MOREGREEN

How agro-ecological services crops affect soil arthropod diversity in Mediterranean organic greenhouse production

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Agroecological services crops - ASC

ASC are generally not directly aimed at improving crop yield, even if most of the time they indirectly contribute to sustain agricultural production by a wide range of mechanisms (Canali, 2013).

- Increase in soil organic matter and improvement of soil structure
- Vegetation management to create a cover crop mulch
- Diversification of cropping systems
- Increased number of beneficial insect (source of pollen, nectar, shelter etc.)
- Separations in community structure of soil arthropods among cover crop species

(House and Alzugaray, 1989; Clark, 2007; Calabrese et al., 2015)

Kohlrabi (*Brassica oleracea* var. *gongylodes)*

"**Looking something like a Sputnik in vegetable form,** with a squat bulb and antennae-like shoots, kohlrabi is part of the cabbage family." (BBC good food)

- 6 – 8 weeks from transplantation to harvesting
- Highly appreciated in Northern European countries

Organic greenhouse (OGH) production

Strategies to improve **functional biodiversity** in OGH are still a challenge.

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"Input substitution paradigm"

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In contrast with basic principles of organic agriculture

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Lack of studies!

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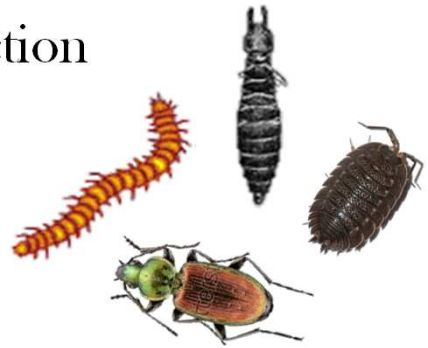
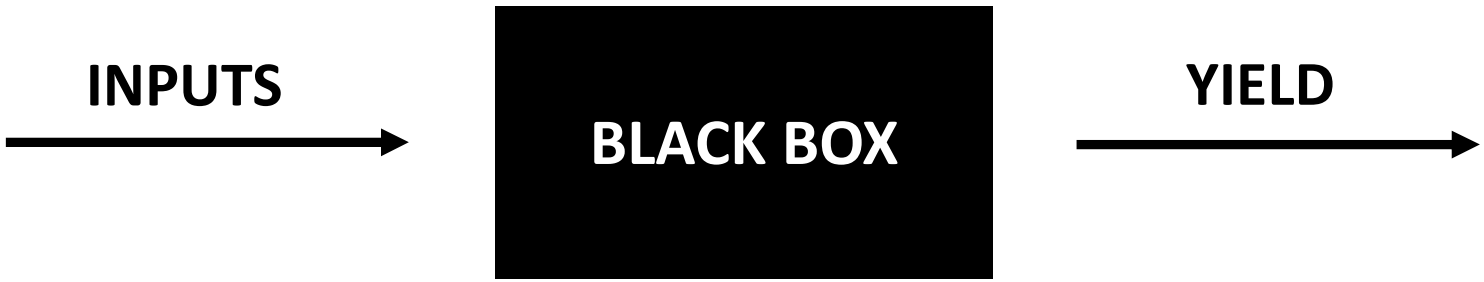
Ecologically-based solutions for OGH production



(Altieri, 1999; Best, 2008; De Wit and Verhoog, 2007; Goldberger, 2011)


INPUTS
BLACK BOX
YIELD

Soil arthropods

- How and where these small organisms could help in assessing environmental status?
- Demonstrated value or strong potential as bioindicators.

Monitoring environmental changes

↓

Comparing different farming techniques

↓

Improving the environmental sustainability of farming systems

↓

Policies aimed at reducing environmental damage

(Paoletti, 1999)

Soil arthropods as bioindicators

Ground beetles (Carabidae)
- Generalist predators
- Granivores
- Sensitive reaction to anthropogenic changes

Rove beetles (Staphylinidae)
- Generalist predators
- Sensitive to habitat disturbance

Spiders (Aranea)
- Pest regulators
- Susceptibility to changes in habitat microclimate

Harvestman (Opiliones)
- Polyphagous
- Sensitive to cultivation and crop rotation

Millipedes (Myriapoda)
- Detritivores - first step of litter fragmentation
- Effect on soil porosity

Woodlice (Isopoda)
- Key system regulators of the decomposition
- Bioindicator for soil pollution

Springtails (Collembola)
- Leaf litter decomposers
- Responsive to a variety of environmental factors (changes in soil chemistry)

(Marc et al., 1999; Snyder and Hendrix, 2008; Woodcock et al., 2010)

OGH Systems under assessment

SUBSTITUTION - bare soil priori to cash crop + organic commercial fertilizer (input substitution system)

OGH Systems under assessment

AGROCOM – ASC cultivation priori to cash crop (used as green manure) + compost produced on-farm

OGH Systems under assessment

AGROMAN - ASC cultivation priori to cash crop (used as dead mulch) + animal manure (from organic husbandry)

Crop rotation

Feb – May 2016

Jun – July 2012

Sep - Jan 2013

Feb –May 2013

Jun – July 2013

Sep – May 2014

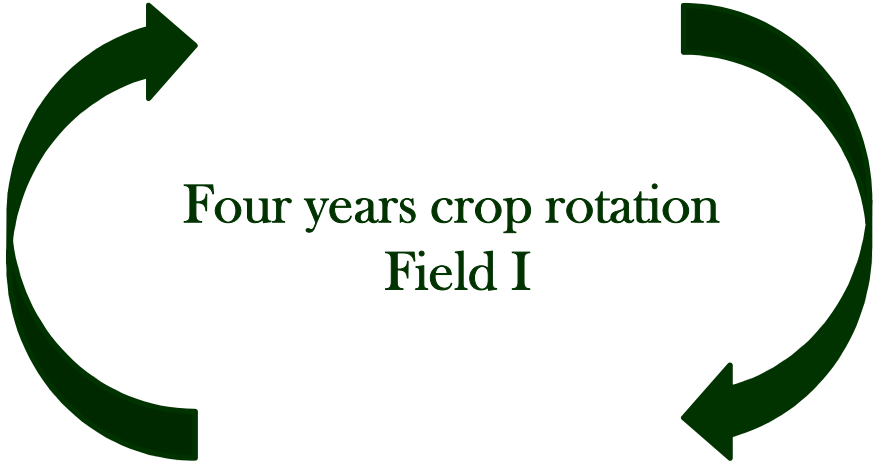
July - Aug 2014

Oct 2014 – Dec 2015

Feb – May 2015

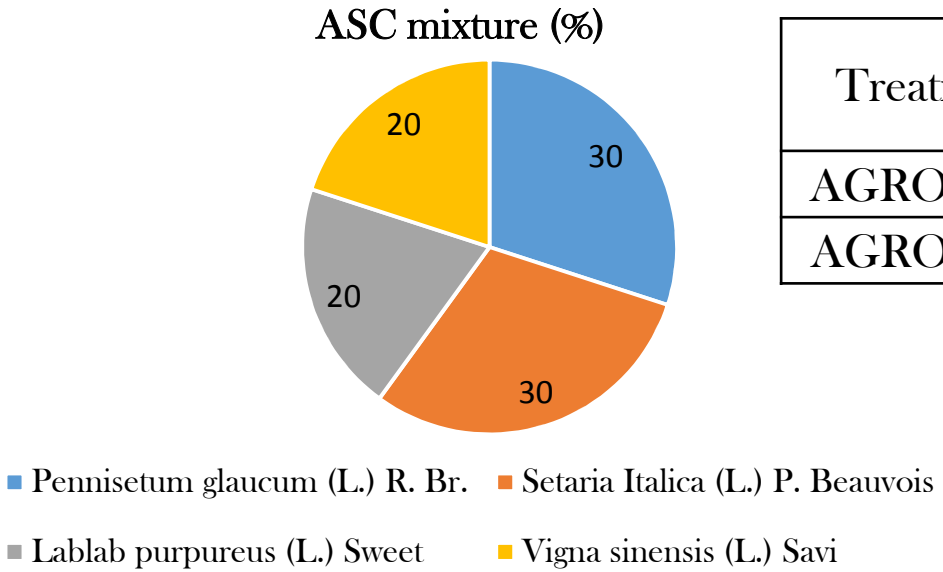
Jun – July 2015

Sep - Jan 2016



CIHEM – MAI Bari
experimental organic GH

ASC mixture sown in AGROCOM and AGROMAN



Treatment	Fresh biomass (t/ha)	Dry biomass (t/ha)
AGROCOM	176.8	22.6
AGROMAN	158.1	26.9

- Biomass production
- Nitrogen fixation
- Balancing C/N ratio

Pearl millet

Foxtail millet

Lablab bean

Cowpea

Soil arthropods monitoring

Agroecological services crops

July → August

SUBSTITUTION

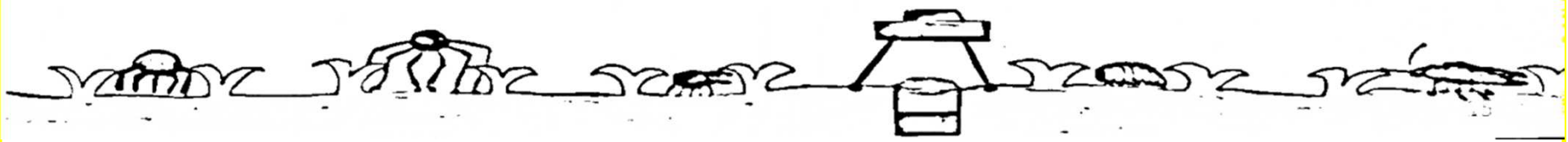
AGROMAN

AGROCOM

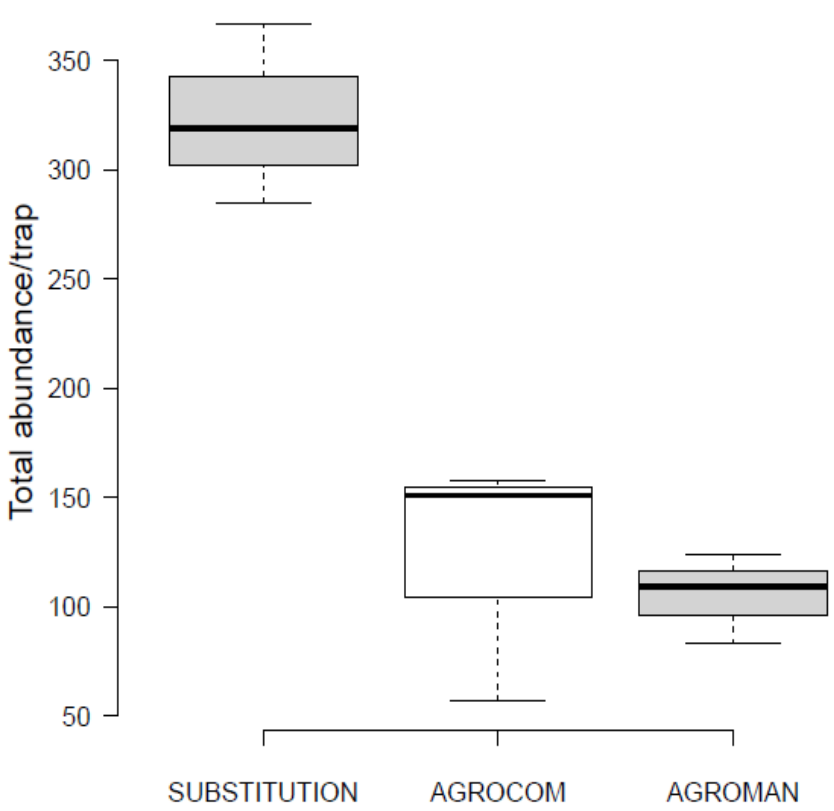
October → November → December

Kohlrabi

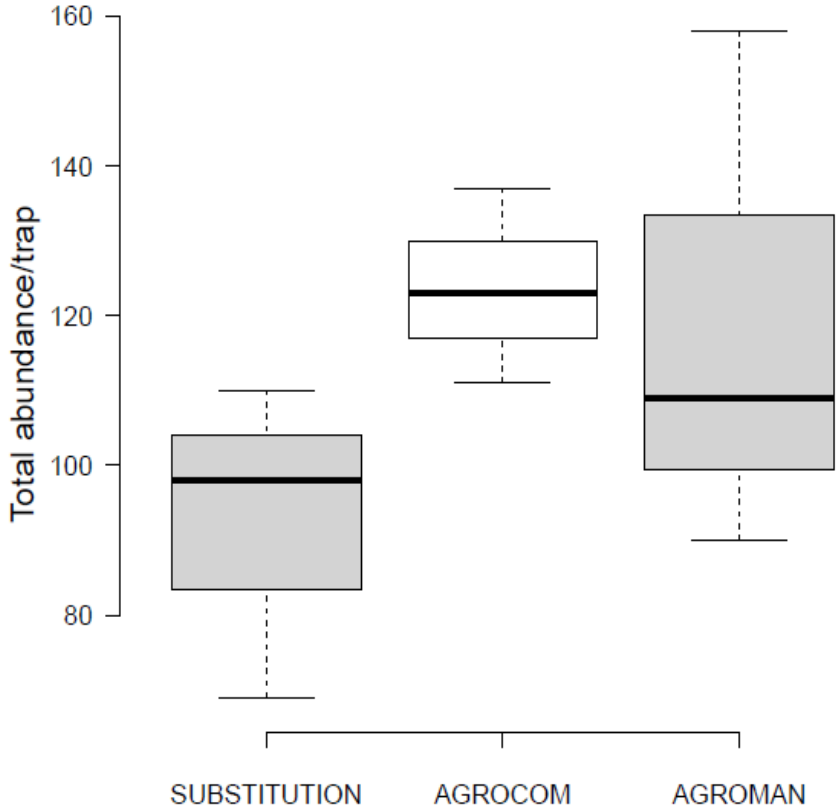
Results



Total Abundance

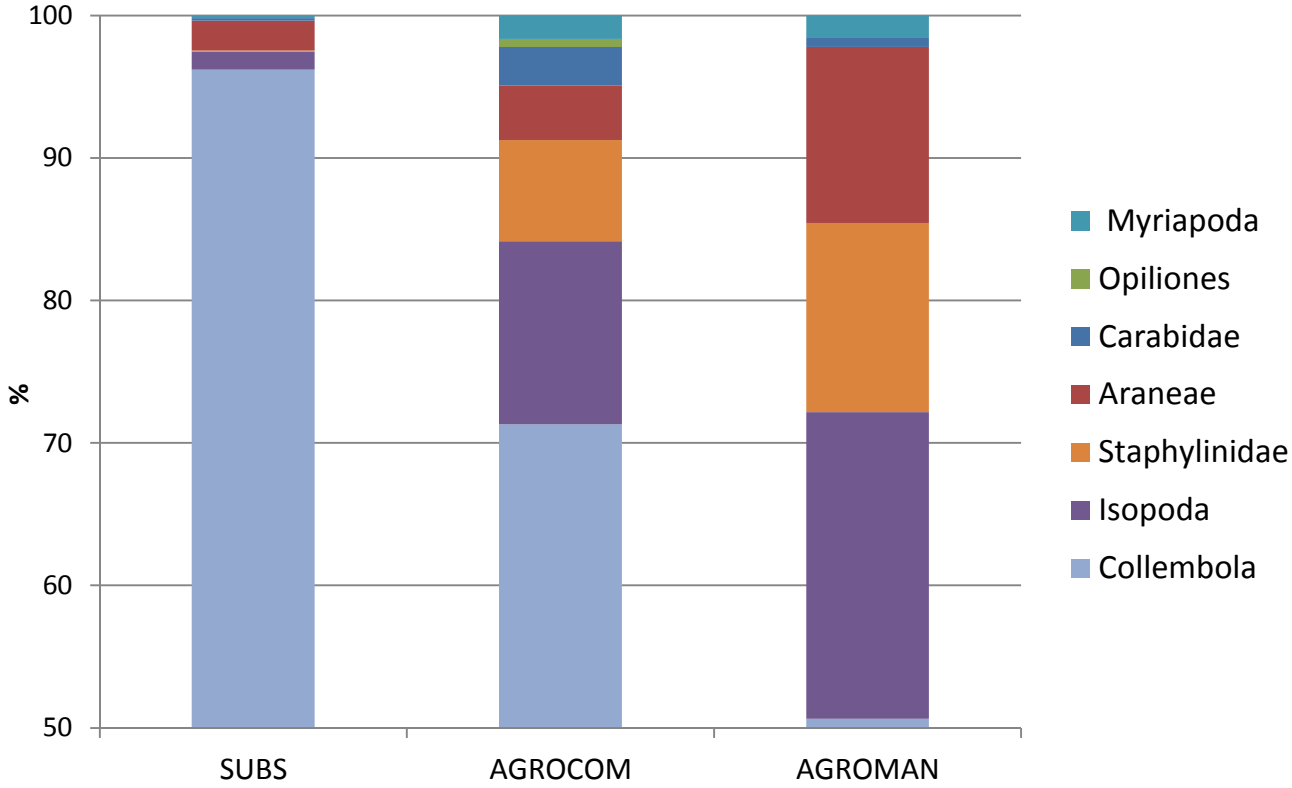


ASC



Kohlrabi

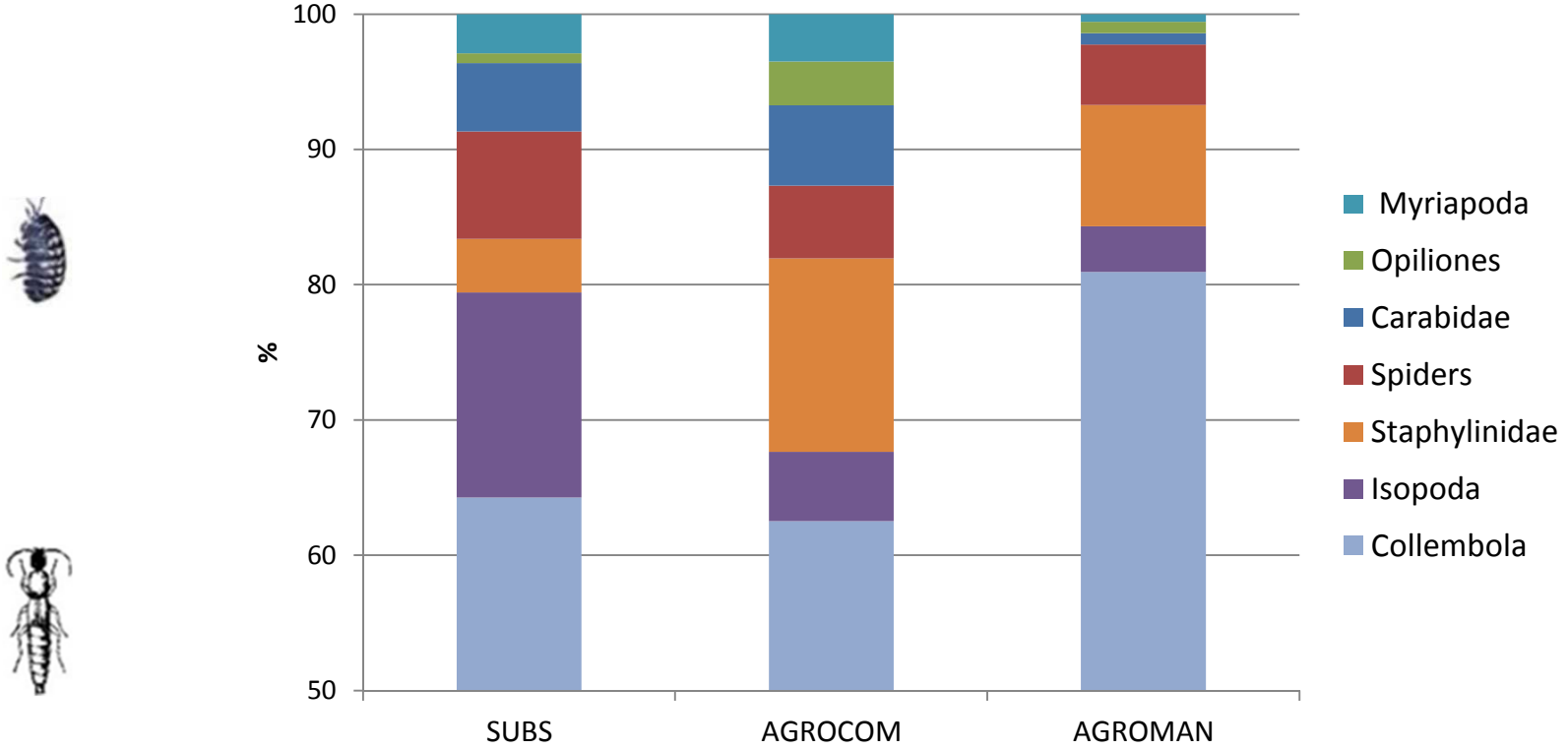
Relative abundance (%) and mean number of soil arthropods - ASC



System/Group	Carabidae	Araneae	Opiliones	Isopoda	Myriapoda	Staphylinidae	Collembola
SUBST	0.7^{a}	5.3^{ab}	0.0^{a}	4.3^{b}	0.7^{a}	0.0^{b}	309.3^{a}
AGROCOM	3.3^{a}	4.7^{b}	0.7^{a}	15.7^{ab}	2.0^{a}	8.7^{ab}	87.0^{b}
AGROMAN	0.6^{a}	13.0^{a}	0.0^{a}	22.6^{a}	1.6^{a}	14.0^{a}	53.3^{b}

*ANOVA, followed by Tukey test, $p \leq 0.05$

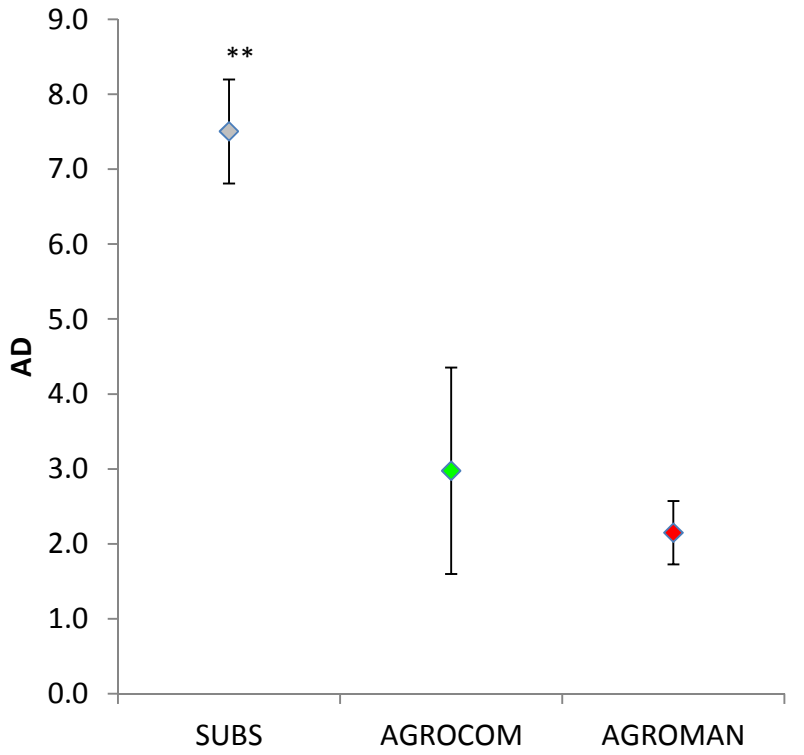
Relative abundance (%) and mean number of soil arthropods – Kohlrabi



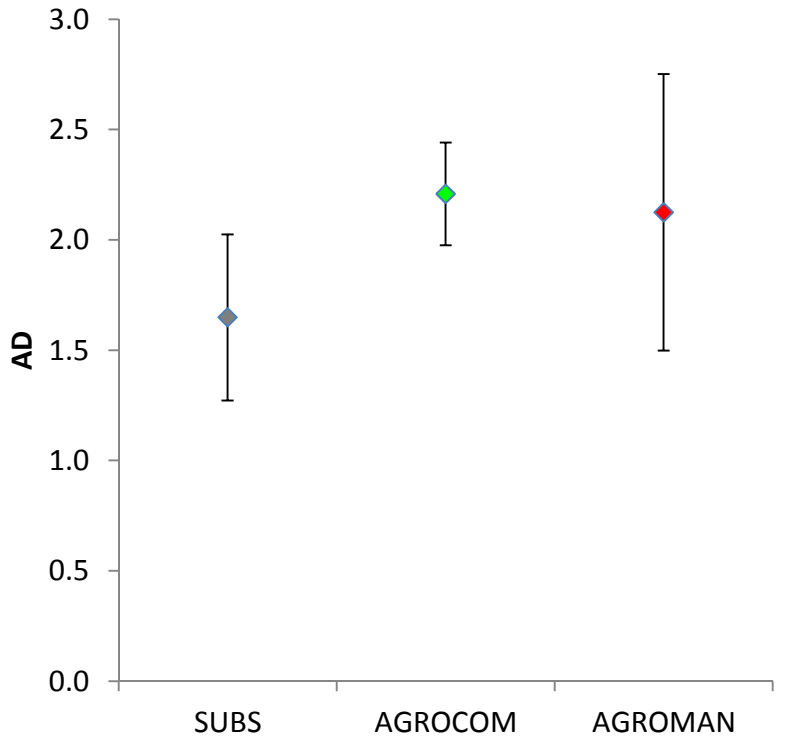
System/Group	Carabidae	Araneae	Opiliones	Isopoda	Myriapoda	Staphylinidae	Collembola
SUBST	4.7^{a}	7.3^{a}	0.7^{b}	14.0^{a}	2.7^{ab}	3.7^{b}	59.3^{a}
AGROCOM	7.3^{a}	6.7^{a}	4.0^{a}	6.3^{a}	4.3^{a}	17.7^{a}	77.3^{a}
AGROMAN	1.0^{a}	5.3^{a}	1.0^{ab}	4.0^{a}	0.7^{b}	10.7^{ab}	96.3^{a}

* ANOVA, followed by Tukey test, $p \leq 0.05$

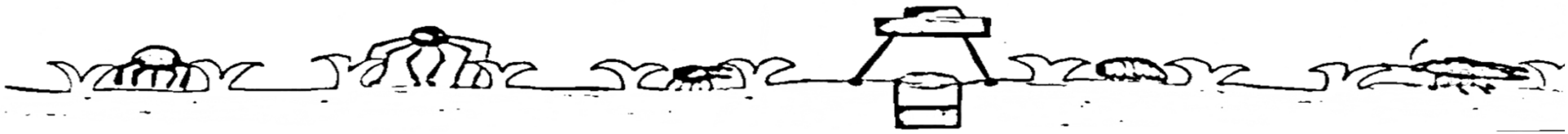
Activity density (AD)



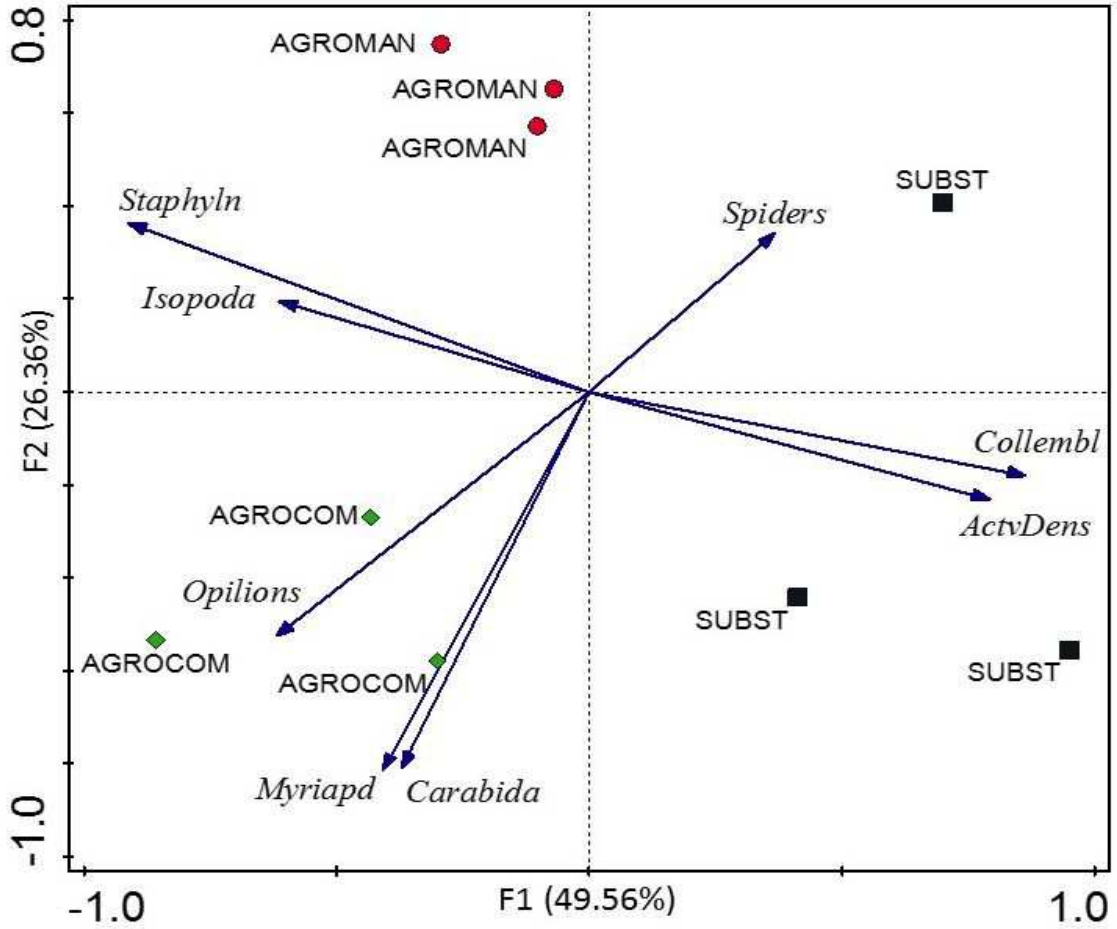
ASC



Kohlrabi



PCA analysis – (total for 97 days)



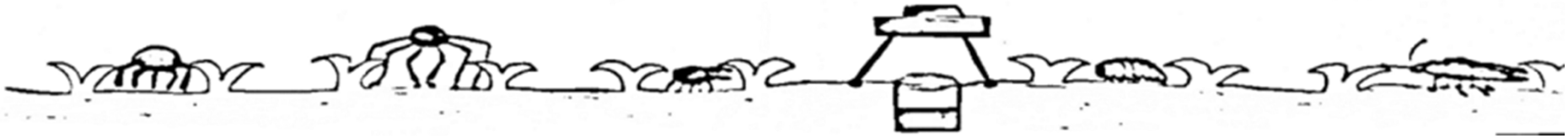
Conclusion

- Results demonstrated ability of soil arthropods to be used as bioindicators.
- However, we should take in consideration variability depending on the considered crop and period of monitoring.
- Agroecological systems studied can bring benefits in terms of increased arthropods biodiversity, especially during cultivation of ASC.

- Multivariate data analysis
- Exploration of data usability for crop rotation modeling in Mediterranean OGH conditions




Thank you for attention



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