

**Title: A Vermont Farmers Breeding Club: Developing Varieties That Work For Us!  
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## **2. Goals of the project**

In order to develop a Vermont Farmers Breeding Club we will need to acquire breeding skills and techniques. To begin we will start with a wheat breeding project. There is considerable interest in selecting improved varieties to develop wheat of high baking and animal feed quality and suitable for our climate. We are interested in growing and selecting from modern cultivars and other heritage varieties such as 'Red Fife' to develop our own wheat varieties.

To acquire "hands-on" breeding skills we will attend an intensive short course on wheat breeding methods during the summer of 2007 under the supervision of Steve Jones – wheat and cereal breeder at Washington State University. We will also meet farmers in Washington that are working on their own breeding projects. We will bring our seeds of knowledge back to the farmers of the Organic Seed Initiative and pass along the skills needed to make new varieties to farmers across the region. During the winter of 2007, Dr. Jones will visit Vermont and work with the Organic Seed Initiative to develop a 5 year on-farm wheat breeding program. During the spring of 2007, Butterworks Farm will seed a small plot with common local cultivars and promising material from the WA wheat breeding program. Upon returning from the "hands-on" training we will practice our new techniques on Vermont ground. Success will be measured by the number of successful crosses that our smaller group can make on the given population.

## **3. Update the information of your farm since your project started:**

There have been no changes to the farm since the project started. A minor change was the addition of a grain elevator and planted 20 acres of winter wheat. Generally we do not plant winter wheat on our farm. My family and I operate Butterworks Farm a 60 cow organic dairy in Westfield, Vermont. We have owned our 300 acre farm for 30 years. Our milk is processed on the farm into yogurt, cream, and cheese. The products are sold locally and regionally. We use

managed intensive grazing practices and store high quality forage for the winter months. In addition, we grow a variety of grains including corn soybean, barley, oats, rye, and wheat. The grains are fed to cows, our family, and some are processed and sold locally for chicken feed, flour, and cornmeal.

For the past 4 years, Butterworks Farm has been involved in the breeding and selection of open-pollinated corn in northern Vermont. We have offered our Vermont strain of "Early Riser Corn" to farmers for planting in 2005 and 2006. We have been able to improve standability and days to maturity with our selections. I am also a seed saver of dry beans and cereal grains. Many of the bean and grain varieties available to producers in Vermont are not suited for our region and our organic production systems.

In addition, I am a founding member of the Vermont Organic Seed Initiative. Like others in our group, I have shared my knowledge of grain and seed production with many farmers in Vermont, New York, and Canada. Our workshops have helped us garner tools to make basic selections from populations in the field; however, we have not gained the knowledge to actually breed varieties. It is the goal of the Organic Seed Initiative to bring these tools and skills to Vermont so we can begin a Farmers Breeding Club and develop our own grain varieties. We have gotten quite proficient at saving, cleaning and, processing cereal seeds. However, the varieties always come from somewhere else, and we are limited in our choices. Varieties adapted to our region would improve farm sustainability by allowing for improved yields, disease resistance, and a higher quality end product, and reduced seed costs. The Vermont Organic Seed Initiative has over 30 active participants and many are interested in learning and developing these skills. It is for this region that I would propose a training program for farmers to learn breeding and selection of cereal and forage crops.

#### **4. Describe your cooperators and their roles in the project:**

Dr. Heather Darby, UVM Extension has been the main cooperator on this project. Dr. Heather Darby was integral in planting, breeding, evaluating, and harvesting the wheat breeding trials. Dr. Darby also attended the intensive wheat breeding training in Washington. In addition, we will work together to present our project at the NOFA-VT winter conference, and the Vermont Organic Grain Producers Meeting this winter. Seth Johnson a Vermont grain producer also attended the intensive wheat breeding training in Washington.



## 5 & 6. Project activities and results:

In the winter of 2007, Steve Jones attended our Vermont Organic Grain Producers meeting in



Bridport Vermont. Dr. Jones taught us some basic breeding skills while in Vermont. We made a plan to develop our own wheat breeding project in Vermont. We obtained 18 heirloom wheat varieties and 1 modern commercial variety for our wheat breeding project. We received 4 varieties from North

Dakota State, 10 varieties from Washington State, 1 variety from New Brunswick, 3 varieties from the USDA germplasm repository, and 1 variety from Quebec.

### Wheat Variety Trial List:

**North Dakota:** Emmer, Mida 2006, Mida 2005, Ceres 2005

**Washington State:** Reb Bobs, Reliance, LaDoga, Thatcher, Marquis, Hope, Komar, Spinkota, Supreme, Scarlet

**USDA Repository:** Defiance, Champlain, and Surprise (originally Vermont varieties from 1886)

**New Brunswick:** Red Fife

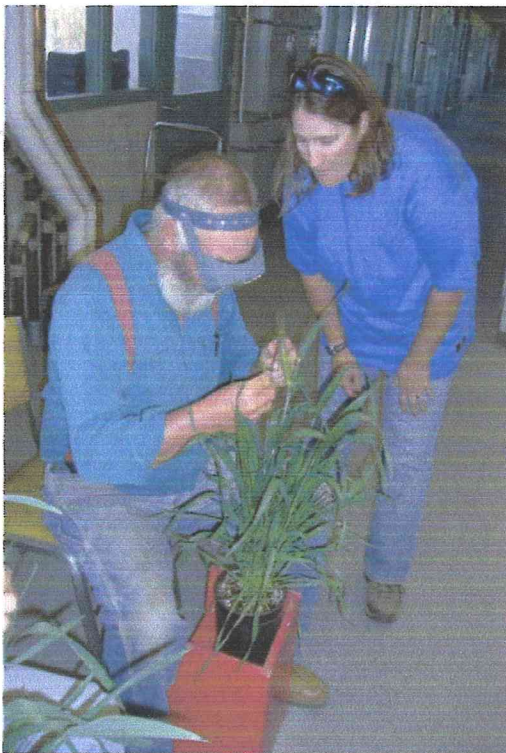
**Quebec:** AC Barrie

The varieties were planted in replicated plots on May 4, 2007. The plots were one-row and seven feet in length. The wheat seed was planted to a depth of one-inch and eight-inches apart. We sowed cover crops between the two replicates. The plots were hand weeded weekly. Wheat was seeded around the plots. The border consisted of Emmer and Dylan wheat. Dylan wheat is North Dakota's first released variety of the Plains Farmer Breeders Club.





In late June, Dr. Heather Darby, Seth Johnson, and I attended a three day short course at Washington State University. On the first day we met with Salvatore Ceccarelli a world renowned barley breeder from Syria. He talked to us about participatory plant breeding in the Middle East. In the afternoon, we toured the Washington State wheat breeding trials. We learned about the relationship between cultural factors, soil fertility, nitrogen efficiency and wheat breeding. We also



learned the process used to develop varieties such as Bauermeister. Dr. Jones and his assistant Kevin Murphy educated on the challenges associated with organic weed breeding. Lastly, we were able to view and talk about the perennial wheat breeding program.

On the second day, we learned how to make wheat crosses. First we were given potted wheat plants from the greenhouse that was just ready to flower. Dr. Jones taught about wheat flower morphology and the process of emasculation and crossing. Then it was our turn! We took are potted plants and began to cut, slice, and yank out the various parts of the flowering wheat. Once we finished emasculating, we than crossed the female with a male counterpart. Dr. Jones sent us on our way with a bag full of plant breeding tools. He gave tweezers, scissors, labels,

pollination bags, and photos.

In the afternoon, Dr. Jones crew brought us to meet the local wheat farmers from his participatory breeding program. We were able to view a variety that was being developed by Lexi Roach the granddaughter of Jim Moore. Jim is a wheat farmer in Kahlotus, Washington. Lexi started her wheat breeding project when she was in grade school. She will begin her college career at Washington State University this year.





The third day, we returned to the plots and Kevin Murphy explained his selection strategies for organic wheat breeding. We returned to Vermont enthusiastic and ready to make our first crosses.

As soon as we returned the wheat was ready to be emasculated. Pollen shed was days away. Our first crosses were made by potting plants from the field and making the crosses in our farm greenhouse. The first cross was AC Barrie x Red Fife. Once we had some practice under our belt we felt it was time to move to the trial plots. This is when we met our match. The first day we made our crosses the weather was hot and humid. There was a thunderstorm in the making. We spent the entire morning emasculating wheat plants mostly by random selection. The first day we did 40 emasculations. We returned 2 days later to make the crosses. To cross we cut a head (male) from one variety and inserted into the pollination paper bag of the emasculated female. We crossed our fingers and hoped for the best. It rained and the wind blew. A few days later we returned and most of the bags had been



blown off the plants. We continued to emasculate and make crosses on some of the later maturing varieties. We noticed a wide range of maturities even within a plot. The weather



remained to be a challenge. We received 8 inches of rain in July. Needless to say we had few successful crosses. Our only success was the cross that was made in the greenhouse. Before harvesting, we conducted a visual assessment of all of the varieties. Our plan was to identify strengths and weaknesses of each variety in the trial. We evaluated the varieties for standability, disease, general appearance, height, head size, and leafiness. From these results we selected the top 10 performers. We harvested the wheat in September. After talking with Dr. Jones, he recommended that we harvest our trials and send him seed and the crosses we had hoped for in our project. Below is a list of the top wheat varieties in our trials and the crosses that Dr. Steve Jones will make for us in the greenhouse this winter.

### **Top Wheat Varieties:**



Champlain, Red Fife, Red Bobs, Defiance, Surprise, Scarlet, Ceres 2005 AC Barrie, Supreme, and, Hope

**Crosses:**

AC Barrie x Red Fife

Red Bobs x Champlain

Red Bobs x Surprise

AC Barrie x Surprise

AC Barrie x Champlain

Hope x Red Fife

AC Barrie x Defiance

Hope x Champlain



In 2008, Dr. Jones provided us with seed from the aforementioned crosses. On May 2, 2008, these crosses were planted in single row plots with 8 inches between the plants and 12" between the rows. We received approximately 10 seeds per cross from Dr. Jones. In addition, the seed we saved from the 19 varieties harvested in 2007 was planted out into larger plots in 2008. These plots were seeded with a Carter Grain Plot

Seeder (see photo). The plots were 2.5 x 25 ft in size. Larger plots of Emmer, white wheat, and hulless barley were planted in the same two acre area for evaluation. Plots were hand weeded in mid-June. Additional weeding as needed was provided throughout the summer. Quackgrass was the major weed issue and removal was extremely difficult.







The wheat from our plots was harvested on August 25<sup>th</sup>, 2008. The crosses were hand harvested with garden pruners and threshed by hand. These F1 populations will be reseeded next year. Essentially, this phase is to increase the seed quantity of each cross. In 2009, we will plant these F1 populations. Our harvest in 2009 will result in the F2 generation. In 2010, we will plant the seeds of each head of wheat in its own individual row – “head-row”. It will not be until 2010 that we will be able to select out plants that exhibit negative traits. The primary lessons that we have learned from this project are:

1. Developing new varieties takes time. We have learned from Dr. Jones that development of a new variety can take between 7 and 10 years. We are only in our first few years.

2. Plant breeding works best in a controlled environment.

After conducting this project, I believe our role as farmers is to make selections from a large and diverse population of genetic material provided to us from plant breeders. For instance, it would make the most sense for the plant breeders to provide us with the already developed F3 generation. At this point we could trial the population, do selections and increases for future variety development.

Of the 19 original varieties we have been working to increase the seed quantity. We started with 100 seeds of each type. It has been difficult to evaluate the agronomics and quality potential of these varieties due to the small size of the plots. This year we planted plots that were 2.5 x 25 ft. This season we were able to harvest the wheat with a plot combine (Almaco SP50)



and had yields between 2-5 lbs for each variety. We have continued to evaluate the varieties



through visual assessments. A 1 (poor)-10 (excellent) scoring system is used to evaluate standability, disease incidence, head size, leaf size, height, and overall appearance. We have not eliminated any of the original 19 wheat varieties from our trials. However, some varieties stand out above the rest. Our favorites include Scarlet, Lagoda, Marquis, Thatcher, Mida,

and Surprise. Next season we will plant out larger plots to more closely simulate normal field conditions. We expect that it will take another 2 years before we have enough to share with other farmers.

#### **7. Conditions:**

We found that successful wheat crossing is best done under a controlled climate. Extended periods of rainy weather, humidity, and wind all contribute to unsuccessful crosses.

#### **8. Economics: N/A**

#### **9. Assessment:**

This was a great project! It allowed Vermont farmers to make contacts with wheat breeders and other industry representatives. It created a good deal of fellowship. Our initial intent was to learn about wheat breeding and work towards the development of adapted varieties. We now understand the complexities of breeding but still fell that in a few years time we will have our own variety as well as a good amount of heirloom seed for field production. We plan to continue working on this project after the termination of this grant. Our plans were outlined above.

#### **10. Adoption:**

Since the onset of this project there has been a considerable amount of interest in local wheat production. Farmers are interested in growing and processing wheat for local consumption.



Locals are demanding unique and flavorful wheat flour. This project has peaked the interest of many including farmers, researchers, bakers, and consumers.

## 11. Outreach

The ideas and results of this project have been shared with multiple organizations. The project was presented at the NOFA-VT Winter Conference in February of 2008. I also presented information at the Vermont Organic Grain Growers Meeting in March of 2008. I have worked with Dr. Darby to publish several articles in local newsletters.



On July 29<sup>th</sup>, 2008, we hosted a workshop titled “Growing Organic Wheat for Feed and Food”. The day long workshop included a presentation by Dr. Steve Jones, Washington State Wheat Breeder, highlighting our participatory wheat breeding project. Heather Darby and I described our wheat breeding experiences. Everyone was able to view the wheat varieties that we have been evaluating for the last two years. A workshop flyer is attached to highlight the agenda for the day. There were 75 attendees that included farmers from Canada, Vermont, Massachusetts, and New Hampshire. This winter we will present the project at the NOFA-VT winter conference, and at the Canadian Organic Cereal Grower’s Conference in Banff, Alberta.

## 12. Summary

Currently there are few cereal varieties being developed for organic farmers in New England. To address this situation organic farmers were trained to make their own wheat crosses and learn how to make selections from their new populations under organic management. Dr. Stephen Jones (Washington State University) provided a “hands-on” breeding course to farmers. In May of 2007, 19 heritage varieties of spring wheat were planted on a Vermont farm. The plots were one-row and seven feet in length. To select potential varieties for crossing, we evaluated the varieties 4 weeks prior to harvest and at harvest. The varieties were evaluated for standability, disease, general appearance, height, head size, and leafiness. From those results the top 10 performers were selected for crossing by the Washington State Wheat Breeding Program. The F1 progeny from these crosses were seeded in the spring of 2008 in Vermont. As a result of this

project, we learned the real meaning of Participatory Plant Breeding. We continue to work at increasing seed lots of the 19 heritage wheat varieties. The goal is to be able to distribute the best heritage wheat and crosses to local farmers. We expect that this goal will be met in the next 2 to 3 years.

Jack Lazor

18 December 2008