

Small Grain Production Meeting

Thursday, August 17, 2023 at 6:30 pm—8:30 pm

Richy Gaige farm, 392 Middle Rd., Schoharie



Growing grains for the local grain economy

Topics:

- Local grain markets
- Where to find variety trial information and how to interpret it
- Rye varieties other than VNS & Aroostook
- Selecting wheat, barley, triticale varieties
- Planting management for small grains
- Grain storage management

Presented by:

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Resources for Small Grain Education Series

Cornell Field Crops webpage, <https://cals.cornell.edu/field-crops>

U.S. Wheat & Barley Scab Initiative (alerts),
https://scabusa.org/scripts/FHB_Alerts/

Northeast Grainshed Alliance, <https://northeastgrainshed.com/>

Northern Grain Growers Association, <https://northerngraingrowers.org/>

New York Seed Improvement Program (oversees production of Certified Seed and Quality Assurance seed), <https://nyseed.cornell.edu/>

New York Seed Testing Lab (seed sold in NY must be tested for germination and noxious weeds), <https://agriculture.ny.gov/seed-testing-laboratory>

Selling Seed in New York,
<https://blogs.cornell.edu/capitalareaagandhortprogram/2016/02/12/ag-seed-sales-in-new-york/>

Grain Testing Labs

(UVM), E. E. Cummings Crop Testing Lab,
<https://www.uvm.edu/extension/nwcrops/cereal-grain-testing-lab>, DON, alfatoxin, falling number, protein, germination

Hartwick Center for Craft Food & Beverage, <https://www.hartwick.edu/about-us/center-for-craft-food-and-beverage/> , grain and malt testing

Variety Trials

Cornell Small Grain Variety Trials (including organic grains),
<https://blogs.cornell.edu/varietytrials/small-grains-wheat-oats-barley-triticale/small-grains-cultivar-trial-results/>

Univ. of Vermont Trial results: <https://www.uvm.edu/extension/nwcrops/research>

Univ. of Maine Variety Trial Results, Fact Sheets, Reports,
Videos: <https://extension.umaine.edu/grains-oilseeds/topics/>

Univ. of Wisc small grain variety trials, <https://coolbean.info/small-grains/variety-trial-results/>

U of Wis Barley & Oats, <https://cerealvarietytrials.labs.wisc.edu/university-of-wisconsin-madison-cereal-grains-variety-development-and-testing/oat-and-barley-wisconsin-performance-tests/>

Michigan State Univ. variety trials, <https://www.canr.msu.edu/varietytrials/>
(wheat), https://www.canr.msu.edu/malting_barley/research (oats & barley)

Organic Research and Extension Initiative Variety Trial Summaries 2012 - 2015
<https://plantscience.psu.edu/research/projects/grains/heritage-grains/heritage-wheat/heritage-pdf-report>

Hudson Valley Small Grains Variety Research and Commercialization Trials
Report 2019-2022,
<https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/5/8858/files/2023/06/Hudson-Valley-Report.pdf>

Hudson Valley Small Grains Project Preliminary Research Summary 2014-2018
<https://ulster.cce.cornell.edu/resources/hv-small-grains-project-prelim-research-summary>

Seed Sources

OGRain organic seed sources: <https://ograin.cals.wisc.edu/resources/organic-grain-resource-list/seed/>

Organic and Heritage Grain Seed Sources (Aaron Gabriel's list), <https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/e/1628/files/2021/02/Seed-Suppliers-Heritage-Ancient-Grains.pdf>

Educational Resources

Value-Added Grains for Local and Regional Food Systems,
<https://eorganic.info/valueaddedgrains>

GRAIN SCHOOL: Grain food safety, grain insect control
<https://blogs.cornell.edu/capitalareaagandhortprogram/2022/02/23/2022-hudson-valley-value-added-grain-school-recordings-presentations/>

GRAIN SCHOOL: Processing Grains, dry bean production,
<https://blogs.cornell.edu/capitalareaagandhortprogram/2023/02/01/9th-annual-hudson-valley-value-added-grain-school-2023/>

GRAIN SCHOOL: Heritage Grains & Corn, Grain Storage Management, **Seed Sources**,
<https://blogs.cornell.edu/capitalareaagandhortprogram/2021/02/16/resources-2021-hudson-valley-value-added-grain-school/>

Grain Storage Management For the Hudson Valley,
<https://blogs.cornell.edu/capitalareaagandhortprogram/2022/03/28/grain-storage-management-education-for-the-hudson-valley/>

Grain Storage, Drying and Cleaning Systems,
<https://blogs.cornell.edu/capitalareaagandhortprogram/2020/10/26/grain-storage-drying-and-cleaning-systems/>

Presentation: Wheat, Wheat Grading, and Wheat Varieties for NYS
<https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/e/1628/files/2020/08/Wheat-Wheat-Grading-Varieties-Aug-2020-w-notes.pdf>

Wheat and Flour Testing Methods: A Guide to Understanding Wheat and Flour Quality, <https://www.uswheat.org/wp-content/uploads/2021/07/Wheat-and-Flour-Testing-Methods-Book.pdf>

Federal Grain Inspection Service (FGIS, a wealth of information),
<https://www.ams.usda.gov/about-ams/programs-offices/federal-grain-inspection-service>

Hudson Valley Mills looking for grain

Ardent Mills grain buyer:

Grain Buyer: Aaron Amundson, 952-412-4841 (cell), 651-333-4562 (ofc),
Aaron.Amundson@ardentmills.com

Ardent Mills grain testing lab:

Attn: Grain Grading
Keith Lochner
100 Grain St.
Albany, NY 12202

Organic Grain Buyers:

Philmont Community Bakery, Koenraad Van Der Meer,
searchfortheholyygrain@gmail.com, 518-821-2148, 84 Main St. Philmont, NY
12565. (spelt)

Milestone Mill, Sarah Brannen, info@milestonemill.com.

Jefferson Main Street / **Middle Brook Mill**, Dorothy Glas, Donna, Lana, 607-214-
4125, jeffersonmainstreet19@gmail.com, 170 Main St, Jefferson, NY 12093.
<https://www.middlebrookmill.com/>

Ground Up Grain, Andrea & Christian Stanley, 413-349-9099.
<https://www.groundupgrain.com/>, christian@valleymalt.com, 3 Valley Mill Road,
Holyoke, MA 01040.

Vermont Tortilla Company, Azur Moulaert, 22 Sage Court, Shelburne VT
05482. 802-999-9905 (cell/text), www.vttortillaco.com, april@vttortillaco.com,
azur@vttortillaco.com. (corn)

Hudson River Foods, Dan Ratner, dan@hudsonriverfoods.com, 22 Hamilton
Way, Castleton, NY 12033. [888-417-9343](tel:888-417-9343).

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- **Cover Crop seed markets**
 - **Neighborhood and regional feed mills**

Rye Varieties

Plant Variety Protected seeds may not be sold for seed. Sometimes you can save PVP seeds and use them on your own farm. You must know the specifics of the protection afforded to the particular variety.

Un-protected varieties can be grown and sold for seed (ie. cover crop seed).

VNS stands for “variety not stated”. The seed is not any specific variety. VNS rye typically is low yielding in New York. Especially if you are selling cover crop seed it pays to plant an un-protected named variety (Danko, Hazlet) to get better yields.

Hybrid rye varieties are very high yielding (around 100 bu/ac and more). These varieties will be “plant variety protected”. The harvested seed will not grow “true”. It would be illegal to plant seed harvested from hybrid rye and it would perform poorly. Hybrid rye is a good choice when selling grain to millers, maltsters, and distillers.

VARIETY DESCRIPTIONS

(from Albert Lea Seed)

Danko

- Dual purpose (grain or cover crop) rye developed in Poland
- Very winterhardy with good yield and test weight
- Feedback shows excellent early-spring growth as a cover crop with good potential in roll down systems

Hazlet:

- Bulk winter rye seed
- Canadian variety; among highest yielding OP varieties available; no license requirement
- Excellent yield potential; matures late
- Shorter height, good standability

Aroostook

- An early-heading variety currently favored in no-till systems with a roller-crimper
- USDA-selected winter rye variety
- Good spring recovery & early-season vigor
- Very tall variety, early maturity (up to a week earlier vs. VNS)
- Growers observe some tillering after rolling
- Recommended 3 bu/acre seeding rate for no-till and roll down system

Protected Rye Varieties	NOT Protected Rye Varieties
FL406	Aroostook
FL405	Danko
KWS Receptor	Hazlet
KWS Aviator	
NF95319B	
AGS104	
Maton II	
KWS Propower	
ND Dylan	
ND Gardner	
KWS Tayo	
KWS Serafino	
Spooner	
Forager	
Wheeler	
Wintergrazer 70	

bu/ac

2022 Hybrid Winter Rye Regional Trial – Cornell University

Entry	Grain Yield (kg/h)				Test Weight kg/hl	Lodging Score 0-9	Height cm	Winter Surv. %	Head Date				
	Regional Locations												
	lth-Cald	lth-Sny	Mean	Rank									
1	Brasetto	7988	6	7339	2	7664 (122)	5	72.9	5	3.7	142	80	5/21
2	Danko	7314	7	6055	7	6684 (106)	7	73.6	1	3.7	153	79	5/20
3	AC Hazlet	7202	8	5521	8	6361 (101)	8	73.5	2	4.3	160	77	5/21
4	Erie (wheat ck)	3242	10	4916	9	4079 (65)	10	72.9	6	8.0	94	97	5/22
5	KWS Serafino	9360	3	7184	4	8272 (131)	3	73.0	4	4.7	140	83	5/22
6	KWS Tayo	10153	1	6921	5	8537 (136)	2	72.5	7	2.0	141	84	5/21
7	KWS Receptor	10023	2	7729	1	8876 (141)	1	73.2	3	3.7	143	87	5/22
8	KWS SH-03	8283	5	6604	6	7443 (118)	6	70.8	10	2.0	122	85	5/20
9	KWS SH-05	8421	4	7218	3	7819 (124)	4	71.7	9	2.7	128	94	5/19
10	Spooner	5823	9	4469	10	5146 (82)	9	72.0	8	4.0	161	88	5/19
	Mean	7781		6396		7088 ^{bu/ac}		72.6		3.9	138	85	
	CV	10.6		9.4									

Entry	Grain Yield						Test Weight		Lodging 0-9 2 Yr	Head Date 2 Yr	Height cm 2 Yr	Winter Surv. 2 Yr	
	8 Year		5 Year		2 Year		2 Year						
	kg/h	b/a	kg/h	b/a	kg/h	b/a	kg/hl	lb/b					
1	Brasetto (200 k/m ²)	5928	94	5658	90	6465	103	69.5	55.6	3.7	5/22	140	88
2	Danko	4830	77	4775	76	5381	86	70.6	56.5	3.1	5/20	157	83
3	AC Hazlet	4396	70	4274	68	4877	78	69.9	55.9	4.1	5/22	159	83
4	Erie (wheat ck)	4385	70	4060	65	3659	58	67.7	54.2	5.0	5/28	96	97
5	KWS Serafino			6062	90	6972	104	69.8	55.9	3.5	5/23	140	89
6	KWS-H176 (Tayo)			6531	104	7247	115	69.4	55.5	2.1	5/22	143	88
7	KWS Receptor					7289	116	70.1	56.1	3.8	5/23	143	90

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cm / 2.54 = inches

Table 5.2.1. 2022 soft white winter wheat cumulative summary.

Variety	Grain Yield, bu/A	Test Weight, lb/bu	Lodging, 0-9 score*	Heading Date	Plant Height, cm	Winter Survival, %	Pre-harvest Sprouting, 0-9 score*	Fusarium Head Blight			
								Incidence, %	Severity, %	Index, %†	DON, ppm§
Caledonia	75	54.5	2.0	5/30	97	99	6.1	82	46	39.5	45.1
Cayuga	66	57.8	4.5	6/2	119	97	2.1	NA	NA	NA	NA
Medina	74	55.7	3.0	5/31	106	99	2.8	59	28	15.5	19.3
NY99056-161	77	55.7	2.0	5/31	98	98	4.5	34	26	9.6	27.1

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* Scores for lodging and sprouting are done on a scale from 0 (no lodging or sprouting) to 9 (completely lodged or sprouted).

† Fusarium head blight index is incidence x severity.

§ DON is deoxynivalenol, a toxin that may be produced in fusarium head blight-infected kernels. Values are from 2020-2021.

Complete variety trial results are at <https://blogs.cornell.edu/varietytrials/small-grains-wheat-oats-barley-triticale/small-grains-cultivar-trial-results/>

Table 5.2.2. 2022 soft red winter wheat cumulative summary.

Variety	Grain Yield, bu/A		Test Weight, lb/bu	Heading Date	Plant Height, cm	Lodging, 0-9 score*	Winter Survival, %	Preharvest Sprouting, 0-9 score*	Wheat Spindle Streak Mosaic Virus, 0-9 score**	Fusarium Head Blight			
	5 Yr	2 Yr								Incidence, %	Severity, %	Index, %†	DON, ppm§
Erie	88	85	56.5	6/1	96	4.0	97	3.2	1.7	68	33	26	10.7
Pioneer 25R40	95	91	56.8	5/30	86	2.9	97	2.8	7.0	91	24	22	36.9
Liberty 5658		83	57.7	5/31	88	2.0	94	2.2	2.7	94	24	23	22.4
SW65SR		92	56.1	5/31	86	4.4	95	1.4		93	23	21	
SW51SR		83	57.0	5/31	88	5.7	96	0.6		68	20	15	
Revere 2169		92	56.5	5/31	85	2.2	97	0.7		89	19	17	
Revere 2148		84	56.9	5/30	87	6.3	97	0.3		81	28	25	

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* Scores are done on a scale from 0 (no lodging or sprouting) to 9 (completely lodged or sprouted).

** Virus ratings are done on a scale from 0 (no disease) to 9 (highly susceptible to disease). Scores below 3.0 are relatively resistant.

† Fusarium head blight index = incidence x severity.

§ DON is deoxynivalenol, a toxin that may be produced in fusarium head blight-infected kernels. Values are from 2020-2021.

Table 5.2.3. 2021 spring oat cumulative summary.

Variety	Grain Yield, bu/A		Test Weight, lb/bu	Heading Date	Lodging, 0-9 score*	Plant Height, cm
	6 Yr	2 Yr				
Ogle	66	78	36.8	6/23	2.9	76
Newdak	67	72	38.5	6/22	6.5	84

Table 5.2.3. 2021 spring oat cumulative summary.

Variety	Grain Yield, bu/A		Test Weight, lb/bu	Heading Date	Lodging, 0-9 score*	Plant Height, cm
	6 Yr	2 Yr	2 Yr	2 Yr	2 Yr	2 Yr
Corral	67	78	37.2	6/25	3.0	70
Steuben	71	77	38.3	6/28	5.0	81
Buff (naked)	56	63	44.7	6/24	3.8	79
AC Gehl (naked)		44	46.4	6/26	3.1	
Navaro (naked)		57	47.5	6/29	1.1	
Fuego (naked)		49	48.9	6/28	3.6	
Casino (naked)		50	49.1	6/29	1.3	
Paul (naked)		52	47.1	6/28	5.1	

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* Scores are done on a scale from 0 (no lodging) to 9 (completely lodged).

Table 5.2.4. 2022 winter malting barley cumulative summary - agronomic traits.

Variety	Row #	Grain Yield, bu/A		Test Weight, lb/bu		Lodging, 0-9 score*	Plant Height, cm	Heading Date	Winter Survival, %	Fusarium Head Blight			Pre-harvest Sprouting, 0-9 score*	Spot Blotch, 0-9 Score‡	Scald, 0-9 Score‡	
		5 Yr	2 Yr	5 Yr	2 Yr	2 Yr	2 Yr	2 Yr	2 Yr	Incidence, %	Severity, %	Index, %†	DON, ppm§	2 Yr	2 Yr	2 Yr
KWS																
Scala	2	85	78	46.7	46.1	2.9	72	5/26	92	74	21	15	11.1	1.6	0.3	4.7
SY Tepee	2	89	83	48.1	47.2	2.7	79	5/26	93	72	17	13	12.1	0.6	2.0	1.1
Lightning																
◇	2	87	78	49.9	49.0	1.8	78	5/24	93	57	13	8	8.0	0.0	3.1	1.0
LCS																
Calypso	2	95	85	48.5	47.4	2.4	87	5/24	90	39	11	4	6.3	0.4	2.3	0.9
LCS																
Violetta	2	88	86	49.2	48.7	2.7	79	5/23	92	48	19	8	11.7	0.5	1.3	0.4
Buck ‡	6	70	58	55.7	53.7	4.9	78	5/27	75	83	40	37	23.6	0.0	1.3	1.5
10.1618 ‡	6	79	65	52.2	51.1	4.0	75	5/23	79	89	41	37	18.3	0.1	2.0	0.8
BC																
Clemetine	2		92		48.6	0.6	80	5/24	89	75	16	8		1.0	1.2	1.3
BC Fay	2		93		46.7	2.6	79	5/26	94	79	20	16		0.2	2.5	0.4

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Acknowledgement of Funding Sources: New York State Ag & Markets, U.S. Wheat and Barley Scab Initiative, Genesee Valley Regional Market Authority

◇ Lightning is a facultative barley, meaning it can be grown as either winter or spring barley. Buck is a naked (hullless) barley.

‡ Buck and 10.1618 are naked (hullless) barley.

* Scores for lodging and sprouting are done on a scale from 0 (no lodging or sprouting) to 9 (completely lodged or sprouted).

† Fusarium head blight index = incidence x severity.

§ DON is deoxynivalenol, a toxin produced in fusarium head blight infected kernels. Values are from 2021.

‡ Spot blotch and scald ratings are done on a scale from 0 (no disease) to 9 (highly disease susceptible).

heads and fallen straw. Look for the small white maggots and brown puparia (the resting stage, commonly called "flaxseeds" for their resemblance to the flat spindle-shaped seeds of flax) deep within the sheaths of the lower leaves in the weeks just before wheat harvest.

No insecticides are recommended for control of the Hessian fly. Plow under stubble of infested grain at least 6 inches immediately after harvest. Destroy all volunteer wheat by disking when the plants are small. Plant wheat only after

the fly-free date for your area but as soon after that date as possible (see Figure 5.8.1 for Hessian Fly free dates predicted for NY). Ask your seed dealer about the availability of Hessian fly-resistant varieties.

5.8.4 Stored Grain Insect Management

Table 5.8.1 provides options for managing stored grain insects.

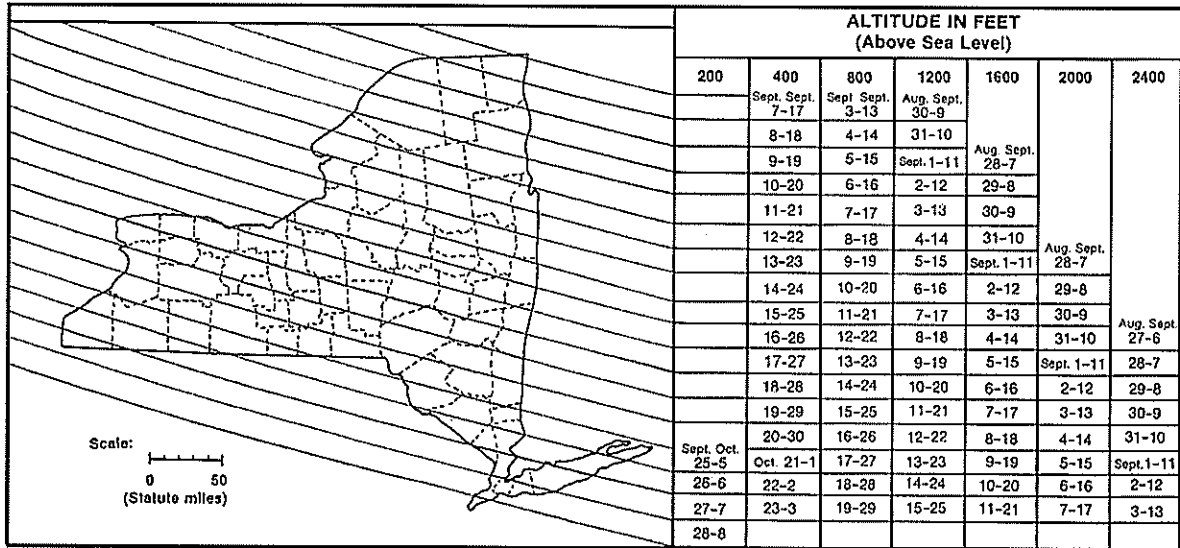


Figure 5.8.1. Hessian fly-free dates.

Table 5.8.1. Stored grain insecticides registered for use in New York state

Note that this is not an exhaustive list; other product options may be available.

Active Ingredient	Trade Name	Labeled Use							
		Empty Bin Treatment	Corn	Barley	Oats	Rye	Soy-bean	Wheat	Comments
aluminum phosphide (phosphine gas)	*Degesch Phostoxin Pellets		X	X	X	X	X	X	See label for pests.
	*Degesch Phostoxin Tablet Prepac		X	X	X	X	X	X	See label for pests.
	*Detiaphos Pellets		X	X	X	X	X	X	See label for pests.
	*Weevil-Cide Pellets		X	X	X	X	X	X	See label for pests.
	*Weevil-Cide Tablets		X	X	X	X	X	X	See label for pests.
<i>Bacillus thuringiensis</i>	Dipel DF		X	X	X	X	X	X	Indian meal moth, almond moth
	Javelin WG		X	X	X	X	X	X	Indian meal moth, almond moth
beta-cyfluthrin	Tempo SC Ultra	X							See label for pests.

Table 5.8.1. Stored grain insecticides registered for use in New York state (continued)

Note that this is not an exhaustive list; other product options may be available.

Active Ingredient	Trade Name	Labeled Use							Comments
		Empty Bin Treatment	Corn	Barley	Oats	Rye	Soy-bean	Wheat	
diatomaceous earth (silicon dioxide)	Desect	X	X	X	X	X	X	X	See label for pests.
	Diatomaceous Earth Insecticide		X	X	X	X	X	X	For any crawling stored grain insect.
	Dryacide 100	X	X	X	X	X	X	X	For any stored grain insect.
dichlorvos	Prozap Insect Guard		X	X	X	X	X	X	Any stored insect pest. See label for specific use instructions.
deltamethrin	*D-fense SC	X	X	X	X	X		X	See label for pests.
	*Suspend SC	X	X	X	X	X		X	See label for pests.
deltamethrin + chlorpyrifos-methyl	Storcide II	X		X	X			X	See label for pests. Has use restrictions and equipment requirements when treating empty bin.
malathion	Malathion 5	X							See label for pests. Only for storages being prepared to store wheat, oats, corn, rye, and barley.
	Malathion 57 EC	X							See label for pests. Only for storages being prepared to store wheat, corn, oat, rye, and barley.
phosphine + carbon dioxide gas	*Eco ₂ fume Fumigant Gas		X	X	X	X	X	X	See label for pests.
pirimiphos-methyl	Actellic 5 EC		X						See label for pests.
pyrethrins + piperonyl butoxide	Prozap Dy-Fly Aerosol Insecticide	X							See label for pests and use instructions.
	*Pyronyl Crop Spray	X	X	X	X	X		X	See label for pests.
	Stryker Insecticide Concentrate	X	X	X	X	X		X	See label for pests.
	Zeposector –S _{II}	X							See label for pests.
pyrethrins	Evergreen Pyrethrum Concentrate	X	X	X	X	X	X ³	X	See label for pests. Can be used as a surface treatment of stored grain to control Indian meal moths, Angoumois grain moths, and Mediterranean flour moths. ³ Label refers to beans as a crop.
(S)-methoprene	Diacon IGR	X	X	X	X	X	X	X	See label for pests. Used to prevent larvae development into adults.

Table 5.8.1. Stored grain insecticides registered for use in New York state (continued)

Note that this is not an exhaustive list; other product options may be available.

Active Ingredient	Trade Name	Labeled Use							Comments
		Empty Bin Treatment	Corn	Barley	Oats	Rye	Soy-bean	Wheat	
(S)-methoprene (continued)	Diacon-D IGR	X	X	X	X	X	X	X	See label for pests. Used to prevent larvae development into adults.
spinosad	Sensat		X	X	X			X	For all insect pests.

Table 5.8.2. Summary of suggested insecticides for small grains insect control, including seed treatments.

Active Ingredient (Example Product(s))	Aphid	Armyworm	Cereal Leaf Beetle	Hessian Fly	Wireworm	Comments
alpha-cypermethrin (*Fastac)	X	X	X			Wheat and triticale only
chlorantraniliprole (*†Prevathon)		X				
cyfluthrin (*Baythroid)	X	X	X			
dimethoate (*Dimethoate)	X					Wheat only
flupyradifurone (*†Sivanto)	X					
lambda-cyhalothrin (*Warrior II)	X	X	X			
spinosad (Blackhawk, Entrust, Tracer)		X	X			
zeta-cypermethrin (*Mustang Maxx)	X	X	X			
Seed Treatments						
imidacloprid (Gaucho)				X	X	
thiamethoxam (Cruiser)				X	X	
*Restricted-use pesticide						
† Not for sale or use in Nassau or Suffolk Counties						

5.9 Weed Control in Small Grains

Although weeds are usually less of a problem in small grains than in row crops, heavy infestations of annual weeds, quackgrass, or wild garlic reduce grain yields and/or quality.

Small grain fields should be checked for weeds in the fall (for winter wheat or barley) or early spring because most herbicide applications should be made prior to jointing (Growth Stage 6), or the appearance of the first node at the base of the plant (usually 4 to 8 inches tall with 12 or more leaves). Herbicide application during grain ripening may aid harvest operations but will not increase grain yields.

Many winter annual broadleaf weeds in winter wheat can be controlled with spring applications of 2,4-D or Banvel/Clarity. Both can cause crop injury if used at growth stages other than those recommended. In addition, Banvel/Clarity may delay wheat maturity when used according to guidelines.

Spring applications of 2,4-D or Banvel/Clarity are not effective against corn chamomile. Bromoxynil is effective on corn chamomile when the rosettes (clusters of leaves in circular form) are less than 1 inch across. Corn chamomile usually reaches this stage within a month after seeding so bromoxynil applications for this weed should be made in the fall. Other annual weeds controlled with bromoxynil are field pennycress, field pepperweed, shepherds-purse, small seed falseflax, wild mustard, wild radish, and yellow rocket.

5.9.1 Herbicide Resistance Management

In the past couple of years, horseweed (a.k.a. mare's tail) has been very visible in winter small grains at harvest. Horseweed has multiple resistant populations to both Group 9 (i.e. Roundup) and Group 2 (i.e. Harmony, Peak) herbicides. For small grain growers, this can be a very troublesome resistant weed to control due to the reliance of certain ALS (or Group 2) herbicides in winter cereal grains. Herbicides such as *†Huskie and the growth regulators (2,4-D and Banvel/Clarity) are effective for horseweed management.

Small Grain Planting Management

Match the crop to soil type & pH:

CROP	SOIL DRAINAGE CLASS				
	Occasionally Dry	Usually Moist	Occasionally Wet	Commonly Wet	Usually Wet
BARLEY	[Barley adaptation range across drainage classes]				
BUCKWHEAT	[Buckwheat adaptation range across drainage classes]				
CORN (Grain)	[Corn (Grain) adaptation range across drainage classes]				
CORN (Silage)	[Corn (Silage) adaptation range across drainage classes]				
OATS	[Oats adaptation range across drainage classes]				
RYE	[Rye adaptation range across drainage classes]				
SORGHUM	[Sorghum adaptation range across drainage classes]				
WHEAT	[Wheat adaptation range across drainage classes]				

Adaptation of grain crops to soil drainage

CROP	SOIL pH							
	BELOW 5.5	5.5+	5.8+	6.0+	6.2+	6.5+	6.8+	ABOVE 7.0
Barley	[Barley adaptation range across pH levels]							
Buckwheat	[Buckwheat adaptation range across pH levels]							
Corn (Grain)	[Corn (Grain) adaptation range across pH levels]							
Corn (Silage)	[Corn (Silage) adaptation range across pH levels]							
Oats	[Oats adaptation range across pH levels]							
Rye	[Rye adaptation range across pH levels]							
Sorghum	[Sorghum adaptation range across pH levels]							
Wheat	[Wheat adaptation range across pH levels]							

Adaptation of grain crops to soil pH

Crop Rotation – will it break or prolong weed, insect, and disease cycles? Fertility management of the rotation?

- Insects: wireworms, grubs, aphids
- Weeds: winter annual, cheat, warm summer annuals
- Diseases: Fusarium head blight, soil viruses, soil fungi
- Break the “green bridge” from volunteer grains after the previous harvest

Crop & Variety Selection:

- What is your attitude, management intensity, and goal
- Managing VNS rye is different than managing 100+ bushel grain crops
- Use University yield trial results
- Prioritize the traits needed for your circumstance: disease resistance, flowering date, maturity, quality, lodging, pre-harvest sprouting, canopy structure, response to inputs

Soil Test & Fertility – guessing is not management. We lose control when we guess.

- Fertilization is dependent on crop history; soil fertility; companion seeding or sole grain crop
- High yielding grains need about 25 lbs of phosphate at planting
- Nitrogen management depends on field history, soil organic matter, planting date. Split N applications in the spring at green-up (only if more tillers are needed) and at Feekes 6 (stem elongation). Fungicide should be applied about 3 days after N is applied at stem elongation.
- Potassium is especially needed at planting if soil test is low

- Drills often band fertilizer in contact with seed. Urea and potassium can harm seeds in small amounts while boron and ammonium thiosulfate should not be in contact with seed.
- High soil pH (above 6.5 or so) can lead to micronutrient deficiencies (manganese, copper), to which small grains are sensitive. Foliar feeds and acidifying fertilizers can help.

Tillage System: any system from full tillage to no-till can work. It depends on the field conditions and many factors of each field.

Planting – uniform spacing and emergence for best yields

- **Plant Depth** – *Where do you want the growing point to be in the soil?* Plant 1” to 1 ½” deep, check you drill, plant deep enough to reach moist soil
 - Smooth seed tubes give more even seed placement
 - Uneven crop residue on the field will result in uneven emergence and growth
 - Consider the type of plant canopy (upright or spreading). An upright canopy may benefit row spacings closer than 7 ½”. Consider planting perpendicular rows.
 - Consider tramlines (wheel paths) for multiple applications for intensive management.
- **Seeding Rate:** 1 to 1.3 million seeds/acre for wheat and probably other grains as well. Adjust up if planting late. You have to know seeds/lb, then calculate volume and calibrate drill. Goal is about 70 seed heads/sq ft.

Weed Control:

- begins with crop rotation planning a year or more in advance
- control weeds in the fall (for both winter and spring grains)
- The 2023 New York Small Grain Herbicide Summary lists the most common herbicides available. Use this to help narrow your selection of herbicides. The NYS DEC Bureau of Pesticides Management - Information Portal lists all pesticides registered in NY. Refer to this database to find New York labels of pesticides, <https://www.dec.ny.gov/nyspad/?0> .

2023 New York Small Grain Herbicide Summary of some formulations, Aaron Gabriel, Cornell Cooperative Extension

Use this table to quickly find which herbicides may or may not work for your situation. Then read the specific pesticide label, which can be found at the NYS DEC Bureau of Pesticides Management - [Information Portal, https://www.dec.ny.gov/nyspad/?0](https://www.dec.ny.gov/nyspad/?0) . Read labels carefully to understand when, where, and how each pesticide may be applied. *It can be complicated. Read carefully.*

Herbicide	Crops	Application Timing of crop	Weeds Controlled	Pre-harvest Interval	Rotation Intervals
Axial Bold (G) Group 1 Pinoxaden + Fenoxaprop	Wheat Barley	Crop emergence to Pre-boot (wheat) or prior to jointing (Barley)	Emerged foxtails, wild oats, barnyardgrass,	70 day grain	30 days –leafy & root crops 90 days – other cereals & other crops
Osprey XTRA (R) Group 2 Mesosulfuron (SLN 12/31/23)	Winter Wheat Winter Triticale	Emergence to jointing	Emerged roughstalk bluegrass, cheat, annual ryegrass	70 day grain	3 mo – wheat & triticale 9 mo barley Bioassay required and/or 3 to 19 mo for other crops
Harmony Extra (G) Group 2 Thifensulfuron Tribenuron	Wheat Triticale Barley Oat	Wht/Brly/Trtcl - 2-leaf to before flag leaf is visible. Oat – 3 leaf to jointing	Emerged corn chamomile, wild garlic, chickweed, and several other broadleaves	45 day grain 7 day graze 30 day hay	45 days most crops
Peak (G) Group 2 Prosulfuron	Wheat Barley Oats Rye	Emergence to 2 nd node of stem elongation	Emerged broadleaf weeds	60 day grain	1 mo field corn 10 mo grasses, sweetcorn 22 mo legumes
Prowl H2O (G) Group 3 Pendamethalin	Wheat & Triticale	1-leaf to pre-flag leaf planted >1” deep	Pre-emerged crabgrass, foxtail & other annual grasses and broadleaves	60 day grain 28 day hay 11 day forage	0 – 24 mo, check label
Clarity (G) Group 4 Diglycoalamine salt of dicamba	Wheat Triticale Barley Oats	Spr Wht & Trtcl – before 6-leaf; Wntr Wht & Trtcl – before jointing; Spr Brly – before 4-leaf; Wntr Brly –before jointing; Oats – before 5-leaf	Emerged annual & perennial broadleaf weeds, some soil residual activity	7 day grain	Rate dependent – see label No rotational restrictions after 120 days for applications of 24 fl oz or less

Herbicide	Crops	Application Timing of crop	Weeds Controlled	Pre-harvest Interval	Rotation Intervals
Banvel (G) Group 4 Dimethylamine salt of dicamba	Wheat Barley Oats	Spr Wht – before 6-leaf; Wntr Wht – before jointing; Spr Brly – before 4-leaf; Wntr Brly – before jointing; Spring Oats – before 5-leaf	Emerged annual & perennial broadleaf weeds, some soil residual activity	7 day grain	20 days per pint of Banvel applied per treated acre; Any crop after a normal small grain harvest
MCPA (G) Group 4 Dimethylamine salt of 2-methyl-4-choloro-phenoxy acid	Wheat Triticale Barley Oats Rye	3 or 4-leaf to pre-boot	Emerged mustard and many other broadleaf weeds. Half dose with low gallons may be applied to grains when under-sown w/ legumes		0 days for labelled crops 60 days for other crops
2,4-D amine (G & R) Group 4	Wheat Barley Oats Rye	Fully tillered and before early boot stage	emerged annual and perennial broadleaf weeds	14 day grain	14 days for some crops
2,4-D ester (G) Group 4	Wheat Barley Oats Rye	Fully tillered and before early boot stage	emerged annual and perennial broadleaf weeds	14 day grain	15 days for some crops
Huskie (R) Group 6 + 27 Bromoxynil Pyrasulfotole (SLN 12/31/27)	Wheat Triticale Barley Rye	1 leaf up to flag leaf emergence	Marestail	60 day grain 25 day forage or graze	7 days wheat, barley 30 days some grasses 4 mo corn, alfalfa, soybean 9 mo Timothy
Moxy 2E (G) Group 6 Bromoxynil	Wheat Barley Oats Rye	Emergence to boot stage	Emerged broadleaf weeds. Contact (burndown) activity only	45 day feed, fodder, forage	30 day all crops

Herbicide	Crops	Application Timing of crop	Weeds Controlled	Pre-harvest Interval	Rotation Intervals
Sharpen (R) Group 14 Saflufenacil	Wheat Triticale Barley Oats Rye	Early pre-plant to pre-emerged crop	Pre-emerged and emerged broadleaf weeds Pre-harvest desiccant for wheat, non-malting barley, triticale when physiologically mature	PHI 3 days for desiccant application	3 mo small grains & corn to 5 mo alfalfa & other crops (rate dependent)
Finesse (G) Group 2 Chlorsulfuron Metsulfuron-methyl	Wheat Barley Triticale	Pre-plant, pre-emergence, post-emerged crop Specific instructions must be followed	Emerged & pre-emerged broadleaves and some grasses including Cheat & Bromus spp,	45 days to grain	Depends on rate, up to 36 months for corn and soybeans
Valor (G) Group 14 flumioxazin	Spring Wheat Spring Barley	Fall burndown for spring barley & spring wheat; Spring pre-plant (30 d) burndown for wheat planted >1 inch; Wheat harvest-aid (desiccant)	Pre-emerged broadleaves and grasses, including Cheat & Bromus spp. Applied in the fall.	10 days to grain, 5 to grazing	14 days corn, 4 months small grains, up to 10 months alfalfa

(R) – Restricted Use pesticide; (G) – General Use pesticide

(SLN) – Special Local Needs label (date indicates expiration of the label)

Always read the label *carefully*. The information in this table is generalized.

of the spike (head). The longer the lag phase, in either growing degree-days or real days, the more kernels per head, since more time is then allowed for more flowers to be fertilized. The maximum number of flowers is set at an earlier stage, but some of them may not become fertilized, depending on temperature, disease, and other factors. The lag phase ends when all flowers that will be fertilized are fertilized. Roughly another 500 GDD, or nearly two-thirds of the heat

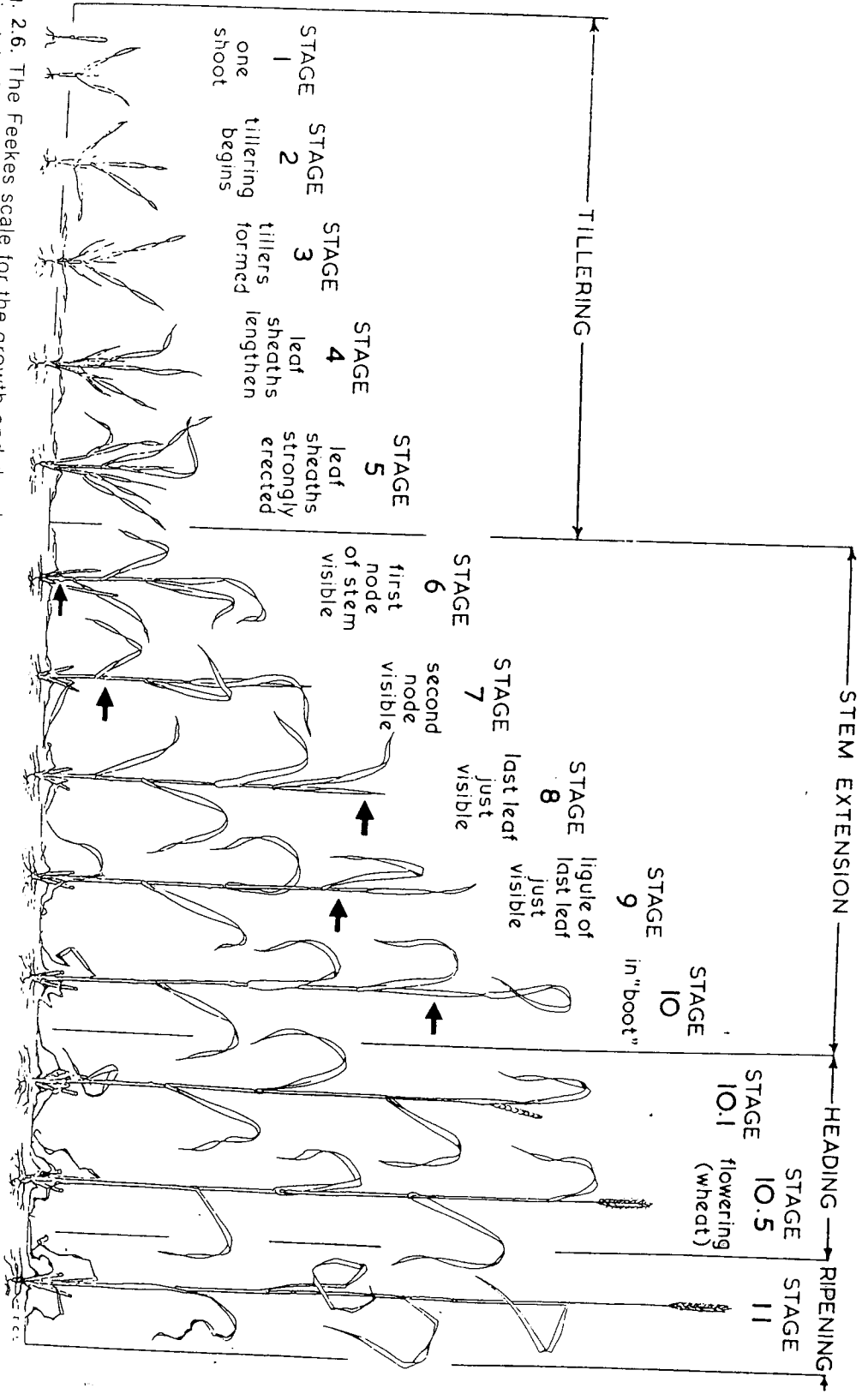


Fig. 2.6. The Feekes scale for the growth and development of cereals. (Reprinted, by permission of the Controller of Her Britannic Majesty's Stationery Office, from E. C. Large, 1954, Growth stages in cereals. Illustration of the Feekes scale, Plant Pathology 3:128-129, © Crown Copyright 1986)

VALUES FOR STAGES OF DEVELOPMENT

Standardized numerical designations are used for each developmental stage that has the same meaning regardless of the year, region, or kind of wheat. Numerical designations have an advantage over descriptive designations when the information is computerized. Several different scales have been developed for this purpose. The most widely used are the Feekes scale (Fig. 2.6), the Haun scale, and the Zadoks scale (Table

Table 2-1. Wheat Growth Stages

Stage	General Description	Scale		Additional Comments
		Feekes	Zadoks	
Germination	Dry seed		00	
	Start of imbibition		01	
	Imbibition complete		03	Seed typically at 35 to 40% moisture.
	Radicle emerged from seed (caryopsis)		05	
	Coleoptile emerged from seed (caryopsis)		07	
	Leaf just at coleoptile tip		09	
Seedling Growth	First leaf through coleoptile	1	10	
	First leaf unfolded		11	
	2 leaves unfolded		12	
	3 leaves unfolded		13	
	4 leaves unfolded		14	
	5 leaves unfolded		15	
	6 leaves unfolded		16	
	7 leaves unfolded		17	
	8 leaves unfolded		18	
9 or more leaves unfolded		19		
Tillering	Main shoot only		20	
	Main shoot and 1 tiller	2	21	
	Main shoot and 2 tillers		22	
	Main shoot and 3 tillers		23	Many plants will only have 2 or 3 tillers per plant at recommended populations.
	Main shoot and 4 tillers		24	
	Main shoot and 5 tillers		25	
	Main shoot and 6 tillers	3	26	Leaves often twisting spirally.
	Main shoot and 7 tillers		27	
	Main shoot and 8 tillers		28	
Main shoot and 9 tillers		29		

Vernalization

Stem Elongation	Pseudostem erection	4-5	30	
	1st detectable node	6	31	Jointing stage
	2nd detectable node	7	32	
	3rd detectable node		33	
	4th detectable node		34	Only 4 nodes may develop in modern varieties.
	5th detectable node		35	
	6th detectable node		36	
	Flag leaf visible	8	37	
Booting	Flag leaf ligule and collar visible	9	39	
	Flag leaf sheath extending		41	Early boot stage.
	Boot swollen	10	45	
	Flag leaf sheath opening		47	
Head (Inflorescence) Emergence	First visible awns		49	In awned varieties only.
	First spikelet of head visible	10.1	50	
	¼ of head visible	10.2	52	
	½ of head visible	10.3	54	
	¾ of head visible	10.4	56	
Pollination (Anthesis)	Head completely emerged	10.5	58	
	Beginning of flowering	10.51	60	Flowering usually begins in middle of head.
		10.52		Flowering completed at top of head.
		10.53		Flowering completed at bottom of head.
½ of flowering complete		64		
Flowering completed		68		
Milk Development	Kernel (caryopsis) watery ripe	10.54	71	
	Early milk		73	
	Medium milk	11.1	75	Milky ripe.
Dough Development	Late milk		77	Noticeable increase in solids of liquid endosperm when crushing the kernel between fingers
	Early dough		83	
	Soft dough	11.2	85	Mealy ripe: kernels soft but dry.
Ripening	Hard dough		87	
	Kernel hard (hard to split by thumbnail)	11.3	91	Physiological maturity. No more dry matter accumulation.
	Kernel hard (cannot split by thumbnail)	11.4	92	Ripe for harvest. Straw dead.
	Kernel loosening in daytime		93	
	Overripe		94	
	Seed dormant		95	
	Viable seed has 50% germination		96	
Seed not dormant		97		
Secondary dormancy		98		
Secondary dormancy lost		99		

Sources: Conley, et al. 2003. *Management of Soft Red Winter Wheat*. IPM1022. Univ. of Missouri. Alley, et al. 1993. *Intensive Soft Red Winter Wheat Production: A Management Guide*. Pub. 424-803. Virginia Coop. Extension. Johnson, Jr., et al. *Arkansas Wheat Production and Management*. MP404. Univ. of Arkansas. Coop. Ext. Serv.

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Eldred Hay, Grain, & Seed, LLC4779 Valentine Road Auburn NY 13021 **Phone:** [315-784-5035](tel:315-784-5035)
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Ward & Vanscoy Inc.162 North Avenue Owego NY 13827 **Phone:** [607-727-4051](tel:607-727-4051)
Lynford Wise1811 Kuney Road Romulus NY 14541 **Phone:** [315-952-7461](tel:315-952-7461)
Turnpike Feeds10169 Turnpike Road Clyde NY 14433
Stillwater Farm1587 South Street Castleton VT 05735 **Phone:** [802-558-5477](tel:802-558-5477)

Seed Suppliers for Open-Pollinated Corn, ancient grains and small grains

Prepared by: Aaron Gabriel, Cornell Cooperative Extension, February 2021

For heritage and ancient varieties of grain, many farmers find seed from other farmers through their personal networks and farmers associations, such as the Northern Grain Growers Association (<https://northerngraingrowers.org/>), Maine Grains Alliance (<https://kneadingconference.com/>), organic farming associations, (Noble Grain Alliance info@noblegrainalliance.org).

Often only small quantities of seed may be available and you need to increase your own seed for large plantings.

There are a few local grain and seed alliances in the western US, but considerations must be made that the western US has a different growing environment than the northeast. There are also some seed companies in eastern and western Canada with good variety selection.

Seed Supplier	Information
Organic Grain Research Information Sharing Network, Elizabeth Dyck, edyck@ogrin.org	Elizabeth networks with northeast farmers to source small quantities of ancient grain seed.
New York Seed Improvement Association	2020 Directory - https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/5/8858/files/2020/12/2020-NEW-YORK-CERTIFIED-SEED-Crop-Directory.pdf (on www.fieldcrop.org) Wheat, Oats, Barley
Ohio Seed Improvement Association	seed directory - https://www.ohioseed.org/publications/ Small grains including spelt
Michigan Crop Improvement Association 2905 Jolly Road Okemos, MI 48864 Phone: 517-332-3546	directory of seed growers – https://www.michcrop.com/seed-products/seed-directory/#1597346317124-25421814-9be2 Wheat, Oats, Barley, Dry Beans
AgriMAXX Wheat Company 7167 Highbanks Road Mascoutah, IL 62258 Phone: 855-629-9432 https://agrimaxxwheat.com/	Conventional Soft Red Wheat & Hard Red Wheat
Albert Lea Seed 1414 W. Main, PO Box 127 Albert Lea, MN 56007 Phone: 800-352-5247 https://alseed.com/	Conventional Small Grains including einkorn & emmer; OP Corn

Dyna-Gro Seed 4648 S Garfield Rd Auburn, MI 48611 Phone: 989-662-0000 https://www.dynagroseed.com	Conventional Wheat
Elk Mound Seed 308 Railroad Street Elk Mound, WI 54739 Phone: (715) 879-5556 https://www.elkmoundseed.com	Conventional OP Corn (1 variety)
Fedco Seeds, PO Box 520, Clinton, ME 04927, 207-426-9900, questions@fedcoseeds.com www.fedcoseeds.com/seeds	Organic OP Corn, broom corn, Wheat, Oats
Henry Beiler, Wholesome Acres 6469 Musser Ln., Watson town, PA 17777 570-538-5949	Organic Einkorn (2 varieties now, will have 3 varieties for fall 2021)
Green Haven Open Pollinated Seed Group 8225 Wessels RD Avoca, NY 14809 Phone: 607-566-9253 Email: opcorn@gmail.com www.openpollinated.com	Conventional OP Corn (23 varieties), Hulless Oats, Danko Rye
Great Lakes Staple Seeds https://greatlakesstapleseeds.com/collecti ons/club-wheat-triticum-turgidum- compactum	Naturally grown Small quantities available (grams to ¼ lb) OP Corn, heritage and ecologically adapted varieties (Michigan environment) of wheat, ancient wheats, small grains, buckwheat, legumes.
Lakeview Organic Grains 119 Hamilton Place, Penn Yan, NY 14527 (315) 531-1038 info@lakevieworganicgrain.com https://lakevieworganicgrain.com/	Organic Small Grains, OP Corn
Lima Grain Cereal Seed 2040 SE Frontage Rd, Fort Collins, CO 80525 Zach Gaines, 907-498-2204 zach.gaines@limagrains.com https://limagrainscerealseed.com/	Conventional Wheat, Barley
Local Seed Company LLC 802 Rozelle St Memphis, TN 38104 Phone: 901-260-6000 https://localseed.com	Conventional Soft Red Wheat

<p>Meridian Seeds, 16553 37th St SE suite 3, Mapleton, ND 58059, Martin Hochhalter (701) 532-3975, mhochhalter@meridianseed.com www.meridianseeds.com</p>	<p>Conventional Small Grains</p>
<p>OPCORN LLC https://opcorn.com/ 724-259-7622</p>	<p>OP Corn (4 varieties)</p>
<p>Rupp Seeds, Inc. 17919 Co Rd. B Wauseon, OH 43567 Phone: 419-337- 1841 www.ruppseeds.com/grain-forage/products/wheat</p>	<p>Conventional Soft Red Wheat</p>
<p>Seedway P.O. Box 250, 1734 Railroad Place Hall, NY 14463 Tel: 800-836-3710 www.Seedway.com</p>	<p>Conventional Small Grains</p>
<p>Soltice Seeds, Brian Stroffolino 74 Gilson Rd. Hartland, VT 05048, 603- 252-1288, solticeseedsvt@gmail.com</p>	<p>Grown without pesticides or conventional fertilizers OP Corn, Oats, Rye, Wheat garden size amounts</p>
<p>Sherck Seeds Bristol, IN john@sherckseeds.com www.sherckseeds.com</p>	<p>Conventional OP Corn, Small Grains, Beans John is phasing out several varieties</p>
<p>The Kusa Seed Research Foundation Post Office Box 761 Ojai, California 93024, info@ancientcerealgrains.org https://www.ancientcerealgrains.org/seedandliteraturecatalog1.html</p>	<p>Grown without pesticides or conventional fertilizers Ancient Grains</p>
<p>The Maine Potato Lady PO Box 65 Guilford, ME 04443 207-717-5451 https://www.mainepotatolady.com/productcart/pc/viewCategories.asp?idCategory=197</p>	<p>Organic OP Corn, Wheat, Hulless Oats</p>

Basic determinations made in grain storage management:

- What is the moisture content and temperature of the grain at harvest?
- How long can it be stored at that moisture and temperature?
- How will the grain initially be held (in what structure/bag) and what is the capacity of the system to deliver heat and air to dry it, or to cool it down.
- Storage structure volume and fan capacity must be matched properly to deliver the need cubic feet per minute (CFM) of air.
- If heat is used to dry the grain, how will it be tempered and cooled before long-term storage.
- For long-term storage, how will the grain be cooled as the ambient temperature drops as winter progresses, to keep it within 15^o F of the average monthly temperature. The grain must be cooled down in steps as winter temperatures drop. Hours to run a bin fan equals 15 / cfm per bushel
- How will grain be monitored periodically (bi-weekly, monthly) for temperature, moisture, and pests?

Find several resources at Grain Storage Management For the Hudson Valley, <https://blogs.cornell.edu/capitalareaagandhortprogram/2022/03/28/grain-storage-management-education-for-the-hudson-valley/>

These are references to grain storage manuals that help you need to design storage, aeration, and drying systems:

- **Midwest Planning Service - <https://www-mwps.sws.iastate.edu/catalog/grain-handling-storage>**
- **North Dakota State University, <https://www.ag.ndsu.edu/graindrying>**
- **University of Nebraska, <https://lancaster.unl.edu/ag/crops/storage.shtml>**