Winter cover crops and nitrate leaching: combining field measurements with modeling to study the effects

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Research goals:

Nitrate leaching losses pose a major environmental challenge. In order to identify useful management strategies to minimize nitrate losses, nitrate movement in the soil should be studied during the winter (rainy) months in addition to the summer cash crop seasons. The study presented here focused on the effects of winter cover crops on nitrate dynamics. The study has three main objectives: (1) examine cover crop dry matter production, N uptake, and root development, including rooting depth and root density distribution; (2) explore differences in soil nitrate distribution in relation to plant canopy and root system development; and (3) develop simple plant growth models that can be used to investigate the effect of planting and termination dates on cover crop N uptake.

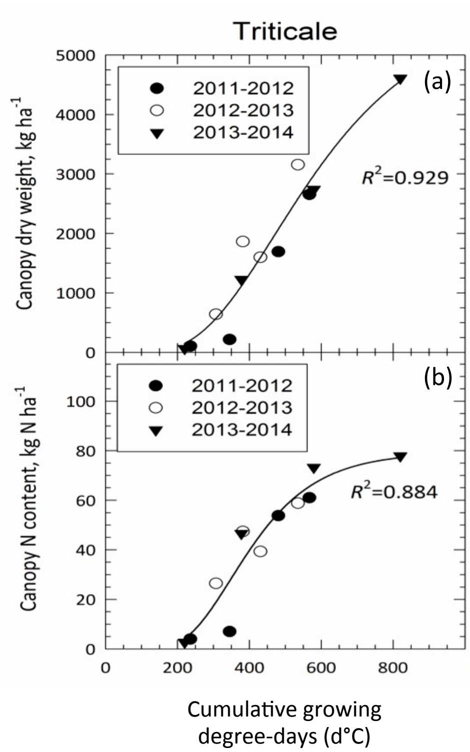


Figure 1. Accumulated temperature (growing degree-days) is a good predictor of triticale dry weight and canopy N content. Relationships are shown for data collected during three cover crop seasons. Tricale was fitted using the Chapman-Richards equation: (a) $y = 5754(1 - e^{-0.004x})^{7.157}$ and (d) $y = 79.34(1 - e^{-0.008x})^{14.03}$.

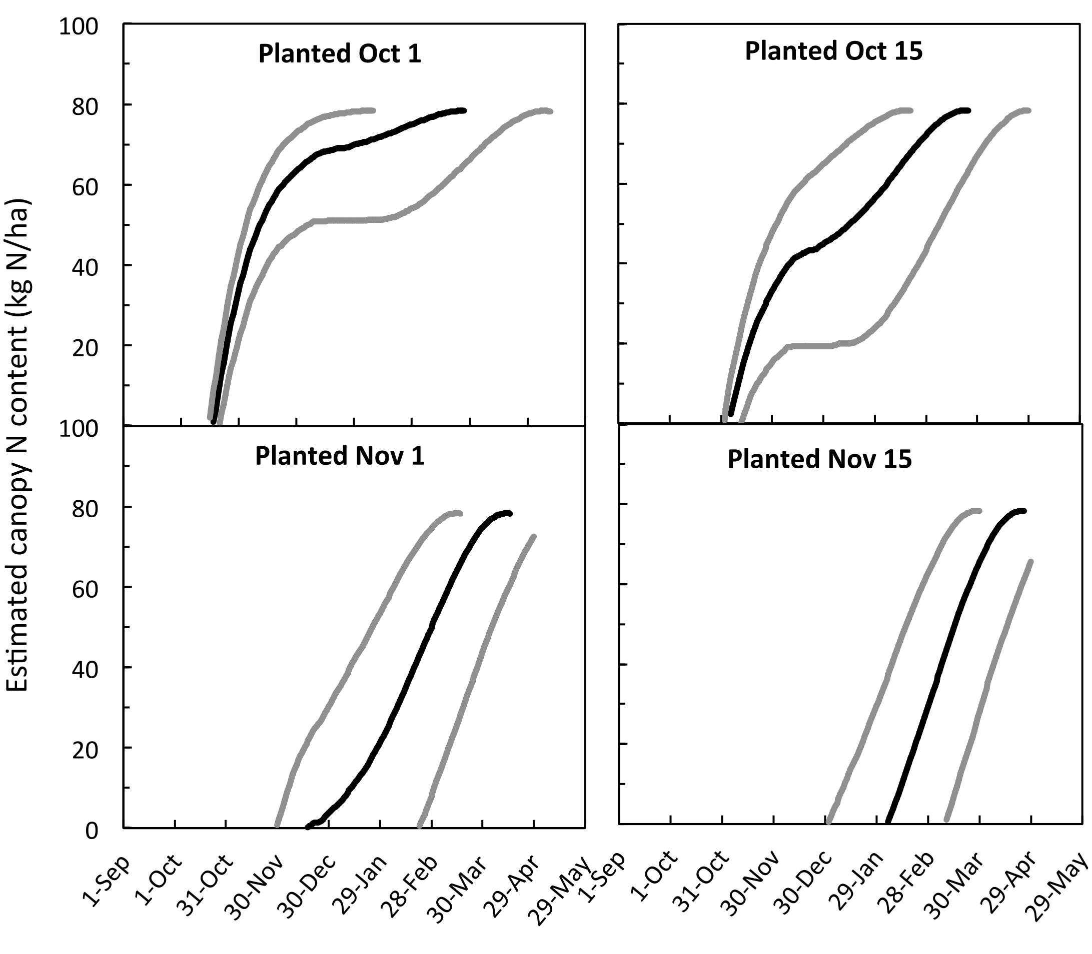
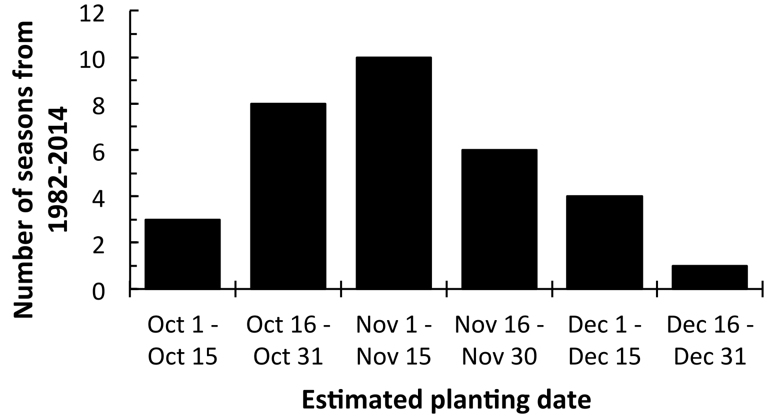


Figure 2. Effect of planting date on estimated N uptake by triticale in average, warmer than average and colder than average years. Normal temperature trends for the cover crop season were estimated by calculating the average temperature for each day using data from 1982 - 2014. Warmer and colder seasons were created by calculating the temperature that corresponds to the 75th and 25th percentile, respectively, for each day. Each set of temperatures were then used to calculate growing degree-days and triticale N content.

Figure 3. Potential planting dates for cover crop seasons from 1982-2014. Optimal planting dates were determined to be two days prior to the first major rain storm or series of storms that provided 1 – 1.5 in. of rain within a five day period.



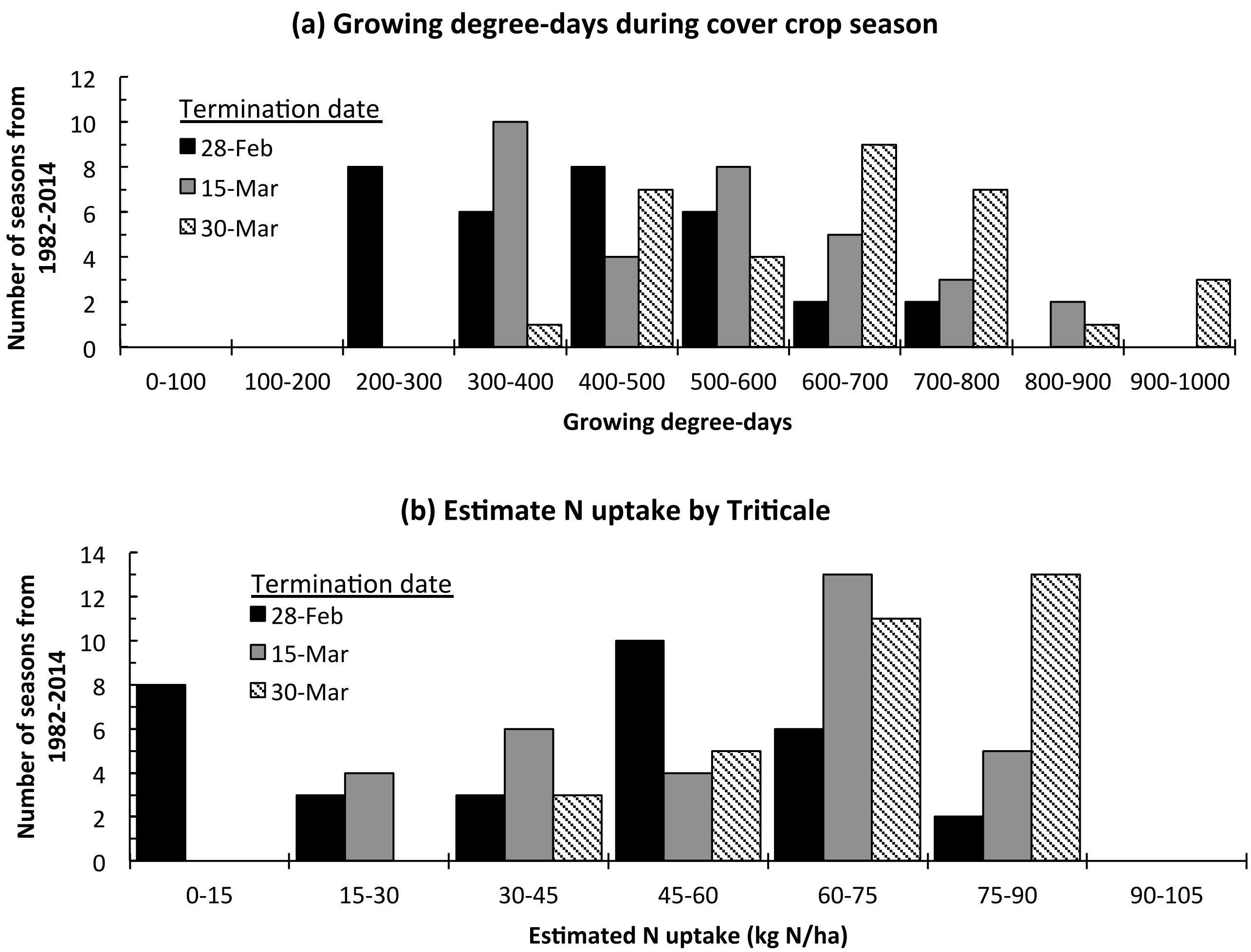


Figure 4. Estimated (a) total growing degree days during the cover crop season and (b) triticale N uptake if planted immediately prior to the first rains and terminated on February 28, March 15, or March 30. Estimates are based on weather data from 1982-2014 for Davis, CA.

Conclusions:

- The planting date has a large effect on potential N uptake. Planting triticale earlier in the fall (early October) enables triticale to accumulate N prior to the wettest winter months. Planting in mid-November pushes back significant N accumulation until March during years with average temperatures.
- Delaying termination until mid- to late-March has a large effect on potential uptake of N by triticale. Planting early would also allow triticale to be terminated earlier.