Organic Management of Heritage Winter Wheat Varieties in the Northeastern U.S.

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INTRODUCTION

This project proposes to add value to the small grain component of the food system by organically cultivating heritage winter wheat varieties with desirable culinary traits. Heritage wheats include varieties that were released in the Northeast prior to the 1950's. Since heritage wheat varieties were bred prior to the widespread use of chemical fertilizers and pesticides, we hypothesized that optimal management practices would differ between heritage and modern varieties. Two field studies were conducted to test this hypothesis and identify the best agronomic management practices for heritage winter wheat varieties grown in organic cropping systems. Both trials were established on certified organic fields at research facilities in Rock Springs, central PA, and Willsboro, northern NY, in 2013, 2014, and 2015.

FERTILITY MANAGEMENT TRIAL

OBJECTIVE

To evaluate organic nitrogen fertilization strategies for heritage winter wheat production.

METHODS

- Two Heritage Varieties: Forward (1920 release) & Gold Coin (1890 release)
- Two Modern Varieties: Fredrick (1971 release) & Appalachian White (2009 release)
- Five Fertilizer Treatments
  1. 39 kg N/ha fall applied
  2. 78 kg N/ha fall applied
  3. 39 kg N/ha fall + 39 kg N/ha spring
  4. 78 kg N/ha fall + 39 kg N/ha spring
  5. No fertilizer control
- Kreher's 5-4-3 granular composted chicken manure fertilizer was used for all fertilizer applications.

RESULTS

Winter wheat responses to the nitrogen fertilizer treatments differed between the two research sites.

Rock Springs, PA - Hagerstown Silt Loam Soil

- In PA there was a consistent trend with increasing yields accompanying increased nitrogen application rates up to a 78 kg N/ha rate (Figure 1).
- Plant heights (Figure 2) and lodging (data not shown) also increased with increasing nitrogen application rates.
- Grain quality was improved with nitrogen applications, as crude protein levels increased up to the 78 kg N/ha treatment level (Table 1).
- No significant N rate x variety interactions were observed

Table 1. 2015 Crude Protein @14% Moisture for Four Winter Wheat Varieties at Five Nitrogen Fertilizer Treatments in PA. (0.05 level LSD=0.4 to compare two nitrogen fertilizer treatments averaged over all varieties)

Variety	0 (control)	39	78	39+39	78+39
Gold Coin	10.5	10.6	11.0	11.4	11.2
Forward	9.7	10.0	10.0	10.5	10.4
Frederick	10.9	11.1	11.8	11.9	11.6
Appl. White	11.0	10.8	11.1	10.9	12.0
Average	10.5	10.6	11.0	11.1	11.3

Figure 1: 2014 Yield of winter wheat varieties at five N fertilizer rates in PA

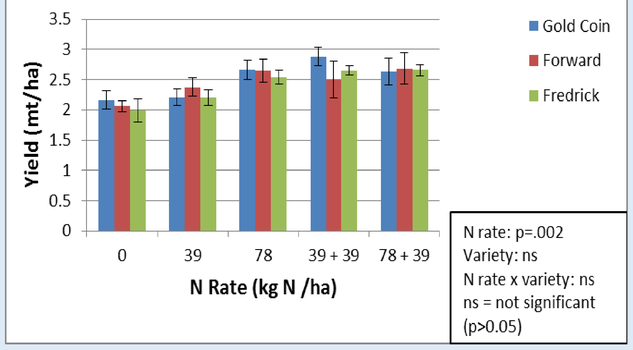
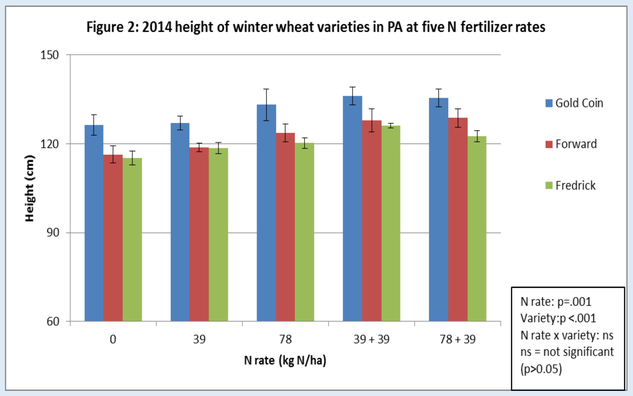


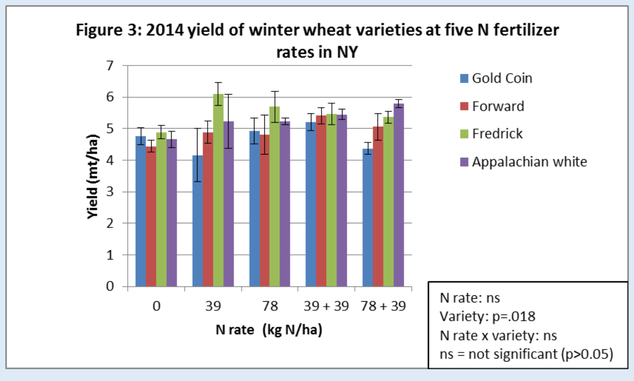
Figure 2: 2014 height of winter wheat varieties in PA at five N fertilizer rates



Willsboro, NY - Kingsbury Clay Soil with Tile Drainage

- The NY test site did not show any significant difference in yield with nitrogen fertilizer applications (Figure 3). Winter wheat yielded well with all five fertilizer treatments, including the unfertilized control plots. The NY organic fields tend to be high yielding, and the winter wheat trials follow a plowed-down three-year-old alfalfa-timothy sod in the rotation. The absence of any yield response to nitrogen fertilizer, suggests that the plowed down alfalfa-timothy sod provided sufficient nitrogen to optimize winter wheat yields.
- As in PA, no significant N rate x variety interactions were observed.

Figure 3: 2014 yield of winter wheat varieties at five N fertilizer rates in NY



CONCLUSIONS

- Optimal nitrogen fertilization regimes for heritage and modern wheat varieties will vary depending on soil type and cropping history.
- On intensively cropped fields, winter wheat yields and grain crude protein levels of both heritage and modern varieties will benefit from organic nitrogen fertilizer applications up to 78 kg N/ha.
- Rotations play an essential role in determining nitrogen needs, as a plowed-down three-year-old alfalfa-timothy sod provided sufficient nitrogen to optimize winter wheat yields without any added fertilizer.
- Nitrogen fertilizer applications can increase plant heights, and increase the potential for lodging in heritage wheat varieties.

SEEDING RATE TRIAL

OBJECTIVE

To identify the optimal seeding rates for organically grown heritage winter wheat varieties.

METHODS

- Four Heritage Varieties: Fulcaster (1886 release), Gold Coin (1890 release), Pride of Genesee (1893 release), Honor (1920 release, NY site only)
- One Modern Variety: Warthog (2006 release)
- Four Seeding Rates: 67, 101, 134, and 168 kg/ha

RESULTS

Yield Responses

- Winter wheat yield responses to seeding rates differed with testing location (Table 2).
- Seeding rate did not affect yields in the NY trials in 2013 (data not shown) and 2014 (Figure 4). In 2015, after substantial winterkill, yield increased linearly with seeding rate (data not shown).
- While varieties tended to differ in yield in all three site years in NY, no significant variety x seeding rate interactions were observed.
- The absence of any yield differences with seeding rate in NY in 2013 and 2014 suggests that the wheat varieties effectively compensated for differences in plant population. Increased tillering in the low seeding rate plots in NY played a role in the compensation process. In contrast to our hypothesis that heritage varieties would exhibit greater tillering capacity than modern varieties, tiller production in the modern variety *Warthog* appears similar to the tiller production of the heritage varieties (Figure 5).
- In PA in 2014 (Figure 6) and 2015 (data not shown), yields increased significantly with increasing seeding rate. The PA trials were planted late in the fall, and it is possible that the late planting dates limited the capacity of the wheat to fully compensate for lower plant populations.

Figure 4: 2014 yield of winter wheat varieties at four seeding rates in NY

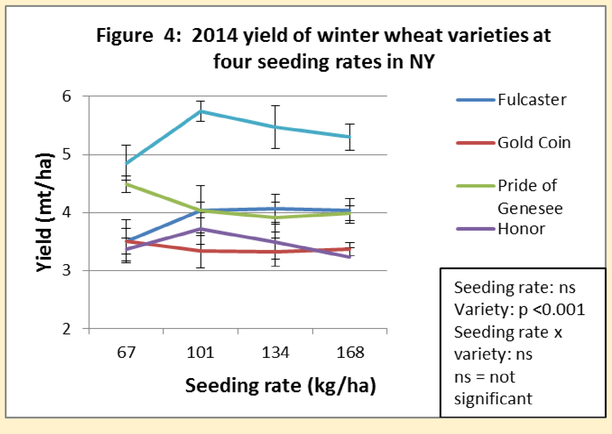


Table 2. Seeding Rate Effects on Winter Wheat Production Parameters in PA and NY. ns = not significant (p>0.05)

SITE-YEAR	YIELD	LODGING	HEIGHT
PA 2013	ns	ns	ns
PA 2014	0.003	ns	ns
PA 2015	0.02	ns	ns
NY 2013	ns	ns	ns
NY 2014	ns	ns	ns
NY 2105	0.04	ns	ns

Figure 5: 2014 tiller production by winter wheat varieties in NY

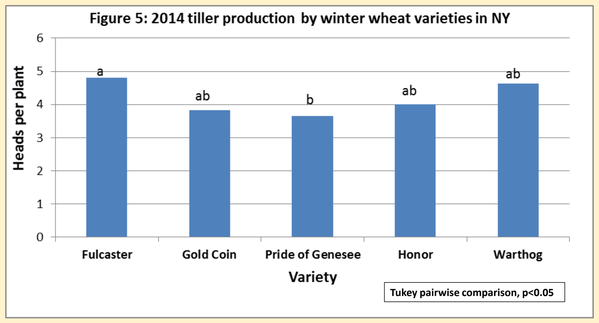
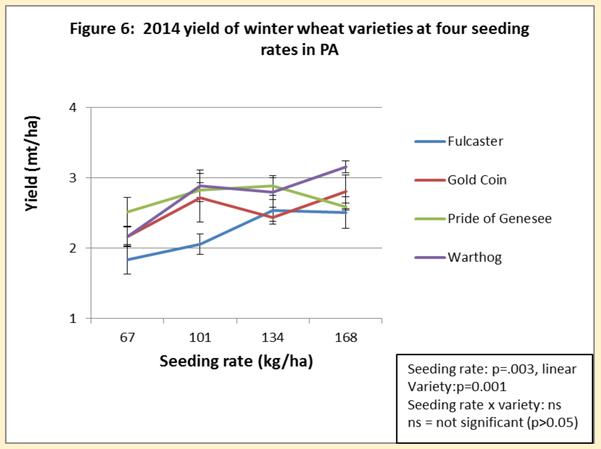


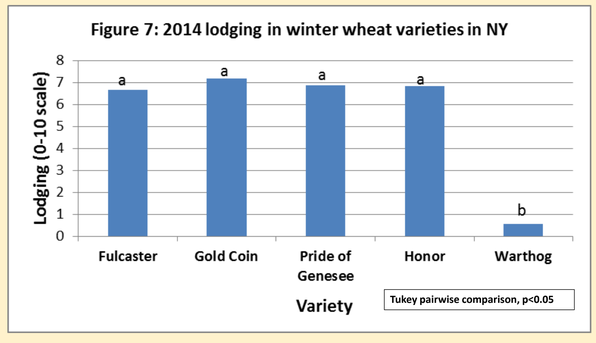
Figure 6: 2014 yield of winter wheat varieties at four seeding rates in PA



Plant Height and Lodging

- Plant heights and lodging were not significantly influenced by seeding rate at either site in any year (Table 2).
- Plant height and lodging differed significantly with variety in NY and PA in all years. The heritage wheats were taller than the modern variety, and had more lodging problems (Figure 7) at all four seeding rates.

Figure 7: 2014 lodging in winter wheat varieties in NY



CONCLUSION

In contrast to historical recommendations, heritage varieties in these trials appear to react similarly to modern varieties to seeding rate. Under optimum planting conditions (timely, excellent seed bed preparation, and optimum planting equipment) reduced seeding rates may be possible for both heritage and modern winter varieties. However, given the often suboptimal planting conditions on farms, and the risk of winterkill in NY and PA, a seeding rate of 100-134 kg/ha for both heritage and modern winter wheat varieties seems warranted.

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