

Pesticide seed treatments containing neonicotinoids have limited effect on soil microbial community structure under different tillage regimes



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Objectives

Investigate how pesticide seed treatment (PST) affects soil microbial communities and soil health under different tillage treatments.



Figure 1. Corn seeds with and without PST.



Figure 2. One plot from each tillage treatment. Photo taken after tilling was conducted in 2018.

Methodology

- Field trial with corn-soy rotation.
- Fully factorial design with 4 replicates of each treatment.
- Tillage treatments since 2013:
 - 1. No Till 2. Strip Till 3. Full Till.
- Pesticide seed treatments since 2016:
 - 1. No PST 2. PST.
- PST is combination of fungicides and insecticides (including neonicotinoid).
- Soil collected from top 5 cm, within rows, 26 days after soy was sown in 2018.

perMANOVAs

	Till	PST	Till x PST
Physico-chemical qualities	0.001	0.824	0.263
Substrate-induced respiration	0.081	0.030	0.708
Enzyme activity	0.442	0.913	0.704
Fungal community	0.001	0.497	0.464
Prokaryotic community	0.001	0.645	0.278

Table 1. p-values from perMANOVAs with a) 13 soil physical and chemical properties b) substrate induced respiration from 15 substrates c) enzyme activities for 5 enzymes d) fungal community (ITS SVs) and e) prokaryotic community (16S SVs).

Microbial diversity

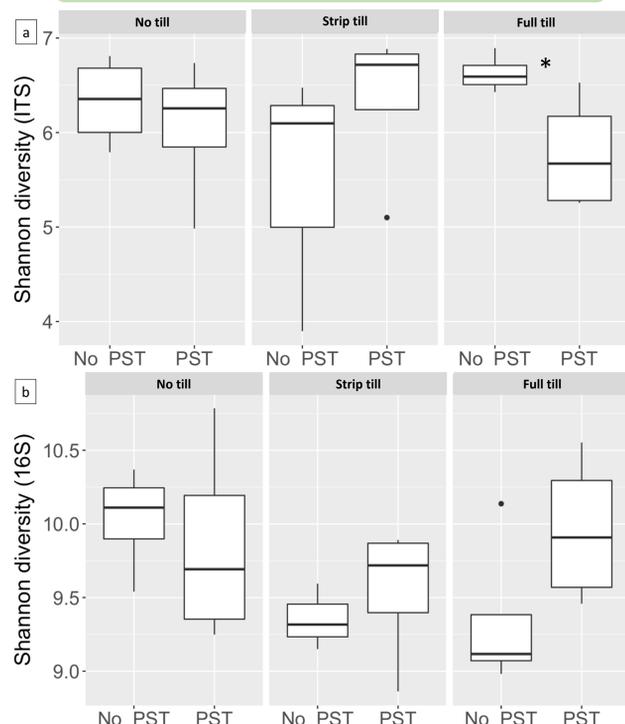


Figure 3. Tillage and PST did not affect diversity (ANOVAs; all p values > 0.05). However, under full till PST reduced fungal diversity (T-test, p=0.04).

Active microbial biomass

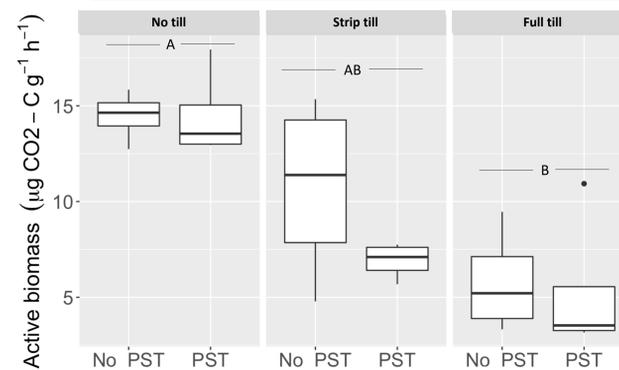


Figure 4. Tillage reduced microbial biomass. PST had no effect on microbial biomass.

Unique/shared taxa

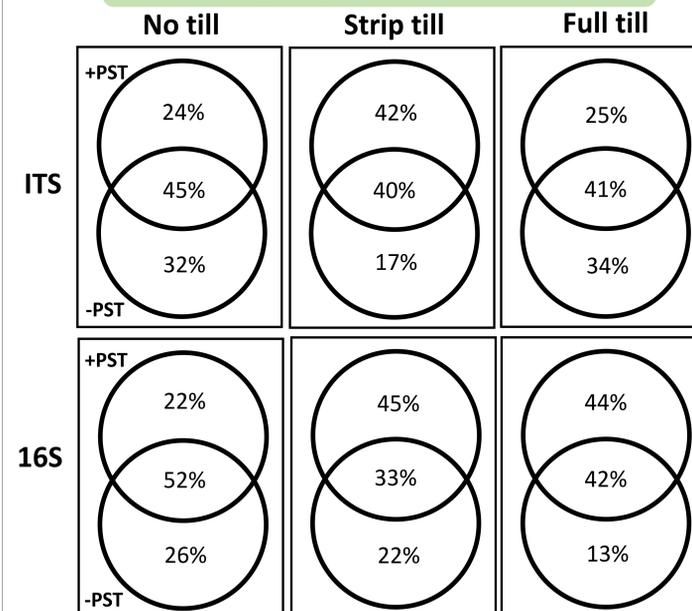


Figure 5. Plots with PST shared 33-52% of their sequence variants (SVs) with plots without PST. The greatest effect of PST on taxa composition was under strip till.

Substrate-induced respiration

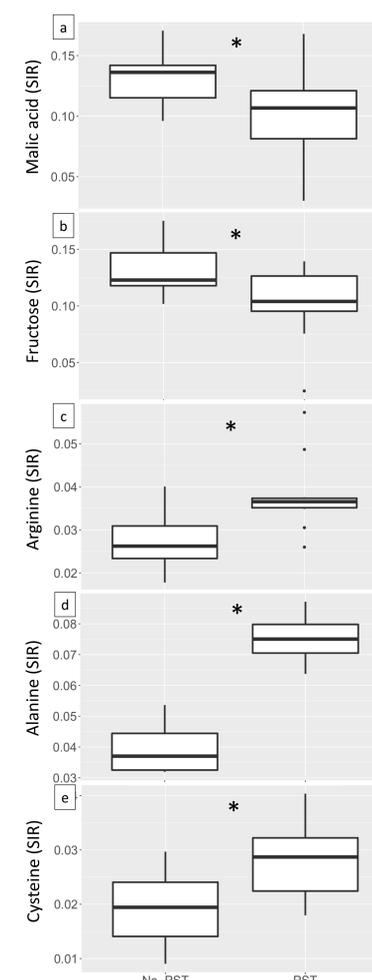


Figure 6. In a MicroResp assay, induced respiration for 5 of the 15 substrates was significantly affected by PST. Graphs show main effect of PST, except for c) which shows the effect of PST under full till. SIR for each substrate is standardized to total SIR.

Potentially mineralizable nitrogen (PMN)

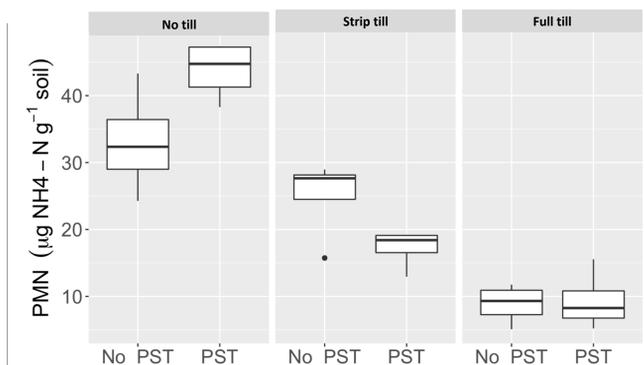


Figure 7. There was a significant interaction between the effect of tillage and PST on potentially mineralizable nitrogen (p-values: Till < 0.05; PST = 0.20; Till x PST = 0.007).

Summary

- Tillage altered soil physico-chemical properties and microbial community structure but had no effect on microbial diversity.
- Under full till, PST reduced fungal diversity.
- Tillage reduced microbial biomass.
- PST altered microbial community structure most under strip till.
- PST altered microbial function, either increasing or decreasing SIR depending on substrate.
- PST increased PMN under no till, but decreased PMN under strip till.

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