# Synchronizing N Supply with Crop Uptake in Spring Wheat Crop Rotations by Altering Green Manure Management Strategies.

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***Background:***
Synchronizing crop N uptake with soil N supply in organic wheat (*Triticum aestivum* L.) production depends on the incorporation timing and season of green manure. Fall incorporation of the green manure red clover (*Trifolium pretense* L.) has the risk of over-winter N loss to the environment, while spring incorporation could delay the planting date of the subsequent crop. Moderate additions of manure or $NH_4NO_3$ fertilizer (< 70 kg N $ha^{-1}$) in the spring may be used in conjunction with fall plowdown to guarantee desired grain yields, yet has the potential to exceed crop N demand and lead to $NO_3^-$ leaching and $N_2O$ emissions. The objective of this study is to assess four green manure management strategies on crop uptake and environmental N loss from a 3-year rotation of red clover (2 years) and spring wheat (year 3) in Truro, Nova Scotia.

***Project Overview:***
Treatments include; i) early fall incorporation + N fertilizer (70 kg N $ha^{-1}$), ii) late fall incorporation, iii) above-ground clover removed as hay & residue late fall incorporated + spring manure (70 kg N $ha^{-1}$), and iv) spring incorporation.

**Whole plant wheat yield & N uptake**

| | Whole Plant Yield | Crop N Uptake | Post Harvest Soil N (0-30 m) |
|---|---|---|---|
| | Mg $ha^{-1}$ | kg $ha^{-1}$ | kg $ha^{-1}$ |
| **Treatments** | | | |
| **early + fert ($N_{70}$)** | 4.0 | 121 | 18.3 |
| **late fall** | 3.4 | 90 | 15.8 |
| **roots only + manure ($N_{70}$)** | 3.5 | 92 | 14.6 |
| **spring** | 2.8 | 74 | 18.6 |

Whole plant wheat biomass at peak N uptake was greatest from the early fall + $N_{70}$ treatment (4 Mg $ha^{-1}$) as compared to spring (2.8 Mg $ha^{-1}$), and N uptake was 121 and 74 kg $ha^{-1}$, respectively. Post-harvest soil N-min (0-30 cm) ranged from 14.6 to 18.6 kg $ha^{-1}$, yet were not different among treatments. Nitrate concentrations in drainage water averaged 6.1 to 8.7 mg $L^{-1}$ from November 2010 to June 2011, without any effect of treatment.

***Conclusions:***
It is clear that the timing of red clover incorporation and the use of supplemental N can significantly affect overall harvest yields and the supply of soil N. Cool and wet spring conditions had a large impact on seasonal N dynamics from the spring treatment, while the two late fall treatments were almost identical, even when above-ground clover was removed and manure was applied at a moderate rate. Post-harvest soil N from the root zone is very low in all treatments, even with the addition of supplemental N at moderate rates of 70 kg N $ha^{-1}$, yet soil N supply and overall plant yield was the lowest from the spring treatment. Ongoing research is addressing over-winter $N_2O$ emissions and $NO_3^-$ leaching from these treatments.

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