

Attachment B. 2011 SARE Farmer/Rancher Grant Progress Report March 27, 2012
Screening open-pollinated vegetables bred and released in North Dakota for suitability to organic production systems and local markets.

Prairie Road Organic Farm/Theresa Podoll, Project Coordinator

Introduction

Prairie Road Organic Farm is a certified organic small grain and vegetable seed farm located in South Central North Dakota. This area is known as the prairie pothole region and receives around 20" of precipitation annually, with approximately 135 frost-free days in the growing season. Annual precipitation on Prairie Road Organic Farm was ~125% above average for 2011. Temperature or heat unit accumulation was slightly above the long term normal for the area. The last frost in the spring was May 26 and the first frost in the fall was September 14. The Prairie Road Organic Farm represents the southern tier of the study area for this project. Prairie Road Organic Farm focused on tomatoes, dry beans, and edamame soybean in 2011.

Variety Information

In 2011 Prairie Road Organic Farm trailed five tomato varieties, two pea varieties, three bean varieties, and one edamame soybean.

Table 1. Tomato varieties trialed in 2011

Variety	Year released	skin color
Millet's Dakota	1913	red
Orange King	1957	orange
Doublerich	1954	red
Omar's Lebanese	Unknown	pink
Fox Cherry	Unknown	red

Table 2: Peas, beans and soybeans

Variety	Year released / GRIN accession number
Homesteader peas	1908 (seed received from Prairie Garden Seeds, SK)
Alaska pea	(PI206781) 1887
Hidatsa Red bean	(PI 351137) "Old cultivar of Hidatsa tribe, Northern Great Plains."
Arikara Yellow bean	(PI633617) Selection from an 1880 landrace; Oscar H. Will & Co.
Hidatsa (Glycine max)	(PI548341) Developer: Oscar H. Will & Co.

Methods and Results

Tomatoes

Tomato plants were started on April 10; transplanted on May 27 into our tomato disease nursery to ascertain their resistance to Septoria Leaf Spot caused by the septoria lycopersici fungus. This fungus thrives in tomato debris and on solanaceous plants in abundant rainfall and temperatures ranging from 60 to 80 degrees F. The spores are transferred by wind and rain. The fungus overwinters well; it is not uncommon for transplants and seeds be carriers of the disease. Our farm utilizes the disease nursery for selecting stock seed for the tomato varieties that our farm stewards, continuously selecting for disease resistance.

Transplants were spaced 1' apart in rows that were 3' wide. The first blooms on the tomatoes were noted June 13. Millet's Dakota was the earliest and most prolific in flowering, followed closely by Doublerich. Fox Cherry and Omar's Lebanese were the slowest in flowering and setting fruit. Septoria Leaf Spot began to show up in mid-July when the plant began to set fruit. The spots began on the bottom leaves of the plant and migrated up the plant. The first ripe tomatoes were noted on July 31 but few were harvestable, due to quality issues; we harvest a good crop of Fox Cherry and just a few nice fruits of each of the other varieties. These were selected and saved for seed. Yield data was not gathered as most plants succumbed to the disease very quickly and the fruit cracked and bore spots as well.

Table 3. Tomato rankings

[Scale: 1 (high resistance/good fruit quality) ; 5 (poor resistance/poor fruit quality)]

Variety	Early Blight Resistance	Septoria Resistance	Fruit quality	Flavor
Doublerich	5	3	2	4
Millet's Dakota	3	4	4	2
Orange King	3	3	3	2
Omar's Lebanese	4	4	3	3
Fox Cherry	1	1	1	1

Doublerich did not exhibit the same level of disease resistance noted in 2010; this is likely due to differences in resistance among individual plants. This indicates that improvement can be made through a vigorous disease resistance selection process. Doublerich again received low marks for taste but high marks for appearance.

Alongside our usual plantings of Green Arrow, Wando, and Little Marvel, we trialed two new varieties of peas this year: *Alaska* and *Homesteader* peas. *Alaska* did not do well in the cool, rainy spring; it took on a decidedly yellow-green hue and did not produce well. *Homesteader* was entirely unaffected and surprisingly delicious. We were all in agreement that this variety is what peas SHOULD taste like.

We were very impressed with healthy foliage and plant growth of the *Hidatsa Red beans*. The *Arikara Yellow bean* showed signs of a rust disease, exhibited more insect damage, and developed chlorosis (a sign of a magnesium deficiency) late in the season. These bean varieties were growing side by side in the same row in the garden. The *Hidatsa Red* grew more slowly but out performed the *Arikara Yellow*.

Growing *Hidatsa edamame soybean* has peaked our interest in this crop. After our presentation at the NPSAS Winter Conference, Jim Orf, a University of Minnesota soybean breeder, approached me and told me about edamame varieties developed through his breeding program. I will be trialing up to four varieties from Jim's program next to *Hidatsa* to find the best adapted, best performing variety for our growing conditions.

Conclusions

The tomato varieties Doublerich and Fox Cherry are candidates for parent plant in breeding efforts focused on Septoria resistance. The varieties Millet's Dakota and Orange King are both candidates for continued selection for improved fruit quality and disease resistance to Septoria. Given Steve Zwinger's consumer choice results, we will conduct ongoing screenings and selection work on Cavalier and Sheyenne for Septoria and resistance.

We will grow both Hidatsa Red bean and Arikara Yellow again on a larger scale; we feel these two varieties are historically significant to our region and should be cultivated.

We will continue to experiment with edamame soybeans to find the best tasting, best performing variety to include in our production plan.

Everyone in the family agreed that Homesteader peas were by far our favorite variety. It has found a place in our garden and on our plates!

I requested the following varieties from GRIN but was unable to obtain any seed:

PI 632383	Daucus carota Gold Pak carrot
G 30512	Raphanus sativus Model Box radish
W6 21057	Phaseolus vulgaris Mandan speckled - ** bean
W6 21058	Phaseolus vulgaris Mandan black bean
PI 644967	Solanum lycopersicum Millets Dakota

I was especially disappointed about Mandan Speckled and Mandan Black beans. The curator told me that the seed they had in storage had failed to germinate and that the varieties are likely lost. This underscores the need for funding for GRIN in order to preserve these critical resources. Millets Dakota tomatoes were not available through GRIN but I was able to find some seed in through a seed saver group in Canada.

The next pages are pictures taken on Prairie Road Organic Farm during the 2011 growing season. (Note: Pictures of diseased plants were taken July 31 and August 27.)



Early blight makes its appearance!



Early Blight closeup.

Septoria leaf disease in Doublerich tomatoes



Millets Dakota
needs selection and improvement work!



Orange King
also in need of selection and improvement.



Fox Cherry! Completed unaffected by the disease pressures surrounding it!



Hidatsa Red
exhibiting lush healthy growth!



Arikara Yellow
Exhibiting signs of disease, possible chlorosis



Homesteader pea

Attachment C. Prairie Seeds Farm/Steve Zwinger, cooperator March 25, 2012
Screening open-pollinated vegetables bred and released in North Dakota for suitability to organic production systems and local markets.

Introduction

Prairie seeds farm is a certified organic vegetable and seed farm located in Central North Dakota. This area is known as the drift prairie region and receives around 19” of precipitation annually, with approximately 120 frost free days in the growing season. The Prairie Seeds Farm represents the central tier of the study area for this project. Precipitation from May-September on Prairie Seeds Farm was measured at 20.4” for the 2011 growing season, well above the long term normal. Temperature or heat unit accumulation was slightly below the long term normal for the area. The farm experienced a number of thunder storms throughout growing season. The most severe storms occurred in July. These storms produced intense rainfall events that included heavy winds and hail that did damage plants. The last spring frost was on May 2, although on May 27 light frost damage was noticed on susceptible plants. The first fall frost (killing) was received at the farm on September 13 and 14. These two nights had an extended freezing period (25 F) that killed all non-hardy plants.

Crops chosen for this year’s evaluation on the Prairie Seeds Farm were potatoes, tomatoes, broccoli, peas, lettuce, Chinese cabbage, and winter squash. The source or developer of potato, tomato and broccoli varieties trialed were from the North Dakota Agricultural Experiment Station (NDAES), or more commonly known as North Dakota State University (NDSU). This breeding station no longer breeds or develops varieties of tomatoes or broccoli. All seed, transplant, and tuber sources for this year’s trials for potatoes, tomatoes, two squash, and broccoli were obtained from Bryce Farnsworth, research specialist with the NDSU potato breeding project. Considering the source, it is felt that the seed lots used are true to type. Chinese cabbage, peas and lettuce were obtained from GRIN (Genetic Resource Information Network). The additional two squash varieties trialed were obtained from seed savers.

Variety Information

Potato breeding and variety development continue at the NDAES with this plant breeding department having both national and international recognition. The first released potato variety from this program, a joint release with USDA-ARS and the Ag Exp. Station of ID, was Early Gem in 1952. Since then the program has released over 30 varieties of potatoes adapted to the region. Potato varieties trialed in 2011 along with the year of release and type are listed in table 1. Of the varieties trialed, Norland is the only known variety that is commercially available. Norland is sold as Red Norland or Dark Red Norland. These varieties are currently available and are planted by both home and market gardeners, along with field scale production for commercial table stock potatoes.

Table 1. Potato varieties trialed in 2011

<u>Variety</u>	<u>year released</u>	<u>type</u>
Norland	1957	red
Norchip	1968	white
Crystal	1980	white

All tomato varieties trialed in 2011 were developed from the NDAES. Tomato varieties were bred and released at NDAES from 1922 to 1990. During that time 26 adapted tomato varieties were released to home and market gardeners for the northern region. Table 2 lists the varieties trialed. Of the varieties trialed, Cannonball and Sheyenne are available as transplants from local nurseries in Fargo area. Bakers Nursery, along with Neil Holland has recently reintroduced these varieties due to their proven performance and adaptability to our region. No seed or transplants are known to be commercially available of any of the varieties trialed.

Table 2. Tomato varieties trialed in 2011

<u>Variety</u>	<u>year released</u>	<u>skin color</u>
North Dakota Earliana	1922	red
Farthest North	1934	red
Allred	1937	red
Cavalier	1953	red
Sheyenne	1960	red
Cannonball	1973	red

At one time fruit and berry species such as apple, cherry, gooseberry, raspberry, and strawberry were developed at NDAES. Sweet corn and popcorn, as other vegetable crops such as broccoli, cabbage, and melons were also bred and developed in the 20's and 30's at the NDAES. These fruit and vegetable breeding programs are no longer in existence. Today NDSU still breeds corn, although it is focused on developing corn inbreds for the hybrid corn industry. Seed sources listed as NDSU in Table 3. were also obtained from Bryce Farnsworth. Table 3 lists all other varieties and crops trialed in 2011.

Table 3. Crops/ varieties trialed in 2011

<u>Crop</u>	<u>Variety</u>	<u>year released</u>	<u>source</u>
Broccoli	Mantador	1960	NDSU
Squash	Buttercup	1932	NDSU
Squash	Arikara	NA	NDSU
Squash	Hidatsa	NA	Beth & Nathan Corymb
Squash	Mandan	NA	Ann Hoffert
		<u>PI#</u>	
Peas	World'sRecord	PI642174	GRIN
Peas	Alaska	PI206781	GRIN
Peas	Lincoln	NA	Agassiz Seed House
Peas	Green Arrow	NA	Irish Eyes Gardens Seeds
Lettuce	Salad Bowl	PI536762	GRIN
Lettuce	Ruby	PI538762	GRIN

Chinese cabbage

Michihili

PI30787

GRIN

Methods and Results

Potato:

Potato tubers were hand planted on June 1 with a 12" spacing between plants and 4' between rows. Potato rows were from 20-60' depending on amount of seed available. Previous crop was a shell pea seed field. Potato rows were hilled numerous times to provide space and protection for the growing potato crop. The majority of the potatoes emerged by June 24 with differences reported in table 4. Fast emergence is felt to be an important trait for weed control as varieties that emerge faster will shade the ground sooner. Colorado potato beetles (CPB) were present from the beginning of July 5 on. The beetles/larva were removed by shaking into a pail 3 times from July 10-22 to avoid damage to plants. Overall the CPB levels were low and no visual differences were detected in tolerance with the varieties. Yields were determined at maturity to better access storage yields from a mature crop. An important trait to measure would be the varieties ability to produce an early harvest of the first 'baby potatoes'. This was not done due to amount of seed available. The trial was harvested on October 2 with the total yields recorded in table 4 for each variety. B potatoes were not separated although there were very few b's this year.

Table 4. Potato variety data and yields in 2011

<u>Variety</u>	<u>Flower Color</u>	<u>Seedling Emergence</u>	<u>Tuber Yield lbs/ft</u>
Norland	purple	6/17	2.5
Norchip	white	6/18	3.1
Crystal	light purple	6/24	2.8

Trait notes: Seedling emergence: indicates date when 75% of plants emerged
 Tuber yield: total yield per foot of row, b potatoes are included in the total yield

Tomato:

Tomato plants were transplanted on June 5 on ground that was a shell pea seed production field the previous year. Transplants were spaced 3' apart in rows that were also 3' wide resulting in a 3 x 3 planting pattern. 12 plants of each variety were used in this trial. The tomato plants then had tomato cages placed over each plant to support the plants and to hold the tomatoes off the ground as they develop. Due to heavy growth the cages began to fall over on 6/18, just prior to flowering. The tomato plants began to flower in mid-late June; initial flowering (50%) dates were

taken (table 5). Early flowering and fruit set are important traits to achieve the first tomatoes for early sales at farmers markets, or from a cool season where it seems to take forever to ripen tomatoes. Data was gathered (table 5) to determine the date when the first tomatoes would be picked per variety. The date when each variety would have a quantity to pick are also noted. The first tomatoes were harvested on August 6 and continued until frost. Yield differences were not quantified between the varieties. Farthest North, a cherry type, had a heavy set with an abundant harvest, which was easy to pick. This variety needed to be picked regularly as it had a tendency to crack.

Table 5. Tomato variety flowering and harvest data from 2011

Variety	50% flower	1 st red	Picking date
North Dakota Earliana	7/2	8/23	8/24
Farthest North	6/21	7/31	8/6
Allred	6/23	8/18	8/21
Cavalier	6/30	8/21	8/25
Sheyenne	6/29	8/17	8/21
Cannonball	6/27	8/23	8/26

Peas

Peas were planted on May 17 on ground that was planted to fresh beans the previous year. Peas were planted in rows with spacing of 2 feet. The varieties Alaska and World's Record were selected for early maturity. These two varieties also had good early season vigor, see table 6. Lincoln is an older variety that is still available. Green Arrow is a very common planted variety and used as a check in this trial. Data gathered from this variety comparison show that Alaska was the first to flower and have pods ready to harvest (table 6). Overall Green Arrow had the greatest numbers of edible pods to harvest, while it was the latest. The seed of Alaska is smooth and round while the remaining varieties are wrinkled. All are green seed.

Variety	height 5/29	Bloom	1 st edible pods
Alaska	4"	6/15	7/2
World's Record	2.5"	6/14	7/7
Lincoln	1.5"	6/28	7/17
Green Arrow	1"	6/30	7/18

Broccoli

The variety Mantador was developed for a cooler northern climate with a shorter growing season. This variety was also developed for the ability to be direct seeded, according to Bryce Farnsworth. Direct seeding and transplants were compared in this study. Transplants were planted on June 10, 2011. Two dates were direct seeded, May 9 and 29. Regardless of planting date or method all plantings grew very vigorous. Transplants were harvested starting on July 10, 63 days after transplanting. Date 1 was harvested on July 28, 81 days after planting, while date 2 was harvested on August 20, 84 days after planting. One unique character of this variety is the amount of side shoots that are produced after cutting the main head. Within 9-13 days after

cutting the main head side shoots were harvested, again regardless of planting date. These shoots needed to be harvested every 3-4 days to maintain productivity.

Lettuce & Cabbage

The varieties Ruby and Salad Bowl were chosen from the 1958 Wills Seed catalog. These were varieties that were marketed in North Dakota during that time period and are no longer available. Both grew very good and were also very appealing to the eye, along with good tasting. Ruby is a red variety of lettuce, while Salad Bowl is green. Both varieties of lettuce were planted on May 9. Chinese cabbage was direct seed on May 29 and June 19. Date 1 harvest was on July 20 and date 2 harvest was July 28. Both dates were ready to bolt at harvest.

Winter Squash

Squash was planted on June 10 into very warm soils, which resulted in fast emergence and growth. Hard frosts on September 13 & 14 completely killed all vines and all squash was harvested on the 14th of September.

Conclusions & future plans:

Information gathered on performance and customer preference indicated that Sheyenne, Cannonball, and Cavalier tomato are tomato varieties that need to be commercially available. Based off of choice by customers at the farmers market, Cavalier followed by Sheyenne were the varieties of choice. The potato variety Crystal has proven to be an excellent potato that is a multiple use variety with very thin white skin. Seed from this variety will be saved and distributed to others. Crystal has been said by some potato eaters to be the best tasting potato ever. Although limited seed was received of Alaska, seed was saved to continue evaluation of this variety. This is a variety Prairie Seeds plans to include in its lineup of varieties. Seed was not saved from Mantador broccoli although seed has been procured for the 2012 growing season, as this is a variety that I will look to produce seed of in the upcoming years.

Varieties saved from Prairie Seeds & plans

Varieties identified of value from this project include: Pinky popcorn, Golden Gem sweet corn, Cavalier and Sheyenne tomato, Alaska pea, Crystal potato, and Manatdor broccoli. Seed that was saved and will continue to be grown, improved, and possibly marketed through Prairie Seeds is Pinky popcorn, Alaska pea, and Crystal potato. As time allows previous crops mentioned will be grown with continual evaluation as potential varieties for seed sales and distribution.

The next pages are pictures taken on Prairie Seeds Farms throughout the 2011 growing season.



Crystal (left) & Norchip potato on July 22



Crystal harvest



Tomato Variety Trial 7/22



Cannonball 8/29



Cavalier 8/29



Sheyenne 8/29



Arikara squash



Hidatsa squash



Mandan squash



Ruby lettuce on July 10



Salad Bowl Lettuce on July 10



Lincoln pea 7/18



Direct seeded Mantador broccoli (left) and Chinese cabbage on Aug 18



Mantador broccoli transplants on July 22



Direct seeded Chinese Cabbage (date 2) on July 22