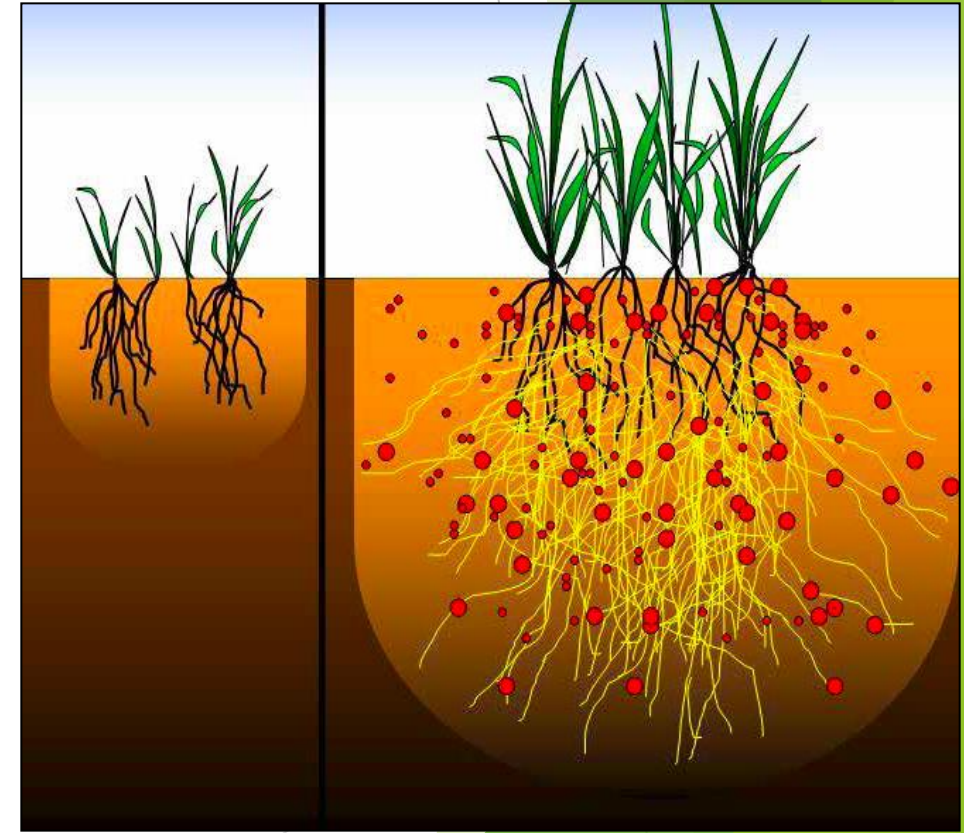
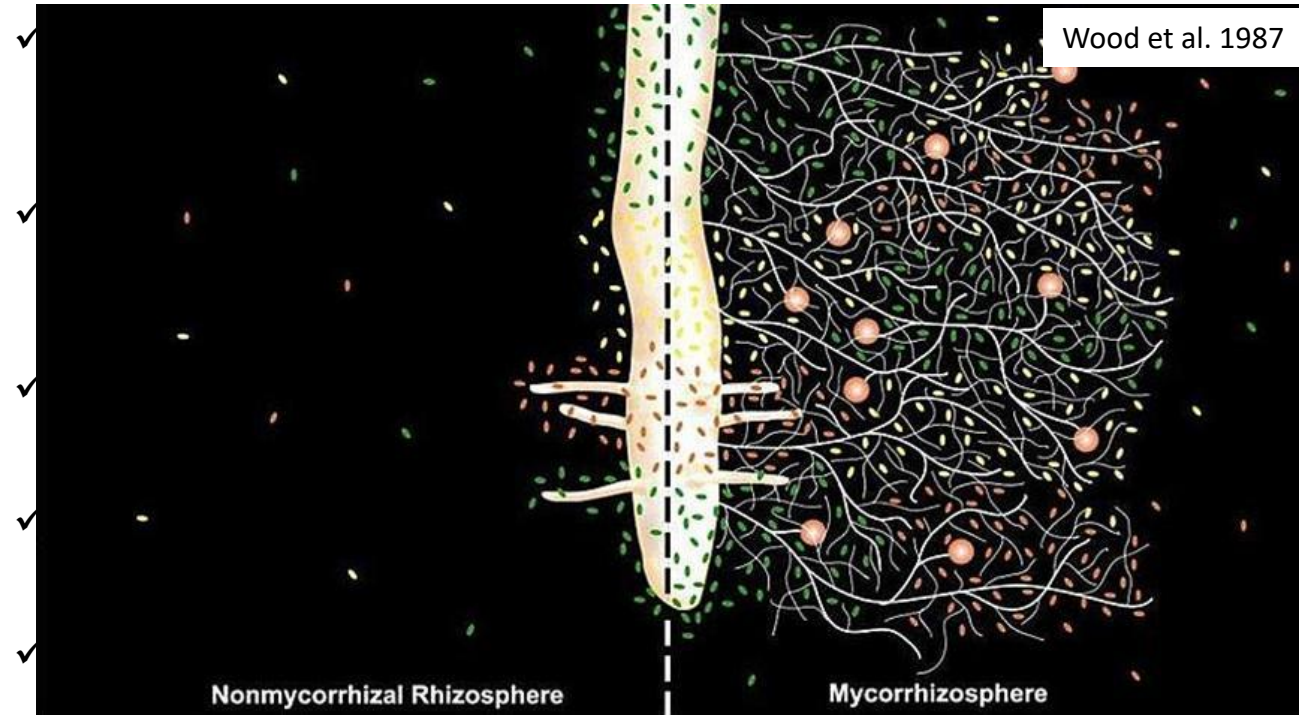
Ektomykorhiza



EcM špičky

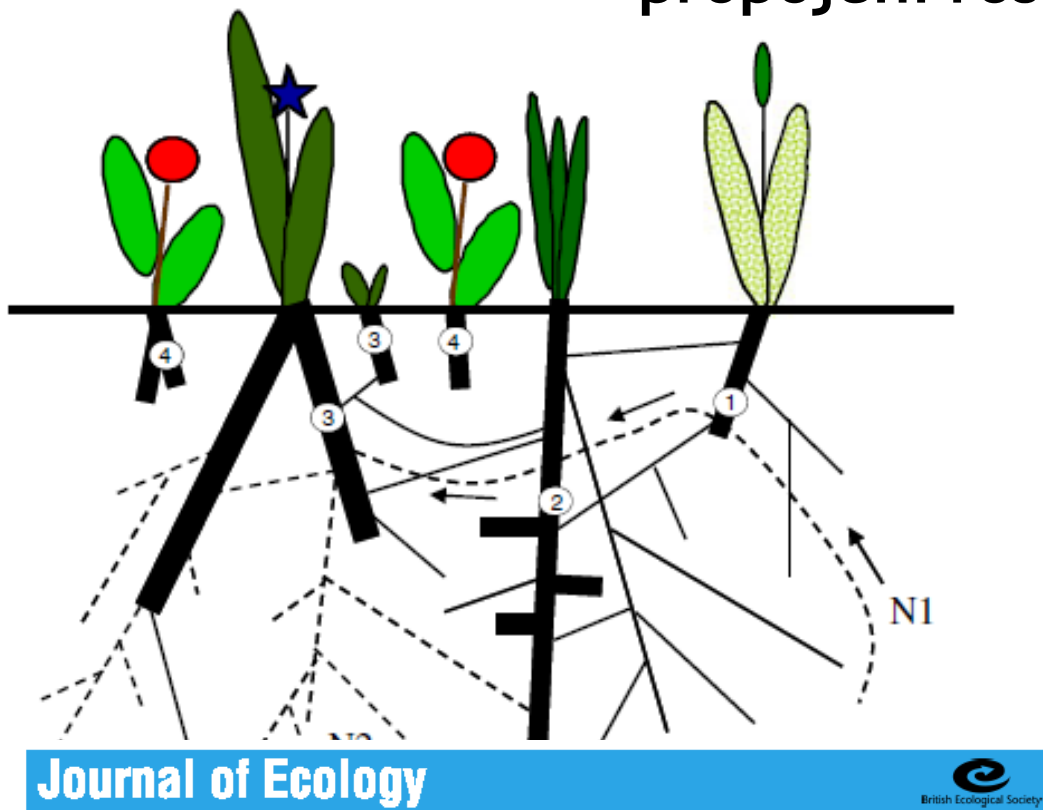
Co mykorrhiza přináší rostlině?

- ✓ Lepší výživa rostlin (P, N, K, někt. mikroelementy, voda)
- ✓ Zvětšení absorpčního povrchu kořenů až 700x a tím i objemu půdy pro čerpání živin.



Společné myceliální sítě

- propojení rostlin ve společenstvu



Journal of Ecology 2009, **97**, 1139–1150

doi: 10.1111/j.1365-2745.2009.01570.x

SPECIAL FEATURE

FACILITATION IN PLANT COMMUNITIES

Socialism in soil? The importance of mycorrhizal fungal networks for facilitation in natural ecosystems

Marcel G. A. van der Heijden^{1*} and Thomas R. Horton²

¹Ecological Farming Systems, Agroscope Reckenholz-Tänikon, Research Station ART, Zurich, Switzerland; and

²Department of Environmental and Forest Biology, SUNY-Environmental Science and Forestry, Syracuse, NY, USA

- Jedna AM houba může kolonizovat více rostlin (stejného i různých druhů)

- Jedna rostlina může být kolonizována více druhy AM hub

→ **propojení rostlin myceliem**

- Pohyb živin v rámci této společné myceliální sítě

- Výhody pro uchycování semenáčků

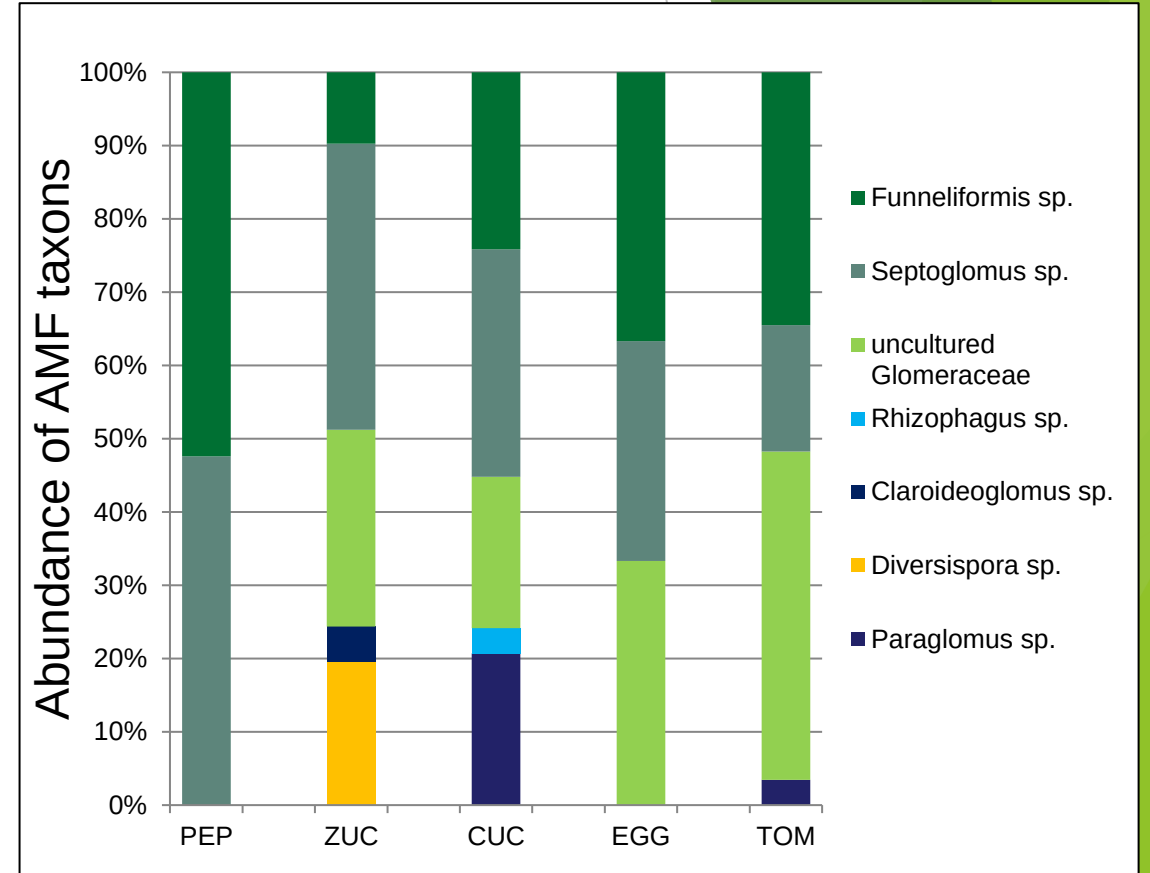
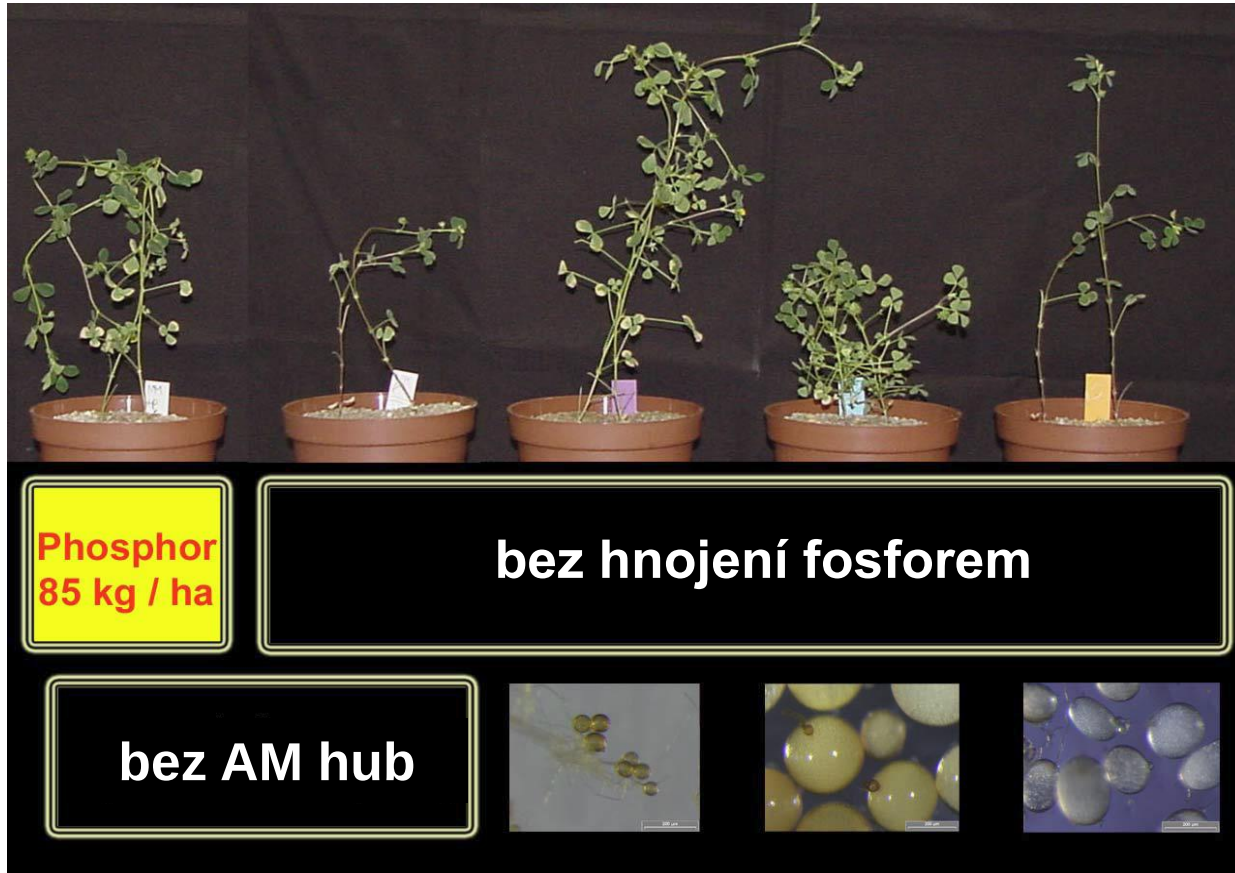


Příklady použití mykorrhizních produktů

- **Zemědělství (konvenční, organické)**
- **Zahradnictví, ovocnářství, vinařství a školkařství (lesní a okrasné)**
- **Údržba veřejné zeleně**
- **Sportovní a okrasné trávníky**
- **Velkoplošné výsadby dřevin (zalesňování, produkce rychle rostoucích dřevin)**
- **Rekultivace – narušené ekosystémy, extrémní podmínky**



A) Lepší růst a výživa



A) Lepší růst a Výnos

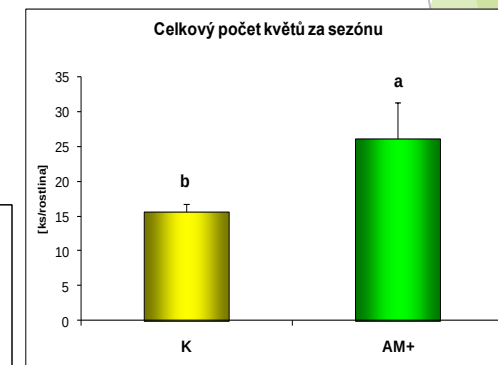
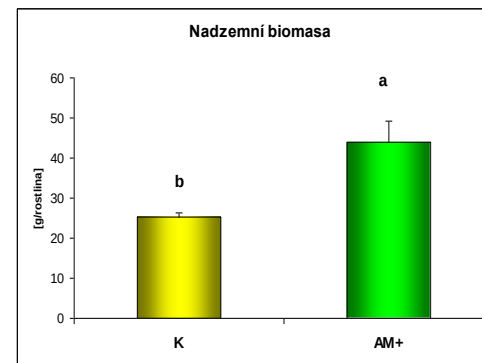
Petunia



Pelargonium

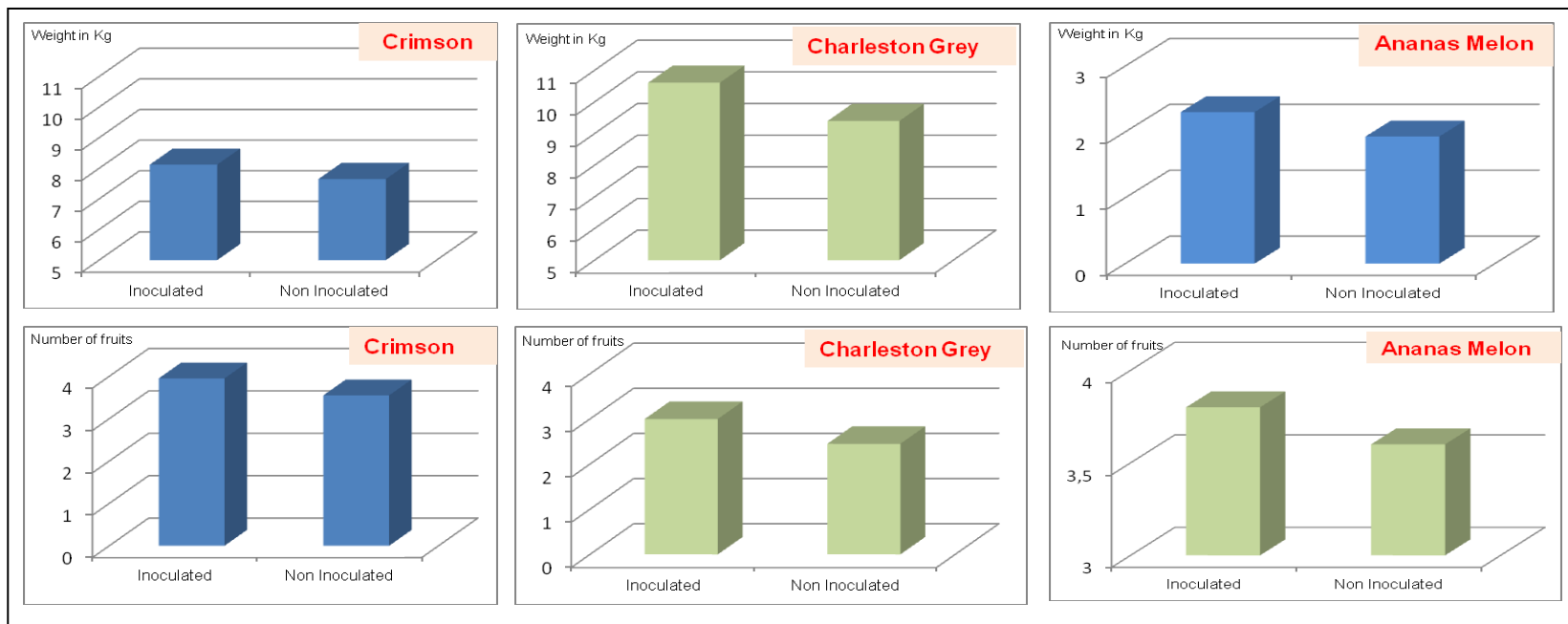


Verbena, Diascia, Torenia



A) Lepší růst a výnos

- polní pokus – vodní meloun, Tunisko, 2012

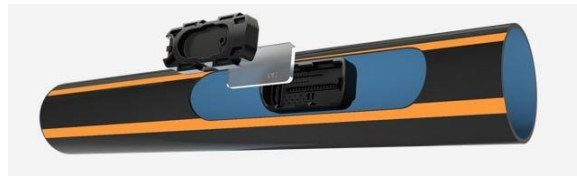


Crimson: zvýšení hmotnosti plodu + 0,5 kg/plod
Charleston Grey: + 1,2 kg/ plod
Ananas d'Amérique: + 0,4 kg/ plod

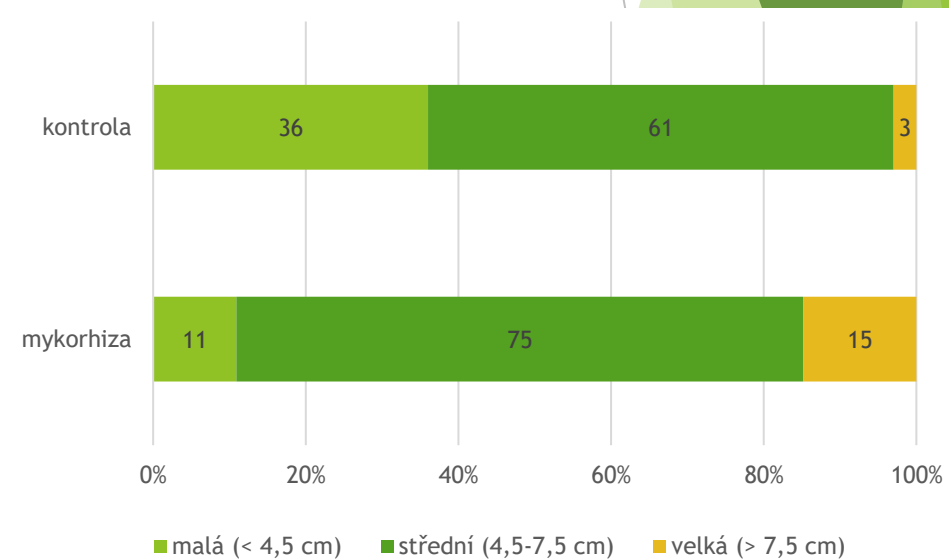
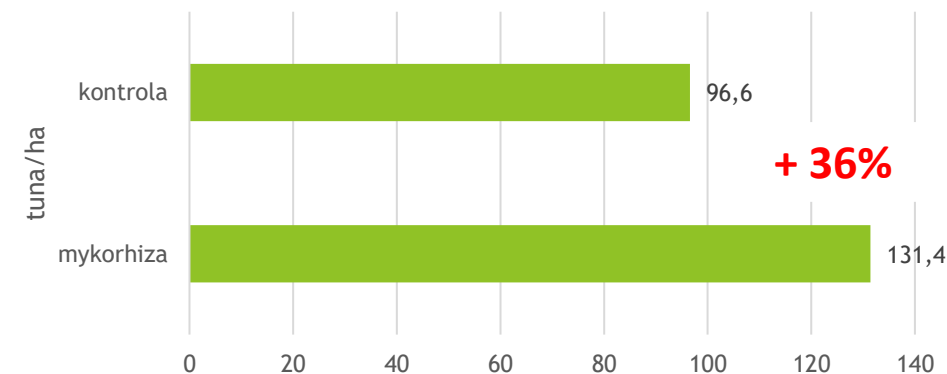
Crimson: výnos vyšší + 4 350 kg/ha
Charleston Grey: + 8228 kg/ha
Ananas d'Amérique: + 7400 kg/ha

A) Lepší růst a výnos

- polní pokus – cibule, Izrael, 2014-2015
- ve spolupráci s Netafim



Výnos



Aplikace v sadech - výsadba

- jabloň cv. Empire, Velká Británie, 2014



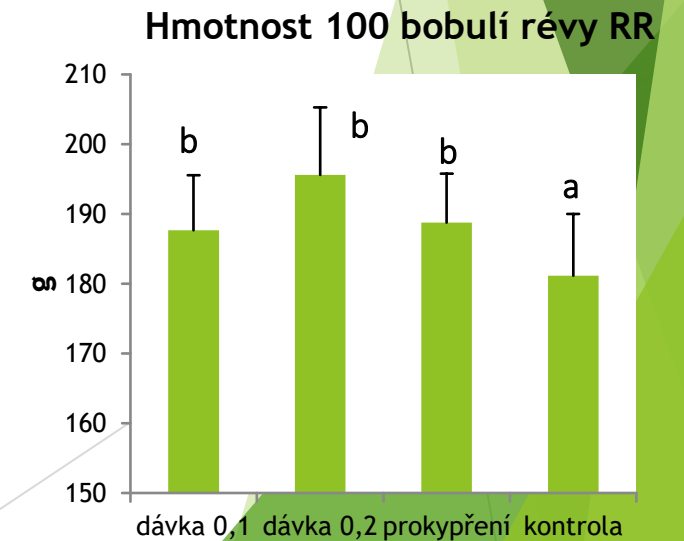
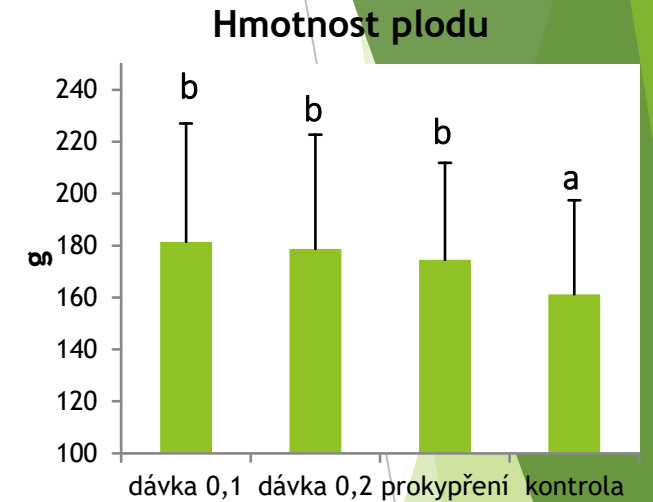
Nárůst:

- 62% delší výhony
- 29% více postranních výhonů
- 18% větší výška



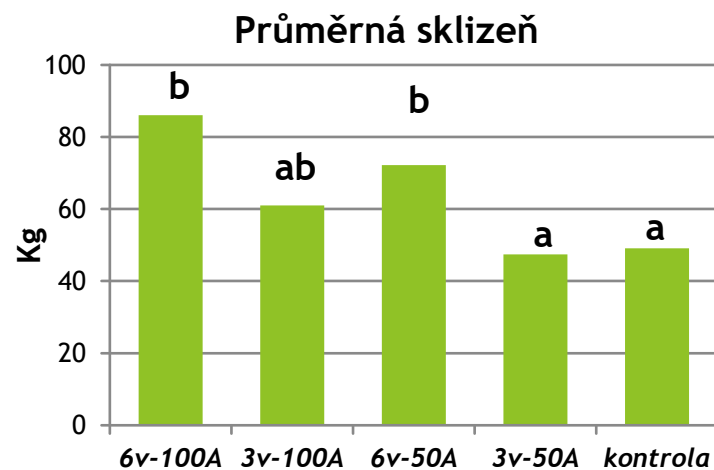
Aplikace v sadech a vinohradech - injektáž

- jabloň & réva (RR), Valtice, 2012



Aplikace v sadech - injektáž

- švestka, Tlumačov, 2011



Aplikace v sadech - injektáž

- ovocné stromy, INSAD Skierniewice, Polsko, 2011

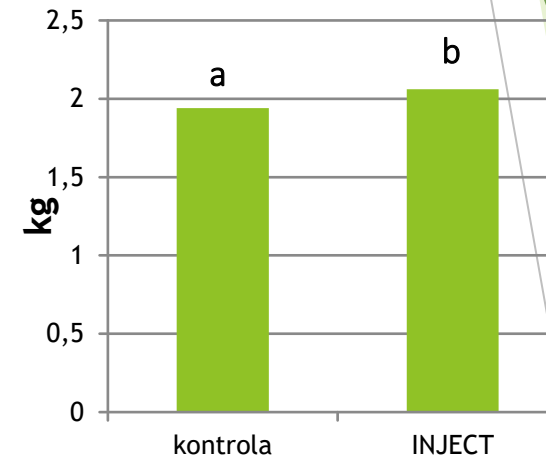
slivoň cv. Shiro



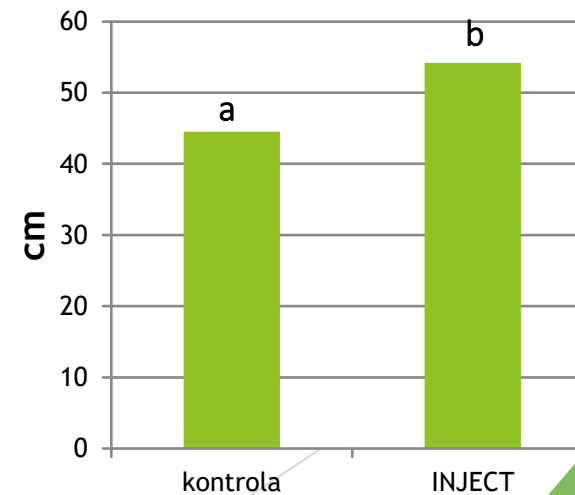
třešeň cv. Burlat



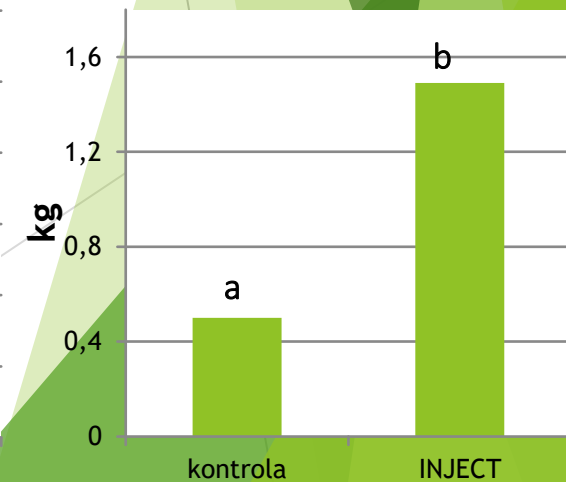
Sklizeň



Obvod kmene



Výnos

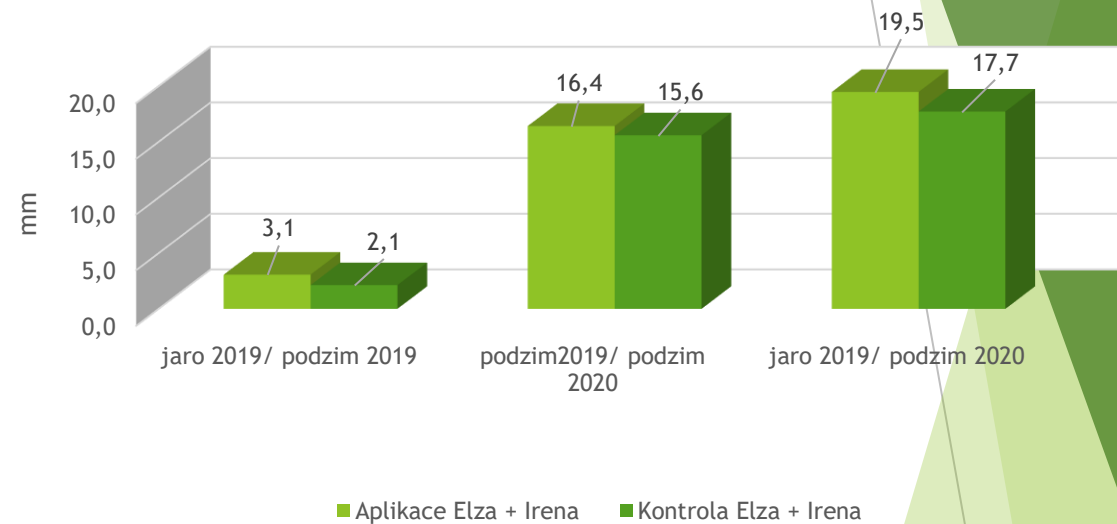


Aplikace v sadech - ruční injektáž

- třešně cv. Elsa a Irena, VŠUO Holovousy, 2019-2020



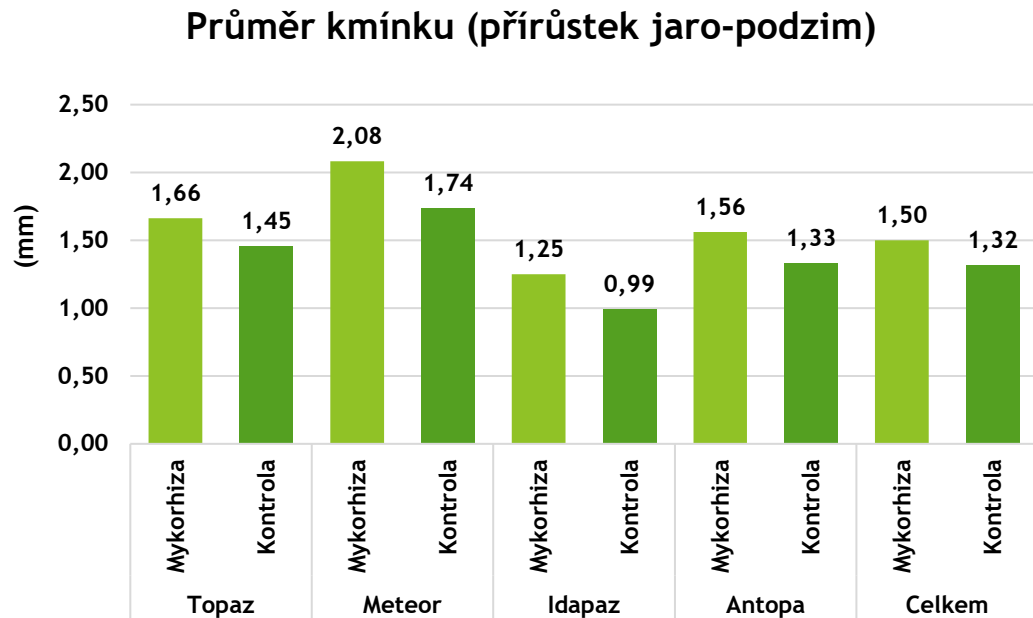
Změna průměru kmínku po aplikaci přípravku Symbivit



Rok	2019	2020	2019 - 2020
Aplikace (Elza + Irena)	3,1 a	16,4 a	19,5 a
Kontrola (Elza + Irena)	2,1 b	15,6 a	17,7 a

Aplikace v sadech - výsadba

- jabloně Topaz, Idapaz, Antopa a Meteor, VŠUO Holovousy, 2022-2023



Varianta	Rozdíl
Mykorhiza (všechny odrůdy)	1,50 a
Kontrola (všechny odrůdy)	1,32 b



Influence of bioproducts and mycorrhizal fungi on the growth and yielding of sweet cherry trees

ŚLAWOMIR GLUSZEK^{1*}, EDYTA DERKOWSKA¹, LIDIA SAS-PASZT¹,
MIROSLAW SITAREK², BEATA SUMOROK¹

¹Microbiology Department, Research Institute of Horticulture, Skierniewice, Poland

²Department of Plant Genetic Resources of Horticultural Crops, Research Institute of Horticulture, Skierniewice, Poland

Table 2. Influence of bioproducts on the fresh and dry weight of roots and mycorrhizal frequency of 'Vanda' sweet cherry trees (IO Pomological Orchard, 2011–2014)

Treatment	Root fresh weight (g/plant)	Root dry weight (g/plant)	Mycorrhizal frequency (F, %)
Control	5.08 ± 1.07 ^a	2.57 ± 0.42 ^a	8.34 ± 2.72 ^a
Mycorrhizal substrate	6.44 ± 2.73 ^b	3.16 ± 1.38 ^b	29.45 ± 2.98 ^b
Biolisa	4.72 ± 1.68 ^a	2.40 ± 0.91 ^a	17.78 ± 3.51 ^{ab}
BF Ekomix	5.90 ± 1.24 ^{ab}	2.70 ± 0.9 ^{ab}	17.78 ± 1.92 ^{ab}
Ausma	4.67 ± 1.68 ^a	2.48 ± 0.59 ^a	20.0 ± 3.07 ^{ab}

THE EFFECTS OF THE MYCORRHIZA ON PLANT GROWTH DURING ACCLIMATIZATION OF SOME *IN VITRO* GROWN SWEET CHERRY ROOTSTOCKS

Nihat Yılmaz^{1,a*}, Selim Çetiner^{2,b}, İbrahim Ortaş^{3,c}

¹Kayseri University, Safiye Çıkrıkçıoğlu Vocational College, Kayseri, Turkey

²University of Sabancı, Faculty of Natural Science and Technology, Istanbul, Turkey

³University of Çukurova, Faculty of Agriculture, Department of Soil Science, Adana, Turkey

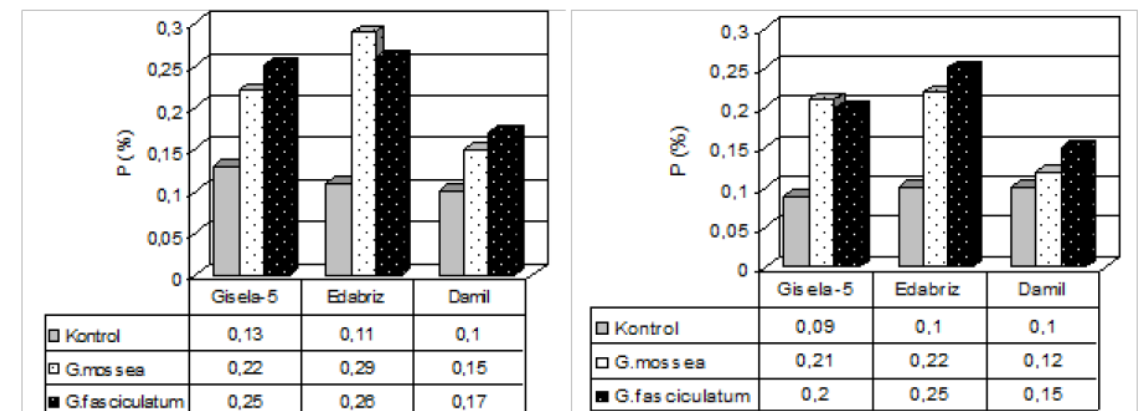


Fig. 8. Cheery rootstocks P content (%) grown on GS-1 and GS-2 (Respectively)

Article

The Effect of Mycorrhizal Fungi and PGPR on Tree Nutritional Status and Growth in Organic Apple Production

Sebastian Przybylko ^{*}, Wojciech Kowalczyk and Dariusz Wrona

Department of Pomology and Horticulture Economics, Institute of Horticultural Sciences SGGW, Nowoursynowska 159 Str., 02-787 Warsaw, Poland; wojciech_kowalczyk@sggw.edu.pl (W.K.); dariusz_wrona@sggw.edu.pl (D.W.)

* Correspondence: sebastian_przybylko@sggw.edu.pl

frequency obtained in the inoculated tree roots was on average two-fold higher than in the roots of the control plants. After four years of AMF + PGPR inoculation, 24% higher trunk cross-section area (TCSA) was observed, with the nitrogen and magnesium concentrations in leaves increasing, on average, by 7.8% and 64.2%, and phosphorus and potassium content decreasing by 37.2% and 46.5%, respectively. This study shows that using AMF + PGPR inoculum supports tree roots colonization by AMF. As a result, better nitrogen nutrition status is observed that promote vigorous growth of trees

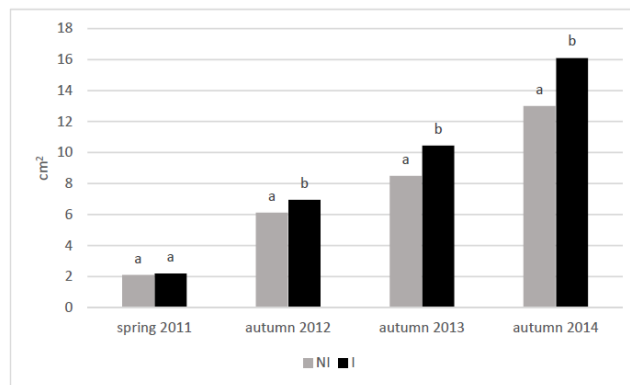


Figure 4. Trunk cross-sectional area TCSA of apple tree depends on inoculation with AMF + PGPR during the course of trial; mean for cultivars (means marked with the same letter within term do not significantly differ at $p \leq 0.05$ according to the Newman–Keuls test). NI: non-inoculated; I: inoculated.

Original Articles

The effect of mycorrhizal inoculation and phosphorus application on the growth and mineral nutrient status of apple seedlings

Maciej Gałtoł, Iwona Domagała-Świątkiewicz & Michał Bijak

Pages 288–299 | Received 02 Jan 2013, Accepted 14 Jun 2014, Accepted author version posted online: 09 Nov 2015, Published online: 07 Mar 2016

Download citation | <https://doi.org/10.1080/01904167.2015.1109114> | Check for updates

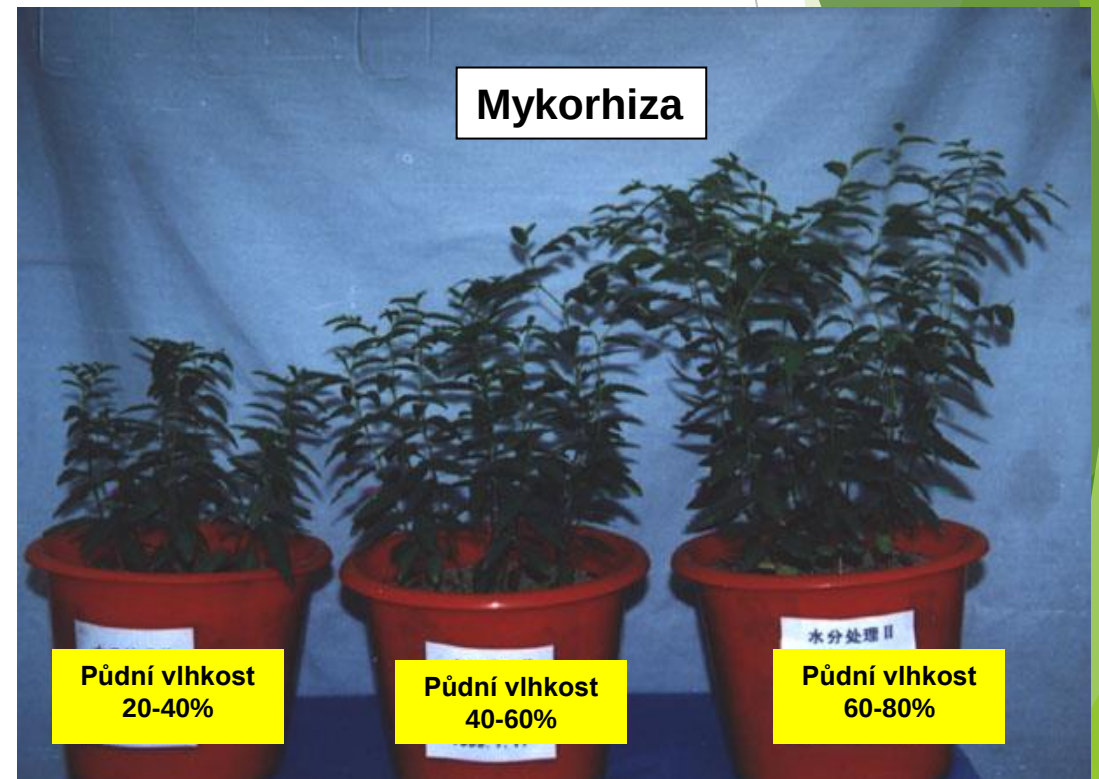
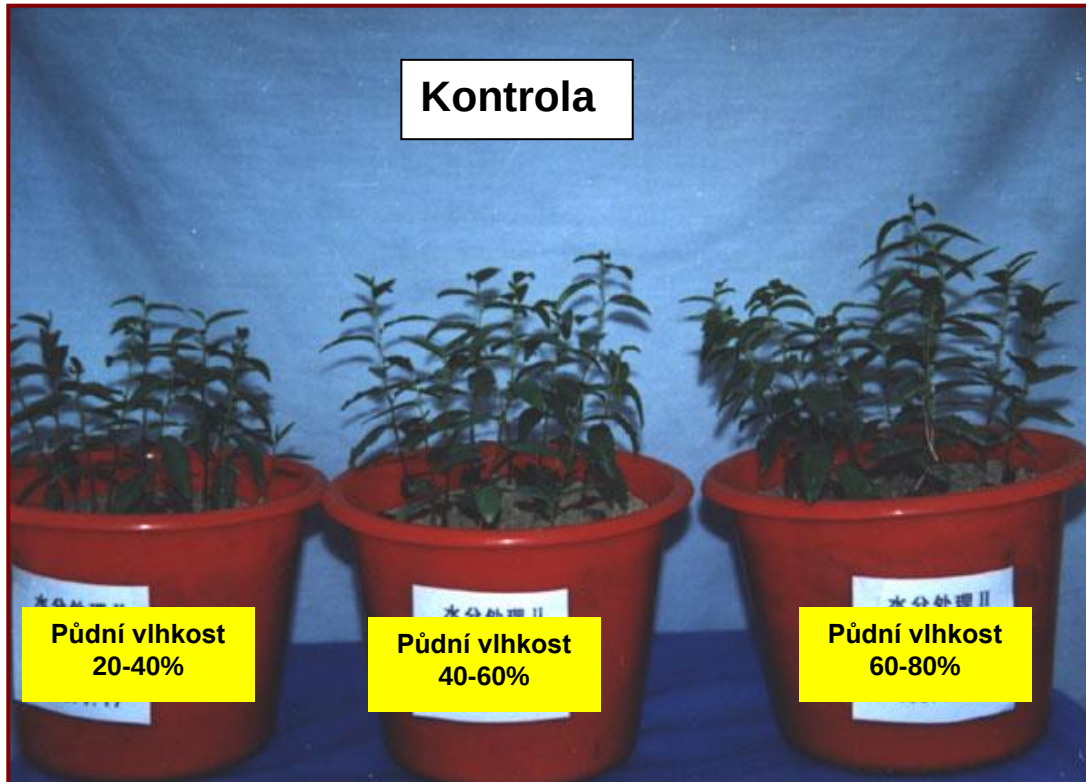
ABSTRACT

Apple seedlings cv. Antonovka were grown in soil taken from an orchard with a distinctive specific apple replant disease. The influence of the different available soil phosphorus (P) level (0, 20, 40 and 80 mg P dm⁻³ of soil) and arbuscular mycorrhizae fungi (AMF) inoculation on the vegetative growth, chlorophyll fluorescence, and the frequency of mycorrhizae were assessed. Moreover, leaf and root mineral composition was ascertained by means of the inductively coupled plasma mass spectrometry (ICP-MS) method. The inoculation with AMF influenced seedlings growth as well as the biomass production and partitioning. The method of inoculation (granular, quick root dip or irrigation) had a great impact on the frequency of mycorrhizae (83.3, 98.8 and 100%, respectively) as well as on the abundance of arbuscules (36.4, 62.9 and 67.3%) as compared to the control (11.7%). The beneficial effect of AMF on leaf PSII efficiency was established. AMF inoculated plants had a significantly higher content of nitrogen, potassium, phosphorus and boron (N, K, P and B) in the shoots and a higher content of nitrogen, sulfur, copper, iron, manganese, molybdenum and titanium (N, S, Cu, Fe, Mn, Mo and Ti) in the roots. Although roots showed a higher concentration of aluminium, barium, lithium, cadmium, lead and vanadium (Al, Ba, Li, Cd, Pb, and V) but upon AMF inoculation, the concentration of these cations was much lower.

Table 2. Vegetative growth properties of apple seedlings as influenced by different mycorrhizal inocula

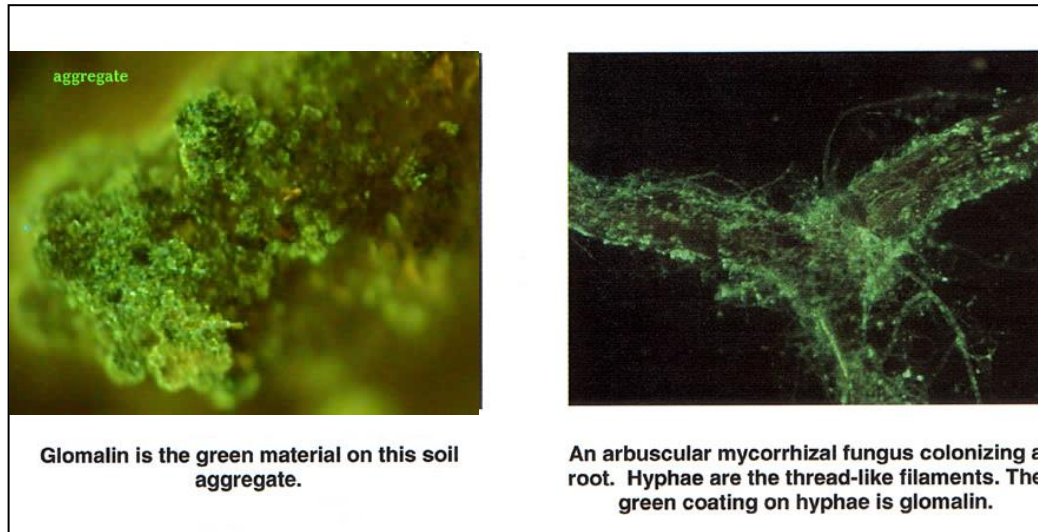
	Seedling height [cm]	Root collar diameter[mm]	Root mass[g]
Control	31.6 a	4.94 a	33.7 b
Micoplant M	33.9 a	5.27 b	31.8 b
Micoplant S	37.7 b	5.24 b	17.1 a
Micoplant E	34.1 a	5.08 ab	60.2 c

B) Odolnost vůči nedostatku vody



C) Agregace půdních částic = protierozní působení

Ztmelení částic půdy působením mycelia
a produkci glomalinu (AM) - hydrofobní glykoprotein



- cca. 3 % celkového půdního C a 5 % N v půdě trop. pralesů ve formě glomalinu
- hyfy a glomalin tvoří až 15 % organického půdního C v travnatých biomech



www.nature.com/scientificreports



Přidání AM hub do narušené půdy může vést k umístění značné množství C pod povrchem (cca 200 tun/ha)

1 g půdy = 2,5 m AM mycelia (pole) až >10 m mycelia v trvalých společenstvech

SCIENTIFIC REPORTS

Arbuscular mycorrhizal fungi enhance soil carbon sequestration in the coalfields, northwest China

Zhi-Gang Wang¹, Yin-Li Bi¹, Bin Jiang¹, Yryszhan Zhakypbek², Su-Ping Peng¹, Wen-Wen Liu¹
& Hao Liu¹

Published: 17 October 2016
 Göttingen, Bismarckweg 2, 37071, Göttingen, Germany. D.S.A.F.R., Università degli Studi della Tuscia, Via
 S. Camillo De Lellis L01100 Viterbo Italy [†]Institute of Biometeorology IRMET-CNR, P.le delle Cascine
 18, I-501
 208 Via

2000

(a) Growing season
 a

(b) Growing season
 a

Università di Udine

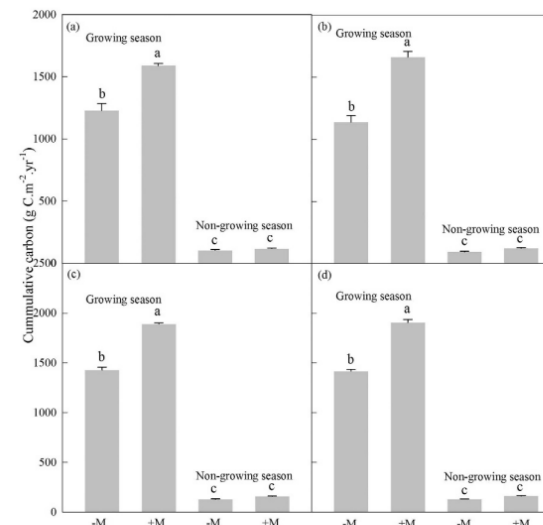


Figure 3. Carbon storage in growing and non-growing season. (a–d) Indicated wild cherry, *cerasus humilis*, shiny leaf Yellow orn, and apricot, respectively. Bar represented means $\pm$ SE. –M and +M denoted without and with AMF inoculation. Different lowercase letters indicated that –M and +M were significantly different at 5% level by LSD.

V přirozeném a zdravém ekosystému
je vysoká biologická rozmanitost
mykorhizních hub

X

Narušené ekosystémy



Produkty PROFI řady



Aplikace



Aplikace



sázecí stroj



ruční aplikátor



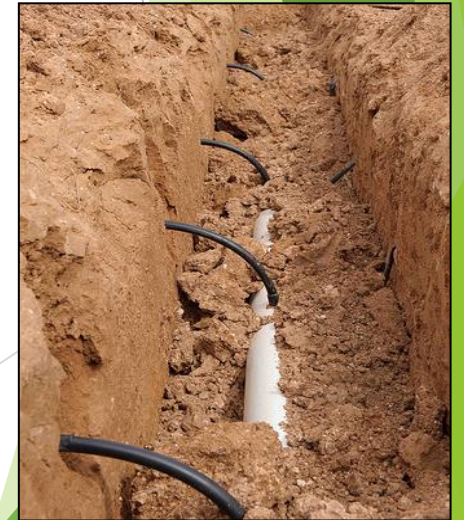
kultivátor



injektáž



přímá aplikace pod sazenici



kapénka

Aplikace kapénkovou závlahou



Použití:

- ovocnářství
- zemědělství
- vinařství

Aplikace:

- kapkové hadice (podpvrchová, povrchová závlaha)
- on-line kapkovače + kapkové jehly

Omezení: filtrace $\geq 130 \mu\text{m}$ (120 mesh)



Společnost CHYTRÁ ZÁVLAHA nabízí:

- Prodej komponentů pro závlahu např. NETAFIM kapkové hadice, filtrační stanice, čerpadla, nádrže GENAP
- Navrhuje, instaluje a servisuje závlahové systémy
- Specializuje se na vzdálené řízení závlahy např. z mobilního telefonu
- Půdní senzory a meteostanice
- Hnojiva aj.



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