Effects of conservative practices on soil ecosystem of Mediterranean high density olive orchard

Gagnarli E. [1], Vignozzi N.[2], Gucci R.[3], Valboa G.[2], Caruso G.[3], Pellegrini S.[2], Goggioli D.[1], Simoni S.[1]

[1]CREA-DC, Firenze, Italy, [2]CREA-AA, Firenze, Italy, [3]UNIVERSITA' PISA-DiSAAA, Pisa, Italy

INTRODUCTION

Edaphic arthropod communities can provide information about the prevailing status of soil quality to improve the functionality and long-term sustainability of the soil. The major role of soil biota in aggregate formation and stabilization is generally acknowledged even if direct empirical evidence to quantify the microarthropods' contribution is scarce.

Soil management considerably affects the soil structure's dynamics and the composition of microarthropod groups: edaphic species, mainly the no-burrowers, tend to colonize air-filled pore spaces and to set different community structures.

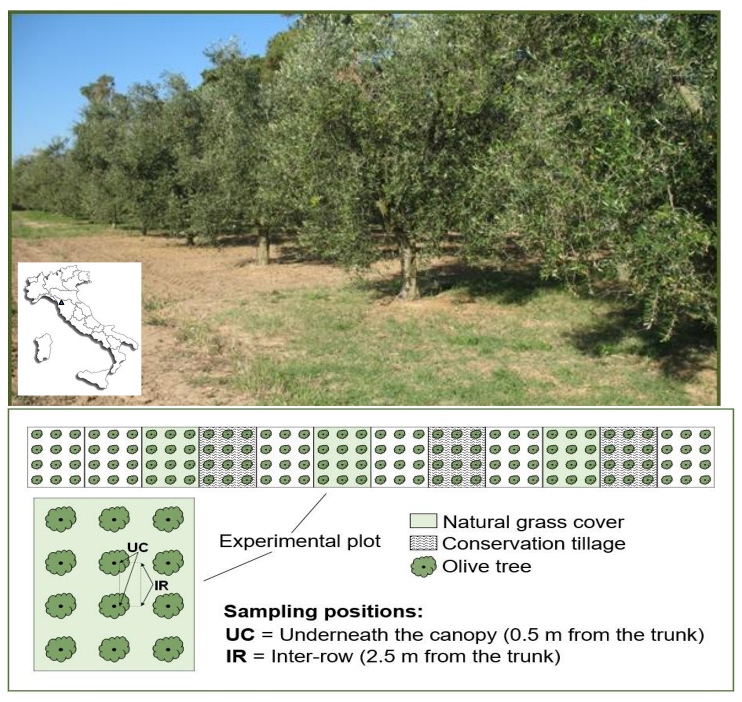


Fig. 1: Experimental site, management (NT, CT), position (UC, IR).

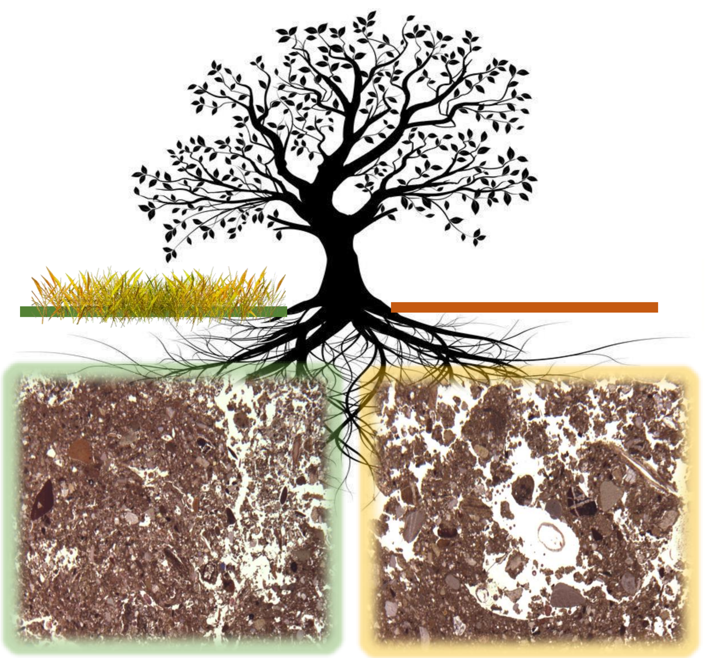


Fig. 2: Thin sections of soil structure in no-tillage (NT) (green border) and till (CT) (yellow border).

Management & position		Acari (N)	Collembola (N)	other Arthr.(N)	TOC (%)	HC (%)	BD (g/cm³)	MWD (mm)	AWC (%)	AC (%)	Reg. pores (%)	T_pores (%)
NC	UC	304.2±120.1	357.2±384,3	90.0±38.6	1.8±0.3	0.4±0.1	1.2±0.2	5.7±0.3	18.2±1.7	16.4±6.0	1.7±0.4	8.3±3.5
	IR	293.0±146.8	228.3±151.4	89.8±75.0	1.9±0.3	0.4±0.2	1.4±0.2	6.6±0.2	16.7±0.4	13.3±8.1	1.5±0.3	7.1±1.3
CT	UC	489.8±294.4	154.2±87.7	39.3±21.7	1.8±0.4	0.4±0.2	1.2±0.1	5.3±0.9	15.7±0.5	26.7±1.8	0.9±0.4	27.0±10.7
	IR	127.0±67.0	70.3±57.6	16.3±8.0	1.4±0.1	0.2±0.1	1.4±0.1	1.7±0.3	14.2±0.1	28.9±2.3	1.0±0.2	25.8±3.0

Table 1: Biological (abundances of Acari, Collembola, other arthropods), chemical (TOC, HC) and physical (MWD, AWC, AC, regular and total pores) properties (μ±SD)

MATERIALS AND METHODS

The experiment was carried out in a high-density olive orchard (*Olea europaea* L. cv. Frantoio) in the coastal Tuscany region (43°01'N; 10°36'E - Venturina, Italy). The soil was a Typic Haploxeralf (sandy loam), under the sub-humid Mediterranean climate. Soil samples in the two different managements (Natural grass cover NT, Conservative Tillage CT) carried out by the core sampling method at 0.0-0.1 m were collected at two distances (Fig. 1). For soil characterization, the experimental protocol was the following:

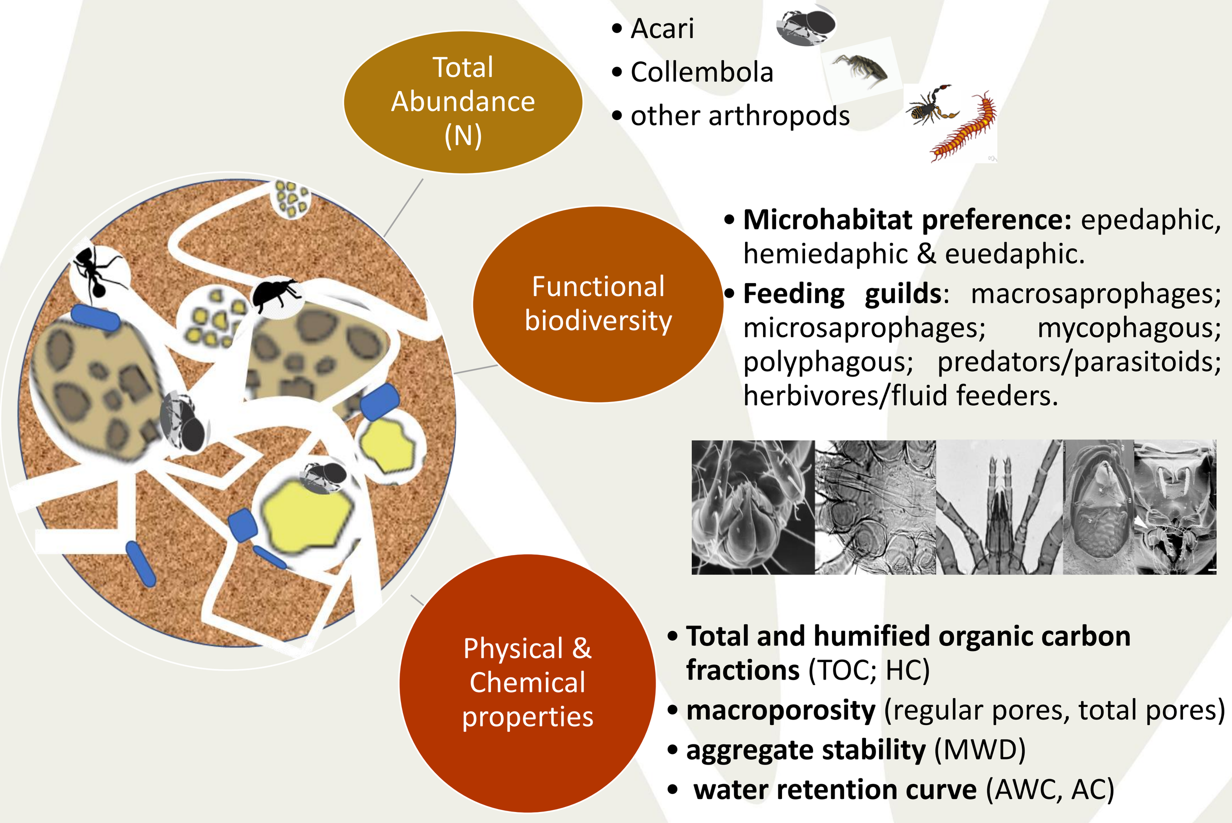


Figure 3: Experimental protocol

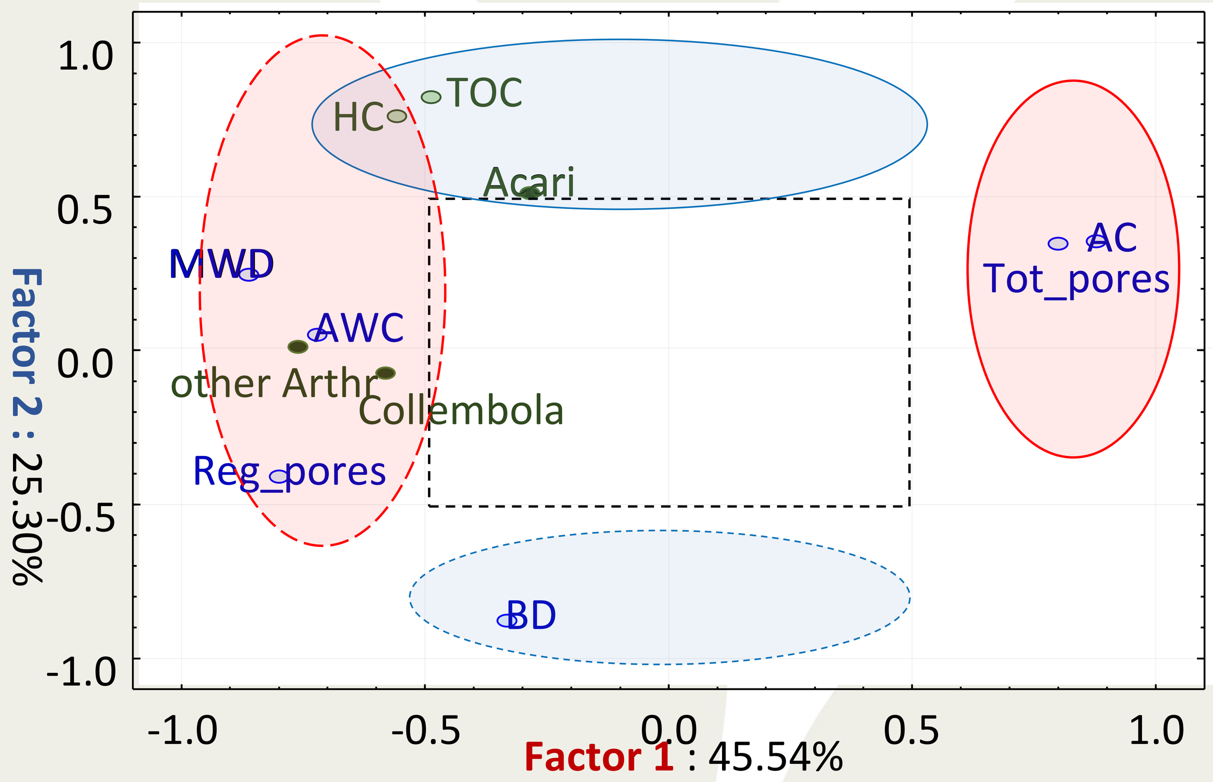
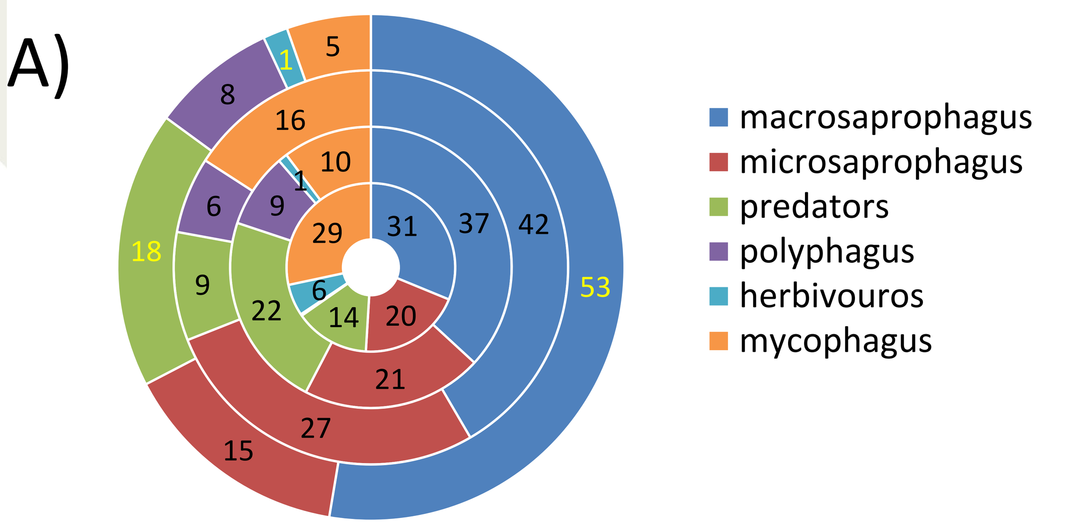


Figure 4: PCA on arthropods and environmental factors.



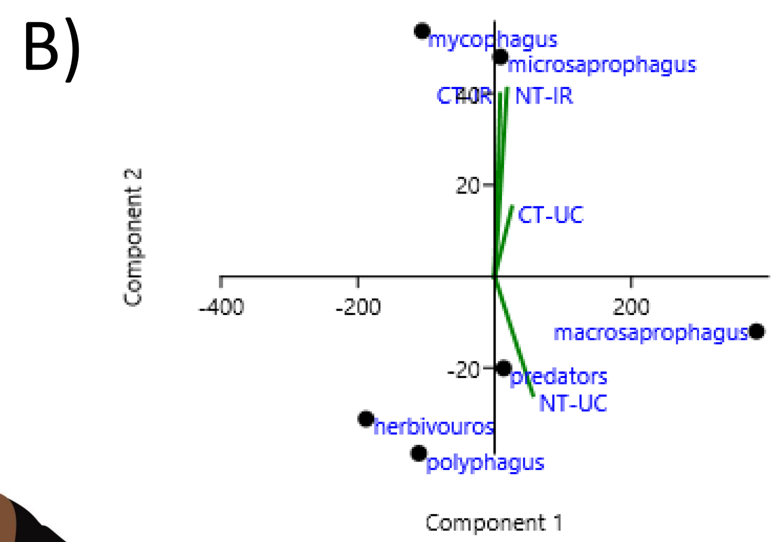


Fig. 5: Functional biodiversity: A) arthropods (%) in NT-UC: (external circle), NT-IR, CT-UC, CT-IR (internal circles); B) soil mites and different soil microhabitats/management.

MAIN RESULTS

Arthropod community: >13,500 specimens (insects, myriapods, arachnids and crustaceans) were collected; the most representative group was Acari, dominated by Oribatida, followed by Prostigmata and Mesostigmata; the Astigmata were only in CTs3.

Soil structure and carbon pools: the soil macroporosity did not change across the NT profile while in the CT it was changed (Fig. 2). The highest transmission of pores was measured in the surface layer of CT-UC. Water retention values were highest in NTs (Tab. 1).

By comparing CT-IR to grass-covering NTs, TOC stock decreased by 17%, HC stock by 34% (Tab. 1).

Soil parameters and animal abundances (Fig. 3): explaining >70% of total variance, the component 1 highlighted Collembola and the other Arthropods positively related to NT soil structure characteristics, regardless of plant distance. Soil pore volume, moisture and air ventilation provide a suitable biotope to eudaphic mesofauna while epedaphic arthropods are generally able to tolerate higher desiccation.

The component 2 highlighted the relationships in CT-UC: the water-stable aggregates (size class: 4.75-10 mm), high TOC and low BD values were all related to a more abundant mite population.

Functional biodiversity: the olive plant determined positive micro-environmental conditions in terms of availability of resources and coenosis then, increasing so soil functional diversity (Fig. 4A). Acari, mycophagous and microsaprophages, according to their r-strategy reproduction, were abundant in inter-rows (IRs), while mite predators and macrosaprophages in UCs (Fig. 4B).

Considerations

The adoption of green cover, if properly managed, can increase soil fertility and biodiversity without affecting a fruit and oil yield (Vignozzi et al. 2019).

Soil arthropods play a determining role as bioindicators of environmental quality and their functional biodiversity can represent a useful tool to assess the sustainability of the crop management adopted or resilience of soil ecosystem.

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