



Beneficial soil microbes: population dynamics in maize and canola fields of MAN-GMP-ITA project

**Microrganismi benefici del suolo: dinamica delle popolazioni
nelle colture di mais e colza del progetto MAN-GMP-ITA**

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Action	2010				2011				2012				•2013			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	•II	•III	•IV
C. Concrete conservation actions :																
C1.Implementation of a methodological proposal for the environmental risk assessment of transgenic genetically modified higher plants				X	X	X	X	X	X	X	X	X				

Activity 1.4 - Assessment of soil quality and microbial diversity (CRA, CNR):

Aims:

To obtain ranges of variables correlated with AMF occurrence in soil describing agroecological variations, to be used for risk assessment of GMPs

To identify possible non-target indicators for GMPs risk assessment



ARBUSCULAR MYCORRHIZAL FUNGI (AMF)

- Symbionts of most land plants
- Key organisms in soil fertility maintenance
- Non target organisms to be monitored in GMPs risk assessment studies

Fungal symbiont:

Acquire C from plant

Transfer mineral nutrients from soil to host plants

Host plants:

Transfer C to fungal symbiont

Advantages:

larger growth and production

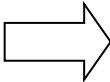
Stress tolerance

Secondary metabolites accumulation

Agricultural soil as a stressful environment for AMF:

- extraradical networks disruption
- community composition alteration

 negative impact on soil biological activities

Soil quality  “potential to sustain biological productivity, maintain environmental quality and promote plant health”
(Doran and Parkin, 1994)

 Chemical - biological characterization

 Evaluation of AMF activity and diversity



Activity



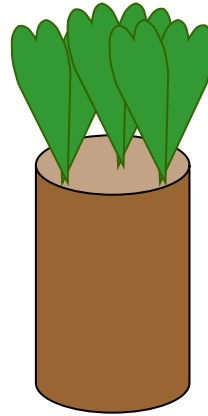
soil and root sampling at crop start and harvest, in canola and maize fields

analysis of AMF activity and diversity in soil:

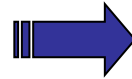
- 1. Quantification of soil mycorrhizal inoculum potential**
- 2. Quantification of root colonization by indigenous AMF in maize and host weeds from canola fields**
- 3. AMF species diversity distribution**



Soil mycorrhizal inoculum potential



**3 plants x 3 test tubes x sample point:
21 sample points in canola
9 sample points in maize**



After 30 days' culture root systems:

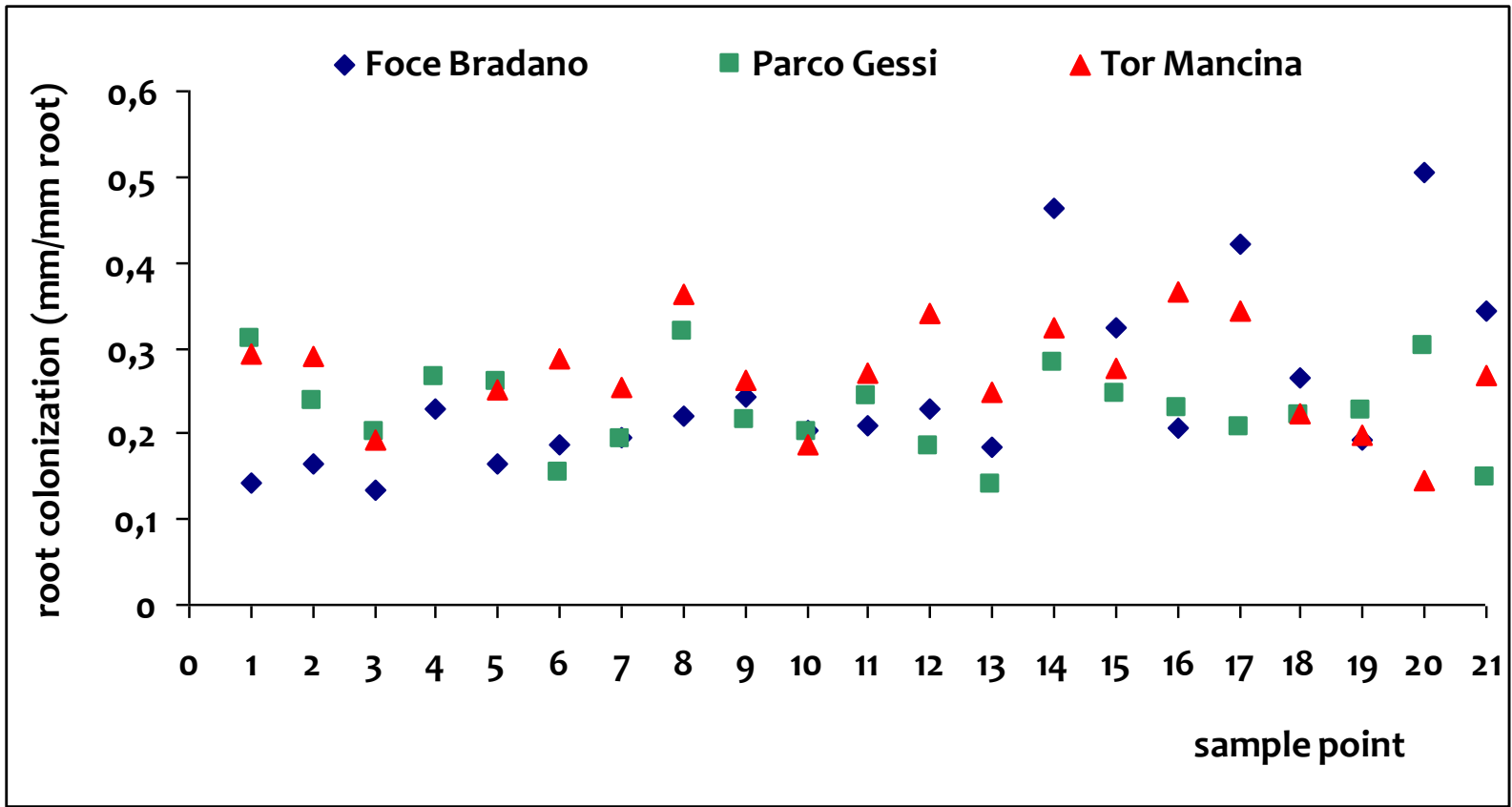
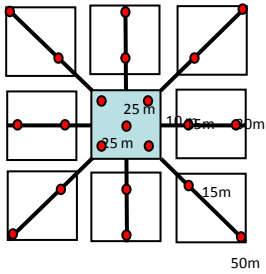
- washed
- stained
- analysed for mycorrhizal colonization



Canola crop start: mycorrhizal inoculum potential

variable MIP values with no statistical differences

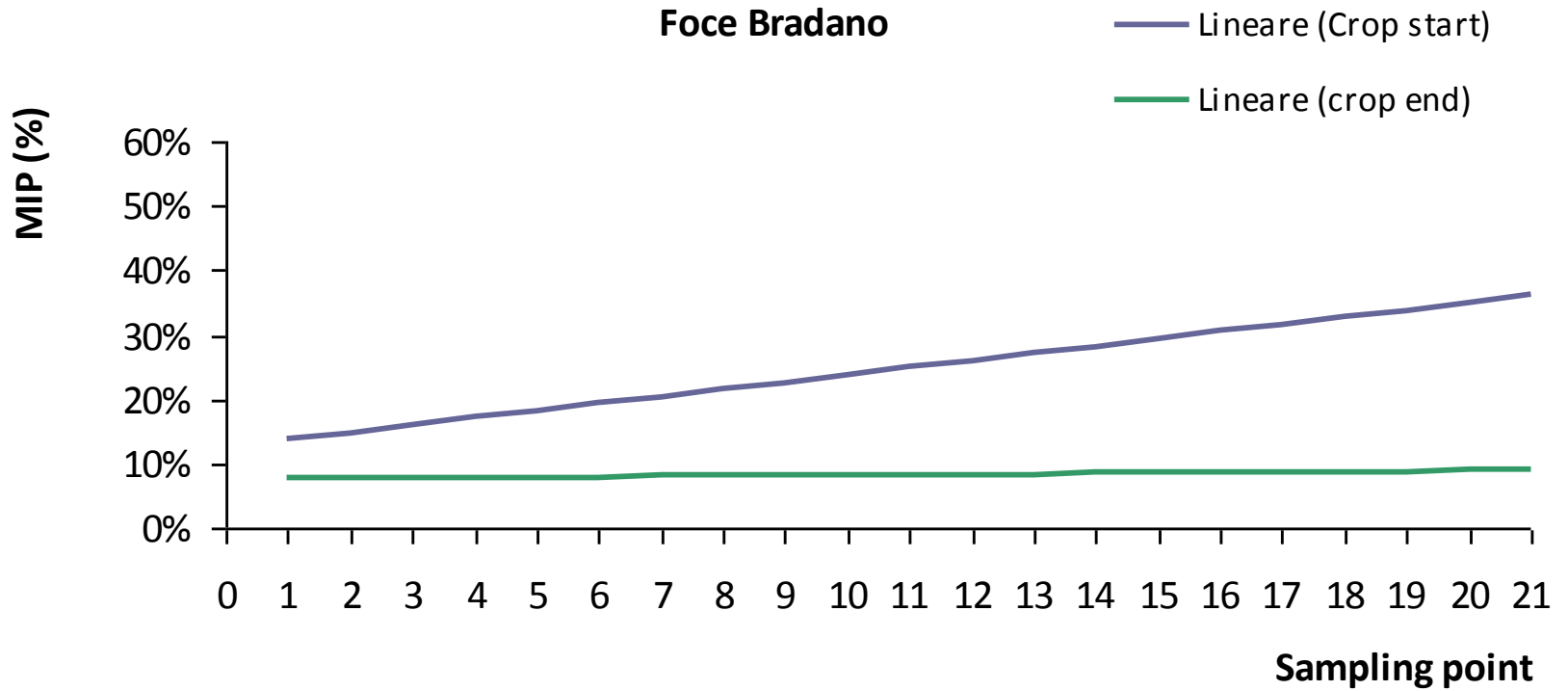
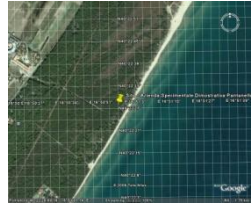
test plant root colonization ranged between 12 and 50% of total root length





Canola crop start/harvest: mycorrhizal inoculum potential variation

Lower MIP at harvest in Foce Bradano field

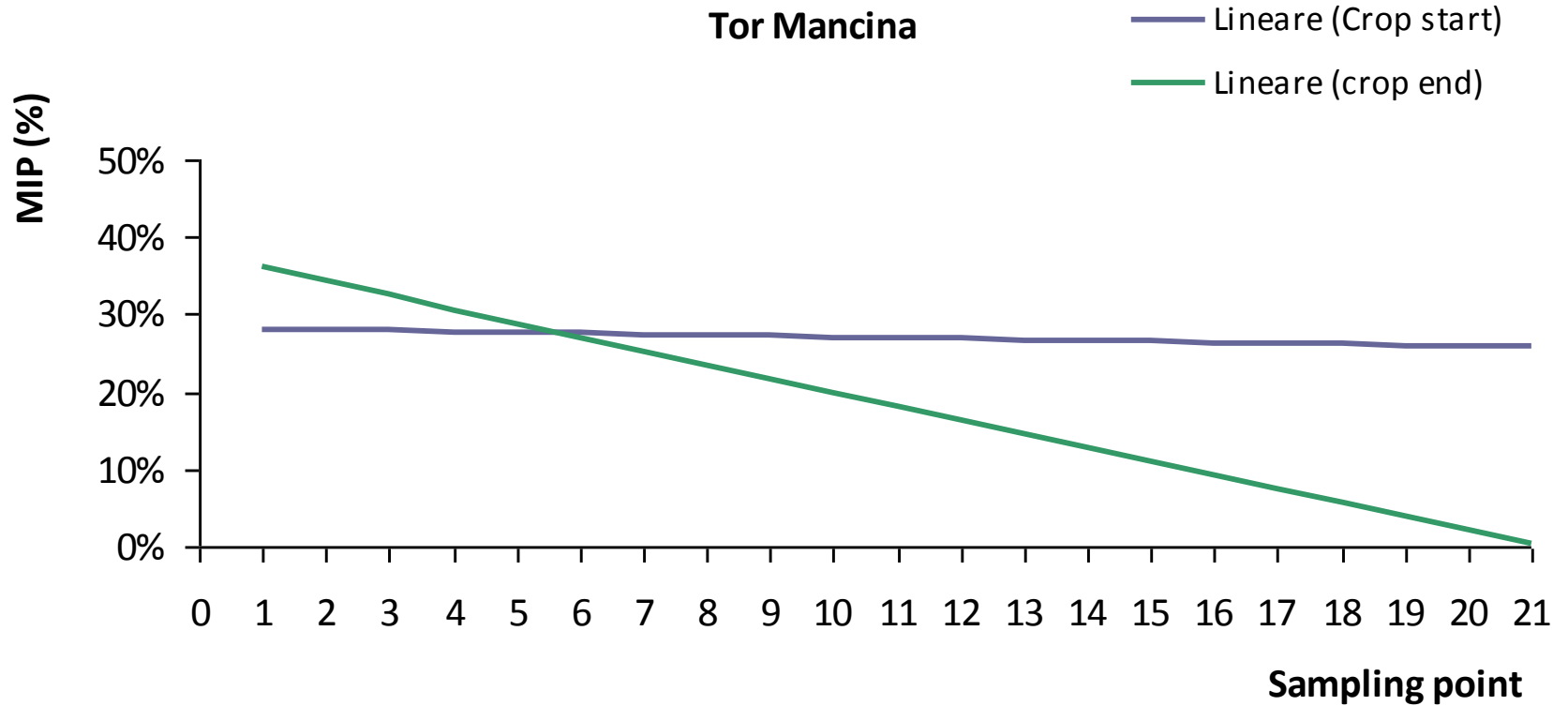




Canola crop start/harvest: mycorrhizal inoculum potential variation



Lower MIP at harvest in Tor Mancina field

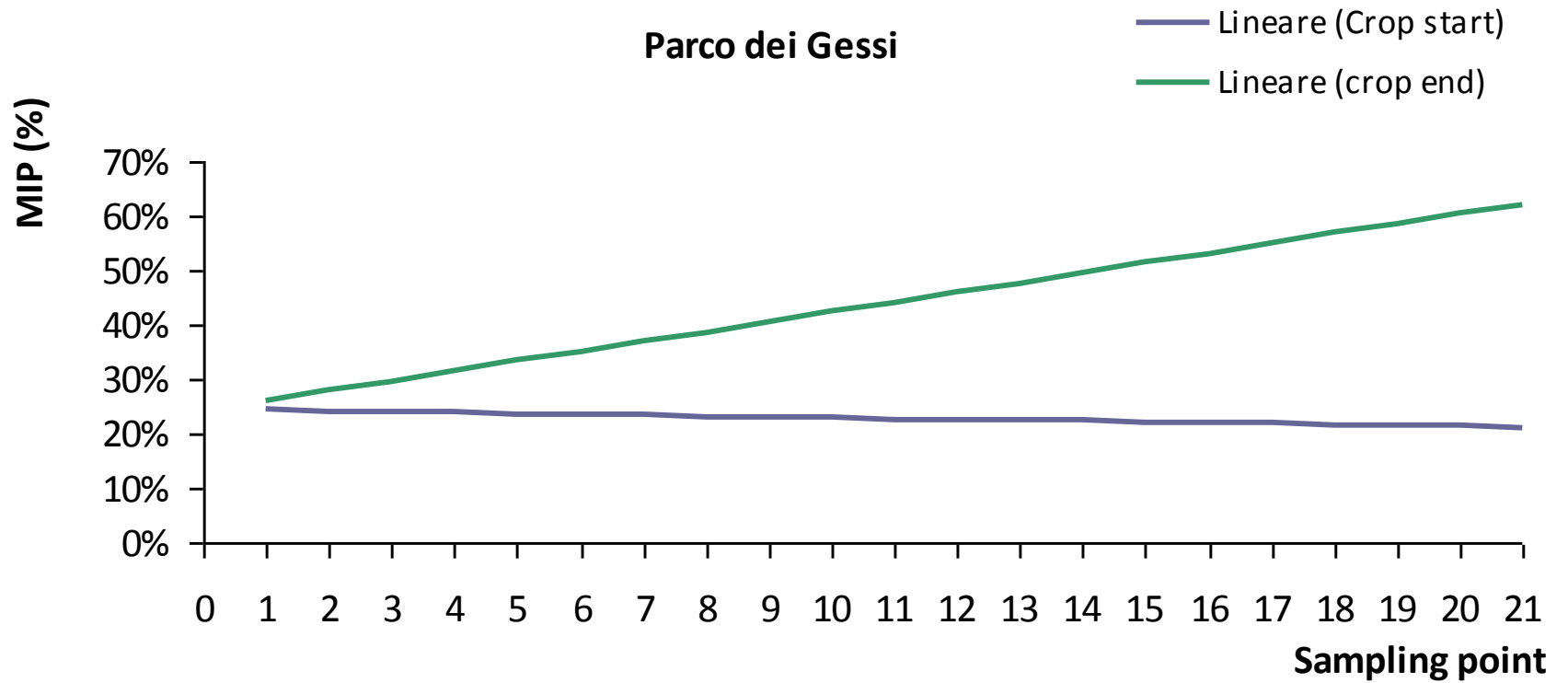




Canola crop start/harvest: mycorrhizal inoculum potential variation

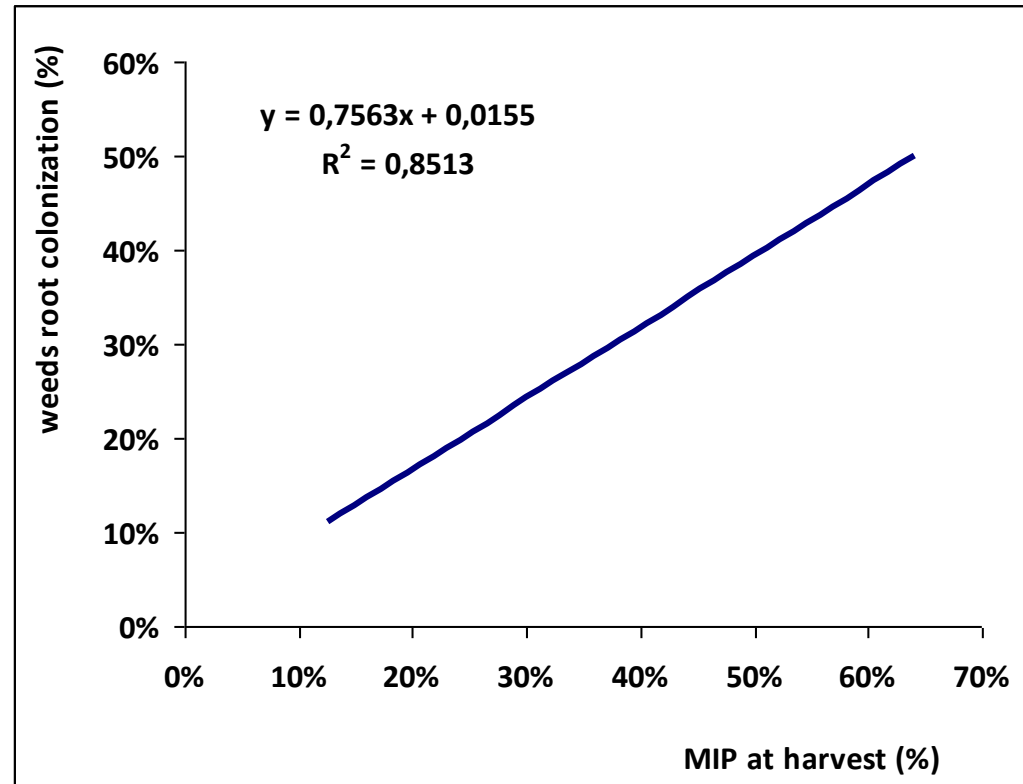


Larger MIP values at harvest in Parco dei Gessi





Correlation between MIP values and host weeds colonization by indigenous AMF at canola harvest



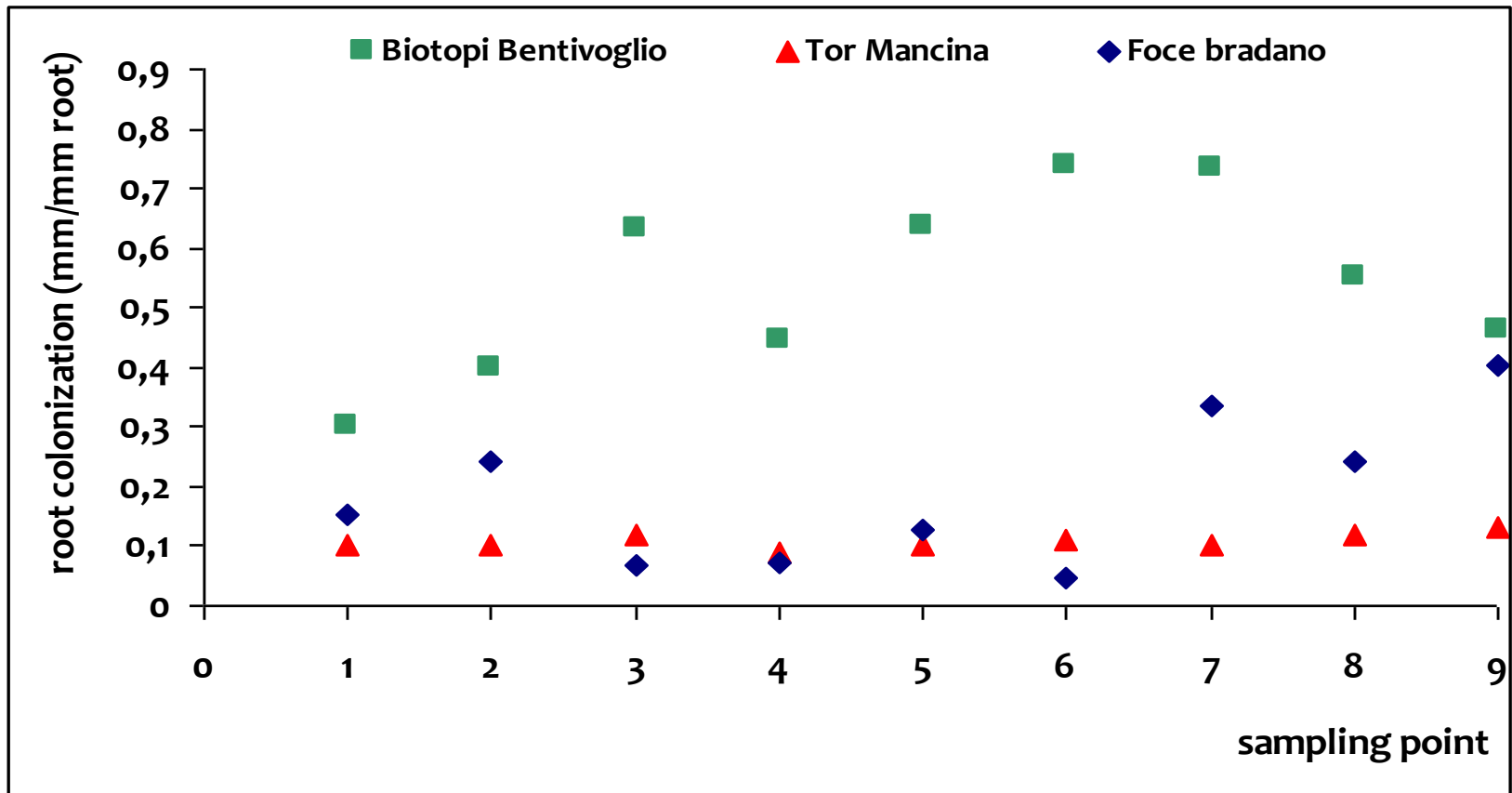
Colonization of host weeds ranged between $14 \pm 3.3\%$ and $51 \pm 3.1\%$ of total root length.



Maize crop start: mycorrhizal inoculum potential

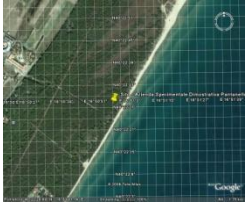
Variable MIP values with no statistical differences

test plant roots colonization ranged between 9 and 74% of total root length

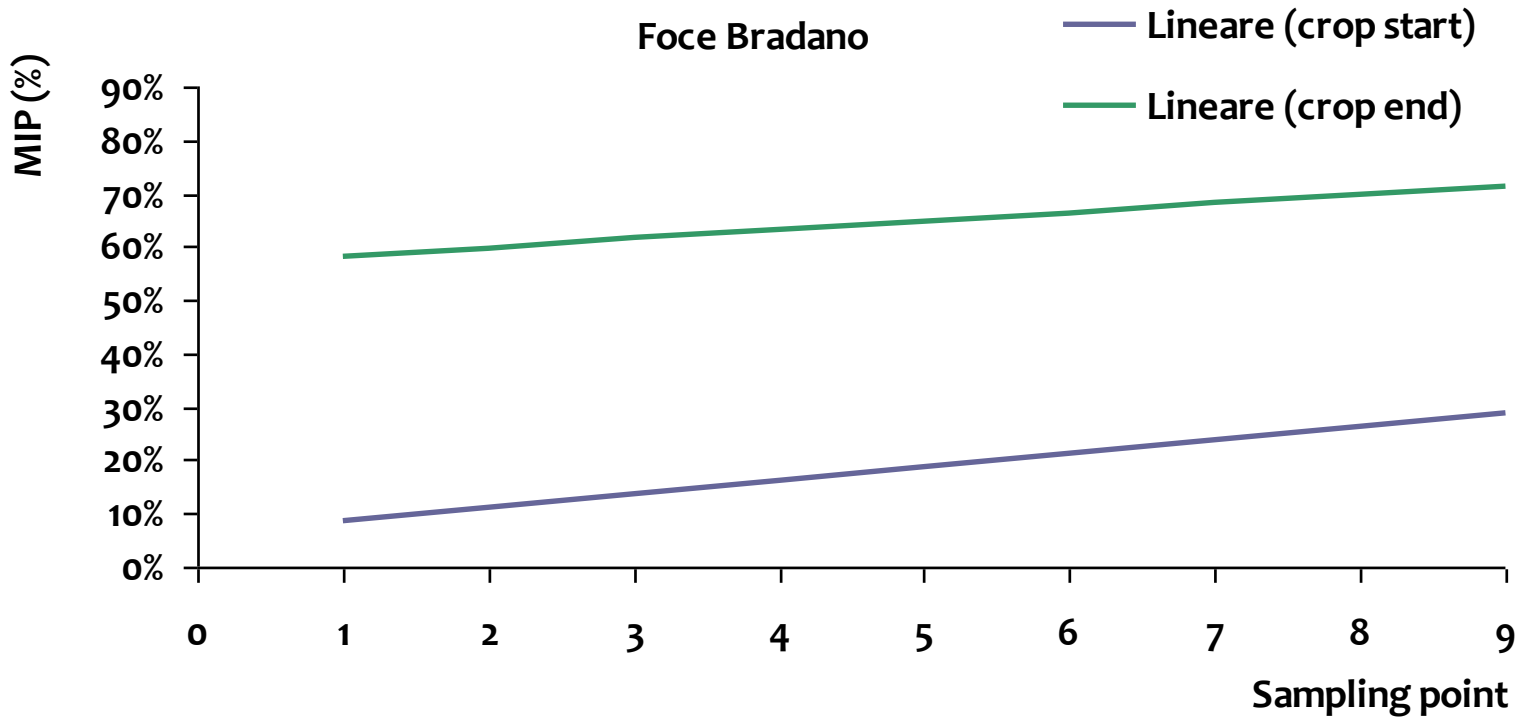




Maize crop start/harvest: mycorrhizal inoculum potential variation



Increasing MIP values in Foce Bradano

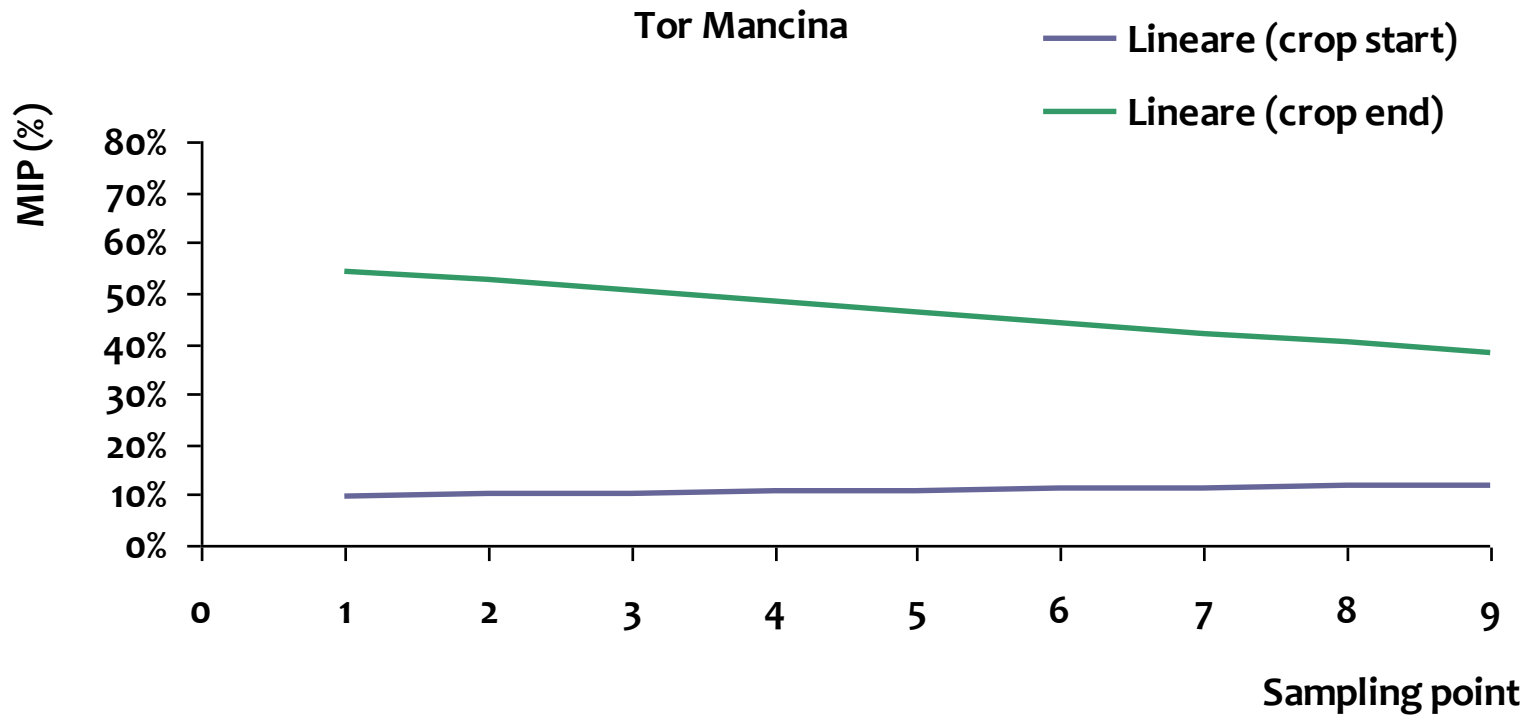




Maize crop start/harvest: mycorrhizal inoculum potential variation



Increasing MIP values in Tor Mancina

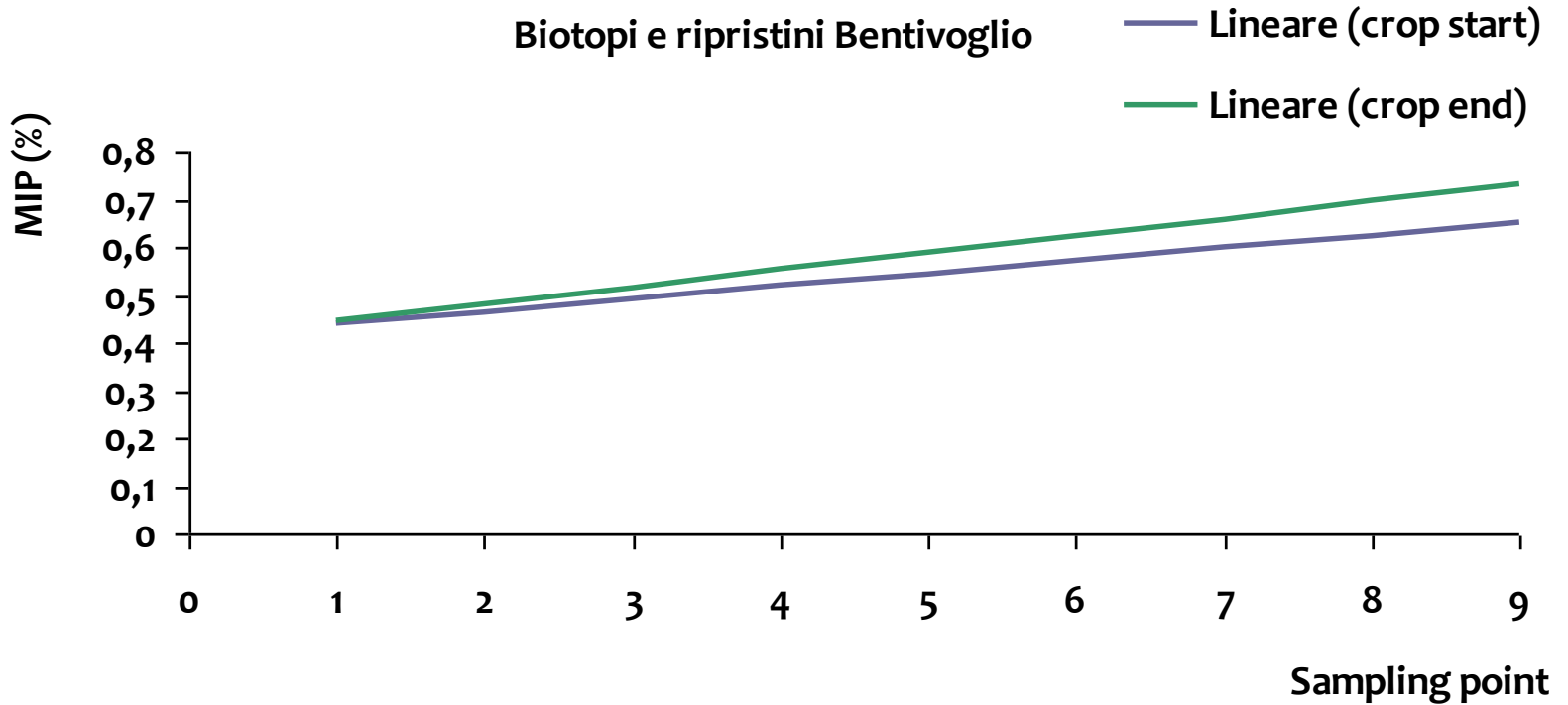




Maize crop start/harvest: mycorrhizal inoculum potential variation

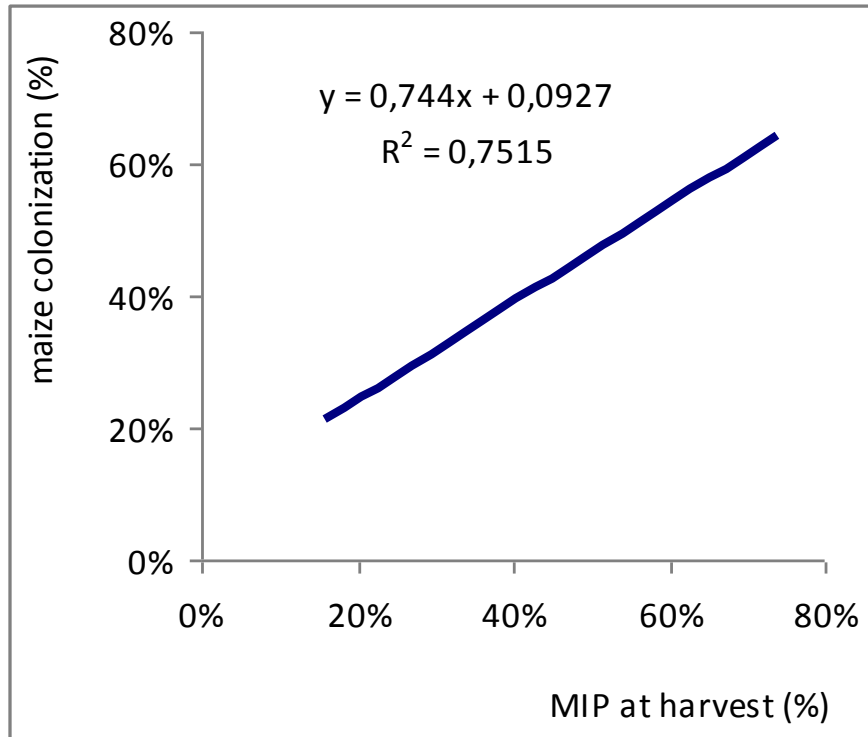


MIP maintenance in Bologna site





Correlation of maize root colonization and MIP values at harvest



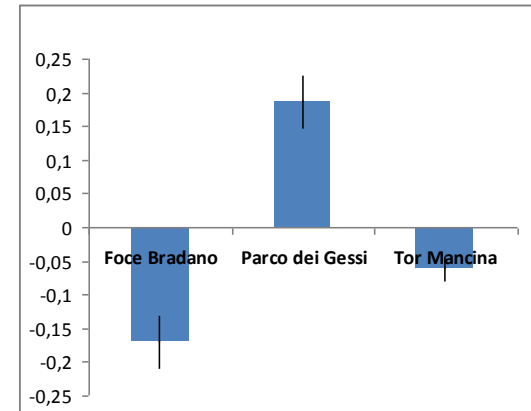
Maize plants from the three field sites showed root colonization lengths ranging between $18 \pm 2.2\%$ and $65 \pm 2.9\%$.

can MIP be considered a suitable indicator for GMP impact on AMF activity?

Case study canola:

Variable MIP trends

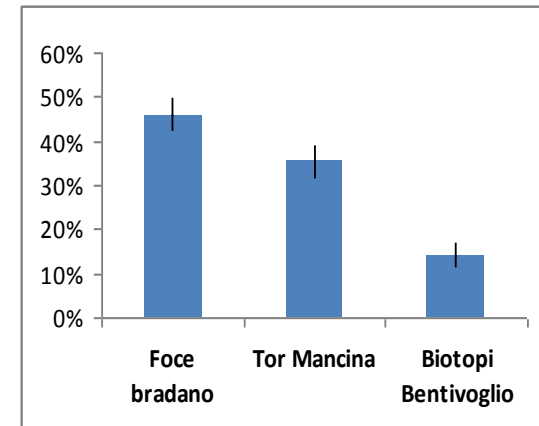
→ MIP values before GM crop have to be available for comparison



Case study maize:

Enhanced MIP values or maintenance of high MIP

→ decreasing MIP values suggest negative impact of GM crop





AMF spores diversity in soil

Quantification and taxonomical identification of spores extracted from soil.

In canola field soil, 40-80 spores/100g soil were retrieved, whereas 120-140 spores/100g soil occurred in maize field.

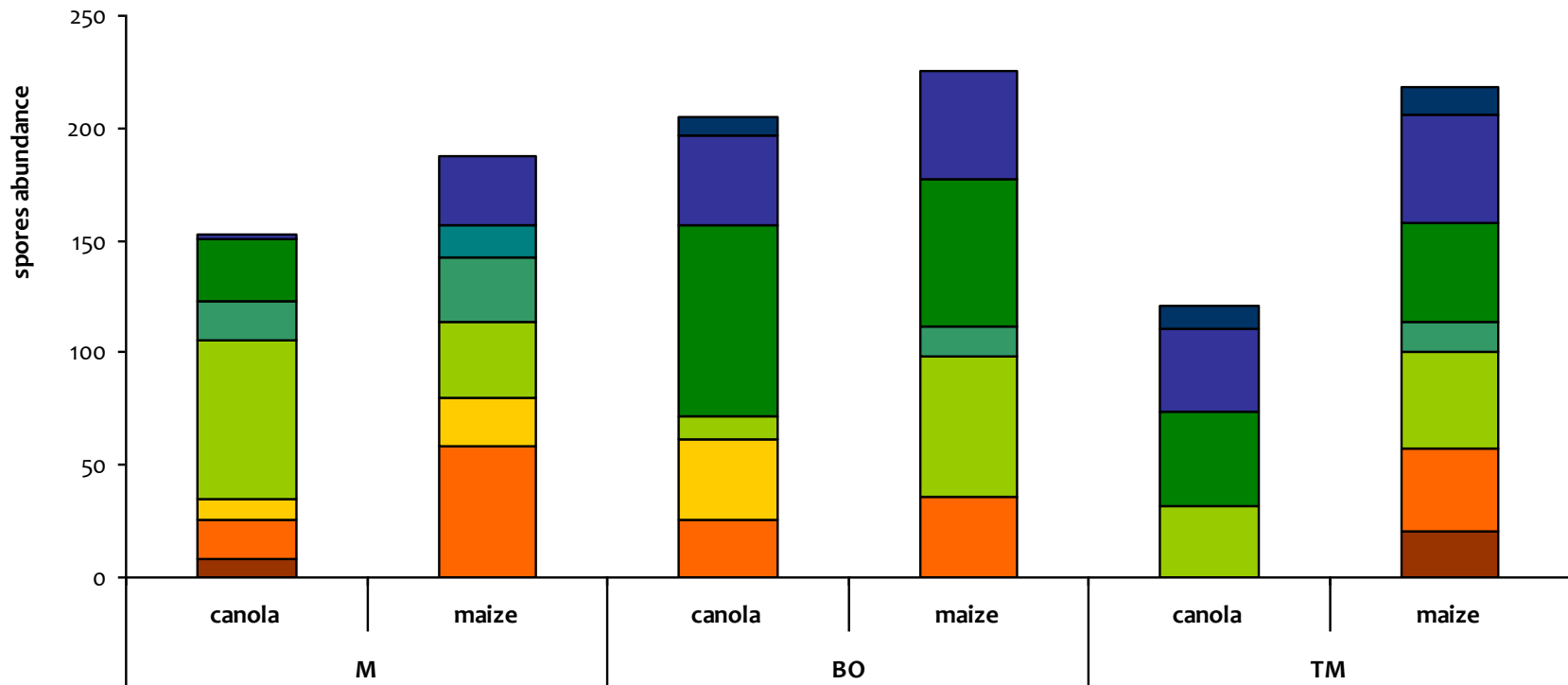


AMF species diversity in soil from canola (C) and maize (M) fields in the three sites

	Metaponto	Bologna	Tor Mancina
<i>Claroideoglossum etunicatum</i>	CM	CM	M
<i>Claroideoglossum claroideum</i>	C		M
<i>Funneliformis geosporum</i>	CM	C	
<i>Funneliformis mosseae</i>	M	CM	CM
<i>Glomus badium</i>	CM	M	
<i>Glomus intraradices/irregulare</i>	C	CM	CM
<i>Glomus monosporum</i>	M		
<i>Glomus viscosum</i>	CM	CM	C
<i>Scutellospora calospora</i>		C	CM



AMF species distribution in soil from canola and maize fields in the three sites



Claroideoglomus claroideum

Claroideoglomus etunicatum

Funneliformis geosporus

Funneliformis mosseae

Glomus badium

Glomus intraradices/irregulare

Glomus monosporum

Glomus viscosum

Scutellospora calospora



is species diversity a suitable indicator of GMPs impact on AMF communities?

Case study canola:

Variable community composition among sites

→ values before GM crop have to be available for comparison

Case study maize:

Consistent population diversity indices

→ deviation may suggest negative impact of GMPs on AMF

New non-target indicator:

→ in Bologna and Roma fields retrieved a species of *Scutellospora*, genus not found in disturbed soil.