Northern NY Agricultural Development Program
2023 Project Report

Cereal Rye Cover Crop Varieties & Planting Dates for Northern New York: Year 1

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Background:
Fall-planted cover crops help reduce soil erosion and nutrient runoff, filter surface and ground water, add organic matter to the soil, reduce weeds and pests, and sequester carbon in the soil. Cereal rye is the most common cover crop due to its unparalleled biomass production, weed suppression, and growth under cold conditions. While rye is a popular cover crop among northern growers, challenges for farmer adoption remain. A focus group was conducted in March 2022 and included 14 farmers and service providers in northern New York (NNY). Participants discussed a range of topics related to the use of rye and other cover crops. Participants identified challenges related to short planting windows, adaptation to cold climate, and seed cost as the main challenges with cover cropping in the region. Improved winter hardiness and tolerance of late planting were identified as top areas for future research and breeding. A range of other topics were also discussed, including earlier flowering for roller crimper systems, improved forage quality, cover crops for interseeding, tolerance of wet soil conditions, tolerance of equipment

traffic, and improved root biomass. This research in 2023 conducted a second year of the cereal rye variety and planting date trial initiated in 2022 to identify rye varieties best adapted for cover crop use in NNY and the varieties best able to tolerate late planting dates.

Previous and ongoing related work:
The NNYADP has funded two years (2022-2023 and 2023-2024 cover cropping seasons) of cereal rye variety and planting date trials across Northern New York. Experiments have been planted in the following locations:

- 3 farms in NNY (Lewis and Clinton counties)
- Cornell Willsboro Research Farm, Willsboro, NY
- CCE St Lawrence County Extension Learning Farm, Canton, NY (*2022-2023 season*)
- Homer C. Thompson Vegetable Research Farm, Freeville, NY (outside funding).

The experiment included 6 rye varieties in the 2022-2023 season and 14 varieties in the 2023-2024 season. Rye was planted on up to four dates between September 25 and October 25 at the research stations and a single date on farms. Data collection included soil testing, seedling emergence, plant vigor, winter survival, growth stage, and biomass.

A set of experiments were also initiated to develop cereal rye with improved ability to emerge and produce sufficient biomass when planted late in the fall. Nurseries were planted in Willsboro, NY, Freeville, NY, and St. Paul, MN. The nurseries include 11 populations derived from crosses between northern-adapted cereal rye cultivars (Aroostook and ND Gardner) and southern-adapted breeding lines with high allelopathy.

The nursery at the Willsboro Research Farm was planted on October 13, 2023. Emergence and vigor were evaluated in fall 2023. The same populations were also planted in Ithaca, NY, in a thermogradient table, which is a controlled environment used to test seed germination over a range of temperatures. The experiment was planted in October 2023 under cold temperatures (2-5°C), and plants were selected among and within families for rapid emergence and vigor. Selected plants were vernalized and intermated in the greenhouse over the winter (2023-2024), and a second cycle of evaluation and selection will take place in the thermogradient table in spring 2024.

In addition to the work above, the Moore lab is engaged in several projects related to cover crop management and breeding. Dr. Moore leads a national Cover Crop Breeding (CCB) Network, which includes rye breeding nurseries in New York, Maryland, Minnesota, and North Carolina, and 15 testing locations across the country. The lab is also testing rye varieties in combination with hairy vetch to determine flowering time and compatibility for roller-crimper systems.

Methods:
Variety x planting date trials: The Year 1 (2022-2023) variety x planting date trial was conducted at the Miner Agricultural Research Farm in Chazy, NY and at the Extension Learning Farm (ELF) in Canton, NY in coordination with a trial planted at the Homer C. Thompson Vegetable Research Farm in Freeville, NY. In spring 2023, data collection took place for the Year 1 variety x planting date trial. Members of the Moore Lab traveled to the locations in NNY to assist with data collection and biomass sampling. Spring data collection included winter survival and plant height, maturity, rye biomass, and weed biomass at termination. The Year 2 variety x planting date trial was planted in fall 2023 at the Willsboro and Freeville research stations. The Canton research station was unable to plant the experiment due to changes with the North Country regional ag team. The trial was planted on up to four dates between September 25

and October 25 (Table 1). The experiment included 6 rye varieties in Year 1 and 14 varieties in Year 2 (Table 2). Plots were drill seeded at a rate of 112 lb/acre. Baseline soil samples were taken and seedling emergence and plant vigor were recorded approximately every 2 weeks after each planting date. Emergence was assessed visually on a percentage basis, and vigor was evaluated on a 1 to 9 scale, with 1 as the least vigorous plot and 9 as the most vigorous.

Table 1: Cereal rye cover crops and planting dates trial locations and planting dates, 2022-2023, NNYADP project.

Location	Year	Planting Date 1	Planting Date 2	Planting Date 3	Planting Date 4
William H. Miner Agricultural Research Institute (Chazy, NY)	1	25 September	5 October	13 October	25 October
	2	25 September	10 October	17 October	6 November
Extension Learning Farm (Canton, NY)	1	12 October	26 October	--	--
Homer C. Thompson Vegetable Research Farm (Freeville, NY)	1	30 September	12 October	20 October	25 October
	2	25 September	4 October	13 October	25 October
Andrew Menard, Happy Haven Farm (Mooers, NY)	1	3 October	--	--	--
	2	24 October			
Sam Dyer (Plattsburgh, NY)	1	12 October	--	--	--
	2	16 October	--	--	--
Terry Pominville, Pominville Farms (Croghan, NY)	1	6 October	--	--	--
	2	27 September	--	--	--

Table 2: Cereal rye varieties planted in variety x planting date and on-farm trials, 2022-2023, NNYADP cereal rye cover crops and plantings dates project.

Variety	Planted Year 1 (all sites)	Planted Year 2 (research stations)	Planted Year 2 (Clinton County farms)	Planted Year 2 (Lewis County farm)
AC Hazlet	Yes	Yes	Yes	Yes
Aroostook	Yes	Yes	Yes	Yes
CoverMax	No	Yes	Yes	No
Danko	Yes	Yes	Yes	Yes
Elbon	Yes	Yes	Yes	Yes
Guardian	Yes	Yes	Yes	Yes
Musketeer	No	Yes	No	No
NC20-R114	No	Yes	No	No
NC20-R109	No	Yes	No	No
NC20-R103-2	No	Yes	No	No
ND Gardner	Yes	Yes	Yes	Yes
Rymin	No	Yes	No	No
Sangaste	No	Yes	No	No
Wrens Abruzzi	No	Yes	Yes	Yes

On-farm variety trial:. Variety trials were planted on three farms in NNY in both Fall 2022 and Fall 2023 (Table 1), including a subset of the varieties evaluated in the research station trial (Table 2). The trials were planted by Soil and Water Conservation Department personnel in strip plots following cash crop harvest on each participating farm. On-farm data collection varied by site, but included seedling emergence, plant vigor, winter survival, plant height, canopy cover, and biomass.

Rye nursery: A set of trials was initiated to develop cereal rye with improved ability to emerge and produce sufficient biomass when planted late in the fall. Nurseries were planted in Willsboro, NY, Freeville, NY, and St. Paul, MN. The nurseries include 11 populations derived from crosses between northern-adapted cereal rye cultivars (Aroostook and ND Gardner) and southern-adapted breeding lines with high allelopathy. The nursery at the Willsboro Research Farm was planted on October 13, 2023. Emergence and vigor were evaluated in fall 2023. The same populations were also planted in Ithaca, NY, in a thermogradient table, which is a controlled environment used to test seed germination over a range of temperatures. The experiment was planted in October 2023 under cold temperatures (2-5°C), and plants were selected among and within families for rapid emergence and vigor. Selected plants were vernalized and intermated in the greenhouse over the winter (2023-2024), and a second cycle of evaluation and selection will take place in the thermogradient table in spring 2024.

Farmer survey: A survey was drafted in spring 2023 to gather feedback from Cornell researchers, CCE personnel, and cover crop professionals in the region. The planned Fall 2023 distribution of the survey was delayed by an unexpected medical leave and postponed to 2024.

Results:

Variety x planting date trials

In Year 1 (data collection in spring 2023), emergence, fall vigor, and winter survival were quite uniform across locations, planting dates, and varieties, except in Chazy. At the Chazy location, stunted and brown plants were observed on November 2, 2022, where an unknown disease caused spotty emergence and vigor particularly in planting dates 1 and 2. There was a strong spatial trend in disease severity, but no significant differences among varieties. There were strong variety, location, and planting date effects on biomass at termination. ND Gardner and Elbon consistently produced the most biomass across all sites and planting dates (Table 3).

As anticipated due to a shorter window for fall establishment, biomass declined with each subsequent planting date in Freeville. Significant differences were not observed between planting dates in Chazy or Canton, with the exception that the final planting date in Chazy was not sampled due to poor emergence and winter survival in 2022-2023. Chazy produced consistently large amounts of biomass; the first planting date in Freeville produced comparable biomass to Chazy but declined in subsequent planting dates. Both planting dates in Canton and at the Lewis County on-farm location produced less biomass than the other locations (Table 4).

Biomass was not collected on the two farms in Clinton County; canopy cover and plant height data were collected (without replication). There was some variation in variety rank for canopy cover between the two farms; Elbon and ND Gardner had the tallest plant heights on both farms (Table 5).

Table 3. Mean biomass dry weight of rye varieties at termination across planting dates in Canton, Chazy, Freeville, and Lewis County; NNYADP cereal rye cover crops and plantings dates project.

Variety	Biomass Dry Weight (lb/acre)
ND Gardner	5045.7[A]
Elbon	4915.7[A]
Guardian	4241.9[B]
Hazlet	4046.8[BC]
Aroostook	4001.4[BC]
Danko	3655.0[C]

Key: A,B, C: denote significant differences between varieties.

Table 4. Mean biomass dry weight at termination at different locations and planting dates across varieties in Canton, Chazy, Freeville, and Lewis County, 2022; NNYADP cereal rye cover crops and plantings dates project.

Location	Planting Date	Biomass Dry Weight (lb/acre)
Chazy	9/25/22	7047.3[A]
	10/5/22	6422.4[A]
	10/13/22	6688.2[A]
	10/25/22	*Not sampled*
Freeville	9/30/22	6730.9[A]
	10/12/22	4229.1[B]
	10/20/22	3760.2[BC]
	10/25/22	3244.7[C]
Canton	10/12/22	1518.0[D]
	10/25/22	1959.1[D]
Lewis County	10/6/22	1687.0[D]

Table 5. Canopy cover and plant height on Clinton County farms, 2022; NNYADP cereal rye cover crops and plantings dates project.

Variety	Canopy Cover (%)		Plant Height (in)	
	Dyer Farm	*Menard Farm*	*Dyer Farm*	*Menard Farm*
Aroostook	34.3	44.3	14	10
Danko	32.9	53.1	14	12
Elbon	68.7	62.8	26	18
Guardian	63.5	50.6	15	12
Hazlet	33.7	30.1	13	10
ND Gardner	52.8	40.8	20	16

Fall 2023 plantings took place as planned at Freeville, Chazy, and on-farm locations. Year 2 emergence and vigor data collection is in the process of being analyzed. Most plantings emerged well with the exception of the 4th planting date in Chazy.

<u>Outreach:</u>

Following completion of Year 2 data collection in spring 2024, results of the rye variety and planting date experiment will be analyzed and published as an extension report and via a peer-reviewed publication. Results will be presented in fall-winter 2024 at the CCE Inservice and

regional meetings, e.g., North Country Crop Congresses, and in newspaper articles, newsletters, and online resources, e.g., 2-5 miute videos targeted to NNY farmers.

Next Steps:

Early winter 2024: feedback-requested survey of Cornell researchers, CCE personnel, and cover crop professionals on cereal rye cover crop adoption, management, species and variety selection, and challenges will be finalized and distributed.

Spring 2024: data on spring stand, maturity at termination, biomass at termination, and optional seed harvest will be collected at the research station and on-farm trial locations.

March-April 2024: winter survival and plant vigor in the Willsboro nursery will be evaluated. Best plants will be selected among and within families at a target selection pressure of 5%. Non-selected plants will be killed, and selected plants will be allowed to randomly intermate in the field. Seed from selected plants will be harvested on an individual plant basis to form half-sibling families.

Fall 2024: feedback survey data will be analyzed and summarized by Moore Lab personnel and the results of the survey will be presented along with field trial results.

Fall 2024: cereal rye evaluation trials will be planted to assess breeding progress towards cold soil emergence and vigor at sites in Willsboro, NY; Freeville, NY; and St. Paul, MN. Data collection will include emergence (seedling count), fall vigor, winter survival, spring vigor, and biomass. Entries will include:

- Balanced bulk of seed from 2023-24 Willsboro and thermogradient table base population
- Thermogradient table populations from first and second selection cycles
- Field population from Willsboro 2023-24 selection cycle, and from Freeville, NY and St. Paul, MN 2023-24 nurseries.

For More Information:

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Photos:

NNYADP Cereal Rye Trial at Beekmantown, NY: Rye varieties no-tilled 10/16/23; photo taken 10/31/23. Photo: Clinton County Soil and Water Conservation District

NNYADP Cereal Rye Trial at Beekmantown, NY
Left: Rye varieties drilled at 112#/acre seed rate on NoB Nicholville soils after a vegetable crop; photo taken 10/31/23. Photo: Clinton County Soil and Water Conservation District

NNYADP Cereal Rye Trial at Mooers, NY

Left: Rye trial planted on 10/24/23 sprouted; it snowed a week later. Photo taken 10/31/23. Photo: Clinton County Soil and Water Conservation District

Right: The weather conditions in Clinton County in 2023 were so wet that it was difficult to get on fields in general and to cultivate corn, especially in the northern reachers of the county. Photo: Clinton County Soil and Water Conservation District