Soil health to human health:
The effects of land management practices on nutrient cycling in an agroecosystem

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Introduction

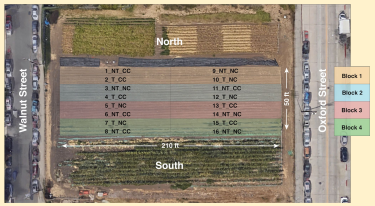
Soil health and human health are intrinsically related, yet their relationship is not immediately obvious. This study aims to illuminate their intersection through the cultivation of black turtle bush beans (*Phaseolus vulgaris*). As crops, beans derive their nutrients from the soil, and as humans we acquire nutrients from beans. Therefore, do healthier soils lead to healthier crops and to healthier humans? Sustainable land management practices of no-till and cover cropping are widely recognized for their benefits to soil health. However, their independent and interactive effects on nutrient cycling and crop nutrient concentration are less known. What are the independent and interactive effects of no-till and cover cropping on soil nitrogen (N) cycling and black bean nutrient content? Fueled by the interest of farmers, agricultural scientists, and public health scholars, this study aims to create more connectivity between the two disciplines of soil health and human health.

Methods

Design: This experiment was conducted at the Oxford Tract Research Station, Berkeley, CA, during the 2019 growing season.
- The experimental design was a split plot, randomized complete block design with four blocks (Fig. 1). Tillage was the main plot with two levels (till and no-till) and cover crop was the sub-plot, also with two levels (cover crop and no cover crop).
- The crop of interest was Peaceful Valley's black turtle bush bean planted on July 12, 2019 and harvested on September 12, 2019.
- During the winter season prior to the experiment, daikon radish was planted in the cover crop plots and broccoli in the non-cover crop plots.

Measurements:
- Soil ammonium (NH_4-N) and nitrate (NO_3-N) concentrations were measured on soils sampled at planting and harvest at depths: 0-5 cm, 5-15 cm, and 15-30 cm.

Figure 1. Field site and experimental design
Image form C. Rainey



- Total soil N, soil micronutrients, and bean macro and micronutrients were measured at the UC Davis Analytical Lab.
- Bean protein content was measured using a specific nitrogen-to-protein conversion factor of 5.4 (Mariotti et al. 2008).
- ANOVA, model selection and linear regression were used for statistical analysis.

Results

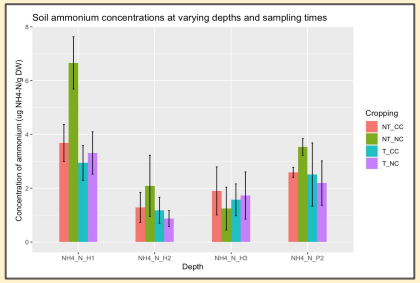


Figure 2. The effect of crop regime on NH_4-N concentration

- At harvest NH_4-N concentrations were higher in the top 0-5 cm of the soil, averaging 4.15 ug NH_4-N/g DW relative to concentrations at 5-15 cm and 15-30 cm in the soil (Fig. 2).
- Tillage had a significant effect on NH_4-N concentrations at harvest at 0-5 cm ($P = 0.05$) and no effect on NO_3-N (Fig. 2).
- Tillage had a significant effect on total soil N in the top 0-5 cm of the soil, with higher concentrations in no-till plots (Fig. 3).
- Cover cropping reported to have no significant effect on any soil health metrics, with the exception of plant biomass at harvest.

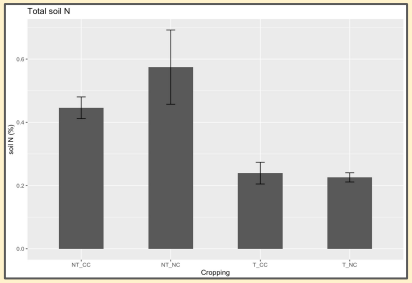


Figure 3. The effect of crop regime on soil total N concentration

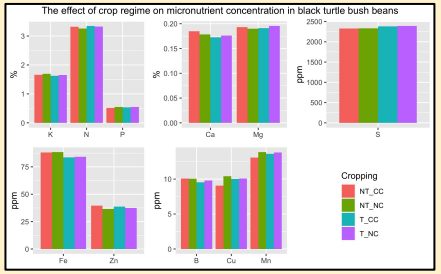


Figure 4. The effect of crop regime on bean nutrient concentration

Macro and micronutrient concentrations in beans are similar across all crop regimes (Fig. 4).

Discussion and Conclusions

- A relatively large amount of residual organic and inorganic N was present at harvest in no-till plots. This can be correlated with the addition of compost to no-till plots and prolonged N mineralization.

- While no-till agriculture reports an effect on metrics of soil health in one growing season, there is no effect of tillage and cover cropping practice on metrics of bean yields and nutrient content. While there may be no immediate, short term effect on bean nutrition, further research should explore the long term effects of crop management practices and soil health on bean nutrition.

Acknowledgements

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References

Mariotti, F., Tome, D., Mirand, P.P., 2008. Converting Nitrogen into Protein--Beyond 6.25 and Jones' Factors. *Critical Reviews in Food Science and Nutrition*. 48:2, 177-184.

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