Soil Microbial Biomass and Mineralizable Carbon as affected by Crop Rotations under No-Till System

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Introduction

No-tillage without soil cover ➡ **"leads to disaster of the system"**

No-till by itself is not perfect ➡ **dynamic system**

Sustainability and crop yield

- Decomposition
- Cover soil
- N and nutrients

Soil microbial

The biochemistry of crop residue

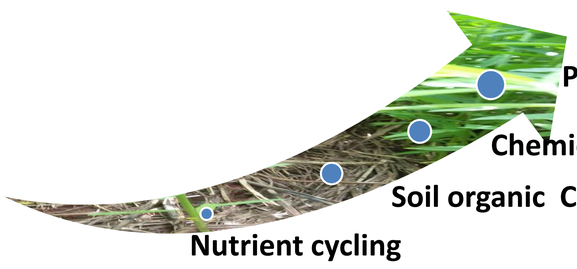
- soil cover

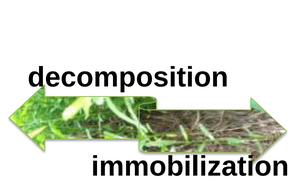
Mineralization of N

Lignin | N

Imobilization of N

+ soil covered





Complementary effects in a crop rotation system

Objective

The aim of this study was to determine if crop rotation would influence soil microbial biomass and mineralizable C. We hypothesize that double-cropping with spring cover cropping could enhance soil biological properties to improve soybean production.

Materials and Methods

The experiment was initiated in 2003 in Botucatu, Sao Paulo, Brazil in a Typic Rhodudalf under no-till, with variations in crops appearing in the dry season as main plots (triticale or sunflower) and in the spring cover crop season (pearl millet, sunn hemp, forage sorghum, or fallow with chisel) as sub-plots. Soybean was grown every year in the summer (Table 1).

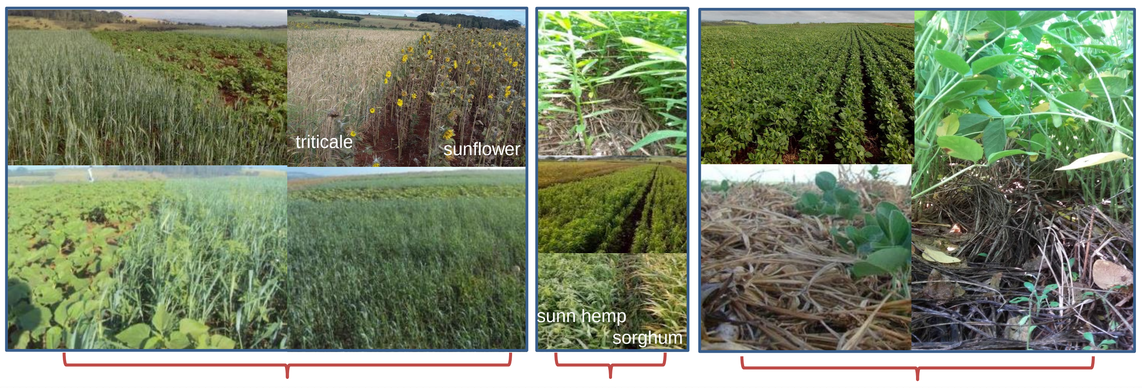
Table 1. Crop sequences of the experiment

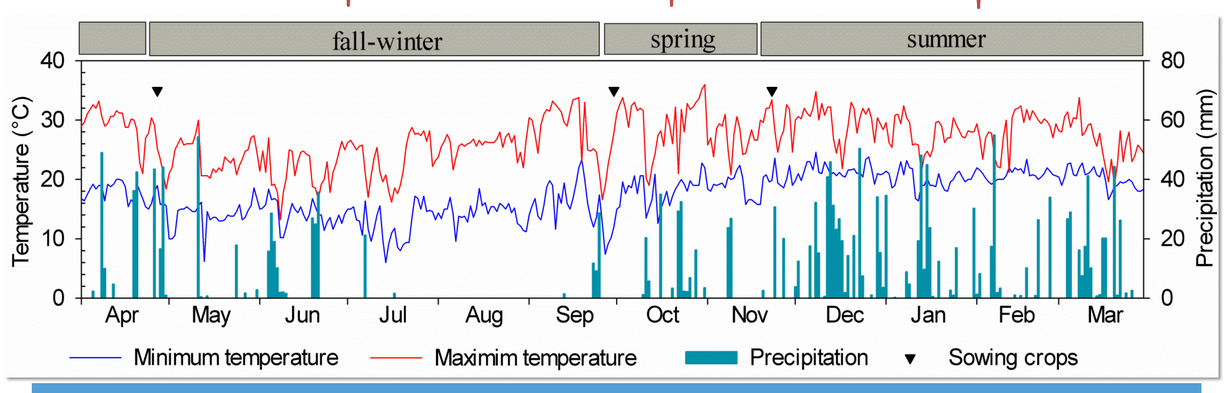
Fall-Winter (April to August)	Spring (September to November)	Summer (November to March)
Sunflower	Pearl Millet	Soybean
Sunflower	Forage sorghum	Soybean
Sunflower	Sunn hemp	Soybean
Sunflower	Fallow (chiseled every 3 years)	Soybean
Triticale	Pearl Millet	Soybean
Triticale	Forage sorghum	Soybean
Triticale	Sunn hemp	Soybean
Triticale	Fallow (chiseled every 3 years)	Soybean

Soil was collected in 2015 at depths of 0-10 and 10-20 cm. Soil microbial biomass C (chloroform fumigation-incubation) and mineralizable C (aerobic incubation at 50% water-filled pore space and 25 °C for 24 days) were determined.

Figure 1. (A) Incubator of the soil samples, (B) Blank sample of each box and thermometers, (C) Boxes with samples inside the incubator, (D) Samples to be fumigated, and (E) Samples ready to be titrated.

Data were subjected to ANOVA ($p<0.05$), and mean values were compared with least significant difference (LSD) ($p<0.05$)





Results

Table 2. Soil C fractions and N under crop rotation systems at depth of 0-10 cm.

Winter crops	Fallow	Sunn hemp	Forage sorghum	Pearl millet	LSD
		Mineralizable C (mg kg^{-1}) (0-3 d)			
Sunflower	**48**	**46**	83	77	18*
Triticale	**63**	85	76	82	
		Mineralizable C (mg kg^{-1}) (0-24 d)			
Sunflower	**170**	**172**	268	273	72*
Triticale	213	270	242	267	
		Soil microbial biomass C (mg kg^{-1})			
Sunflower	**672**	**630**	754	850	176*
Triticale	672	779	836	765	
		Total organic C (g kg^{-1})			
Sunflower	21	19	21	21	4*
Triticale	22	**25**	21	21	
		Total nitrogen (g kg^{-1})			
Sunflower	1.9	1.7	1.9	1.9	0.4*
Triticale	2	**2.4**	1.9	1.9	

Table 3. Soil C fractions and N under crop rotation systems at depth of 10-20 cm.

Winter crops	Fallow;chisel	Sunn hemp	Forage sorghum	Pearl millet	LSD
		Mineralizable C (mg kg^{-1}) (0-3 d)			
Sunflower	37	36	29	32	22 ns
Triticale	33	30	34	29	
		Mineralizable C (mg kg^{-1}) (0-24 d)			
Sunflower	125	134	97	108	83 ns
Triticale	100	96	115	102	
		Soil microbial biomass C (mg kg^{-1})			
Sunflower	522	521	451	449	186 ns
Triticale	467	438	497	479	
		Total organic C (g kg^{-1})			
Sunflower	18	16	17	17	5 ns
Triticale	18	16	19	16	
		Total nitrogen (g kg^{-1})			
Sunflower	1.6	1.6	1.6	1.6	0.4 ns
Triticale	1.6	1.6	1.8	1.5	

Conclusion

- Soil C fractions at the soil surface were greater with spring cover crops under no-till compared with fallow-chisel (bare soil) – type of cover crop was important
- Carbon input and lack of soil disturbance were reasons for enrichment of soil C fractions at the soil surface
- Therefore, accumulation of surface residues and enrichment of soil microbial habitat are important in improving the quality of soil for soybean in the tropics.

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