

Response of soil biological indicators after 37 years of wheat production management practices in a semi-arid climate

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OBJECTIVES:

- Understanding the link between soil organisms and ecosystem functioning and the impact of agricultural practices.
- Investigate the relationship between SOM and soil biological indicators in a semi-arid environment under mono-culture wheat production practices.



METHODOLOGY:

- Bethlehem, South Africa
- Since 1979
- MAR – 743 mm
- E_0 – 1815 mm
- T_{max} – 22.4 °C
- T_{min} – 6.8 °C
- Mono-culture wheat
(*Triticum aestivum* L.)



METHODOLOGY:

- Plinthosol
 - ✓ orthic A (0-300 mm) – 18% clay
 - ✓ yellow-brown apedal B1 (300-650 mm) – 23% clay
 - ✓ soft plinthic B2 (> 650 mm) - 36% clay



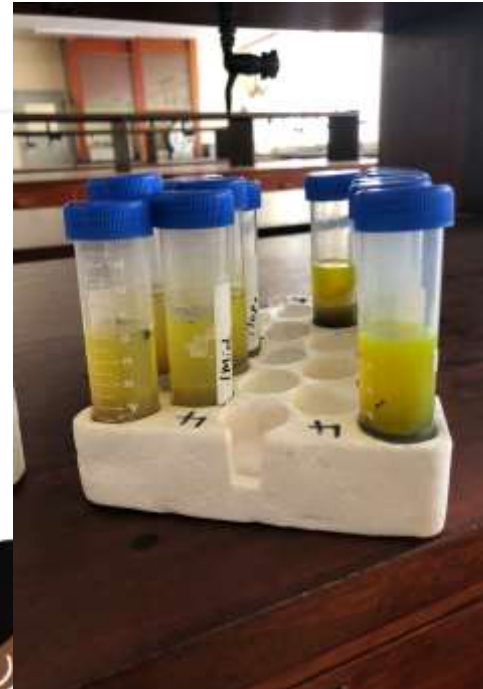
TREATMENTS:

- 3 X Tillage:
 - ✓ ploughing, stubble mulch and no-till
- Combined with chemical weeding
- Crop residue incorporated
- N-rates: 40 kg/ha



SOIL SAMPLING & ANALYSES:

- 0-5 and 5-10 cm soil layers
- Total C & N (Leco)
- Soil enzymes (β -glucosidase and dehydrogenase)
- Microbial biomass (FDA)













RESULTS:



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Tillage practice	Soil layer (cm)	Total C (%)	Total N (%)	Dehydrogenase (INF mg/kg/2h)	β -glucosidase (p-nitrophenol mg/kg/h)	Total microbial biomass (μ g FDA/g)
NT	0-5	0.836	0.0798	106	8636	40
	5-10	0.798	0.0732	104	7409	33
SM	0-5	0.733	0.0787	57	4267	16
	5-10	0.715	0.0668	46	5728	45
CT	0-5	0.725	0.0702	56	3414	21
	5-10	0.709	0.0707	45	4557	11

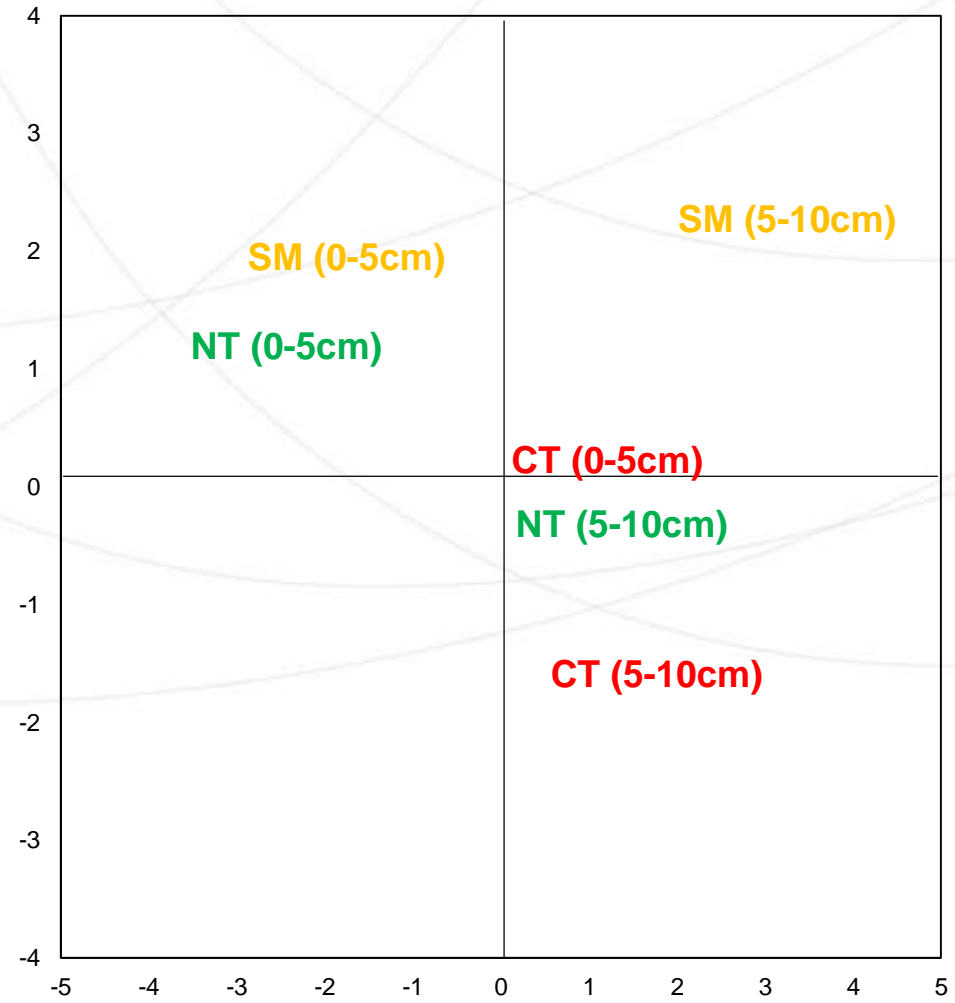
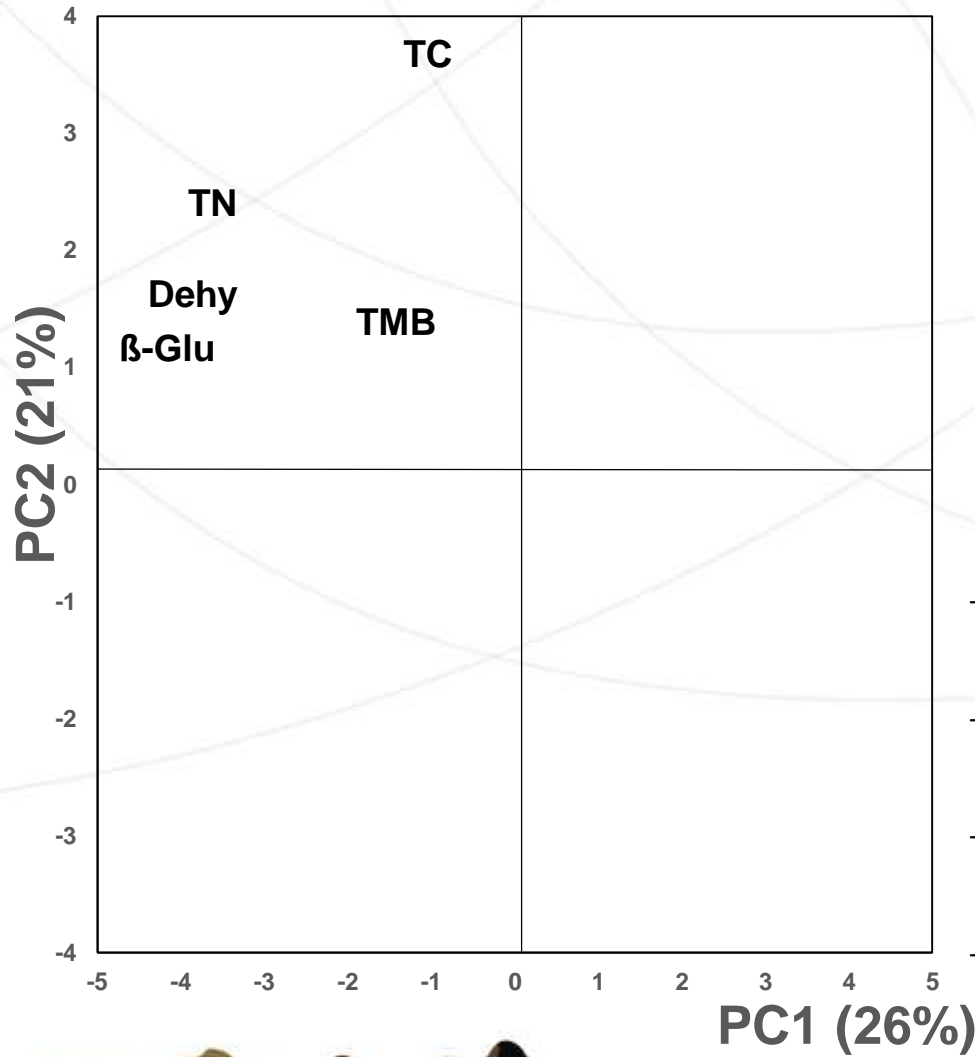
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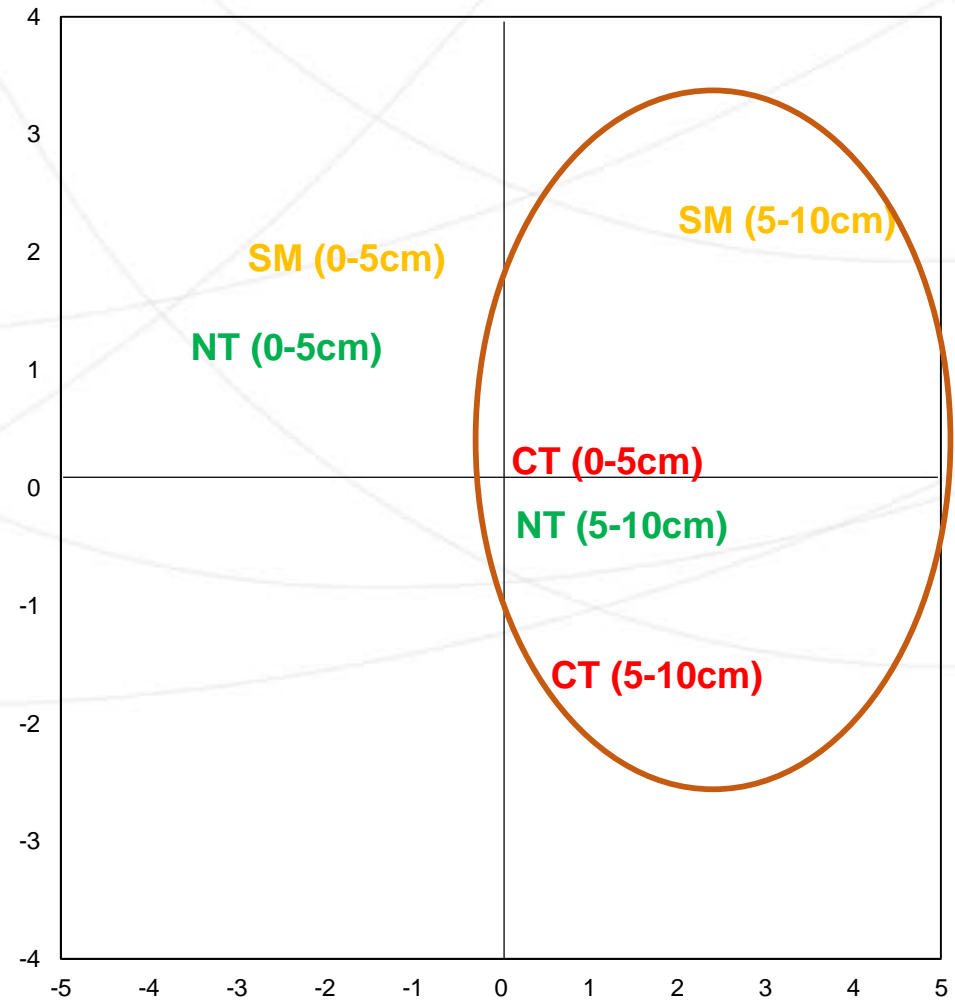
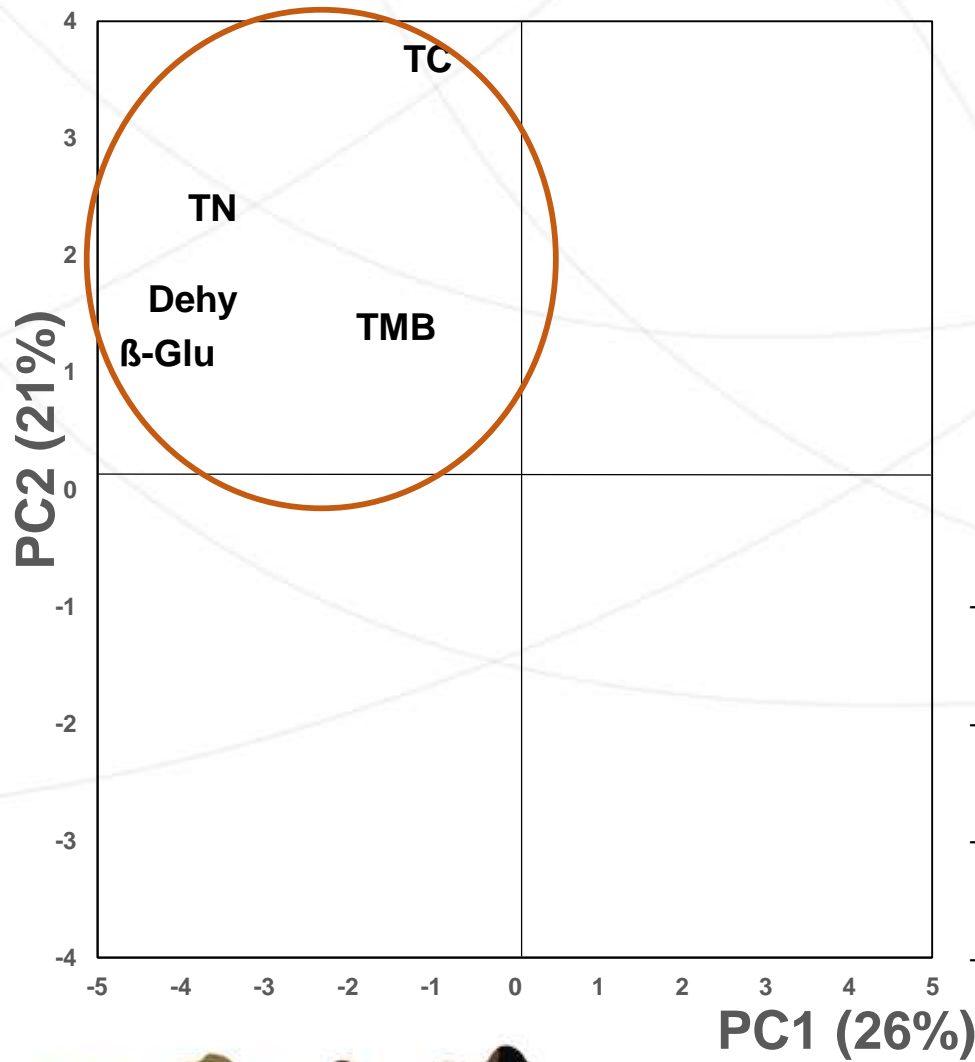
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DISCUSSION:

- Elevated values in NT and SM in 0-5 cm soil layer.
- SOM stratification and accumulation benefitting microbial populations.
- Total N strongly correlated with dehydrogenase and β -glucosidase, indicating soil enzyme activities are quicker to respond to changes in production management practices and land use, compared to total C and N.
- PCA showed increase in soil enzyme activities associated with soil C. Tillage destroys enzyme producing mycelia, breaks down soil aggregates serving as habitat for soil microorganisms.
- Increased amounts of SOM lead to resistance to erosion, better water infiltration, suppressed soil borne diseases and nutrient sink for plants, ultimately the sustainability of many agroecosystems.



CONCLUSION:

- CA practices (NT and SM) are associated with abundance of soil microbial populations.
- CA practices retain higher C contents compared to CT practices, which promotes a healthy soil ecosystem.
- Soil microorganisms can be used as sensitive predictors of soil quality.





**Thank you for
your attention**