Management for High Quality Wheat and Ancient Grain Production in the Northeast

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http://www.extension.org/organic_production

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MANAGEMENT FOR HIGH-QUALITY ORGANIC WHEAT AND ANCIENT GRAIN PRODUCTION IN THE NORTHEAST

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This presentation is supported through a USDA-NIFA OREI PROJECT:

Value-added grains for local and regional food systems

Project Partners: Cornell University, Penn State University, OGRIN, NOFA-NY, PASA, Northern Plains Sustainable Agriculture Society, Greenmarket, Oregon State University, and North Dakota State University

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VALUE-ADDED GRAINS FOR LOCAL AND REGIONAL FOOD SYSTEMS : OBJECTIVES

- Evaluate germplasm of potentially high market value small grains: heritage wheat, emmer, spelt, and einkorn
- Develop management recommendations
- Optimize grain quality through identifying management techniques
- Document a variety of approaches to grain dehulling and milling
- Investigate strategies for accessing regional markets through "active" learning events

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Grain quality webinar outline

- Common wheat quality issues
- Critical grain quality parameters and testing
- Management for high-quality wheat and ancient grains
  - Sourcing seed
  - Crop rotation
  - Fertility management
  - Field preparation
  - Planting dates/rates
  - Weed management
  - Harvesting
  - Seed cleaning
  - Storage

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Common grain quality issues

- Low protein (bread wheat)
- Off-flavors
- Stones
- Moldy grain
- Sprouting in the head/low falling number
- Insect damage
- Diseased seed

→**Multiple causes, but in most cases, good management can avoid or minimize these issues.**

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Critical grain quality parameters: milling & baking

- Protein content (bread wheat): 11.5-12.5%
- Falling number
  - a measure of sprouting damage in the grain
  - Falling number of less than 200 seconds: poor quality products: bread with poor texture, mushy pasta
  - Falling number above 300: Good
  - Vomitoxin: Less than 1 ppm in the finished product

→**Buyers will require, at minimum, results of a vomitoxin test.**

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Critical grain quality parameters, cont.

- Malting
  - Lower protein: preferred 9-11%
  - High germination (95% or above)
  - Falling number as for milling
  - Plump kernels
  - Vomitoxin: May allow more than 1ppm
- Distilling
  - Lower protein: ~8-10%
  - Vomitoxin: May allow more than 1 ppm

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JOB NO: 3377565 Elizabeth Dvck 07/31/2012

Identification	Grade and Kind	FN	VOM	PROT	Remarks
[redacted]	HRS	409.0	0.0	14.4	VOMO= 1.5.
[redacted]	HRW	344.0	0.0	8.7	VOMO= 0.0.
Red Fife 1	HRS	423.0	0.0	15.2	VOMO= 0.4.
Red Fife 4	HRS	409.0	0.0	15.6	VOMO= 0.4.
Spelts	SPELTS	414.0	0.0	13.9	VOMO= 0.3.
Average		399.8	0.0	13.6	

Cost at this lab:
Protein: $3
Falling Number: $10
Vomitoxin: $28

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Grain quality testing

- Test for vomitoxin, protein, falling number
- Collect representative sample
- Send to third-party lab
  - University of Vermont: www.uvm.edu/extension/cropsoil/cereal-grain-testing-lab
  - USDA Agency directory: http://archive.gipsa.usda.gov/aboutus/oa-dir.htm#desist

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SOURCING AND GROWING HIGH QUALITY SEED

- ✓ Certified Seed – Double Certified?
- ✓ Variety Selection

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WHY BUY CERTIFIED SEED?

Seed Certification is voluntary in NY

Added expense in production of seed

Higher quality standard may be difficult to meet

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Certified Seed Standards

1 NYCRR, Parts 96-118

- ✓ Limited Generation (*Approved Planting Stocks = Pedigree, Provenance*).
- ✓ Field standards
  - Isolation, rotation, weeds (prohibited and restricted)
  - Genetic identity
  - Genetic purity (other variety, crop)
  - Diseases
- ✓ Seed Standards
  - Genetic identity, purity
  - Weed seed (esp. prohibited weed species)
  - Inert Matter
  - Germination
- ✓ Post Harvest Growout or Testing
- ✓ Grade Requirements

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For the Consumer

The "Blue Tag" means:

- Independent, third-party verification
- Proper labeling
- Correct kind, variety
- Minimum standards

The "Blue Tag" is equivalent regardless of:

- Origin of seed (FSA, AOSCA)
- Company marketing the seed

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VARIETY SELECTION

- ✓ Well adapted to region
- ✓ Disease tolerance
- ✓ Sprout resistant
- ✓ Lodging resistant
- ✓ Good Quality Characteristics
- ✓ Check public Varietal Trials in your region.
  - http://smallgrains.cals.cornell.edu
  - http://extension.psu.edu/small-grains/trial-reports

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VARIETY SELECTION

2012 OREI Spring Wheat Summary – Cornell (2 locations) and Penn St.

Entry No.	Entry Name	Yield kg/ha	Yield Rank	Test Wt kg/hl	Test Wt Rank	Height cm	class	Heading Date (June)
1	Stoa	2357	11	73.8	16	83	HRS	11
2	Red Fife	1727	19	74.5	15	117	HRS	13
3	RB07	2727	4	74.8	12	85	HRS	9
4	ND735	2652	5	77.9	2	91	HRS	11
5	Ada	2179	16	76.8	4	83	HRS	11
6	MN00261-4	2607	7	77.0	3	85	HRS	11
7	Tom**	2463	8	76.0	7	92	HRS	10
8	MN06078W	2744	3	74.5	14	93	SWS	10
9	Steele	2816	1	76.2	5	90	HRS	10
10	MN05214-3	2274	13	76.1	6	82	HRS	11
11	Sabin**	2785	2	75.5	9	84	HRS	10
12	Louise	2220	15	71.9	21	90	SWS	13
13	MN06079W	2448	9	72.1	20	81	SWS	7
14	Glenn**	2325	12	79.6	1	93	HRS	7
15	Ulen	2621	6	75.0	11	91	HRS	8
16	Reed	2146	17	70.6	22	79	SWS	11
17	Grandin	2379	10	75.4	10	90	HRS	11
18	McNeal	2244	14	74.7	13	90	HRS	13
19	Thatcher	1474	20	72.9	18	112	HRS	16
20	AC Barrie	2071	18	75.6	8	98	HRS	12
21	Mida	1329	21	73.7	17	112	HRS	14
22	Ceres	1280	22	72.6	19	106	HRS	15

** Moderately resistant to Fusarium head blight (Scab)

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Problems Sourcing Quality Seed

- Seed Saving
  - Public varieties maintained year after year on farms, without methods in place for maintaining variety purity.
- Scale
  - Production – Niche market, while potentially lucrative may not warrant enough for Certified seed production. Potential high cost and low return for some of the heritage varieties.
  - Much higher cost for production of Certified seed on small acreage.

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Resources for Sourcing Quality Seed

Association of Official Seed Certifying Agencies (AOSCA)
http://www.aosca.org/index.htm

Northeast Members

- NEW YORK SEED IMPROVEMENT PROJECT – Alan Westra
  - Wheat, Barley, & Oats
- MAINE DEPARTMENT OF AGRICULTURE
  - Oats & Barley
- VERMONT DEPARTMENT OF AGRICULTURE
  - No grains
- OHIO SEED IMPROVEMENT ASSOCIATION
  - Wheat, Barley, & Oats

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Resources for Sourcing Quality Seed Double Certified

- New York Seed Improvement Program
- Lakeview Organic Grain, Penn Yan, NY
  - Frederick Soft White Winter Wheat
  - Kame and Esker Oat
- Albert Lea Seed, Albert Lea, MN
  - Glenn, RB07, & Prosper Hard Red Spring Wheat
- Johnny's Selected Seed, Fairfield, ME
  - Glenn Hard Red Spring

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CROP ROTATIONS

- Crop rotations can play a key role in limiting disease, reduce weeds and supply nitrogen to small grain
- Rotations should also be designed for crops to complement each other ex.:
  - Corn-soybeans-wheat/clover
  - Corn-oats-wheat/clover

Winter Grains

- Ideal preceding crops
  - Oats
  - Soybeans, Dry beans,
  - Vegetable crops
  - Clover/Alfalfa
- Less desirable
  - Corn
  - Grass hay
- Undesirable
  - Wheat, barley, rye

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CROP ROTATIONS

- Crop rotations can play a key role in limiting disease, reduce weeds and supply nitrogen to small grain
- Weed control is more difficult for spring grains
- Spring grains can benefit from residual N from corn or tilled legume hay fields

Spring Grains

- Ideal preceding crops
  - Clover/Alfalfa
  - Legume cover crops
  - Corn
  - Potatoes
- Less desirable
  - Soybeans
  - Grass hay
- Undesirable
  - Wheat, barley, or rye

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FERTILITY

- Nitrogen is critical for tillering, head development and grain protein
- Rotations with legumes, manures, esp. poultry and organic fertilizers are key N sources
- Avoid excessive reliance on manures
- Adjust rates based on rotation

Winter Wheat and Spelt

- Manure in fall or late winter
- Rates
  - 50 to 75 lb total N in manure in fall is typical
  - 2nd application of 50 lb in late winter if necessary
- Spring topdress can add to grain protein (Cost?)
- Spelt is less responsive than wheat (avoid lodging)

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FERTILITY

Spring Wheat

- Preplant manure or fertilizer applications can complement residual N from corn or legumes
- Often about 70 lb N as total N in manure applied preplant has resulted in good success if no legumes

Heritage wheats

- Similar approach to modern wheats
- Some varieties may be prone more lodging
- May be appropriate to be more conservative on N rates for some varieties
- We are looking at this as part of our objective

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FERTILITY

Emmer and Einkorn

- Less N responsive than wheat
- Manure is likely not necessary following a good legume cover crop
- Avoid excessive N that can contribute to lodging
- One of our project goals is to address this issue

Photo Courtesy NDSU

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FERTILITY

- Phosphorous and Potassium and soil pH are also important
- Monitor with soil testing
- Straw removal can deplete potassium quickly – avoid if possible unless it will be reapplied in some form (manure or compost)

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FIELD PREPARATION

- Till fields well in advance of planting if possible
- Perform secondary tillage immediately prior to planting to kill emerged weeds
- Avoid overworking soils and destroying soil structure

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PLANTING DATE

- Timely planting is critical for tiller development and good yields
- Planting too early can increase diseases such as powdery mildew and barley yellow dwarf
- Insects such as Hessian fly and aphids can be an issue with early planting
- Plant winter wheat and spelt as soon after the Hessian Fly free date if possible
- Plant spring wheat, emmer and einkorn as soon as feasible in the spring- often late March through mid- April in the Northeast

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SEEDING RATES

- Wheat: 120 to 150 lb/a of seed (2-2.5 bu/a)
  - At 12000 seeds/pound, this results in 1.4 to 1.8 million seeds/acre
  - 19 to 24 seeds/foot in 7 inch rows
  - Increase seeding rates by 10%/week if seeding is delayed past fly free date by more than two weeks
  - Seed spring wheat at 2.5 bu/acre
- Heritage Wheat: Lower seeding rates may be better for some lines
  - In one Cornell study, 47 lb/a was preferable to 95 lb/a with many varieties yielding more and lodging less at the lower rate

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SEEDING RATES

- Spelt:
  - In the hull: 150 lb/a
  - Dehulled: 120 lb/a

- Emmer: (100 lb/a)
  - NDSU: increasing from 50-100 lb/a resulted in 200 lb/a higher yields
  - In high fertility fields where lodging is anticipated, seeding rates could be reduced to 75 or 50 lb/a

Photos Courtesy NDSU

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HULLED VS. DEHULLED SEED

- Hulled seeds
  - More readily available
  - Often germinates more quickly
  - Fewer actual seeds per pound of seed
  - Can be difficult to get enough seed on in some situations

- Dehulled seed
  - Easier to meter
  - Easier to estimate planted seed population

Photos Courtesy NDSU

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WEED MANAGEMENT

Cultural & Mechanical Practices

- ✓Crop Rotation
- ✓Site Selection
  - Don't inherit problems
- ✓Cover crops
  - Choose wisely – vetch would be a poor choice – considered noxious in small grains.
- ✓Cultivar Selection
  - using quality seed, compete with weeds rapid growth and tillering

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WEED MANAGEMENT

Cultural & Mechanical Practices

- ✓ Planting date and seeding rate
  - Over-seeding with clover?
- ✓ Sanitation and Field Inspection
  - Pre-wash equipment before entering field - Mowers, planters, tillers, etc.
  - Scouting field several times through the season is imperative. Address problems with early detection.

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WEED MANAGEMENT

Cultural & Mechanical Practices

- ✓ 'False' Planting
  - Field is prepared early, weed seed germinates, a harrow or planter is run over the field to disturb the weeds
  - Planting follows after several days
- ✓Hand Rogueing
- ✓Tine or harrow weeding
  - 3 to 4 weeks after planting – plants established to minimize damage.

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WEED MANAGEMENT

Tine weeding in early spring

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More on non-mechanical weed management

Rotation of crops…is the most effective means yet devised for keeping land free of weeds."

Clyde Leighty in Soils and Men (1938)

Crop Rotation:

Series of crops that differ in

- plant family
- planting/harvesting dates
- growth habit
- planting method

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Crop rotation for weed management

Weed suppressive crop:

Two-or-more-year **mowed** legume sod crop (annual grasses, perennials)

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Crop rotation for weed management , cont.

Cover crop that allows for early, midsummer, late summer tillage, e.g., buckwheat

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Crop rotation for weed management, cont.

Traditional cleaning crops:
e.g., potatoes, other root crops

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Crop rotation for weed management, cont.

Row crop that is <u>effectively</u> cultivated

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Non-mechanical weed management. cont

Interseeding with a forage legume

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Non-mechanical weed management. cont

- Higher seeding rates
  e.g., organic growers' seeding rate for wheat ranges from 120-180+ lbs/A
- Choose the appropriate crop to fit the field's weediness

Lower potential weediness → Greater potential weediness

Winter wheat→spring emmer→spring wheat

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ISSUES LEADING UP TO HARVEST

✓ Fusarium Head Blight (Scab)

- Infects heads at flowering, usually late May to early June in Northeast
- Infected head has bleached spikelets evident about 2 to 3 weeks after flowering
- Scouting at this time is imperative, as Scab is not as evident in mature, harvestable heads
- Deoxynivalenol (DON) is a vomitoxin detected infected kernels. The limit is 1 ppm at the mill!

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FUSARIUM HEAD BLIGHT IN LATE JUNE CORNELL, ITHACA, NY

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ISSUES LEADING UP TO HARVEST

- ✓ Fusarium Head Blight (Scab) – Management
  - Avoid harvesting areas of high infection. Areas by hedgerows, windbreaks or low areas might be regions of higher moisture and more conducive to infection. Scouting would alert you to these problem areas.
  - Infected kernels tend to be smaller. Raising fan speed on combine can help.
  - Investigate resistant varieties!!
    - US Wheat & Barley Scab Initiative website

http://www.scabusa.org/

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ISSUES LEADING UP TO HARVEST

- ✓ Pre-harvest Sprouting (PHS)
  - Germination of the grain occurs in the spike prior to harvest.
  - A period of prolonged rainfall and/or high humidity can cause PHS
  - Can ruin grain quality for any milling and baking.

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Pre-harvest Sprouted Wheat

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ISSUES LEADING UP TO HARVEST

- ✓ Pre-harvest Sprouting (PHS) Management
  - Scout field to check moisture.
  - Harvest at higher moisture if grain dryers are an option
  - Look for unusually low test weight or falling numbers.
  - Investigate sprout resistant varieties – Reds tend to be more sprout resistant than whites but there are some tolerant varieties.

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Seed cleaning

- Before harvest
  - Make sure combine is clean!
- Immediately after harvest
- Before testing and sale
- Before storage
  - Make sure bins are clean!

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Seed cleaning, cont.

Immediately after harvest:
Double-screen rotary cleaner to remove coarse green matter (legume, weed) and weeds seeds →prevents grain spoilage, off-flavors

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Seed cleaning, cont.

Before quality testing and sale:
Air-screen cleaner to remove chaff, weed seeds, other contaminants.

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Seed cleaning, cont.

Before sale:
Other cleaning may be necessary, e.g.,

- Gravity table: separates by density or specific gravity, e.g., can separate such things as stones, oats, wild radish seed out of wheat
- Indent separator: separates on the basis of seed length, e.g., can separate vetch from grain

Excellent, free resource on seed-cleaning: Harmon et al. ,1968, ***Mechanical seed cleaning and handling***, Agr. Handbook 354, http://naldc.**nal.usda.gov**/download/CAT87208718/PDF

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Dehulling: spelt, emmer, einkorn

- Larger quantities
  - Take to dehulling facility
  - Cost (excluding transport):
- Smaller-scale
  - Buy or share a small-scale dehuller
    - U.S. :Codema, Forsberg
    - European: Heger, Zanotti, Osttiroler, Columbini, Repietro

→factor in cost, power requirements, effectiveness (% dehulled, cracked kernels), separation of hulls from kernels

Website on dehullers: http://www.spelt.se/maskiner.htm

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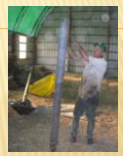
Grain drying

Moisture content: **13% or below for long-term storage**

Larger scale
•Grain dryer
•Clean bins with drying floors and fans
Smaller scale:
•Screw-in aerator
•Jury-rigged air circulation
•Grain spread onto clean surface, and periodically turned



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Small-scale storage

- Types
  - Ton or half-ton totes
  - Wooden bins
  - Plastic containers

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Storage: Insect control

- Sanitation
- Pheromone lures, sticky traps (monitoring)
- Diatomaceous earth
- Heat
- Cold or Freezing
- CO_2, N_2

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Storage: Rodent control

- Sanitation
- Cats
- Rat-proofing
  - Metal strips on bottom of doors
  - Wire mesh over windows

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Common grain quality issues

- Low protein (bread wheat):
  - → appropriate variety, fertilization, weed management
- By-tastes from weed contamination in grain
  - →sound weed management, rogueing, rotary cleaner
- Stone in grain
  - →avoid lodging (excessive N fertilization), proper combining
- Moldy grain
  - →Rotary cleaner, storage at 13% moisture
- Sprouting in the head/low falling number:
  - →Timely harvest, appropriate variety
- Insect damage in storage
  - →good sanitation & storage conditions, diatomaceous earth
- Diseased seed: Fusarium infection with vomitoxin production
  - →appropriate variety, sound rotation, scouting, avoid harvesting areas of high infection, seed cleaning, appropriate market

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Find all upcoming webinars and archived eOrganic webinars at http://www.extension.org/pages/25242

Find the slides as a pdf handout and the recording at http://www.extension.org/pages/66869

Additional questions about organic farming? https://ask.extension.org/groups/1668

We need your feedback! Please fill out our follow-up email survey!