Organic Management of Ancient Wheats in North Dakota and the Northeast

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INTRODUCTION

The overall goal of this project is to add value to the small grain component of the food system by promoting the organic production of grains with distinct culinary traits and high market potential. Millers, bakers, food processers, and consumers have shown increased interest in the ancient wheats emmer, einkorn, and spelt. Replicated field trials were conducted in North Dakota, New York, and Pennsylvania to characterize best organic management practices for spring emmer and spring einkorn, in addition to spring spelt and modern spring wheat. Two studies evaluated 1) the effect of planting date on the productivity of spring emmer, spring einkorn, spring spelt, and modern spring wheat, and 2) optimal seeding rates for spring emmer and spring einkorn. Trials were repeated over four field seasons from 2012 through 2015.

SPRING PLANTING DATE EFFECTS ON ANCIENT & MODERN WHEAT PERFORMANCE

OBJECTIVE

To determine whether emmer or other ancient wheats are more tolerant of late planting date than modern spring wheat.

METHODS

Replicated field trials were conducted on certified organic plots in Cathay, North Dakota and Willsboro, New York. Entries in the Cathay trials included *Glenn* hard red spring wheat, *Lucille*, emmer, and *TM23* einkorn. Willsboro trial entries were *Glenn* hard red spring wheat, *North Dakota Common* emmer, *TM23* einkorn, and *CDC Zorba* spelt (2015 only). Planting dates for each site and year are listed in Table 1.

RESULTS

Data from three of the four trials support the hypothesis that delayed planting can differentially affect wheat species yield.

- There was a highly significant (p=0.0002) interactive effect of planting date on species in the Willsboro 2012 trial (Figure 1). From the first to second planting dates, emmer yield was reduced by 6%, while einkorn and spring wheat yields were reduced by 39% and 40%, respectively. At the third planting date emmer had a higher yield than einkorn or spring wheat, but all three species suffered catastrophic yield loss (91%-99%).
- Trends in the Willsboro 2015 trial were similar to the 2012 trial (Figure 2), although the interactive effect (p=0.075) was not significant at the p=0.05 level. It is notable that the general trend was repeated in 2015 even though all three planting dates could be classified as "late."
- Yield data from the Cathay 2014 experiment showed no statistically significant treatment effects, but the same trend was evident in terms of emmer and wheat performance: Emmer yield was reduced from the first to second planting date by 26% and yield of wheat by 41% (Figure 3). In this experiment, einkorn also exhibited reduced yield loss (14%) from first to second planting date.
- In the Cathay 2015 experiment, yield was significantly reduced by delayed planting date but was unaffected by species (data not shown).
- The number of grain-producing tillers per plant declined with later planting dates for all four species in the 2015 Willsboro experiment (Figure 4). Emmer produced a higher number of tillers per plant than spring wheat or spelt at all three planting dates. While einkorn had a higher tiller number than emmer at the first planting date, einkorn showed a steeper reduction in tiller numbers as planting date was delayed than did emmer.

Table 1. Planting Dates for Each Trial Location and Year.

	1st Planting	2nd Planting	3rd Planting
Willsboro, NY			
2012	April 4	April 30	May 19
2015	May 1	May 15	May 29
Cathay, ND			
2014	May 16	June 10	
2015	April 16	May 5	May 27

Figure 1: Effect of planting date on wheat species yield: Willsboro, NY 2012

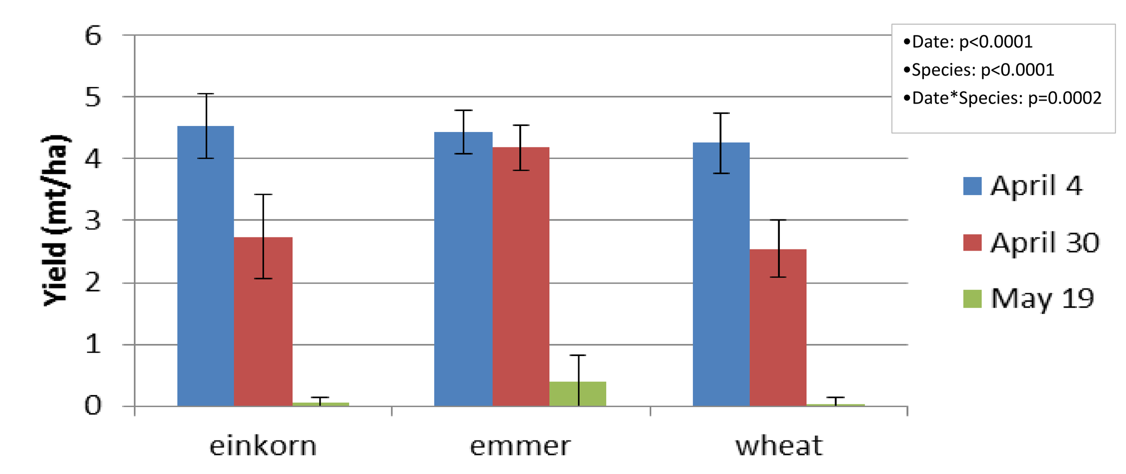


Figure 2: Effect of planting date on wheat species yield: Willsboro, NY 2015

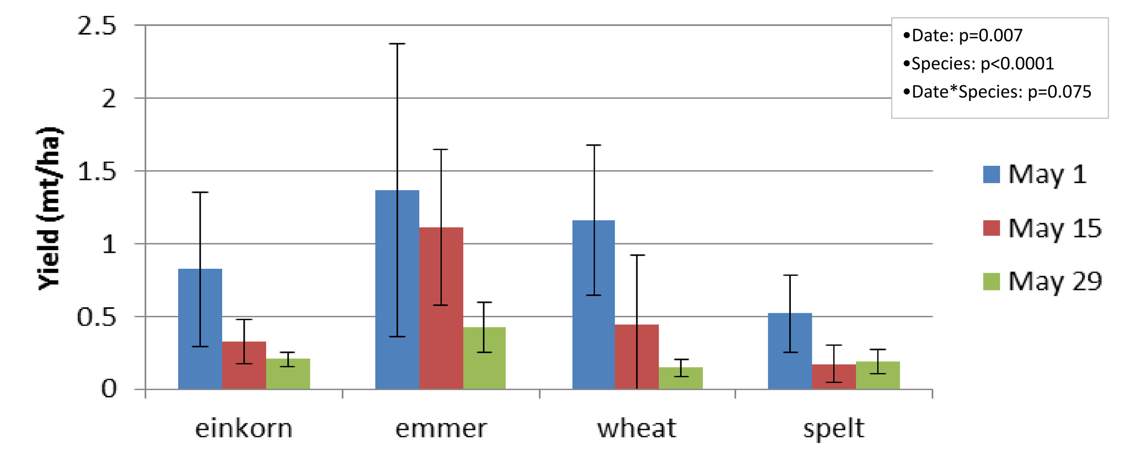


Figure 3: Effect of planting date on wheat species yield: Cathay, ND 2014

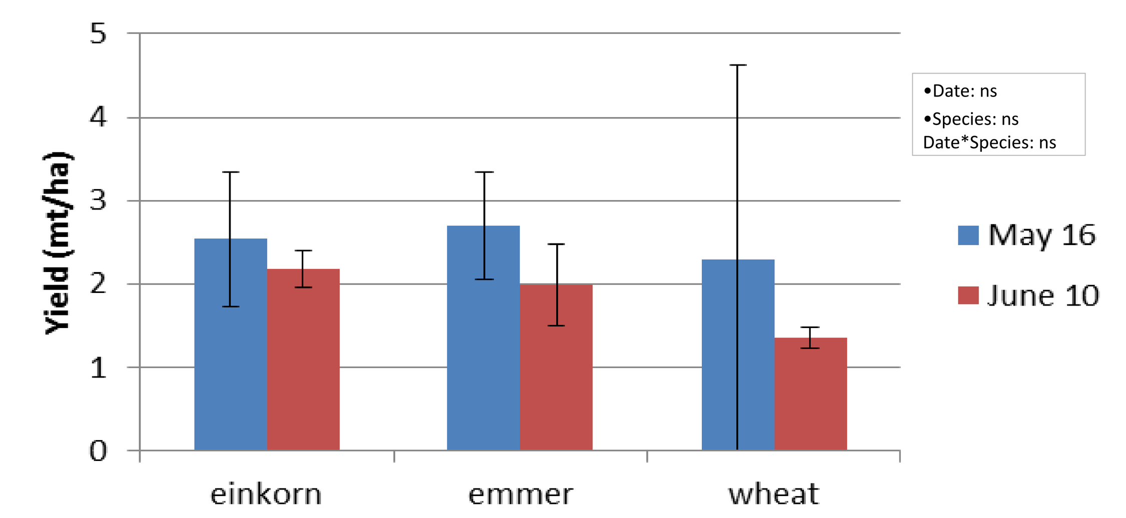
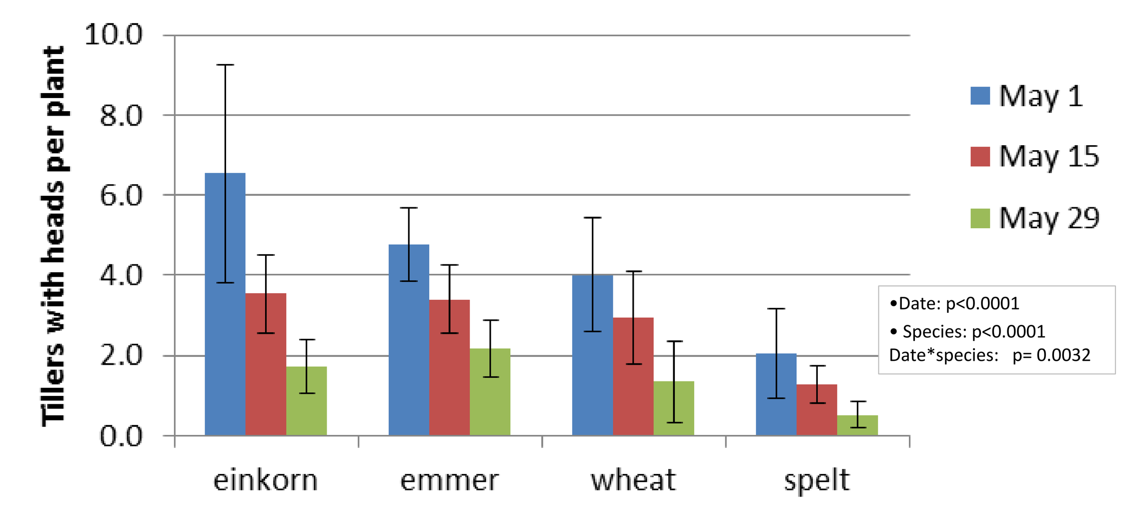


Figure 4: Number of tillers with heads per plant: Willsboro, NY 2015



CONCLUSIONS

- Results suggest that emmer yields may be less affected by delayed spring planting than those of modern spring wheat, spelt, or einkorn.
- The ability to maintain a relatively high tillering capacity as growing conditions shift from spring into summer may be one factor in the better performance of emmer at delayed planting dates.

Emmer wheat growing in North Dakota

EINKORN SEEDING RATE TRIALS

OBJECTIVE

To evaluate the effect of seeding rate on einkorn performance.

METHODS

- Field trials were conducted at three locations in North Dakota: Carrington Research Extension Center (2013, 2014, 2015), Cathay, ND (2014, 2015), and Robinson, ND (2013, 2014, 2015).
- Five seeding rates were used: 56 kg/ha, 84 kg/ha, 112 kg/ha, 140 kg/ha, and 168 kg/ha.
- The einkorn variety was *TM23*.

RESULTS

- Stand counts increased in a linear fashion with increased seeding rate in all sites and years (data not shown).
- Yields tended to increase as seeding rate increased from 56 kg/ha to 112 kg/ha (Figure 5).
- Einkorn yield responses to seeding rate increases from 112 kg/ha to 168 kg/ha varied widely with location and year. For example, as seeding rates increased from 112 kg/ha to 168 kg/ha, yields continued to increase in the 2015 Cathay trial, but decreased in the 2015 Carrington trial (data not shown).
- Lodging increased linearly with increasing seeding rate in three of the experiments, and a similar trend was observed in the other site years (Figure 6).
- Einkorn days to heading decreased linearly with increased seeding rate (data not shown).

Figure 5: Effect of seeding rate on einkorn yield:

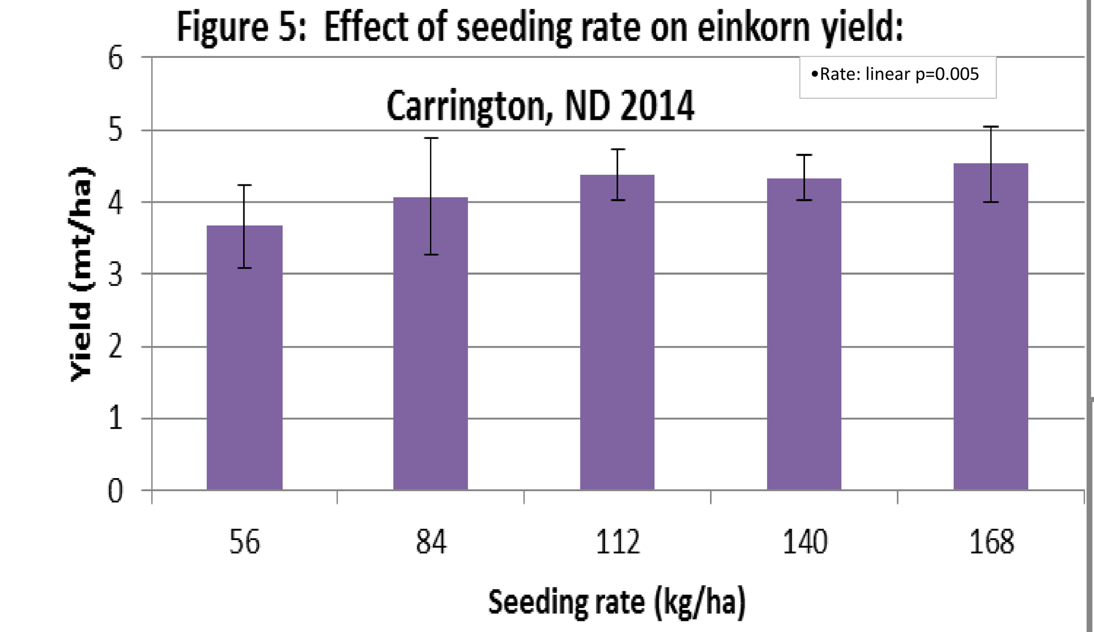
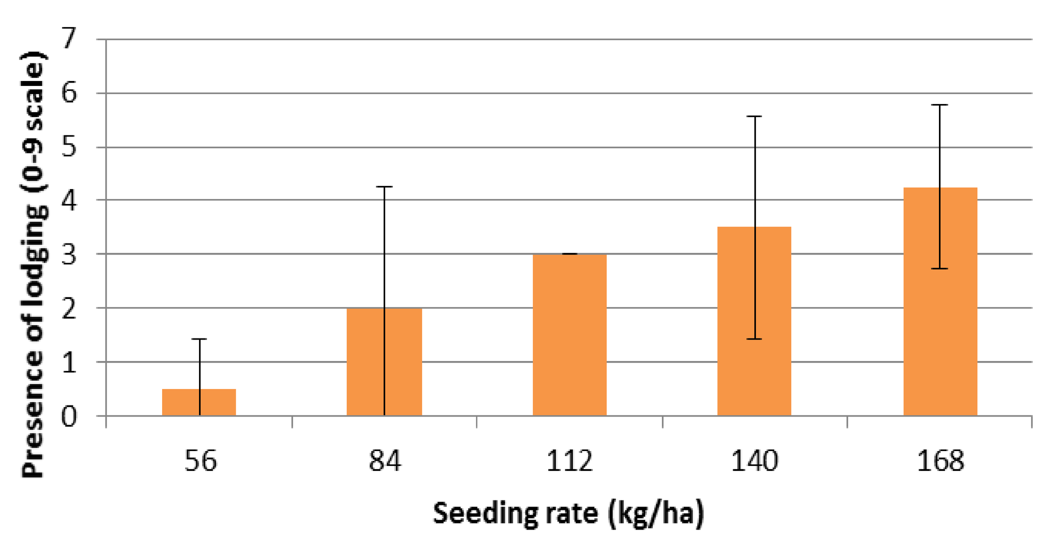


Figure 6: Effect of seeding rate on lodging ... Carrington, ND 2015



CONCLUSION

Increasing seeding rates translated into increased plant populations which influenced einkorn development and yield. Given that yields consistently increased with increasing seeding rates up to 112 kg/ha, and that lodging increased linearly with increasing seeding rates, a 112 kg/ha seeding rate appears to optimize yield potential over a range of conditions while hedging against the significant lodging problems that can occur in very dense stands.

EMMER SEEDING RATE TRIALS

OBJECTIVE

To determine the effect of seeding rate on emmer development and yield.

METHODS

- From 2013 through 2015 field trials were conducted in Rock Springs, PA, Willsboro, NY, and three locations in North Dakota: Cathay, Robinson, and the Carrington Research Extension Center.
- Five seeding rates were used: 56 kg/ha, 84 kg/ha, 112 kg/ha, 140 kg/ha, and 168 kg/ha.
- *North Dakota Common* emmer was the test variety.

RESULTS

- While yield responses to seeding rate varied with location and year, emmer yields generally increased as seeding rate increased from 56 kg/ha to 112kg/ha (Figure 7). Emmer yield responses to increasing seeding rates from 112 kg/ha to 168 kg/ha were mixed, but tended to either plateau or continue to increase.
- Increased seeding rates decreased days to heading (data not shown).
- Lodging generally increased significantly with increased seeding rates (data not shown).
- Grain yield per plant and grain yield per head (Figure 8) decreased as seeding rates increased.

Figure 7. Effect of seeding rate on spring emmer yield: Rock Springs, PA 2013

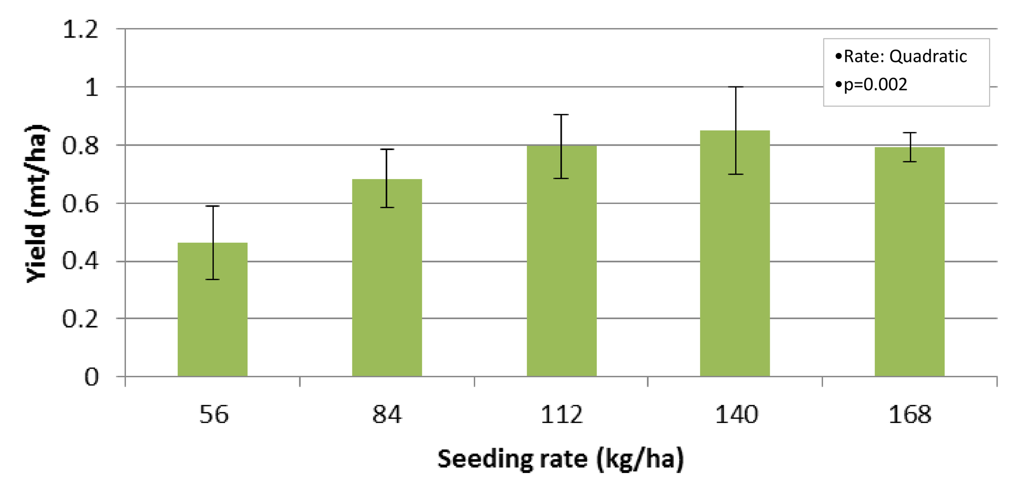
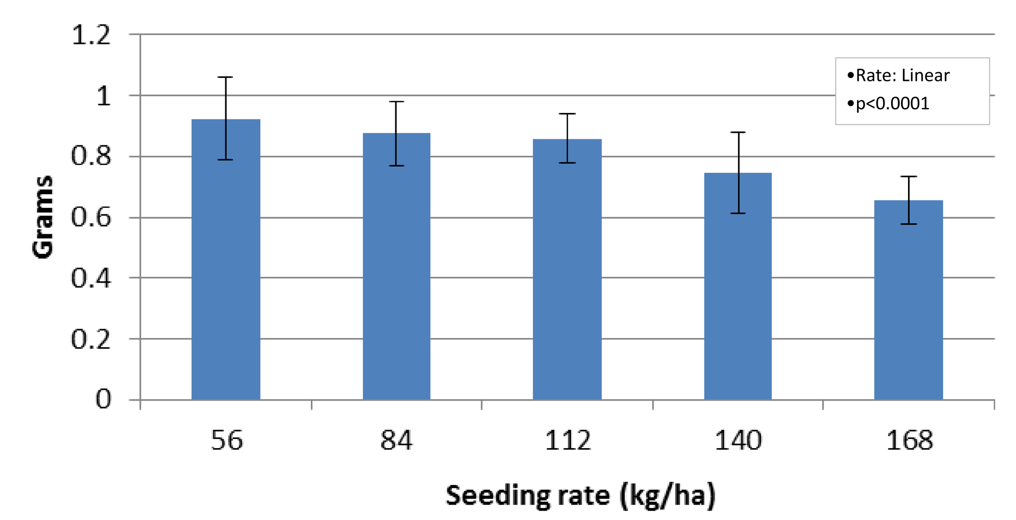


Figure 8. Effect of seeding rate on spring emmer grain weight per head: Willsboro, NY 2015



CONCLUSION

Emmer responses to seeding rate are consistent with einkorn and other small grains as increased seeding rates reduced the days to heading and increased lodging potential. The consistent increase in yields that accompany seeding rate increases from 56 kg/ha to 112 kg/ha illustrate that emmer is unable to fully compensate for the lower plant populations that result from the lower seeding rates. It appears that a seeding rate of at least 84-112 kg/ha is needed to produce stands that can optimally utilize field resources and maximize grain yields.

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