Value Added Grains for Local and Regional Food Systems

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Abstract

Interest in locally produced ancient and heritage grains has grown in recent years. Organic farmers stand to benefit from producing and marketing these grains. Our on-farm research and farm, processing, and marketing case studies will add value a) through production techniques that achieve and maintain high grain quality and b) through processing and identification of high-value varieties/landraces that are well adapted to organic management. Results of agronomic trials conducted in the Northeastern and Upper Midwestern regions of the US are presented. Varieties suitable for growing value added grain products using organic methods are presented.

Introduction

Farmers, consumers, processors, handlers and retailers have all expressed interest in locally adapted crop varieties suitable for cultivation under organic farming conditions. Wheat (Triticum aestivum ssp. aestivum), with a consumption rate in the United States of 132.5 lbs/person/year, is a commodity of particular importance (ERS, 2013). Additionally, production and consumption of hulled wheat relatives, such as spelt (Triticum aestivum, ssp. spelta), emmer (Triticum turgidum subsp. dicoccum) and einkorn (Triticum monococcum) is rising (NASS, 2007). Most wheat in North America is currently grown in the great plains of the United States and the prairies of Canada.

Small grains provide multiple benefits to organic farms. The fibrous root systems and high carbon plant residues of small grains can improve soil health, bolster microbial communities, increase water holding capacity, buffer soil temperature extremes, and provide nutrient binding sites. Winter grains can be planted and harvested in windows that do not compete with labour needed for other operations. Such crops can be relatively competitive against weeds and help break pest and disease cycles for other high value crops. Despite these benefits, many organic farmers frequently do not plant small grains because of their relatively low economic value compared to other organic crops, such as fresh market vegetables. Organic farms in the Northeast United States, 85% of which are defined as "small farms" (NASS, 2007), also struggle to find production and processing equipment appropriate to their scale of production.

Organizations in the Northeast—where consumer demand for locally grown grain is rapidly expanding—and in North Dakota, which has developed expertise in hulled grain production, have joined forces to add value in multiple ways to wheat and specialty grain crops to enhance the diversity and sustainability of organic farms. The project "Value-added grains for local and regional production systems" promotes the incorporation of small grains in organic systems by establishing foundational knowledge on growing, selling, and processing high-value small grains.

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Objectives

The project's objectives are to:

1) Evaluate heritage wheat and spelt varieties and landraces of emmer and einkorn for adaptability to organic management and desirable grain and baking characteristics;

2) Develop best management practices for heritage wheat, emmer, spelt, and einkorn;

3) Optimize grain quality through improved management;

4) Investigate a variety of approaches to grain de-hulling and milling that will work for small and larger-scale growers or entrepreneurs; and

5) Explore multiple strategies for accessing local and regional markets.

Materials and methods

Preliminary research results indicate promising small grain varieties for organic production systems. Researchers collected and evaluated diverse germplasm from around the world, including 125 winter and 24 spring wheat varieties, 28 winter and 6 spring spelt varieties, 18 winter and 68 spring emmer varieties, and 27 winter and 4 spring einkorn varieties. These varieties and species were assessed for grain yield, kernel quality, pest resistance, height, lodging, and heading date at locations in Pennsylvania, New York, Vermont, and North Dakota.

Results

Agronomic Trials

Farmers have limited experience with growing varieties of heritage wheat, emmer, einkorn, and spelt in the Northeast United States. Results from two years of agronomic field trials can help farmers select the most effective seeding rates, seeding times, and nitrogen rates for optimal use on organic farms. Preliminary analysis shows that spring wheat exhibited a lower relative yield loss due to late planting (51%) than did spring emmer (68%).

High protein content is particularly important for farmers seeking to add value to their production through artisanal bread markets. A replicated on-farm trial on top-dressing hard red winter wheat with N-fertilizers permissible under NOP standards showed that wheat top-dressed with either Chilean nitrate or blood meal at late boot stage had protein contents over 1% higher than untreated wheat.

Variety Trials

Data from the first year and second year of field trials show significant differences among varieties for yield, test weight, lodging, height, and heading date (Table 1).

Value-added Production

In order to add value to production, the project will assess the quality of heritage and modern wheat, spelt, emmer, and einkorn varieties. Milling, baking, and sensory evaluations will take place in the winter of 2013-2014. Wheat varieties were analysed for test weight, protein, falling number, and DON. After receiving laboratory results, six wheat varieties were chosen to represent a wide range of quality characteristics for baking evaluation. The baking evaluation will gather eight artisanal bakers from the Northeast United States to evaluate the selected wheat varieties for baking characteristics. Bakers will prepare and rate variety-specific breads according to the representative baking method of the region: traditional fermented sourdough. Following the baking evaluation, a trained panel including both bakers and consumers will characterize the sensory quality of breads baked from distinct varieties.

Table 1. Top ten yielding winter wheat, spring wheat and emmer† cultivars 2012-2013

Name	Yield (kg/ha)‡					Test Wt.	Ht.	Lod-ging	Head-ing
Variety	FV	PA	WB	ND	Mean	(kg/hl)	(cm)	(1-9)	(d+5/1)
Winter Wheat									
Arrow	3181	2880	4643	NA	3568	70.8	103	0	30
Warthog	2901	2932	3999	NA	3277	74.5	89	0	30
Susquehanna	2672	2802	4358	NA	3277	70	89	0	33
ARS09-173	2317	3243	4182	NA	3247	75.6	76	0	26
Genesee	2756	2816	4165	NA	3246	71	109	2	32
Yorkstar	2608	2784	4264	NA	3219	69.8	107	1	31
ARS07-1214	2925	2625	3990	NA	3180	74.4	79	0	28
Appalachian White	2346	3030	4097	NA	3158	74.6	79	0	27
NuEast	2065	3069	4190	NA	3108	76	78	0	27
AC Morley	2585	2648	3948	NA	3060	74.6	96	0	30
*Spring Wheat**									
Tom	2997	1804	4201	2965	3001	72.3	91	0	43
Sabin	3332	2022	3599	3090	2984	70	84	0	44
MN00261-4	3292	1797	3807	ND	2965	71	85	0	45
Steele	3343	2050	3357	ND	2917	70.9	89	0	45
ND735	3137	1668	3944	ND	2917	70.6	92	0	46
RB07	3138	1742	3853	1924	2911	68.8	83	0	43
Ulen	3098	1835	3684	1120	2872	70.1	89	0	43
Glenn	2873	1840	3634	2334	2783	73.9	89	0	42
MN06078W	2875	1484	3734	ND	2698	69	90	1	43
Grandin	3078	1292	3609	ND	2660	68.5	90	0	43
Spring Emmer									
Lucille	2820	802	3216	4220	2765	44	109	3	56
Red Vernal	2550	839	3206	3885	2620	44.5	109	3	57
ND Common	2658	891	2984	3860	2598	44.7	107	4	57
Vernal	2699	917	3050	3555	2555	45.2	106	2	56
Common-MC	2393	687	2193	3170	2111	44.1	105	3	57
PI254148	1693	669	3217	2595	2043	36.2	74	3	49
Common-M	2293	601	2263	3014	2043	43.2	106	3	57
Common-R	2222	508	2133	2959	1955	41.7	102	3	58
Common-H	2019	598	2058	3130	1951	42.3	101	4	57
Bowman	2022	578	1907	3201	1927	41.2	102	4	57

NA: no data from site-year; MD: data missing from at least one site-year; † emmer yields are presented in hull; ‡ FV: Freeville, NY, PA: College Station, PA, WB: Willsboro, NY, ND: Carrington, ND; * spring wheat means are calculated without ND data

Conclusion

Small grains can help create more sustainable cropping systems on organic farms. To foster adoption of small grains in organic systems, this research establishes foundational knowledge on growing and processing high-value ancient, heritage, and modern wheat. Results from two years of field trials can help farmers select the most effective seeding rates and seeding times for optimal use on organic farms.

Additionally, research has identified superior genotypes for organic production and is assessing quality for artisanal baking in the Northeast.

References

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