Effects of Cover Crop Mixtures on Biological Indicators of Soil Health

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Abstract

The use of cover mixtures in agronomic systems has been widely promoted since increasing plant diversity may enhance ecosystem services leading to better soil health. In this study, effects of cover crop mixtures on biological indicators of soil health were examined in a conservation cotton (*Gossypium hirsutum* L.) production system. Biological indicators of soil health evaluated were active C, soil respiration, glomalin-related soil proteins (GRSP), and arbuscular mycorrhizal colonization of cotton. Winter cover crop treatments included fallow, cereal rye (*Secale cereal* L.), cereal rye + crimson clover (*Trifolium incarnatum* L.), cereal rye + radish (*Raphanus sativus* L.), crimson clover + radish, and a mixture of all three cover crops. These treatments had been in place for one year when soil samples were taken at depths of 0–5, 5–10, 10–15, 15–30, and 30–45 cm. Amounts of active C ranged between 80 and 442 mg/kg soil and GRSP between 1.2 and 5.1 g/kg soil from the lowest depth to the surface. Active C accounted for 2.2 to 5.1% of the soil organic C. There were no significant differences in active C, soil respiration and GRSP among the six treatments at any soil depth, but mycorrhizal colonization of cotton following the cereal rye + crimson clover treatment was higher than that after the fallow treatment. Overall positive correlations were observed between active and soil organic C (r = 0.60), active C and soil respiration (r = 0.82), GRSP and active C (r = 0.91), as well as GRSP and soil respiration (r = 0.68). A longer duration for cover crop treatments may be needed to detect changes in biological indicators of soil health.

Objectives

1.Determine effects of cover crops and their mixtures on biological indicators of soil health;

2. Determine the changes of biological soil health indicators with soil depth

Methods

Field Experiment

- *Study site:* Auburn University's E.V. Smith Research Center in Shorter, AL
- .*Experimental design:* Randomized complete block design with four replications.
- *Treatments:* cereal rye, cereal rye + crimson clover, cereal rye + radish, crimson clover + radish, and a mixture of all three cover crops.
- *Soil sample collection:*
  - Sampling time: May 2016 for arbuscular mycorrhizal colonization.
    October 2016 for active C, soil respiration, and GRSP.
  - Sampling depths: 0–5, 5–10, 10–15, 15–30, and 30–45 cm for active C, soil respiration, and GRSP.

Laboratory Analysis

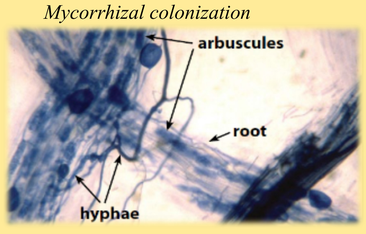
Active C

Soil respiration

GRSP

https://media.biocompare.com/m/37/article/177742/

Mycorrhizal colonization



https://s3.amazonaws.com/soilquality-production/resources/2/original/Biol_

Data Analysis

Data were analyzed with JMP software (Ver. 13) using analysis of variance (ANOVA) and linear regression analysis.

A view of the study site

Table 1: Active C, soil respiration, and GRSP at the 0–5 cm depth by treatments

Treatments	Active C (kg/ha)	Soil respiration (kg/ha)	GRSP (kg/ha)
Fallow	271.8a	3469.7a	25.8a
Cereal rye	289.4a	3576.8a	33.9a
Cereal rye + crimson clover	302.3a	3590.6a	28.7a
Cereal rye + radish	302.9a	3448.1a	33.6a
Crimson clover + radish	326.0a	3670.4a	38.8a
3 way mix	300.1a	3477.7a	30.6a

Different letters within a column indicate significant differences among treatments at the 0.05 level.

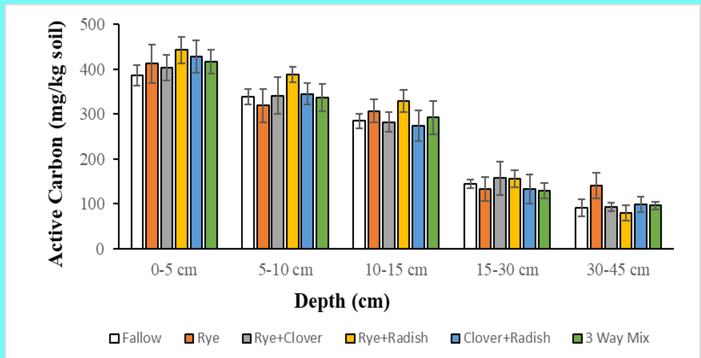


Figure 1 : Active C for the six treatments at different depths. Error bars represent standard deviation (n=4).

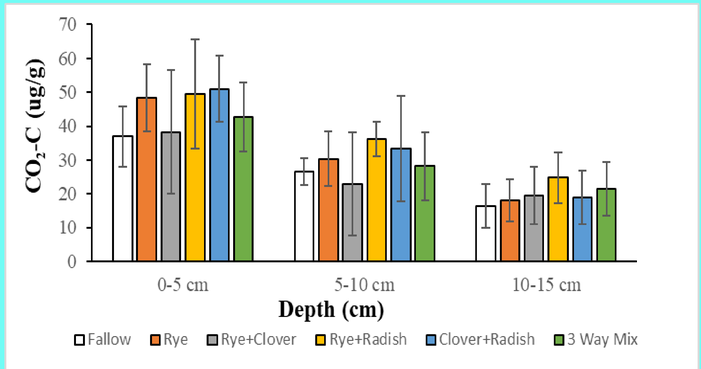


Figure 2: Soil respiration for the six treatments at different depths. Error bars represent standard deviation (n=4).

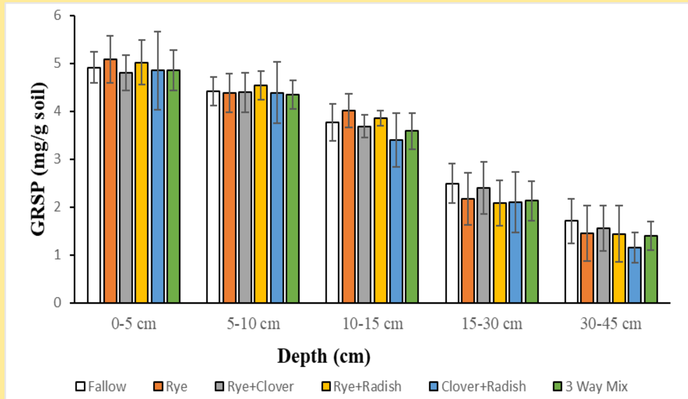


Figure 3: Glomalin-related soil protein (GRSP) for the six treatments at different depths. Error bars represent standard deviation (n=4).

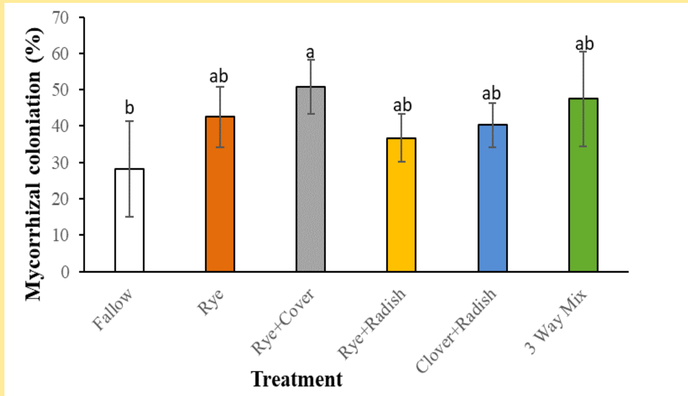


Figure 4: Arbuscular mycorrhizal colonization of cotton by treatments. Error bars represent standard deviation (n=4).

Results

- Active C, soil respiration, and GRSP did not show significant difference among the treatments statistically. Numerically, active C, soil respiration, and GRSP were the highest in the treatment of cereal rye + radish, crimson clover + radish, and cereal rye, respectively, at the surface depth (0–5 cm) (Figures 1, 2, and 3).
- Active C, soil respiration, and GRSP decreased as soil depths increased for all treatments (p=0.0001) (Figures 1, 2, and 3).
- Mycorrhizal colonization of cotton roots was higher in the cereal rye + crimson clover treatment than in the fallow treatment (p=0.05) (Figure 4).
- Active C consisted of 2.2 – 5.1 % of soil organic C for different treatments.
- There were positive correlations between active C and soil organic C (r = 0.60), active C and soil respiration (r = 0.82), GRSP and active C (r = 0.91), as well as GRSP and soil respiration (r = 0.68) (p<0.0001).

Summary

In the first year of cover crop treatments, no significant changes were observed for biological indicators of soil health except for arbuscular mycorrhizal colonization. A longer duration of cover crop treatments might be needed for changes to occur in sandy soils of

Acknowledgements

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