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Potential Contributions of Legume Cover Crop Root Biomass to Labile Organic Matter Pools

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INTRODUCTION

Cover crops play an important role in soil fertility enhancement as well as soil carbon (C) sequestration. While contributions of above ground biomass to soil C and nitrogen (N) pools are well known, less is understood for rooting systems. Depth to which roots add organic matter may influence labile soil C pools and is an important consideration especially for organic farming systems.

To investigate root contributions to C and N pools, three legume species were assessed for C and N concentrations in field systems. We sampled two depths, distinguishing between fine (<2 mm) and coarse (>2mm) roots. We hypothesized that most organic matter would accumulate in the upper rooting zone, and based on previous lab root architecture assessments, that crimson clover would yield the greatest organic matter in both zones.

OBJECTIVES

- Quantify root derived organic matter associated with four cover crop species at spring termination prior to cash crop planting
- Compare C and N deposited via cover crop roots at two soil depths

EXPERIMENTAL DESIGN

We used a randomized complete block design with four replications of each legume species:

Austrian Winter Pea (*Pisum sativum*)

Hairy Vetch (*Vicia villosa*)

Crimson Clover (*Trifolium incarnatum*)

Control - No cover crop

METHODS

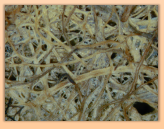
- Planting date of cover crop: October 3rd, 2011
- Sampling date of cover crop: May 7th, 2012

One representative sample was taken from each block, yielding 16 samples divided by two depths, top 10 cm and bottom 20 cm, totalling 32 samples.

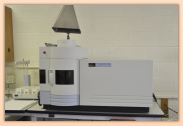
Root cores of 7cm in diameter were taken at 30 cm depths using an AMS Soil Core Sampler.

Samples were washed using a series of fine mesh sieves at 2mm, separating fine roots plus organic debris and coarse roots. The fine root hairs and organic debris was sieved using a 0.10 mm sieve and the remaining debris further sieved and descanted with a 5 mm sieve.

A mix of living and dead fine root samples



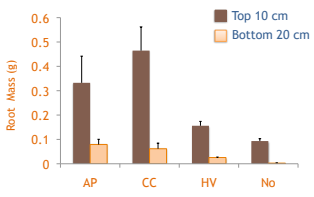
Fine and coarse roots before separating



- Roots were dried for 48 hours at 65 C and then weighed.
- The samples were finely ground and analyzed for total C and N using a PerkinElmer model 2400 CHN Elemental Analyzer.

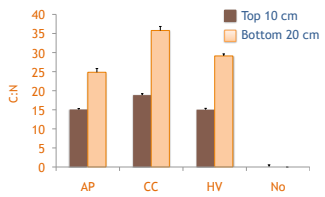
RESULTS

Coarse Root Mass by Depth



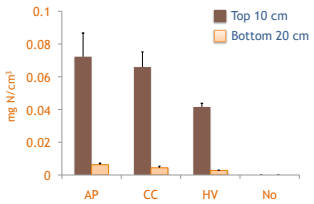
- Less coarse root mass was present at lower depths compared to upper ($p < 0.0001$).
- Crimson clover and Austrian winter pea coarse roots contribute greater root mass to upper horizons than do hairy vetch roots ($p < 0.01$).

Coarse Root C:N



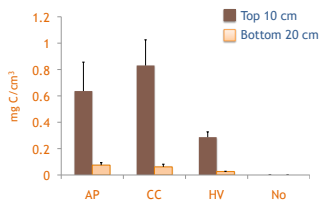
- Upper rooting zones contain lower C:N ratio roots than do lower rooting zones ($p < 0.0005$).
- There was no difference in C:N among cover crop species roots ($p > 0.05$), ranging in the upper horizon from 15 for Austrian winter Pea and hairy vetch to 17 for crimson clover.

Total N Contribution Per Unit Soil



- Percent N by volume soil is greatest in the upper 10 cm of rooting zone ($p < 0.0001$).
- Austrian winter pea and crimson clover contributed a greater amount of N per unit soil than hairy vetch ($p < 0.05$).

Total C Contribution Per Unit Soil



- Percent C by volume soil is greatest in the upper 10 cm of rooting zone ($p < 0.0001$), confirming this zone to be the region of greatest C sequestration.

CONCLUSIONS

- In the sandy loam soils of central North Carolina, common winter annual legume cover crop roots deposit a far greater amount of overall root mass, C and N in the top 10 cm of soil root zone.
- Crimson clover and Austrian winter pea contribute a greater mass of coarse roots in the upper rooting zones to the soil than hairy vetch.
- Crimson clover and Austrian winter pea contribute a greater proportion of N to the upper soil horizons, mainly through coarse roots, than hairy vetch ($p<0.05$).
- When measuring roots contributions to the soil, care must be taken to distinguish between roots and debris. We encountered difficulty in separating roots approximately 2 mm in diameter from soil debris (dead roots, minerals, weed roots, etc.), which resulted in a potential loss of coarse roots.
- This study demonstrated that roots from winter annual cover crop legumes have the potential to contribute great amount of N and C to labile soil pools via root deposition.

THANK YOU

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