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Introduction

The rising demand for local, organic bread wheat may present economic and agronomic opportunities for our region's organic dairy producers.

- Dairy farms have a cost-effective nitrogen (N) source, manure, to produce organic bread wheat.
- Bread wheat can provide added farm income as a relatively high-value cash crop; and grain that does not meet quality standards for bread flour can be used as on-farm feed.
- Wheat may enhance the production of high-quality perennial forages, critical to organic milk production, by providing an opportunity to re-establish perennial forage stands. Perennial forage quality declines with age as legume composition decreases; and wheat is ideally suited to act as a "nurse crop" for new perennial forage seedings, through interseeding.

To be a viable crop on organic dairy farms, wheat must have adequate:

- Quality - to be sold into the high-value local bread flour market (ex. protein levels $\geq 11\%$) or be used as organic feed for milk production.
- Yields - to be profitable.

Research Question

Can bread wheat, grown in organic dairy crop sequences, be produced profitably for the bread flour market and improve perennial forage yields and quality via reseeded?

We compared five different three-year crop sequences that included winter wheat (WW) or spring wheat (SW) and ended in re-established forage.

Our objectives were to:

- Determine how prior crop affects wheat grain yield and protein concentration.
- Compare perennial forage yield, composition, and projected milk yield among forage stands that follow wheat and a continuous perennial forage control.
- Evaluate the profitability of different crop sequences.

Materials and Methods

- A 3-year field was established in 2010 and again in 2011 at two sites in Maine.
- A randomized complete block design was used and plots were 10.7 x 4.9 m.
- Soils were Suffield coarse loam and Melrose very fine sandy loam, both with clayey substratum with slow to very slow permeability. These soils are typical of Northeast dairy farms.
- Crop nutrient needs were met with pre-plant manure and, in some cases, forage plowdown. Target available N rates were 85 kg ha⁻¹ for WW and 76 kg ha⁻¹ for SW.



Perennial forages were frost-seeded into WW and seeded with SW at planting.



Wheat grain yield and protein were determined on samples collected from a 12.2 m² area with a plot combine.



Forage yield and quality were measured at 3 cuts per year from a 13.4 m² area.



Forage was sorted into grass, legume and weeds.

Treatment	YR 1	YR 2	YR 3
C-WW-PF	Silage corn (short-season)	Winter wheat	Perennial forage
PF-WW-PF	Perennial forage	Winter wheat	Perennial forage
C-SW-PF	Silage corn (full-season)	Spring wheat	Perennial forage
S-SW-PF	Soybeans	Spring wheat	Perennial forage
PF-SW-PF	Perennial forage	Spring wheat	Perennial forage
PF-PF-PF	Perennial forage	Perennial forage	Perennial forage

Note: All plots were in perennial forage prior to trial establishment. The continuous perennial forage control was seeded in the spring prior to Year One and was 40% alfalfa, 40% perennial ryegrass, 20% timothy. The reseeded perennial forage was 60% red clover, 20% perennial ryegrass, 20% timothy.

Results

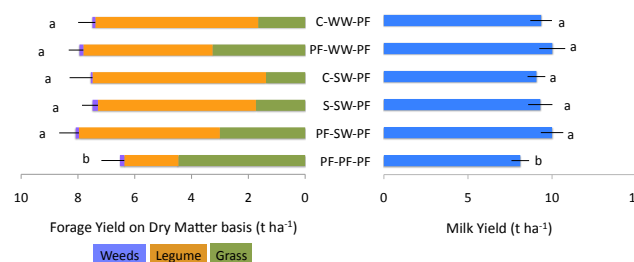
Wheat Grain Yield & Protein



† Treatment means that share common letters are not significantly different at p<0.05. Error bars are standard error.

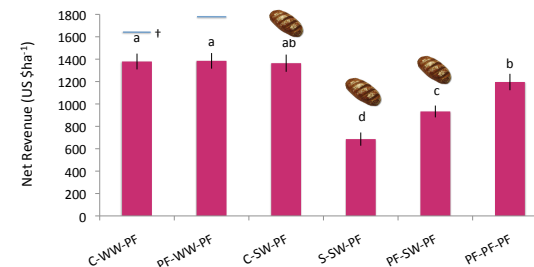
- Grain yield and protein differed primarily by wheat type. An inverse relationship between grain yield and protein was evident.
- Spring wheat yields suffered due to planting delays caused by wet springtime weather and slow draining soils at both sites.
- Winter wheat yielded adequately but protein levels did not qualify for the bread flour market.
- Grain protein was greater when winter wheat followed forage versus corn, likely because the timing of N mineralization differed between the two sources (forage plowdown vs. manure).

Forage and Projected Milk Yields



- Perennial forage reseeded after wheat produced higher yields and contained a higher proportion of legumes than the continuous perennial forage control.
- Projected milk yields (MILK2013, U. Wisconsin) were greater for the reseeded treatments due to greater yields and legume content.

Net 3-Year Revenue (Off-Farm Sales)



† Net revenue when winter wheat is valued as bread flour assuming added costs for topdressing N to achieve acceptable protein levels.

- Only spring wheat had grain protein levels suitable for the bread flour market, but the net revenue of spring wheat crop sequences was reduced due to low grain yields.
- Crop sequences with winter wheat had the highest 3-year net returns despite receiving a lower pay price as organic feed than as bread wheat.
- Higher grain protein levels for organic winter wheat are attainable in our region through variety selection and topdressing N in the spring (Mallory and Darby, 2013). Net revenue for the winter wheat sequences increased when costs for topdressing an approved organic N source were added and grain was valued at the price for bread wheat.
- This economic analysis assumes all crops are sold off the farm. A more realistic evaluation that translates feed and forage crops into milk production will be conducted.

Conclusions

- Rotating out of perennial forage and into one or two years of annual crops followed by forage reseeded proved to be a viable strategy for improving perennial forage yields, quality, and in some scenarios, increasing overall profitability.
- Spring wheat was not a viable crop on the soils used in this study, which are typical of dairy farms in our region, because poor drainage delayed spring planting. Proper site selection and use of winter instead of spring wheat are important considerations for profitable wheat production on dairy farms.
- Winter wheat can be a valuable crop for dairy producers to increase net revenues and perennial forage production. Profitability would be improved by using management strategies that increase wheat grain protein levels such as following a perennial forage plowdown, selecting high protein varieties, and topdressing with an approved organic N source in the spring.

References

- Mallory, E.B., and H. Darby. 2013. In-season nitrogen effects on organic hard red winter wheat yield and quality. *Agron. J.* 105: 1167–1175.
- Undersander, D., Shaver, R., Combs, D., Hoffman, P. 2013. MILK2013. University of Wisconsin Extension, Madison, WI. <http://www.uwex.edu/ces/forage/articles.htm#milk2000> (accessed 29 Oct. 2014).