



## Northern New York Agricultural Development Program 2025 Project Final Report

### Winter Pea Breeding for Cover Crop Use in Northern New York Cropping Systems

#### **Project Leaders:**

Cornell University, School of Integrative Plant Science (SIPS), Plant Breeding & Genetics Section (PBG)

- Virginia Moore, Ph.D., Assistant Professor and Forage & Cover Crop Breeder, SIPS PBG, Cornell University, 162 Emerson Hall; 607-255-4221; [vm377@cornell.edu](mailto:vm377@cornell.edu)
- Solveig Hanson, Ph.D., Research Support Specialist III, SIPS PBG, Cornell University, 106 Love Lab; 607-793-0412; [sh2458@cornell.edu](mailto:sh2458@cornell.edu)

#### **Collaborator:**

- Michael Davis, Ph.D., Farm Manager, Willsboro Research Farm, Cornell University Agricultural Experiment Station, Willsboro, NY, 518-963-7492, [mhd11@cornell.edu](mailto:mhd11@cornell.edu)

#### **Background:**

Due to the narrow window between row crop harvest and the onset of winter in Northern New York, cereal rye monoculture is the most prevalent choice for overwinter soil cover here. Adding a winter-hardy legume to overwinter cereal rye cover crops would enhance biological nitrogen fixation and increase overwinter species diversity, but hairy vetch – the most winter-hardy legume cover crop – carries a fraction of hard seed that can cause weedy volunteer plants in subsequent seasons. Winter pea offers the benefit of nitrogen fixation without the risk of weediness due to dormant seed, but winter survival of winter pea needs to be improved for its reliable use in Northern New York and other locations in USDA hardiness zones 4 and 5.

Genetic variation exists for both cold temperature tolerance and winter survival in winter pea, and both research and commercial breeding efforts have demonstrated that winter hardiness can be improved in winter pea. The Cover Crop Breeding Network (CCB Network), led by Drs. Moore and Hanson, has been breeding winter pea for cover crop use since 2016. Primary breeding goals have been winter survival, biomass accumulation, and spring vigor; fall vigor, disease resistance, and seed yield are secondary breeding goals. The CCB Network has established winter pea breeding nurseries in 4-9 locations nationwide each year since 2017 and has developed an effective protocol for nursery establishment and germplasm selection.

Historically, the best breeding environments for improved winter survival have been in Wisconsin, North Dakota, and Minnesota on both research stations and collaborator farms. Indeed, winter survival is a complex trait that depends on the interaction of temperature, snow cover, soil moisture, soil texture, and wind, so field breeding is an irreplaceable strategy for developing winter hardy germplasm.

Recent Moore Lab research has investigated winter pea cover crop performance across four fall planting dates. Experiments over two years at Ithaca, NY (USDA hardiness zone 6a) showed that while most winter pea varieties achieved maximum biomass from a mid-September planting, some varieties performed better than others at the latest planting date in mid-October. This result suggests that genetic variation exists for winter survival after late planting, so establishing a winter pea nursery in Northern NY at both optimal and late planting times could allow identification of lines with exceptional winter survival capacity for Northern NY winters.

## **Methods:**

### ***Farmer/farm industry input***

On April 2, 2025, we convened a listening and discussion session via Zoom videoconference to gather farmer input on cropping cycles and cover crop breeding priorities. The attendees were agriculture support professionals with experience working with many farms in the region. Our discussion focused on prominent North Country cropping systems, windows for fall cover crop planting, barriers to fall cover crop planting, and keys to cover cropping success in Northern NY.

### ***Winter pea nursery establishment***

To screen winter pea germplasm for performance in Northern NY, we planted identical germplasm on two dates: September 18, 2025 and October 2, 2025. The first planting date would be consistent with planting after silage corn harvest, and the second would be consistent with planting after early grain corn harvest. Plots consisted of 80 seeds in a single 10' row planted into Stafford fine sandy loam at 30" row spacing.

Twenty winter pea lines were entered into the Willsboro, NY winter pea breeding nursery (Table 1). Of these, fifteen entries were derived from a Cornell University crossing block composed of the best 12 CCB Network advanced lines. This crossing block produced 117 F1 crosses, which were increased to make F2 families with high genetic variability. These F2 populations were screened for winter survival in 2024-25 at Freeville, NY, and seed from the best 30 entries were harvested as genetically diverse F3 bulks. Fifteen of these F3 bulks – genetically diverse families, as opposed to single-plant selections – were advanced to the Willsboro winter pea nursery. These included 8 bulks with >90% winter survival in the F2 breeding nursery, along with 7 bulks showing 78-87% winter survival in Freeville, NY but possessing outstanding spring vigor and/or early maturity. All F3 bulks had normal leaves and vining habits; 13 of 15 bulks were segregating for flower color, showing both white and purple flowers within the population.

The remaining five entries included three commercially available varieties that have been used in CCB Network nurseries and trials for multiple seasons, along with two F5 lines originating from University of Minnesota crosses. These experimental lines are under final evaluation for advancement to CCB Network Advanced Line Trials, and both have white flowers and the semi-leafless trait.

### ***Winter pea nursery evaluation***

The winter pea nursery was evaluated for stand establishment and vigor on two dates. The early planting was evaluated on October 21, 2025, and the second planting was evaluated on November 21, 2025. Emergence was rated visually on a 0-100% scale, regardless of plant size; 0% emergence would indicate absence of plants, and 100% emergence would indicate a full plot with no skips or spaces in the row. Vigor was rated on a plot basis using a 1-9 scale. For each vigor rating date, a scale was created based on the range of plant size in the nursery. A model plot was designated for 1 (low vigor), 5 (medium vigor), and 9 (high vigor) and was documented

with photos. We had planned to note prostrate vs. upright growth habits, but these were not distinguishable at the time of rating.

**Table 1:** Willsboro, NY winter pea nursery entries with winter survival, fall vigor, spring vigor, and growth stage scores from the 2024-25 F2 winter pea nursery in Freeville, NY. For flower color, W=white, P=purple, and P/W = a segregating mixture of purple and white. For leaf type, S=semileafless, and N=normal.

<b>Entry</b>	<b>Generation</b>	<b>Winter Survival 25NYWP Nursery</b>	<b>Fall Vigor 25NYWP Nursery 1=low 9=high</b>	<b>Spring Vigor 25NYWP Nursery 1=low 9=high</b>	<b>Growth Stage Higher = earlier</b>	<b>Flower Color</b>	<b>Leaf Type</b>
Blaze	Check	100%	1	4	5	W	S
Survivor	Check	NA	NA	NA	NA	P	N
WyoWinter	Check	84%	3	6.5	5	P	N
24x-16-0	F3 bulk	98%	7.5	6.5	5	P/W	N
24x-21-0	F3 bulk	95%	6	7	5	W	N
24x-20-0	F3 bulk	95%	4.5	7	5	P/W	N
24x-72-0	F3 bulk	93%	7	7.5	4	P/W	N
24x-61-0	F3 bulk	92%	8	7.5	5.5	P/W	N
24x-92-0	F3 bulk	92%	5	6.5	5	P/W	N
24x-112-0	F3 bulk	90%	6	7.5	6	P/W	N
24x-83-0	F3 bulk	90%	6	7	4.5	P/W	N
24x-108-0	F3 bulk	87%	7.5	6.5	5.5	W	N
24x-40-0	F3 bulk	86%	5.5	7	6	P	N
24x-18-0	F3 bulk	86%	5	7	5.5	P/W	N
24x-15-0	F3 bulk	83%	6	7	6	P/W	N
24x-17-0	F3 bulk	80%	6.5	7.5	5	P/W	N
24x-56-0	F3 bulk	78%	7.5	7	6	P/W	N
24x-109-0	F3 bulk	78%	6.5	7	6	P/W	N
MNWP22-007-1AH-0	F5	NA	NA	NA	NA	W	S
MNWP22-028-1AH-0	F5	NA	NA	NA	NA	W	S

### *Video recording*

Mike Davis recorded excellent video footage of seed preparation, cone seeder preparation, and tractor planting of the second planting date. Dr. Hanson is currently editing this footage into a video that will describe the NNY winter pea project and invite growers to a May 2026 winter pea selection event, along with the July 8, 2026 Willsboro Research Farm Field Day. The video will be published to the existing CCB Network playlist on the Cornell SIPS YouTube channel.

### ***Farmer/farm industry outreach***

Fall 2025 brought another opportunity for farmer contact via an October 21, 2025 Cover Crop Field Meeting coordinated by Cornell Cooperative Extension. Of the 19 attendees, eight were farmers; of those, six used fall-sown cover crops, and three used summer cover crops. Dr. Hanson shared a brief introduction to the CCB Network, an overview of CCB Network winter pea breeding work, winter pea planting tips, and research results from a Cornell winter pea planting date study. The Willsboro winter pea nursery had emerged nicely, and Hanson showed examples of different pea leaf types and vigor levels in the winter pea germplasm.

### **Results:**

#### ***Farmer/farm industry input***

From the April 2, 2025 listening session, major takeaways were:

- Dairy is prominent in Northern NY, and dairy farmers would plant fall cover crops either after silage corn harvest (September) or grain corn harvest (starting in October).
- Cover crop planting after silage corn harvest offers more opportunity for fall-sown legume establishment than does planting after grain corn.
- Farmers are busy during harvest season no matter what their cropping system, so cover crop planting often gets pushed later than ideal.
- If we could develop a winter pea variety that would perform well after relatively late establishment, it could be appealing to Northern NY farmers.
- Winter survival for fall-sown legume cover crops is an extremely important breeding priority for NNY farmers, which is consistent with winter hardiness as a central goal of the CCB Network winter pea breeding program.

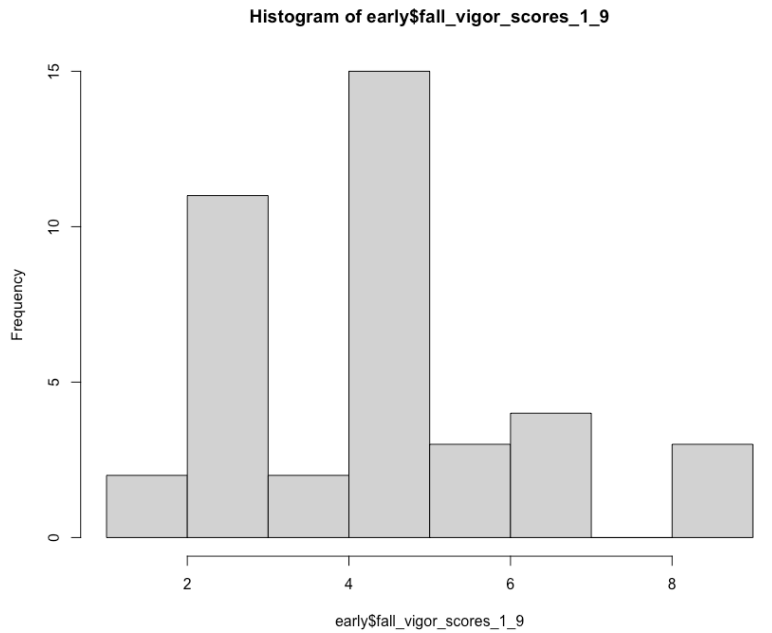
The October 21, 2025 field day offered additional insights into Northern NY cropping systems. For the 6 farmers in attendance who used fall-sown cover crops, grasses were the most widely used species. Cereal rye was most commonly used; one grower also used winter wheat, and another was experimenting with spelt. One grower added leftover red and white clover to fall-sown grass cover crops, but that addition seemed more incidental than strategic. The growers in attendance planted fall cover crops after potato, corn, vegetables, and small grains; the same crops followed in the spring, often in rotation. While the farmers at the October field day mentioned more cash crop diversity than was discussed at the April listening session, the prominence of late cover crop planting was consistent.

#### ***Winter pea nursery establishment & vigor***

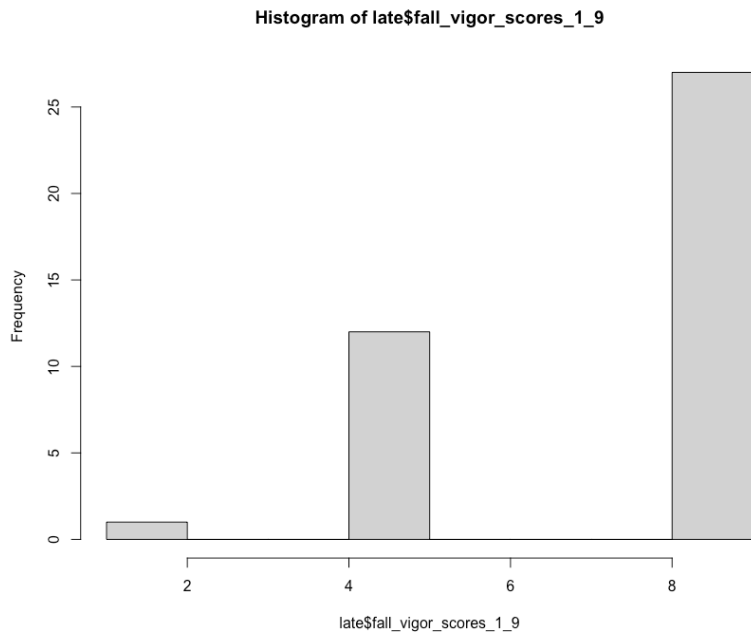
Nursery establishment was excellent, with all plots showing between 90-100% emergence. While differences in fall emergence aren't substantial enough to be a criterion for selection in the Willsboro winter pea nursery, the strong stands lay the groundwork for easily distinguishable differences in spring stand. Winter survival will be calculated as a ratio of (spring stand / fall stand), and it will be a major selection criterion.

Fall vigor scores showed greater variability and more normal distribution for the first planting date than the second. A histogram of fall vigor scores for the first planting (Figure 1) shows a generally normal distribution with a slightly larger abundance of lower-vigor plots than higher-vigor plots. In contrast, a histogram of fall vigor scores for the second planting (Figure 2) shows that many plots showed relatively high vigor, some plots showed moderate vigor, and a few plots contained mostly small plants. Davis reported that since plants were much smaller in the second planting than first – due to cooler temperatures after the October 2 planting date – it was more difficult to make meaningful distinctions in plant size.

**Figure 1:** Histogram of fall vigor scores for winter pea entries planted on September 18, 2026. Scores range from 1 (low) to 9 (high) on a scale created from the plant sizes present within the nursery.



**Figure 2:** Histogram of fall vigor scores for winter pea entries planted on October 2, 2026. Scores range from 1 (low) to 9 (high) on a scale created from the plant sizes present within the nursery.



**Conclusions:**

As this project is just beginning, no conclusions have been drawn. However, our interactions with farmers confirmed that breeding for winter hardiness in cover crop winter peas is critical for their practical use in the North Country. In addition, the NRCS deadline for winter rye planting

for Northern NY is October 16, and farmers reported pushing or passing that date. Thus breeding for tolerance of late planting would be additionally helpful for the regional dairy and crops industries.

### **Outreach:**

On April 2, 2025, we convened a listening and discussion session via Zoom videoconference to gather farmer input on cropping cycles and cover crop breeding priorities, as described above. In addition, we communicated with North Country farmers about the NNY winter pea breeding project – and about use of winter pea as a fall-sown cover crop more generally – at an October 21, 2025 Cover Crop Field Day convened by Cornell CCE. A video, currently in production, will describe the NNY winter pea breeding project and invite North Country growers to join us for a winter pea selection day in May 2026 and at the July 8, 2026 Willsboro Research Farm Field Day.

### **Next Steps:**

- **March-April 2026** – Spring stand and vigor evaluation
  - Winter survival will be calculated as a ratio of (spring stand / fall stand), and a selection index will be developed based on winter survival, spring vigor, and relative maturity.
- **May 2026** – Late-spring vigor evaluation & Participatory Selection Field Day
  - Hanson will generate selection recommendations based on field ratings, and selections will be made by Hanson and Davis along with attending farmers. Discussion will focus on grower needs in terms of cover crop establishment, termination, and grazing, along with potential interest in North Country winter grain pea breeding.
- **July 2026** – Presentation at Willsboro Research Farm Field Day
  - Hanson will describe the Northern NY winter pea breeding project, and attendees will see selected families in the seed production stage.
- **August 2026** - Production and publication of NNY winter pea YouTube video
  - Using video footage from both events and from spring field evaluations, Hanson will compose a video describing the winter pea selection process, highlighting promising germplasm, and outlining plans for the fall 2026 Willsboro winter pea nursery.
- **September-October 2026** – Nursery establishment
  - Germplasm will be selected based on farmer feedback and results from the 2025-26 Willsboro winter pea nursery
- **October 2026** – Fall evaluation

### **Acknowledgements:**

We acknowledge the Northern New York Agricultural Development program for funding this project, and Mike Davis for his assistance with the NNY winter pea nursery establishment.

### **For More Information:**

- Virginia Moore, Ph.D., Assistant Professor and Forage & Cover Crop Breeder, SIPS PBG, Cornell University, 162 Emerson Hall, Ithaca, NY; 607-255-4221; [vm377@cornell.edu](mailto:vm377@cornell.edu)
- Solveig Hanson, Ph.D., Research Support Specialist III, SIPS PBG, Cornell University, 106 Love Lab, Ithaca, NY; 607-793-0412; [sh2458@cornell.edu](mailto:sh2458@cornell.edu).