α- and β-glucosidase Activities of an Ultisol: Effect of Tillage, Residue Management, and Various Nitrogen Sources

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Introduction

Soil is important in agriculture and for the maintenance of global environmental quality because minor alterations in the soil-stored-elements such as carbon significantly influence global processes. Agricultural practices that require soil tillage, residue management, and various nitrogen sources result in soil changes which need to be monitored. Glycosidases such as α- and β-glucosidases, degrade low molecular weight carbohydrates to release sugars for soil microbial function and are sensitive to soil changes. When assessed alongside other soil properties, α- and β-glucosidases can be useful indices of soil changes.

Objective

Evaluate the effect of various tillage, residue management, and nitrogen sources on α- and β-glucosidase activities of a Decatur silt loam soil (Ultisol).

Materials and Methods

The treatments included various combinations of tillage systems (conventional till, mulch till, and no-till), cropping systems and management practices [cotton in summer and rye (*Secale cereale* L.) cover crop in winter], and nitrogen sources [ammonium nitrate (0 and 100 kg N ha^{-1}) and poultry litter (0, 100, and 200 kg N ha^{-1})]. Soil properties measured included pH, moisture, bulk density (BD), soil organic carbon (SOC), particulate organic carbon (POC), microbial biomass carbon (MBC), potential carbon mineralization (PCM), total nitrogen (TN), particulate organic nitrogen (PON), and microbial biomass nitrogen (MBN).

Results

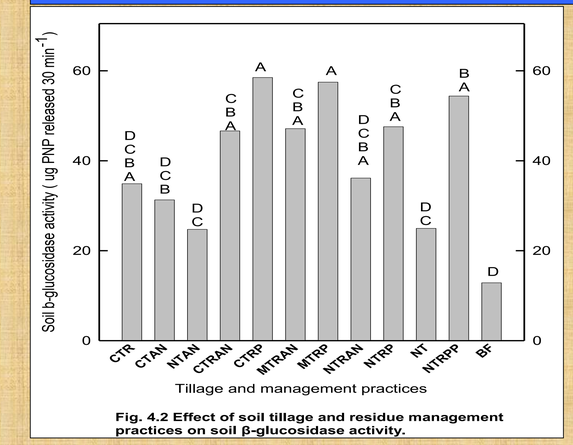

Fig. 4.2 Effect of soil tillage and residue management practices on soil β-glucosidase activity.

CTR= Conventional-till, Rye cropping
CTAN= Conventional-till, Ammonium Nitrate
NTAN= No-till, Ammonium Nitrate
CTRAN =Conventional-till, Rye, Ammonium Nitrate
CTRP= Conventional-till, Rye, 100 kg N ha-1 from Poultry Litter
MTRAN= Mulch-till, Rye, Ammonium Nitrate
MTRP= Mulch-till, Rye,100 kg N ha-1 from Poultry Litter
NTRAN= No-till, Rye,100 kg N ha-1 from Ammonium Nitrate
NTRP= No-till, Rye,100 kg N ha-1 from Poultry Litter
NT=No-till, Cotton-winter fallow
NTRPP=No-till, Rye cropping, 200 kg N ha-1 form poultry Litter
BF=Bare Fallow-no crop planted

Bars within graphs with the same letters are not Significantly different.

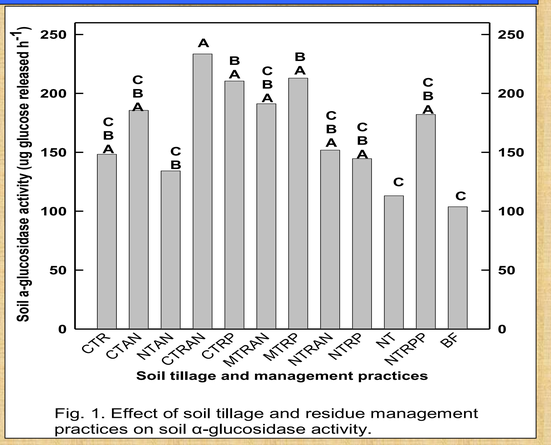

Fig. 1. Effect of soil tillage and residue management practices on soil α-glucosidase activity.

Table 1. Correlation coefficient between soil α- and β-glucosidase activities and soil physical chemical properties.

	Glc[a]	PNP	Moisture	pH	BD	SOC	MBC	POC	MBN	PCM	TN
	r[b]										
PNP	0.746***										
Moisture	0.156NS	0.021NS									
pH	0.118NS	0.215NS	0.248NS								
BD	-0.016NS	0.143NS	-0.121NS	0.030NS							
SOC	0.628***	0.754***	0.168NS	0.113NS	0.106NS						
MBC	-0.382**	-0.545***	-0.191NS	-0.105NS	-0.171NS	-0.712***					
POC	0.579***	0.651***	0.027NS	0.136NS	0.066NS	0.736***	-0.516***				
MBN	0.155NS	0.205NS	-0.047NS	0.490***	0.156NS	0.013NS	-0.204NS	0.337*			
PCM	-0.302*	-0.495***	0.093NS	-0.173NS	-0.048NS	-0.483***	0.394**	-0.313*	-0.249NS*		
TN	0.481***	0.595***	-0.054NS	0.0.145NS	-0.178NS	0.591***	-0.210NS	0.482***	-0.067NS	-0.447***	
PON	0.003NS	0.056NS	0.270NS	0.487***	0.217NS	0.187NS	-0.309*	0.169NS	0.322*	0.056NS	-0.116NS

Glc, (Glucose in soil α-glucosidase assay); PNP, (*p*-nitrophenol in soil p-glucosidase assay); BD, (bulk density); SOC, (soil organic carbon); MBC, (microbial biomass carbon); TC, (total carbon); POC, (particulate organic Carbon); MBN, (microbial biomass nitrogen); PCM, (potential carbon mineralization); TN, (total nitrogen); PON, (particulate organic nitrogen); NS, (Not significant). b *, **, ***, significant at $P \leq 0.05, 0.01, 0.001$; respectively.

Summary

- The results showed that treatments which received higher N-fertilization exhibited higher α- and β-glucosidase activities (Figs 1 and 2), SOC, and MBN, but less PCM.
- Both α- and β-glucosidase activities were significantly inter-correlated and were also correlated with SOC, MBC, POC, PCM, and TN (Table 1).
- The highest SOC were recorded in the fertilized rye treatments regardless of whether it was conventionally tilled, no-tilled, poultry litter or ammonium nitrate fertilized.

Acknowledgments

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