Carbon and Nitrogen Mineralization from Canola, Wheat, and Pea Residues Differing in Nitrogen Content and Carbohydrate Composition

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Conflicting studies indicate that net N mineralization can either increase or decrease when following canola relative to cereal crops. Understanding decomposition and N mineralization is critical for residue and fertility management within a crop rotation that includes canola under zero-tillage. Interactions between N fertility and biochemistry in the decomposition and N release/retention of various crops requires further study, ultimately to determine whether more or less fertilizer N is needed following canola. In 2013, we collected nine crop residues from canola, wheat, and pea crops with varying N contents and characterized the residues with NMR (Bruker DRX 400 ^{15}N CP/MAS solid state NMR and Varian Vx 400 1H NMR) and elemental analysis for total C and N, solubel and NH_4^+/NO_3^-, and dissolved organic C and N. Proximate fiber analysis (ANKOM 200 sequential fiber digestion) was performed to determine the Neutral detergent fiber (NDF), Acid detergent fiber (ADF), and Acid detergent lignin (ADL) total and step-wise mass and TC/TN determination. We conducted three laboratory experiments examining residue mass and TC and TN losses, weekly CO_2 evolution rates (GRACEnet protocol for gas sampling at 0, 2, 4, and 6 hour deployments), and net N-mineralization rates via destructive sampling for NH_4^+-N and NO_3^--N in a Palouse soil amended with 0.4% residue at over 16 weeks. We found that canola residue, like pea, had a higher proportion of soluble components. Most residue N was easily soluble and not bound up in structural carbohydrates. Dissolved organic N and NDF soluble N was strongly related to the total N content of the residues in all crop residues (R^2 = 0.97 and 0.99). Over the 16 weeks, mass and C losses from canola were similar to pea and wheat, despite differences in biochemistry. Within the first 4 weeks, the average CO_2 mineralization rate was strongly correlated to the readily available fraction of C that was NDF soluble and greatest in soil amended with canola and pea and least in wheat. N dynamics were largely explained by differences in TN, DON, and NDF soluble N with crop residues, with canola and pea residues being more enriched in N on average. However, residues with C:N ratios above 25:1 did not differ in their net N immobilization potential, suggesting overall similarities in quality. However, further research needs to consider the interactive effects of residue quantity and quality on N cycling.

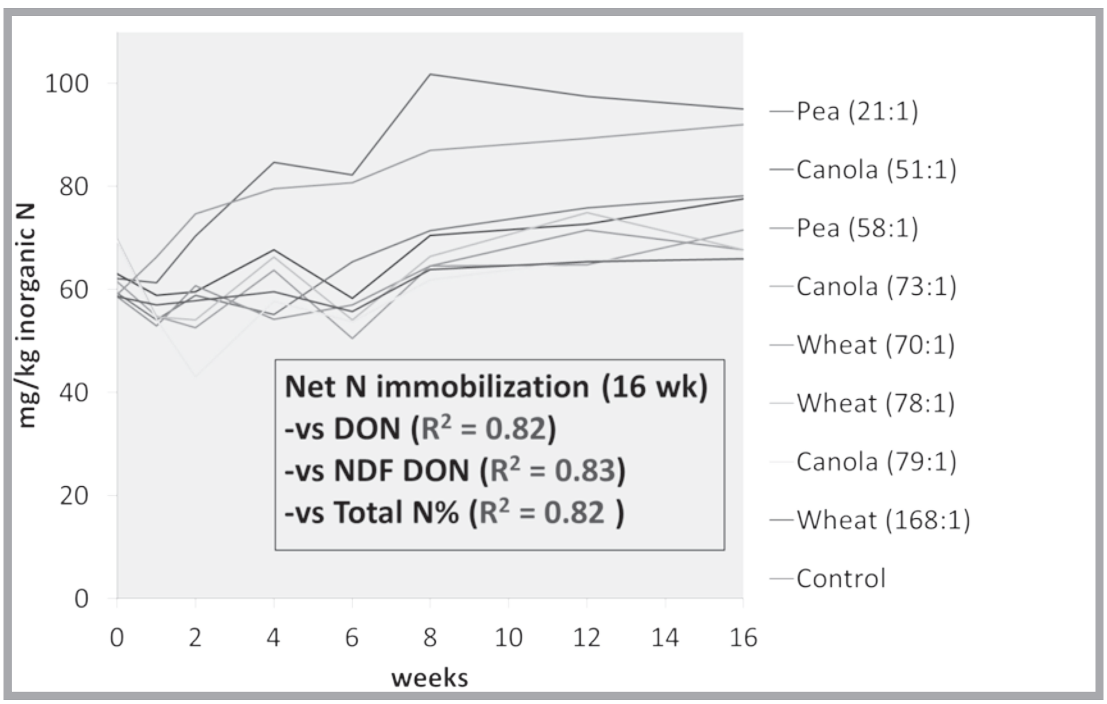

Figure 1. N dynamics following the addition of pea, canola, and wheat residues with variable C:N ratios (in parentheses). Cumulative net N immobilization over a 16-week incubation was correlated to dissolved organic N, neutral detergent fiber soluble N, and total N content. Majority of N in residues is readily soluble.