ASSESSMENT OF SOIL ECOSYSTEM IN DEGRADED AREAS OF VINEYARDS AFTER ORGANIC TREATMENTS (preliminary results)

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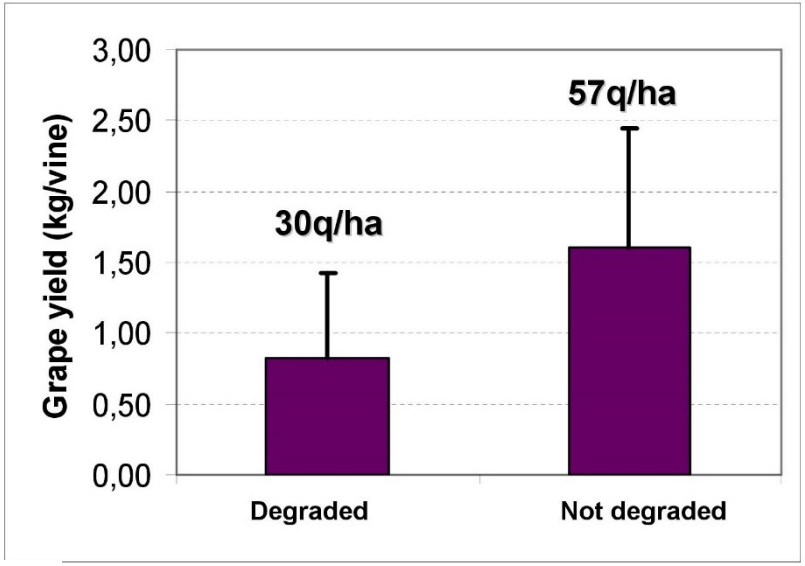
In vineyards, it is quite common to have areas characterized by problems in vine health, grape production and quality.

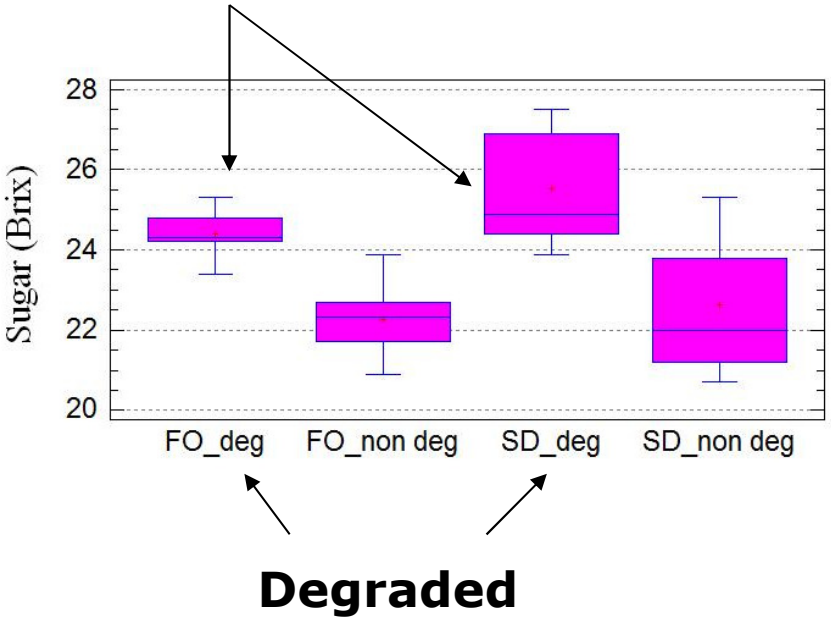
Caused by improper land preparation before vine plantation and/or management (erosion)

Effects on grapevines

Lower yield



Too elevated sugar
(14.5-15.8%vol alcohol!)



Degraded

Unbalanced
composition

Higher grapevine mortality and abiotic stress

Different organic management in degraded areas

Compost adding

(25-30 tons/ha dry mass, 50-60 tons/ha moist)

Cover crop for green manure (Field beans and barley)

Cover crop for mulching (Clover)

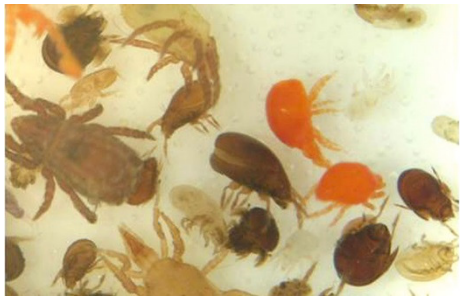
<u>What are the effects of the different treatments on soil ecosystem?</u>

Proxies:

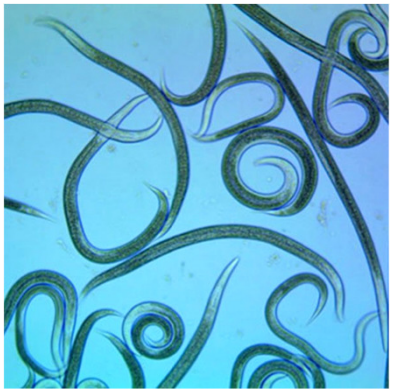
SOC, Ntot and C/N

Tea bag index (OM recycling)

Enzymes



Microartrhopods



Nematodes

See PICO 5b.11

STUDY AREAS

2 organic farms, Tuscany

Fontodi farm (Firenze)

Organic since 2000

Organic since 2014

San Disdagio farm (Grosseto)

Experimental blocks (around 250 m^2)

Each block: 3 treatments + 1 control + 1 not degraded external control site

Effects of soil degradation on soil ecosystem

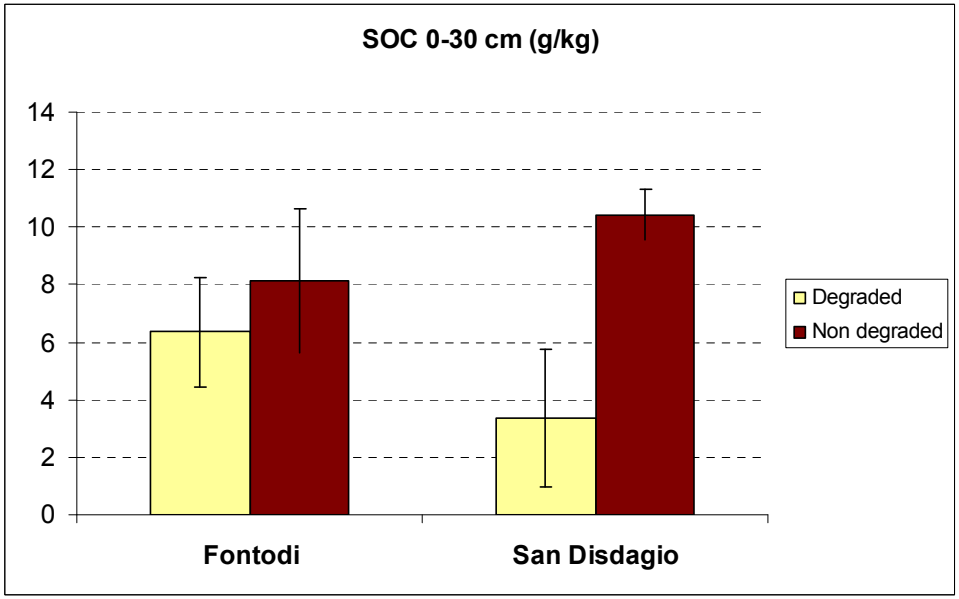
Organic matter and its turnover

Soil enzymes

Microarthropods

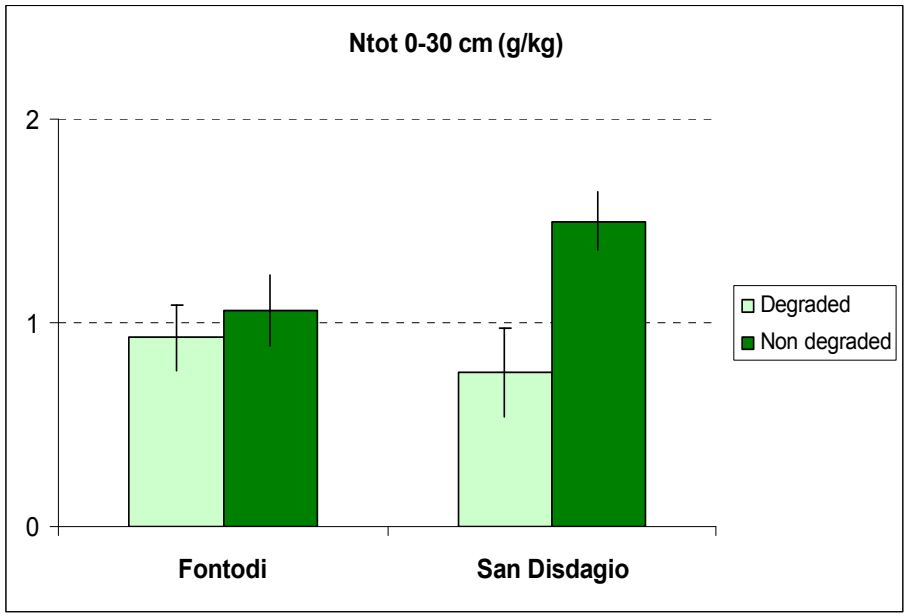
Nematodes

Organic carbon, total nitrogen

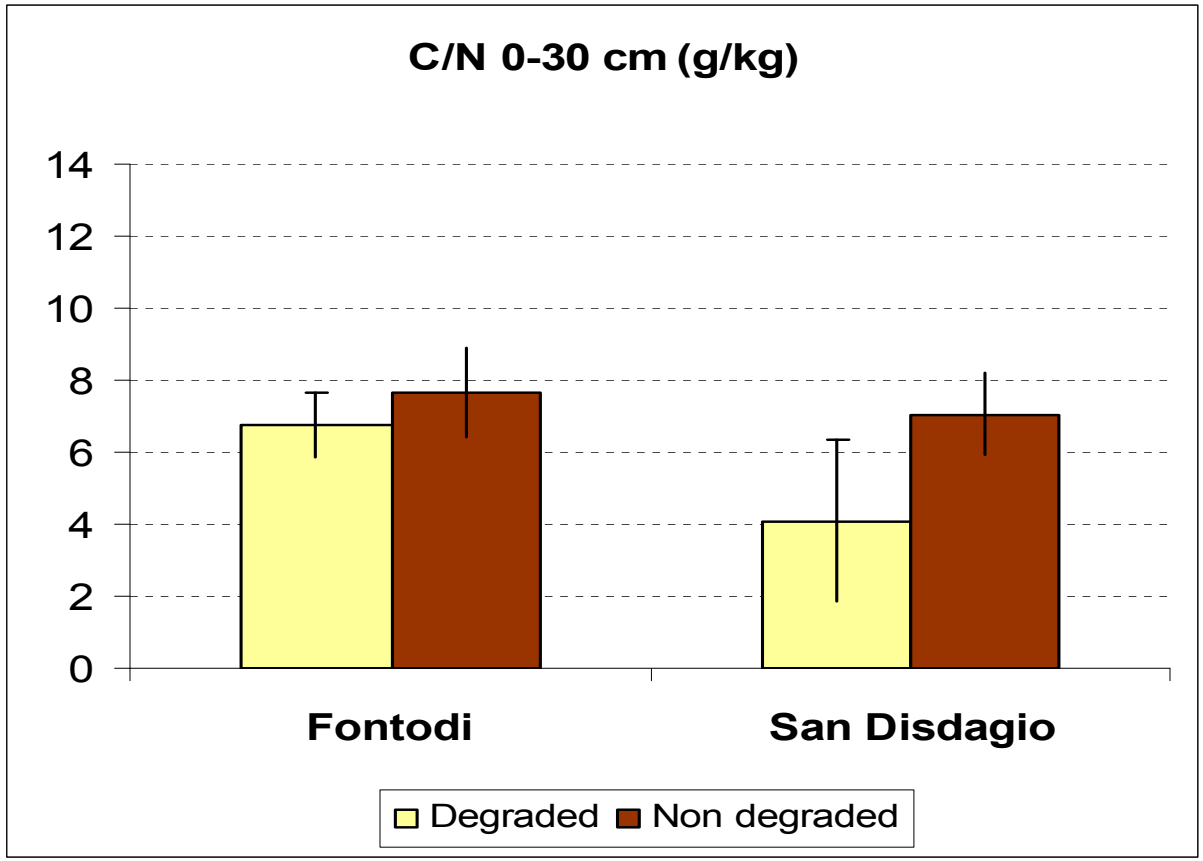


Significant higher SOC and Ntot only in San Disdagio farm.

Fontodi degraded areas: lower rooting depth, lower water availability, higher calcium carbonate



Organic matter turnover



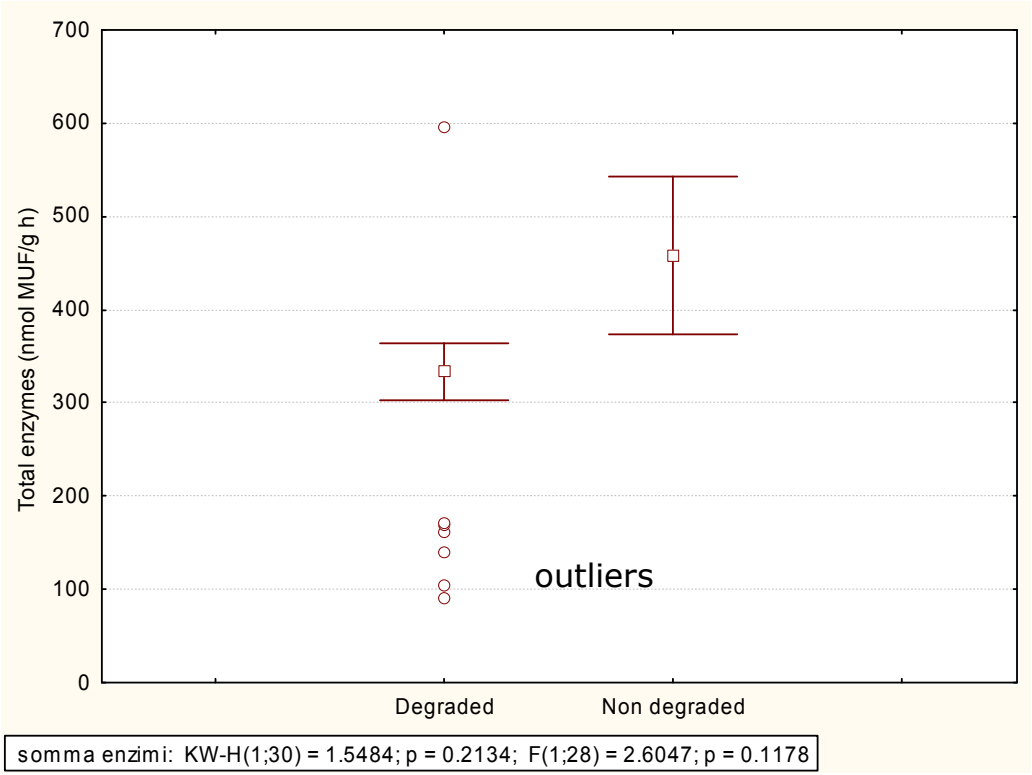
No significant differences of C/N ratio, although it is generally higher in the non degraded areas.

Soil enzymes

No significant differences between degraded and non degraded (high standard deviation).

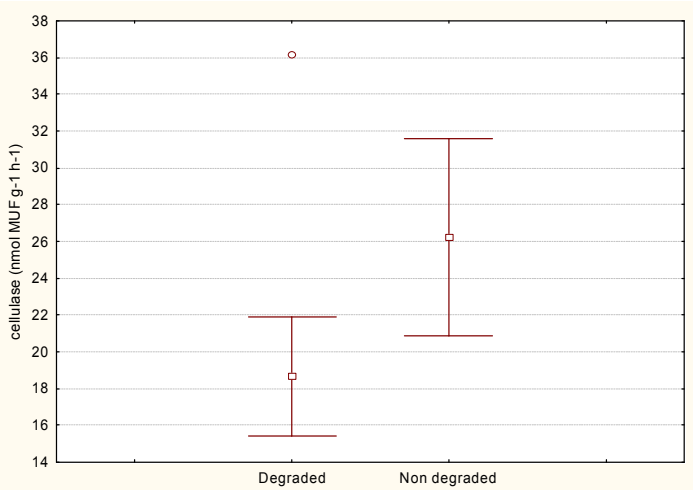
General higher amount in non degraded

Total enzymes (0-10 cm)



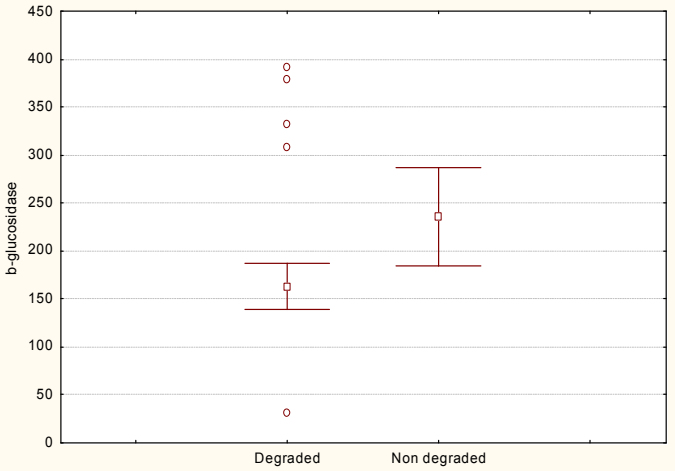
somma enzimi: KW-H(1;30) = 1.5484; p = 0.2134; F(1;28) = 2.6047; p = 0.1178

Cellulase



cellulase (nmol MUF g-1 h-1): KW-H(1;30) = 1.9601; p = 0.1615; F(1;28) = 1.0589; p = 0.3123

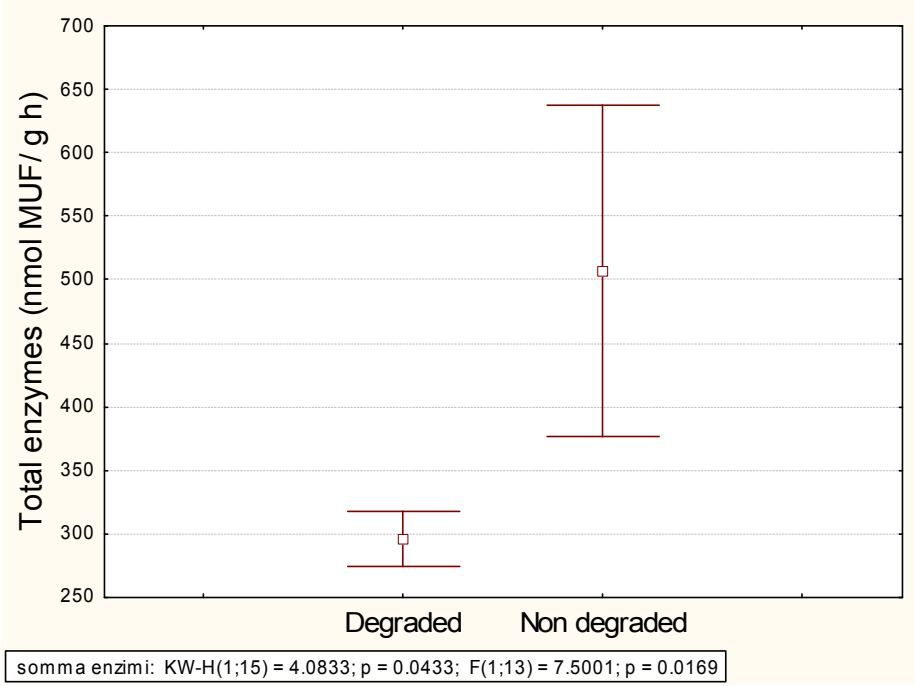
Beta-glucosidase

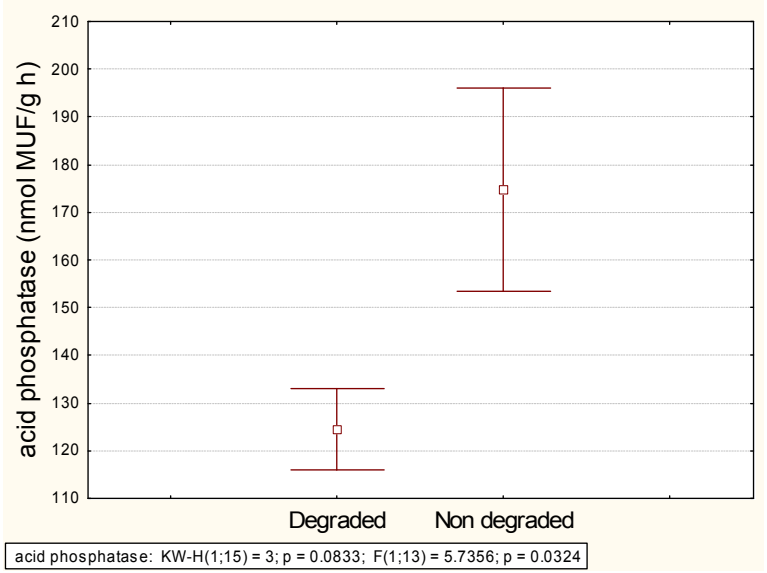


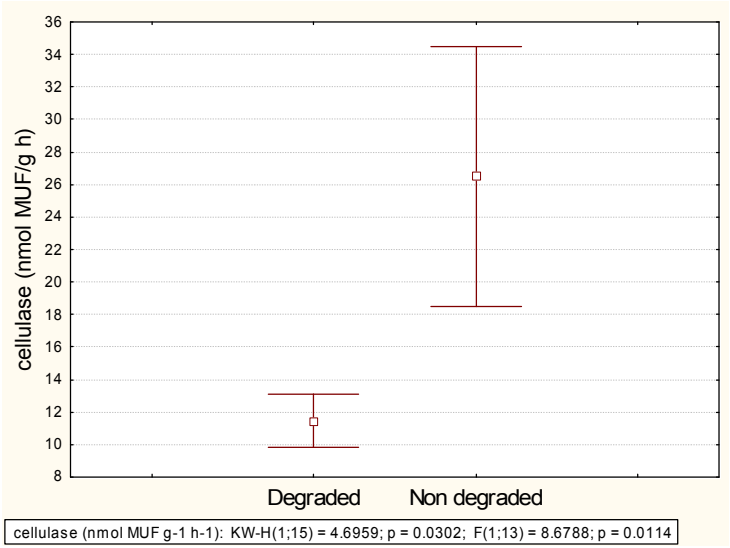
b-glucosidase: KW-H(1;30) = 2.7527; p = 0.0971; F(1;28) = 1.5975; p = 0.2167

In San Disdagio farm:

Cellulase, acid phosphatase, Beta-glucosidase, arylsulfatanase, and total enzymes are significantly higher in non degraded areas.





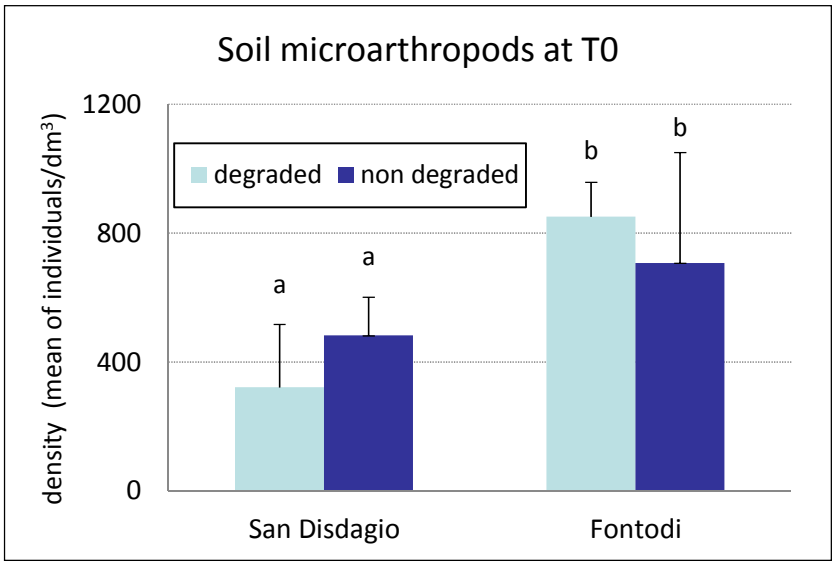


Soil microarthropods

Soil microarthropods abundance is not related to soil degradation but to the age (and the quality) of soil organic management!

San Disdagio:

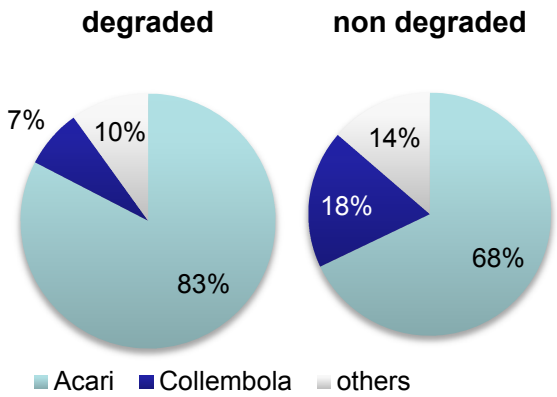
New organic farm (1 year, earlier soil tillage)



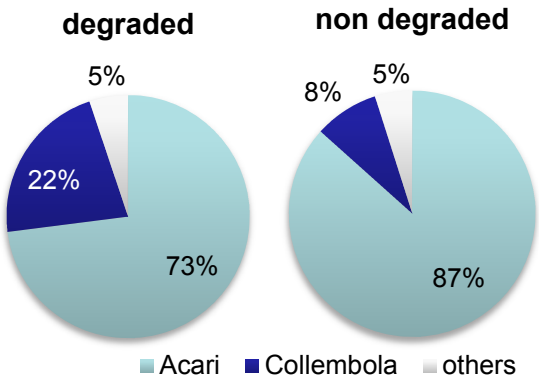
Fontodi:

Old organic farm (15 years of organic management with use of compost and permanent grass cover)

San Disdagio, community structure

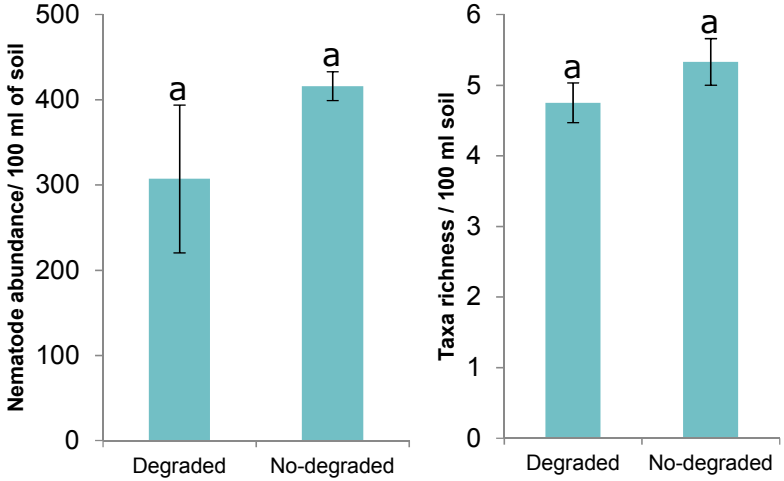


Fontodi, community structure

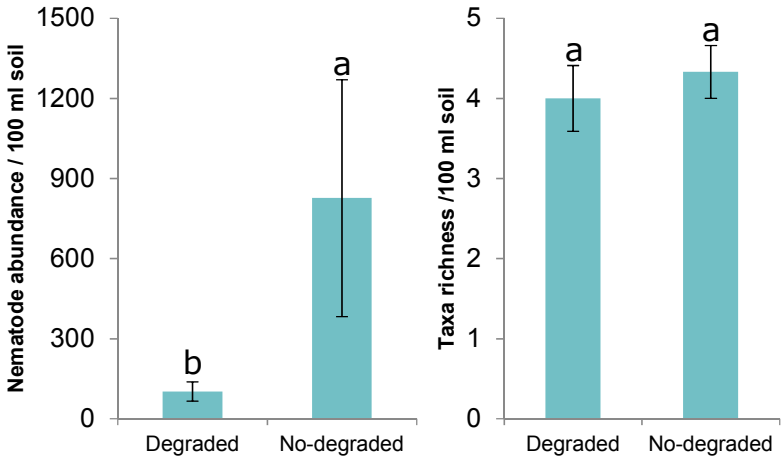


Nematodes

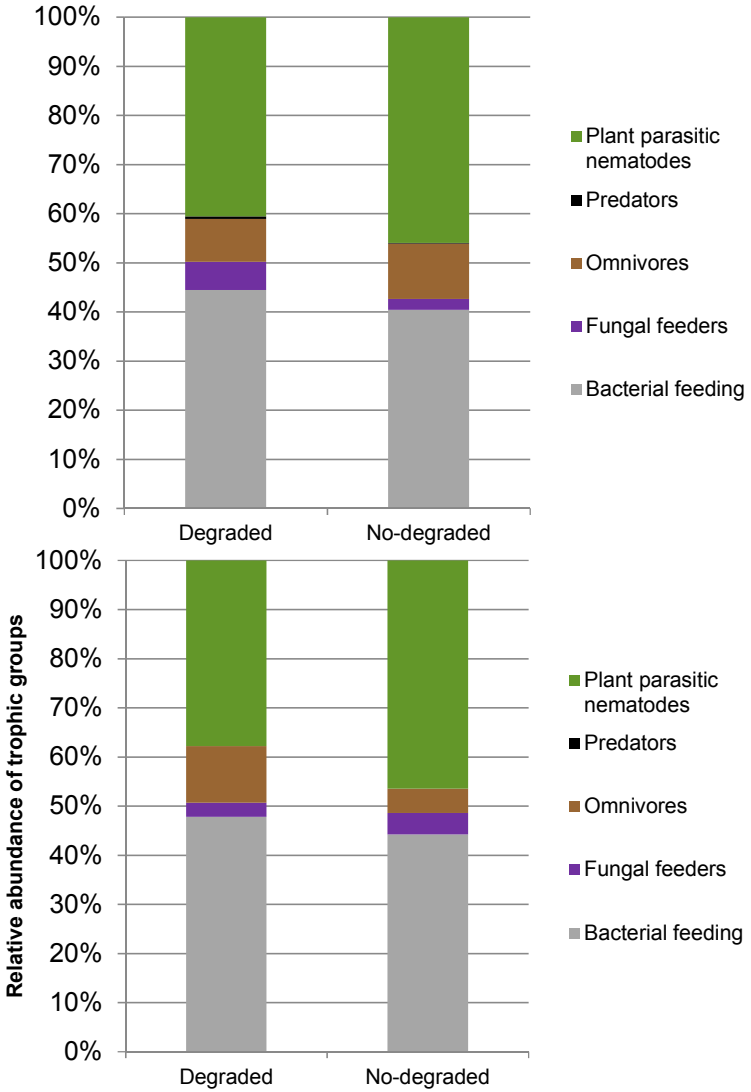
Fontodi



San Disdagio



Nematode abundance, taxa richness and maturity (MI) and plant parasitic (PPI) indices were higher in non-degraded area, but differences were not significant.



In general, MI (1.5-2)and PPI (2.5-3) values indicated the high presence of generalist opportunistic.

- Bacterial feeders were dominant in degraded areas.
- The most representative group in non-degraded areas was plant parasitic nematodes.
- Fungal feeders and predators were low in both areas.

TREATMENTS of soil functionality recovering

Compost adding

(25-30 tons/ha dry mass, 50-60 tons/ha moist)

Cover crop for green manure (Field beans and barley)

Cover crop for mulching (Clover)

Effects of the treatments on soil ecosystem

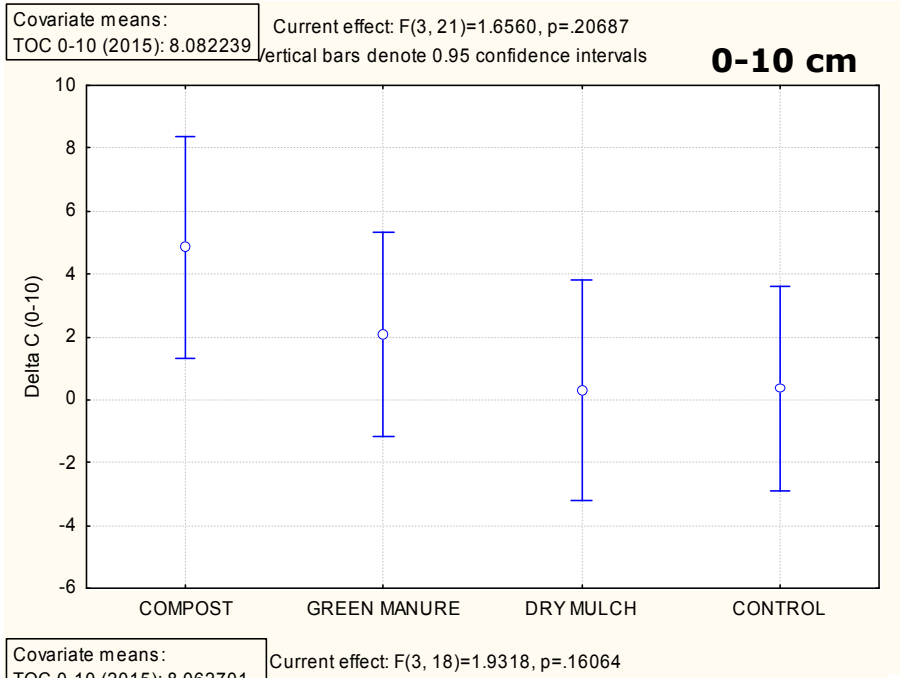
Organic matter and its turnover

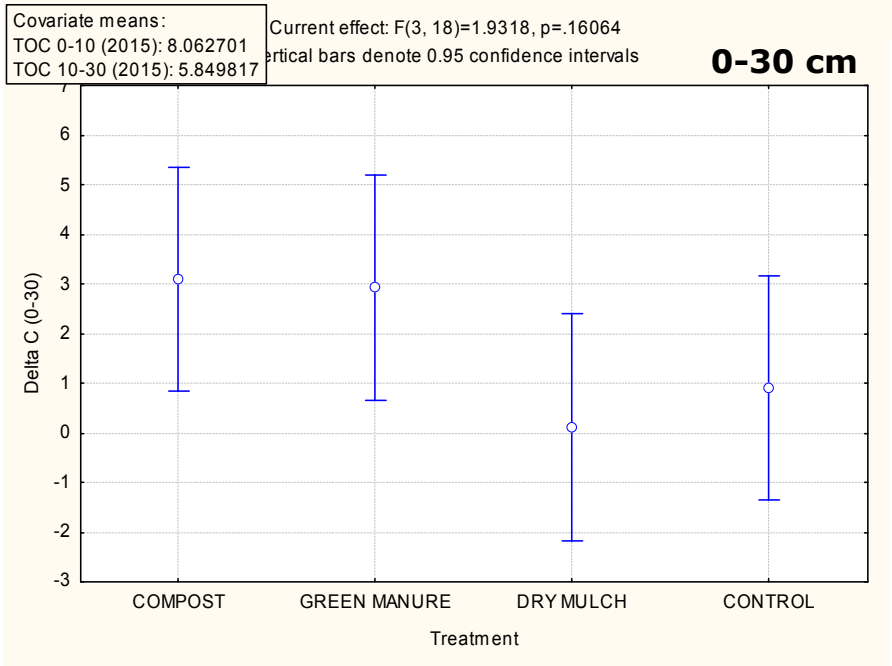
Soil enzymes

Microarthropods

Nematodes

Variation in SOC after 1 year treatments





No significant statistical differences between treatments

General increasing in compost and green manure

(on average +3 g/kg)

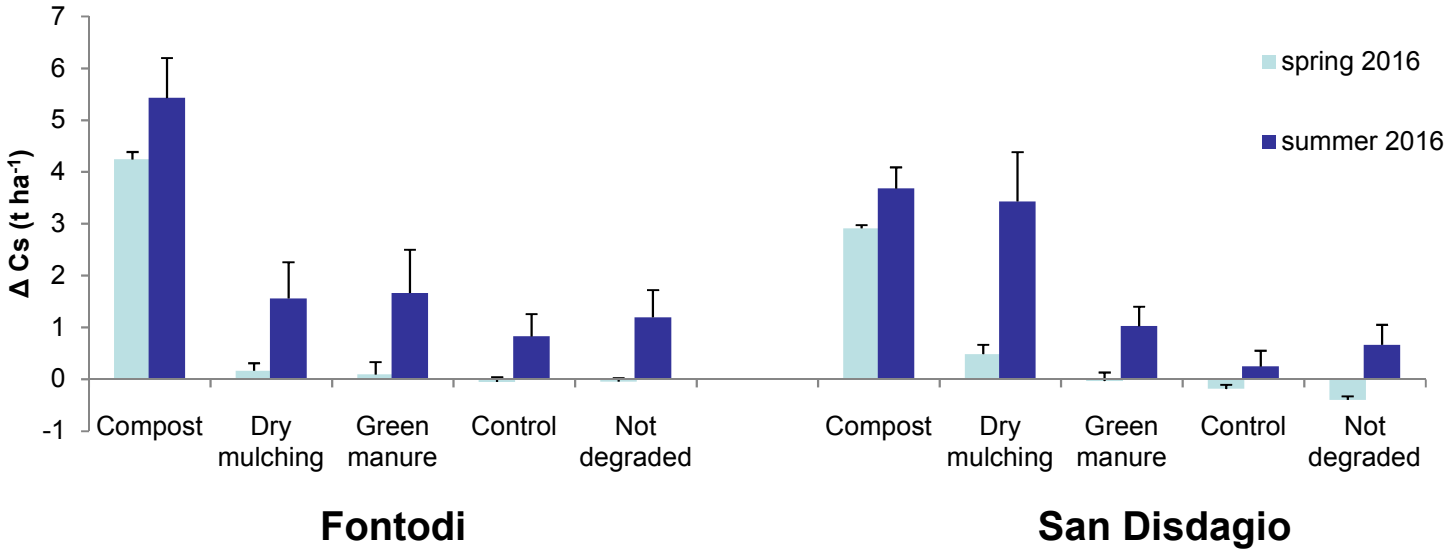
Estimated ΔC stock 2015-2016

Carbon dynamic assessment based on Hènin-Dupuis model (D'Avino et al, GSOC 2017) taking into account 30 cm topsoil specific characteristics and organic matter inputs:

Soil Organic carbon, bulk density, coarse fragments, clay, total carbonates

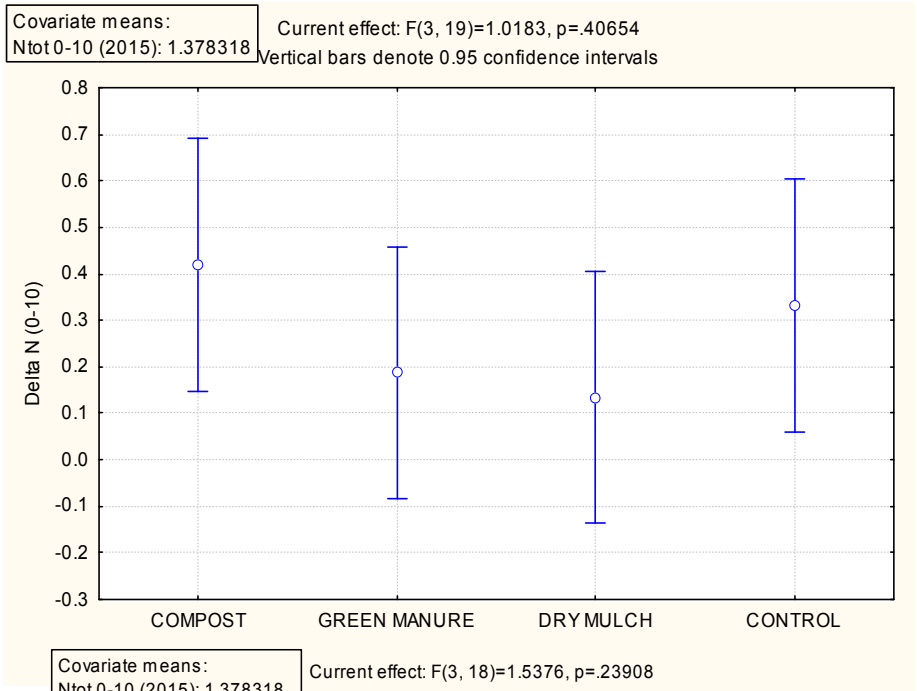
Weather Mean annual air temperature

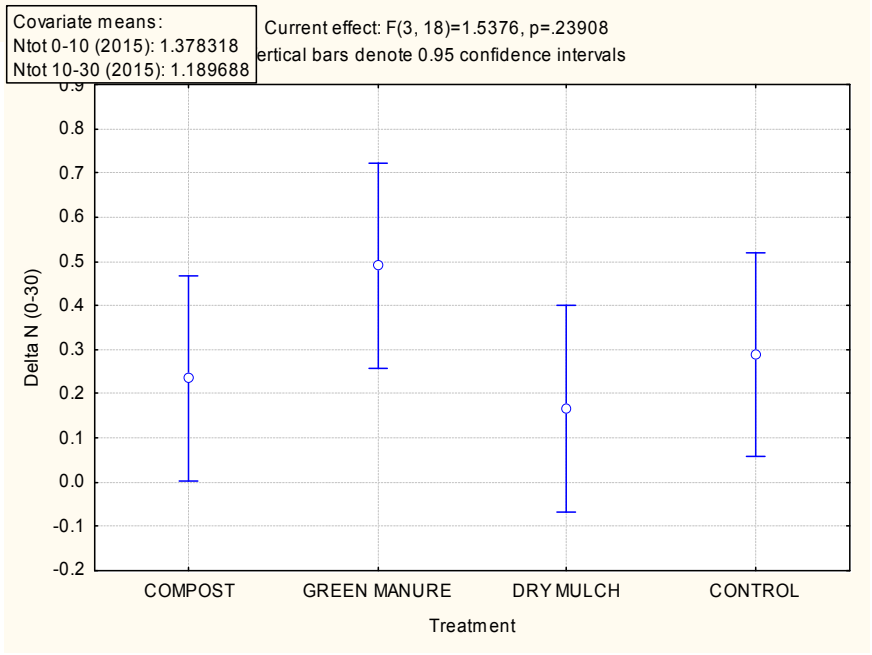
Cropping system tillage (frequency and depth), manure (frequency, amount and type) and residues incorporation (epigeal and hypogeal biomass)



Carbon stock variations estimated before and after mowing end/or incorporation of residues in May 2016

Variation in total nitrogen after 1 year treatments





No significant statistical differences between treatments

In 0-30 cm depth, general increasing in green manure (on average 0.5 g/kg)

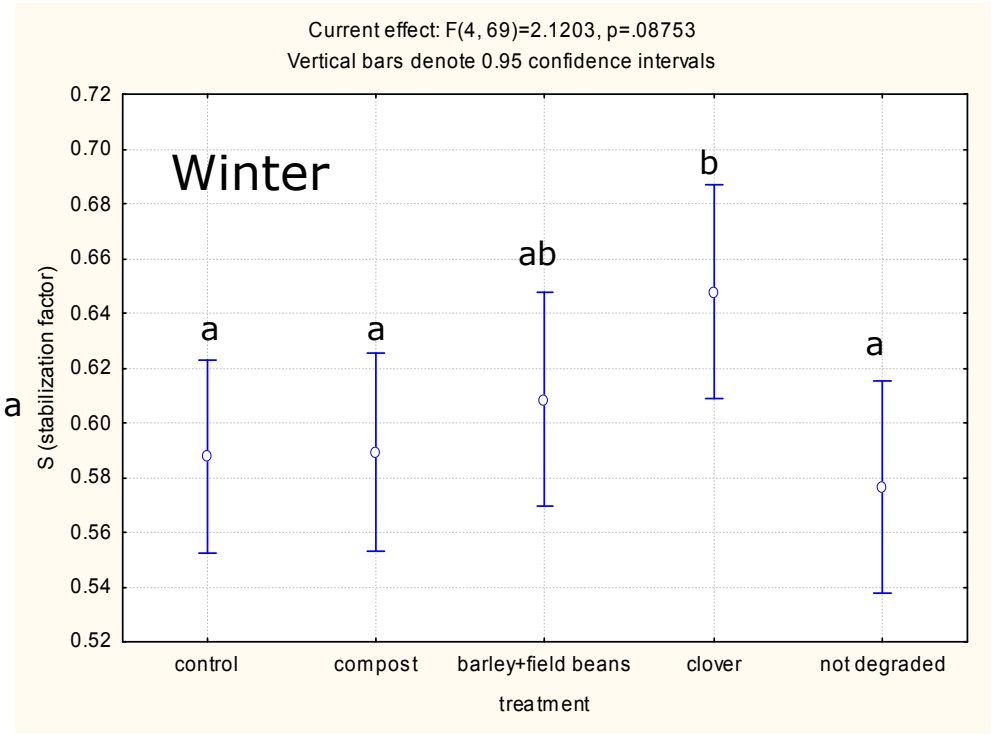
Tea bag index

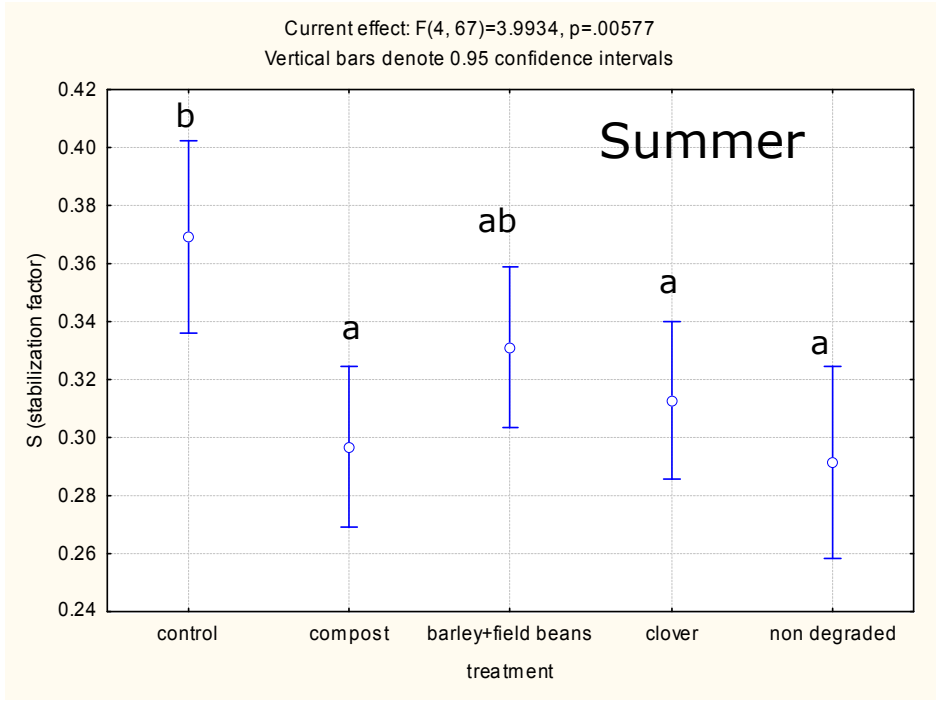
(Keuskamp et al. 2013)

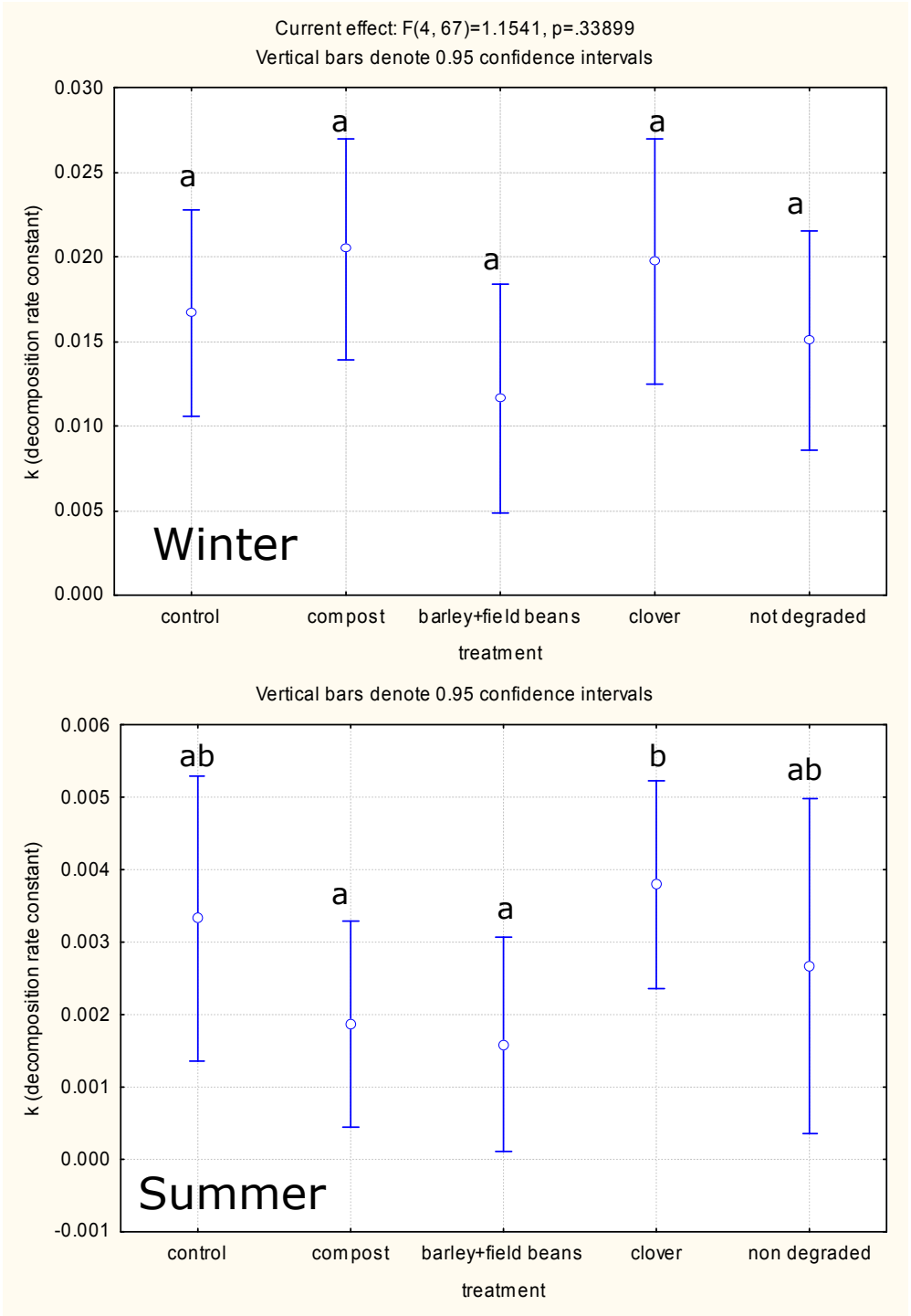
SOM stabilization:

In winter, SOM more stable in clover cover crop

In summer, SOM more stable in control (naturally grass cover after autumn tillage)







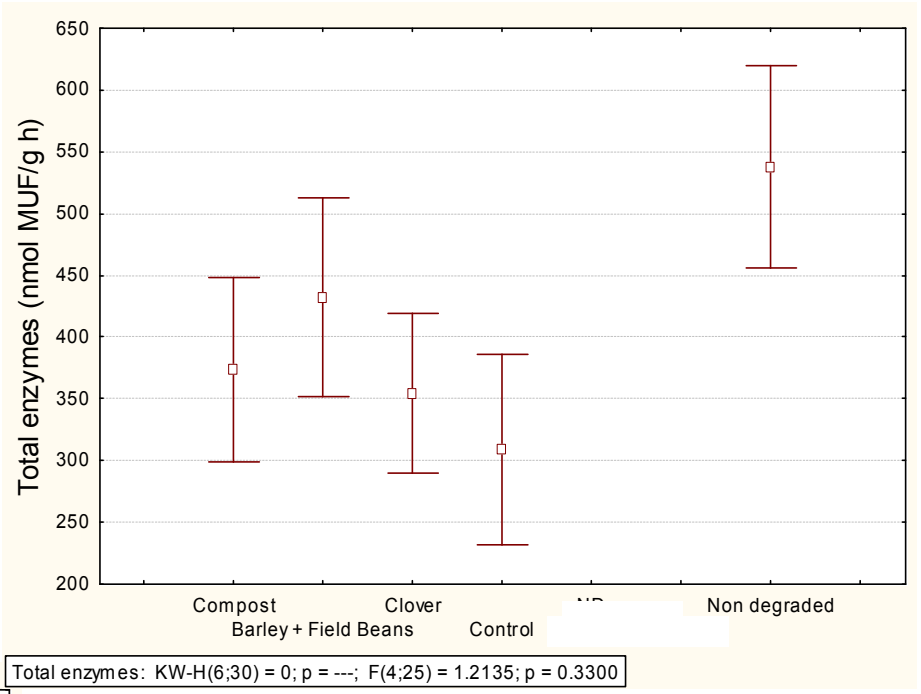
k: decomposition rate

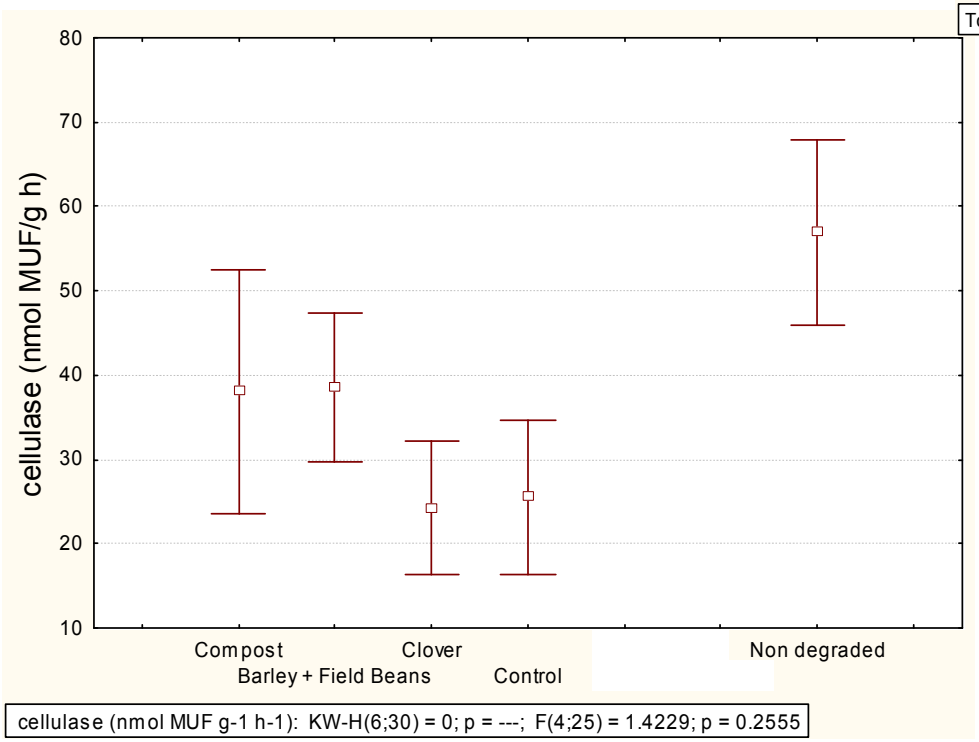
No differences in winter

Higher in clover treatments (mowed and leaved in the ground during summer – dry mulching)

Enzymes

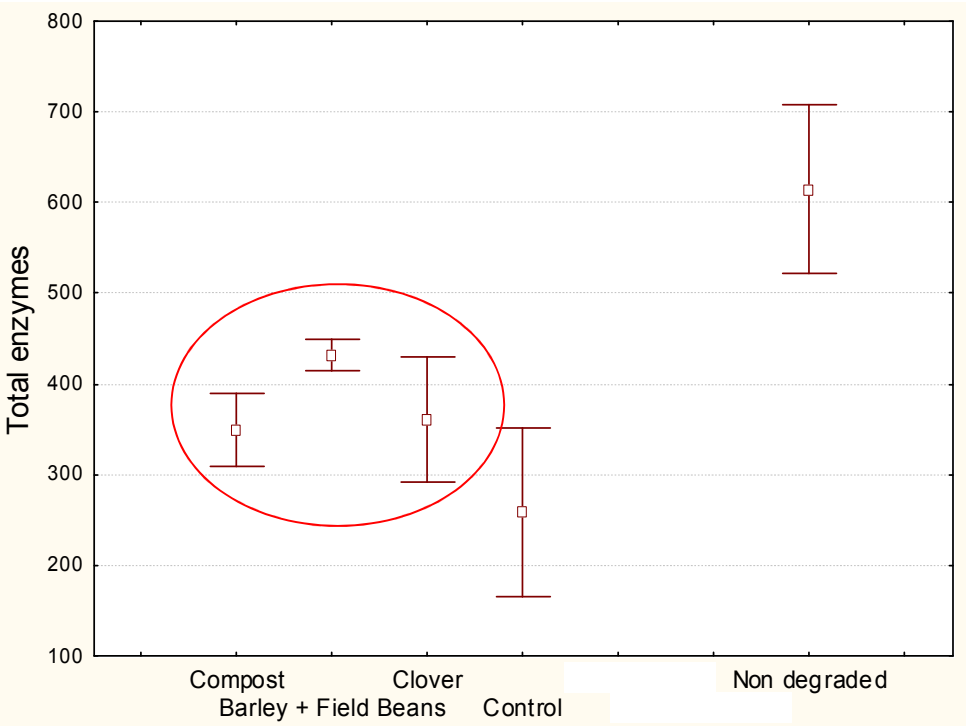
After 1 year, any treatments didn't reach the non degraded area.

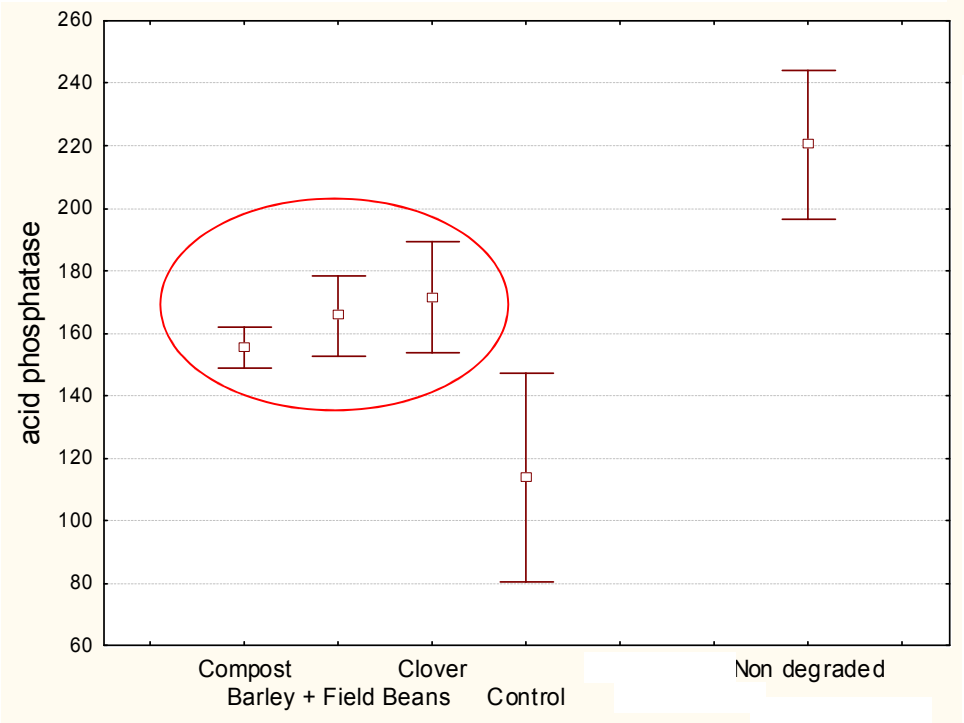


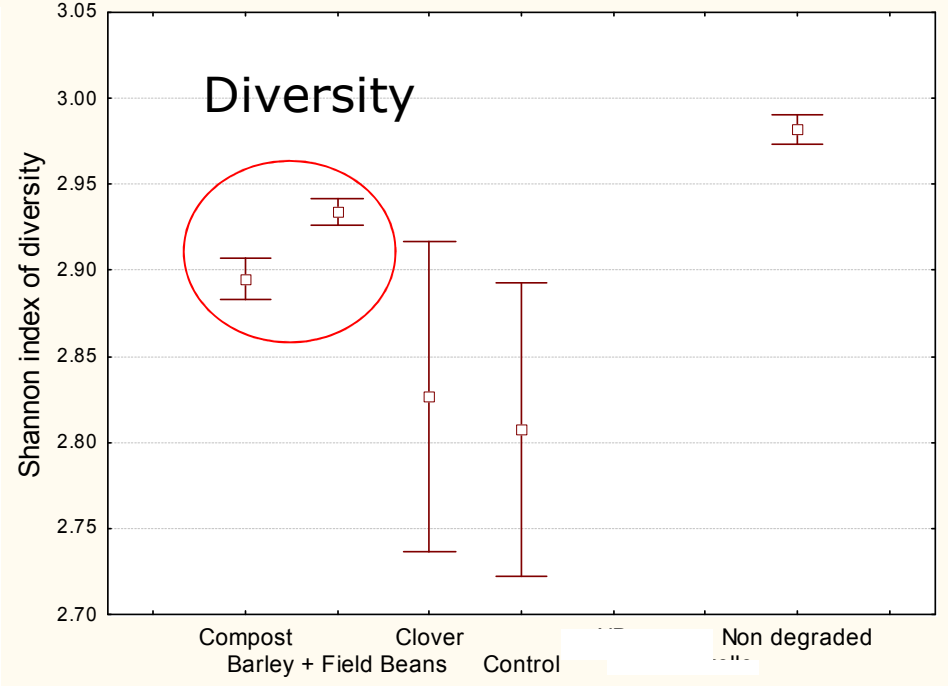


In **San Disdagio farm**,

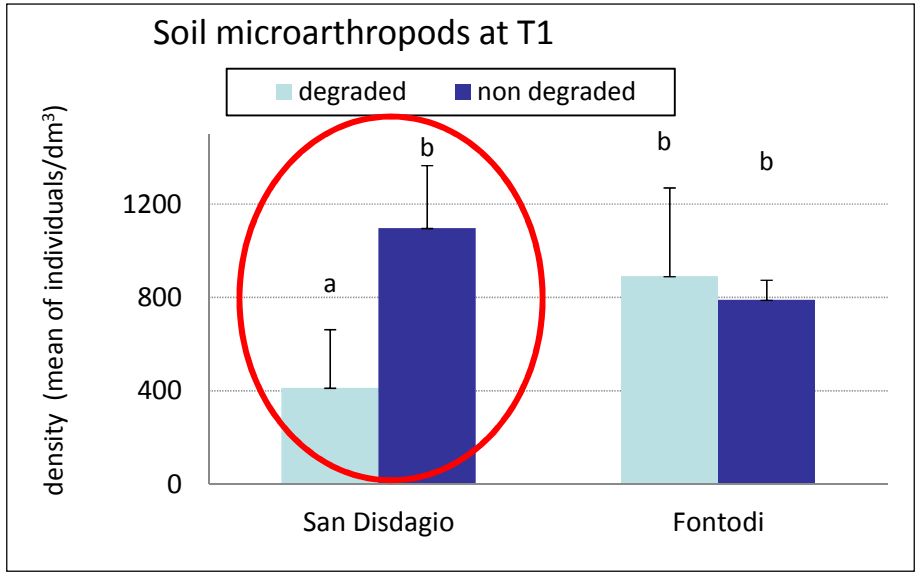
enzymes activity increased in all the treatments, although did not reach the non degraded area.



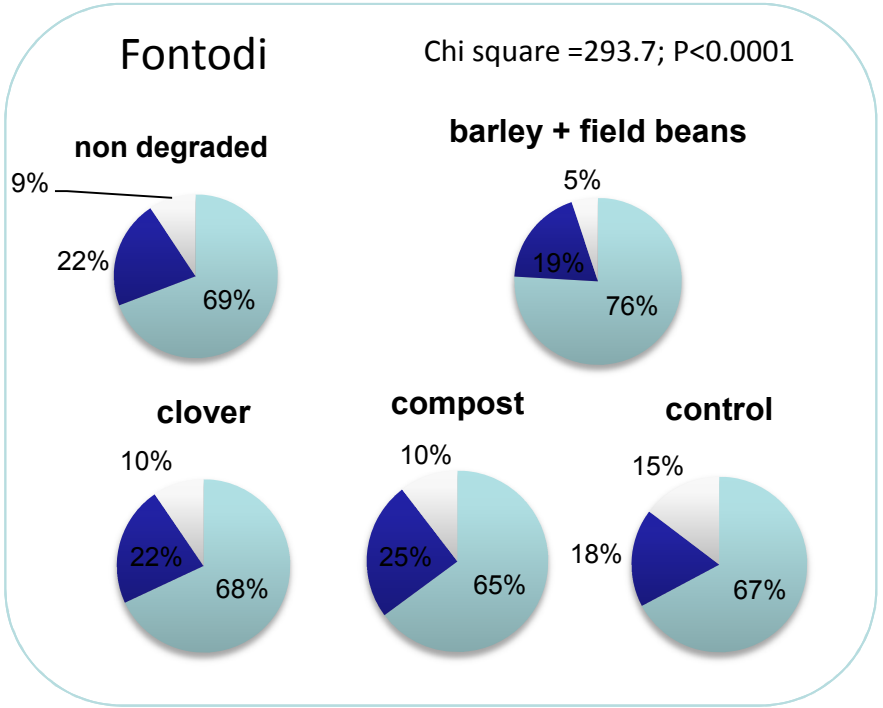


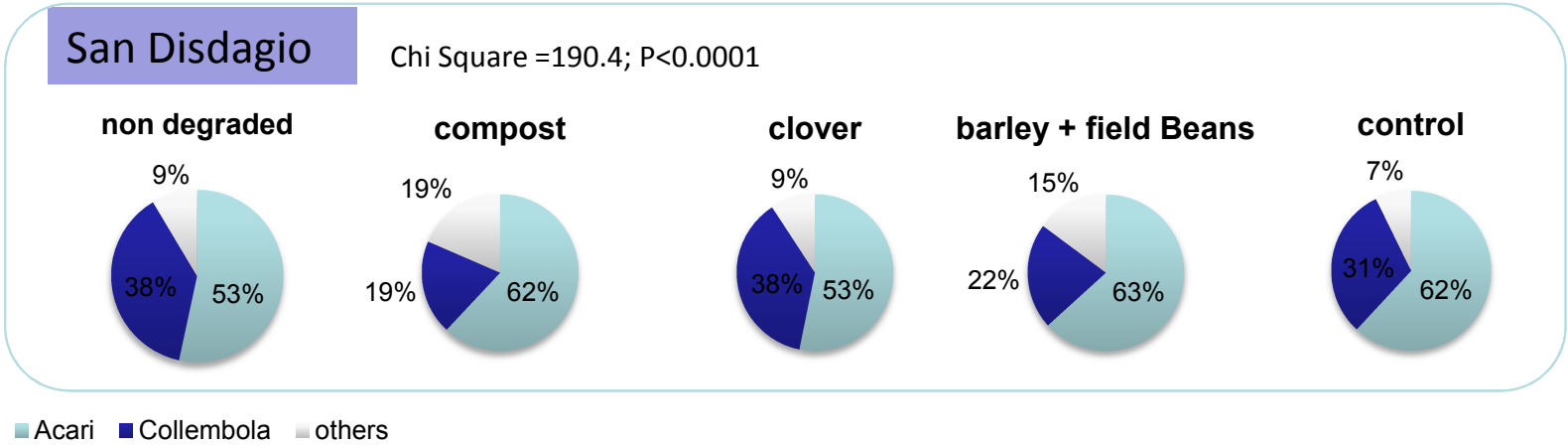


Microarthropods



t-test df Sig. (2-tailed) t=-4,193; P=0,001

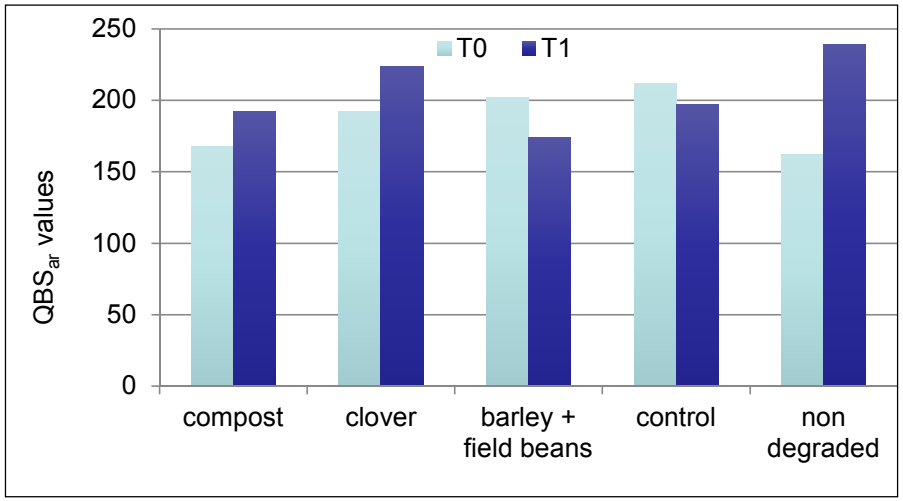




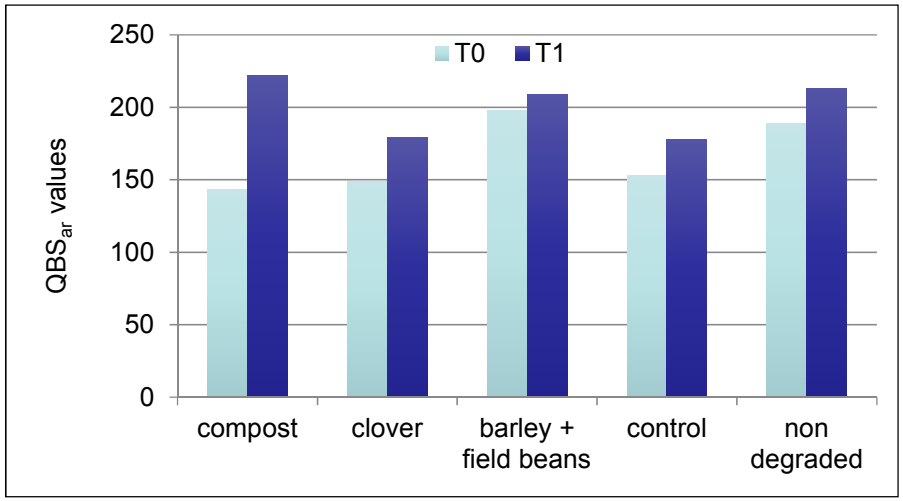
After the treatments, high difference was in the distribution of the three main microarthropod groups (Acari, Collembola, other arhropods).

Microarthropods' biodiversity: biological soil quality (QBS index) and Taxa richness trend

Fontodi



San Disdagio



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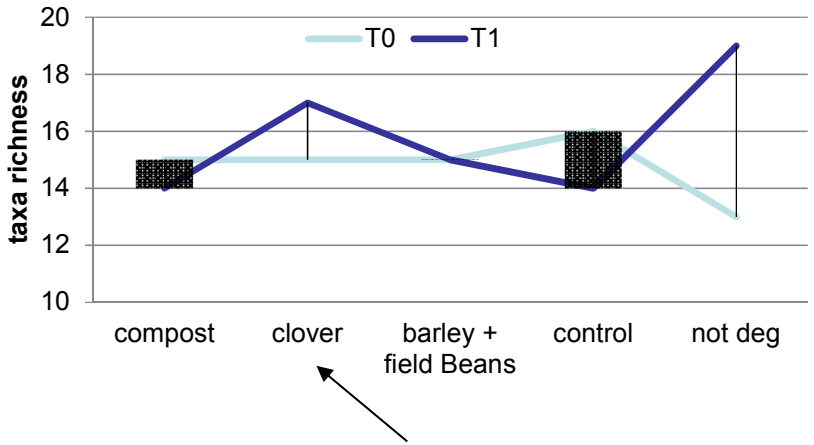
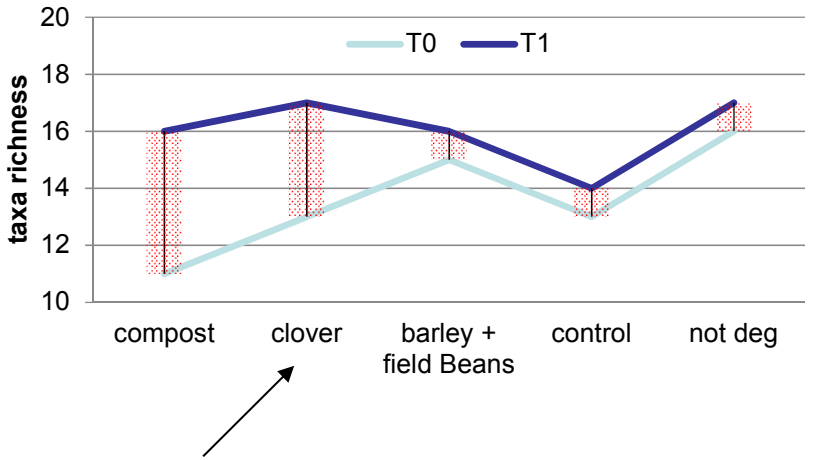


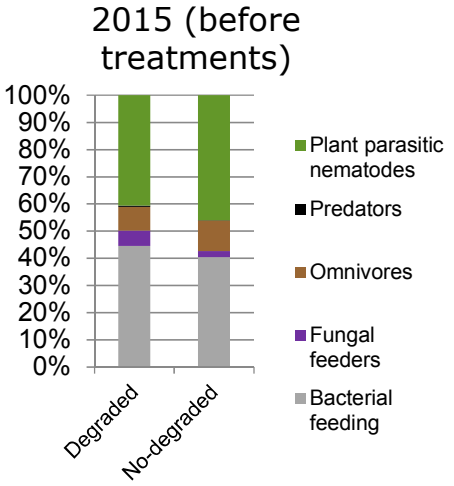
San Disdagio

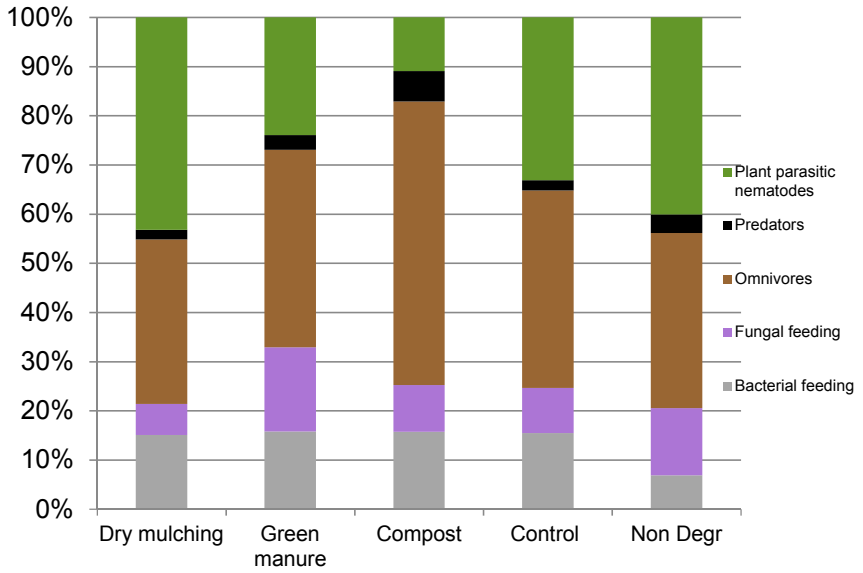


Clover treatment facilitated taxa richness increasing in both the farms

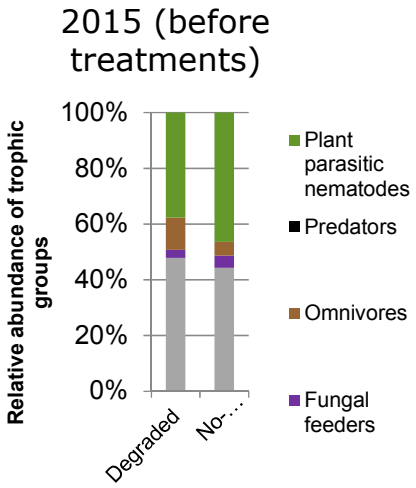
Nematodes -after treatments -

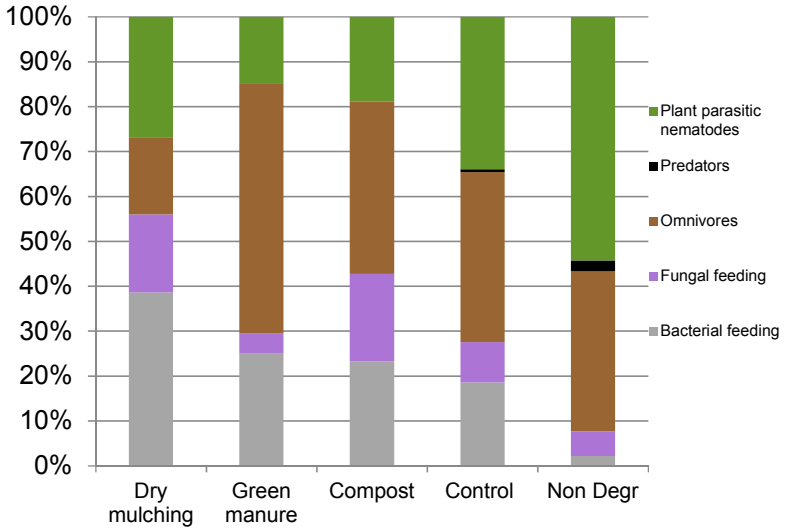
Fontodi



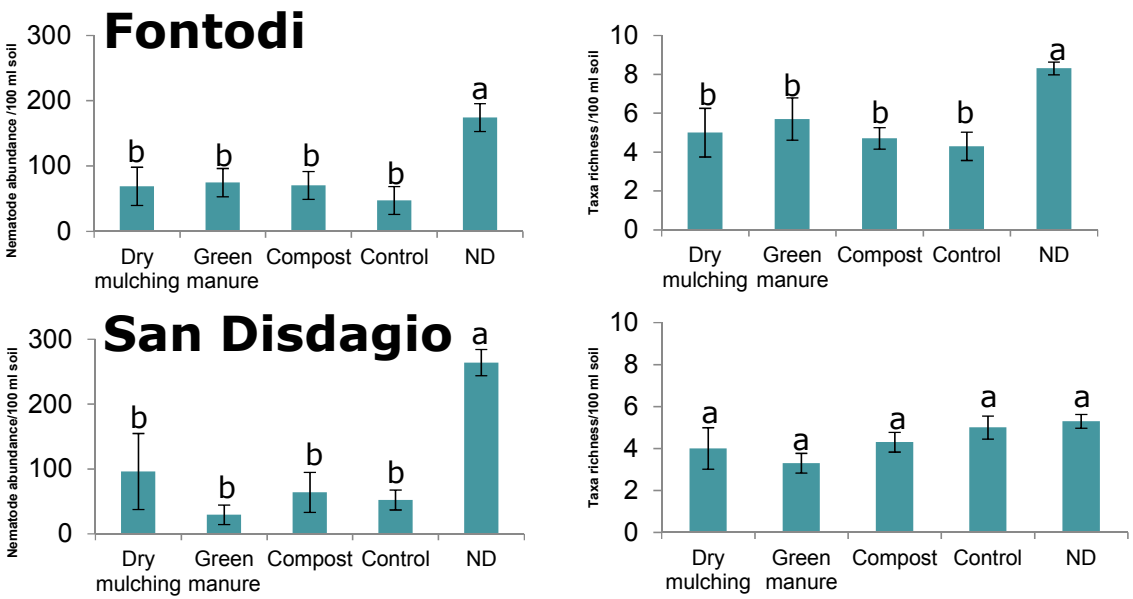


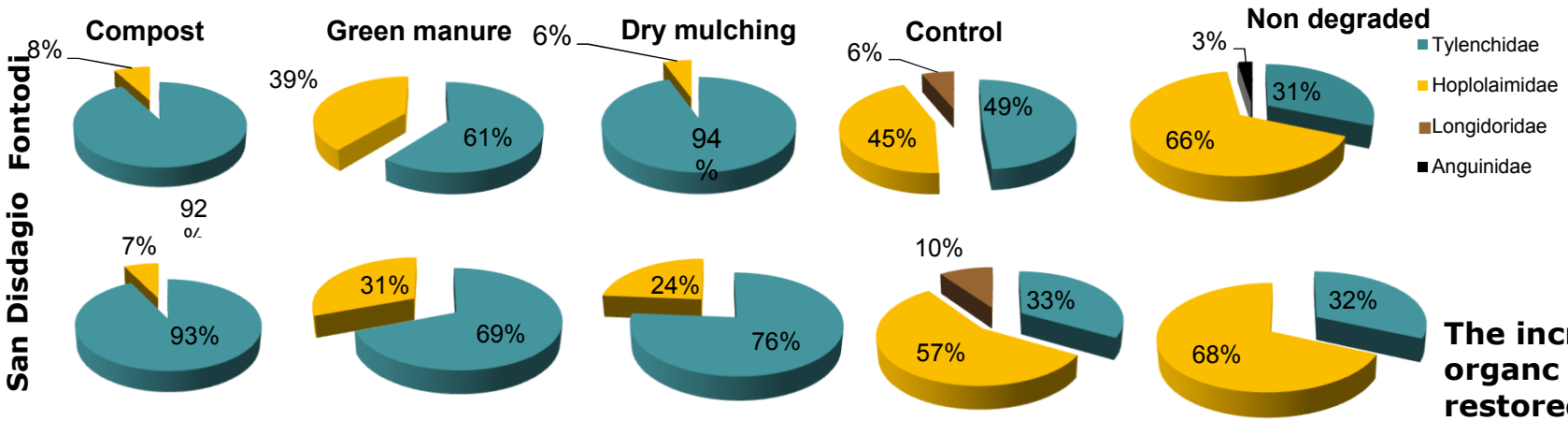
San Disdagio





All the treatments increase the number of predators. Moreover, cover crops increase the fungal feeder nematodes.





The major pest of grapes, the virus-vector *Xiphinema index* (Longidoridae), disappeared in the organic treated plots.

The increase of organc matter in restored soil reduces the number of plant parasitic nematode taxa.

Conclusions

Soil degradation in vineyards

-Degraded areas within vineyards showed lower organic carbon, carbon stock and total nitrogen only in one farm (San Disdagio).

- Degradation in Fontodi was due to limited rooting depth and higher calcium carbonate

- Soil degradation in vineyards, due to erosion and/or levelling influences soil ecosystem only in part.

- Prolonged organic management strongly increase the number and the biodiversity of microarthropods

Conclusions

Effects of 1 year organic treatments (compost and cover crops)

- After only 1 year of strong compost adding and cover crops (barley+field beans for green manure, and Trifolium squarrosum for mulching) no significant increase of SOC, Ntot, enzymes, microarthropods and nematodes abundancy were individuated.

- The most interesting result were shown by nematodes. All the treatments increased the number of predators and omnivores, and the most dangerous nematode family (Longidoridae, *Xiphinema index*) disapperead.