Developing Perennial Grain Cropping Systems and Market Opportunities in the Northeast

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Background

Perennial small grain crops are a promising option for sustainable agriculture. They require fewer material and labor inputs while simultaneously providing ecosystem services, such as erosion control and soil health improvement, that are not possible with annual crops (Asbjornsen 2013). During the last few decades, breeding programs have developed perennial grain varieties with several nearing commercial viability (Acharya 2004; DeHaan 2014). Recently, the launch of the first major commercial food product made with perennial grains has created substantial interest from potential growers, food industry companies, and consumers (Karnowski 2017).

At Cornell University we are investigating the potential for incorporating perennial grains into cropping and food systems in the Northeast. Our research includes **basic agronomic optimization** of fertilization rates, planting density, and harvest methods, **quantification of ecosystem services** and other sustainability metrics, identification and management of **potential pest issues**, and exploration of where perennial grains can fit into **local and regional food value chains**.

Field Experiments

1) Comparison of perennial and annual systems using:

- Intermediate wheatgrass cv 'Kernza' (*Thinopyrum intermedium*)
- Perennial rye cv 'ACE-1' (*Secale cereale* x *S.* montanum)
- Hard red winter wheat cv 'Warthog' (*Triticum aestivum*)
- Malting barley cvs 'Endeavour' and 'Scala' (*Hordeum vulgare*)

Data collected include yields, crop biomass, soil health indicators, disease incidence and severity, weed species and biomass, and energy and labor inputs.

2) Intercropping field pea with 'Kernza' and 'ACE-1'. This new experiment will use Land Equivalent Ratios to explore whether growing perennial grains in monoculture or intercropped with food-grade field pea is more productive. We are also testing oats as a nurse crop for perennial grains in this experiment.

3) Strip tillage as a tool for 'Kernza' stand renovation. In this experiment we are examining whether soil disturbance can stimulate yield in mature 'Kernza' stands.

Experimental Data

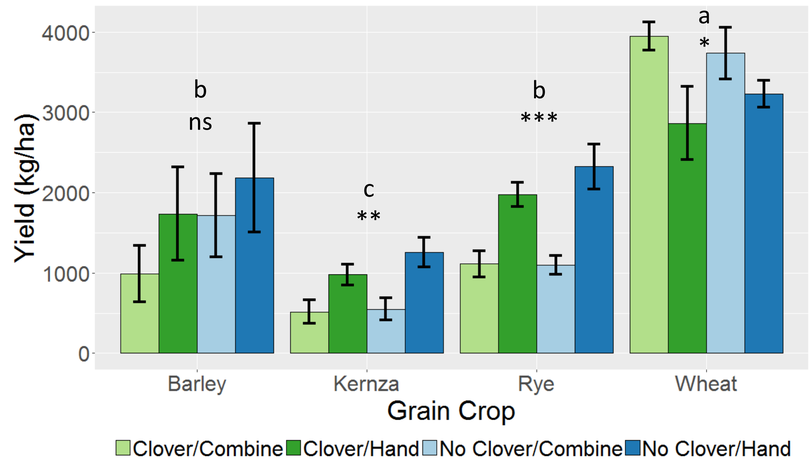

Figure 1: Combined and hand-harvested grain yields of two annual (barley, wheat) and two perennial (kernza, rye) small grains intercropped with red clover. Crop species with the same letter did not have significantly different yield at α = 0.05. Differences observed between hand-harvested and plot combine yields are indicated as follows: ns (not significant), * ($p < 0.05$, ** ($p < 0.01$), * ($p < 0.001$). Establishment issues reducing barley and kernza stand density impacted these data.**

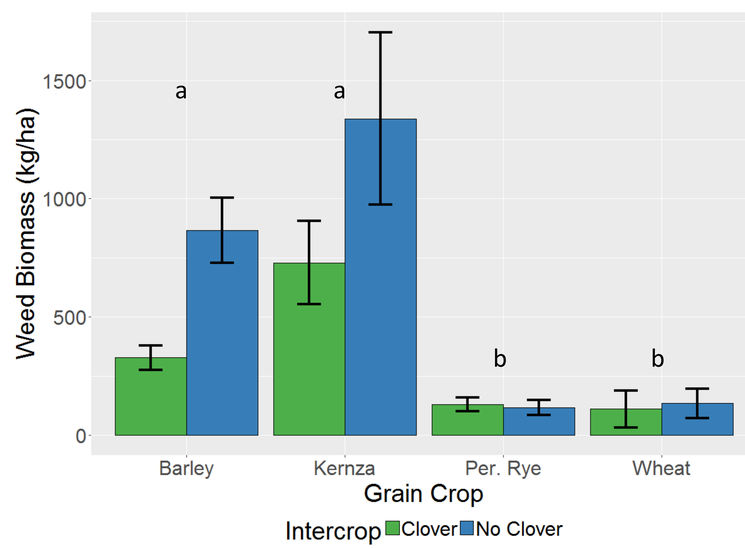

Figure 2: Total weed biomass sampled during July 2017, separated by crop species and clover intercrop treatments. Crop species with the same letter did not have significantly different weed biomass at α = 0.05.

On-Farm Trials

Who we are working with: Three high-profile Fingerlakes grains farmers are hosting strip trials: ~0.5 ha of 'Kernza' and 'ACE1'. Trials were planted in late summer of 2016.

What we hope to learn: Will perennial grains have a positive impact on soil health? How do perennial grains perform on farms with different soil conditions, fertility levels, and field histories? How do farmers conceptualize perennial grains? What management techniques can we learn from grain farmers?

Challenges: Harvesting and processing 'Kernza' are challenges, due to the small seed and its hull. 'Kernza' establishment appears to be more sensitive to seed placement, moisture, and weed competition than the annual grain crops the farmers are familiar with.

Preliminary observations: 1) Cutting forage from 'Kernza' and 'ACE1' was an alternative to harvesting for grain in a poor season. The farmer in Penn Yan reported his cows ate both crops without issue. 2) The best harvest was 'ACE1' at the farm in Newfield, with a 1,600 kg/ha yield. The farmer described the 'ACE1' grain as "beautiful."

Above: 'ACE-1' (LH) and 'Kernza' (RH) roots, December 2017 after first production season.

Above: 2-wk old 'Kernza' seedlings in Interlaken. Seeding rate is low to accommodate future tillering.

Above: 'ACE-1' (LH) and 'Kernza' (RH) grain

Above: Researcher Sandra Wayman in the Newfield planting of 'ACE-1', June 2017.

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