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Potato is the most important vegetable and horticultural crop grown in North Dakota. In 2012, potatoes were planted on about 35,612 ha; total ha harvested were approximately 33,994. The average yield was 33.6 t per ha. In 2012, 43% of ha eligible for certification by the North Dakota State Seed Department were planted to cultivars developed by the NDSU potato breeding program, or to strains thereof.

Potato research has been conducted at NDSU since the late 1800s. Early work was mainly in regard to production practices such as plant population and planting depth. The potato breeding program was initiated in 1930 by the North Dakota Agricultural Experiment Station (NDAES). Since 1930, 25 cultivars have been named and released by the NDAES, in cooperation with the USDA-ARS, and others. Many additional collaborative releases with state Agricultural Experiment Stations, the USDA-ARS, and Agriculture Canada have also occurred. Traditionally, NDSU potato cultivar releases have been widely adapted and adopted, significantly impacting production in North Dakota and Minnesota, the Northern Plains, and throughout North America.

As a leader in potato breeding, selection, and cultivar development, our goal is to identify and release superior, multi-purpose cultivars that are high yielding, possess multiple resistances to diseases, insect pests, and environmental stresses, have excellent processing and/or culinary quality, and that are adapted to production in North Dakota, Minnesota, and the Northern Plains. Our interdisciplinary improvement team emphasizes disease, insect pest, and stress resistance, including late blight, cold-sweetening, Colorado potato beetle, Verticillium wilt, pink rot and Pythium leak, silver scurf, sugar end, Fusarium dry rot, and aphid resistance breeding. In order to develop durable long-term resistance to these pests and stresses, breeding efforts include germplasm enhancement, incorporating resistance and improved quality attributes through the use of wild species, wild species hybrids, and the use of released cultivars and advanced germplasm from breeding programs around the globe. Dedicated crossing blocks are used in hybridizing efforts to develop resistance to pests and stresses, and in improving quality attributes. Breeding, evaluation, and screening efforts are successful because of the cooperative and interdisciplinary efforts amongst the NDSU potato improvement team, the North Dakota State Seed Department (NDSSD) and Minnesota Department of Agriculture, and with potato producers, research and industry personnel in ND, MN, the Northern Plains, and across North America.

In order to meet the needs of producers and industry, we have established the following research objectives:
1) Develop potato (Solanum tuberosum Group Tuberosum L.) cultivars for North Dakota, the
Northern Plains, and beyond, using traditional hybridization that are genetically superior for yield, market-limiting traits, and processing quality.

2) Identify and introgress into adapted potato germplasm, genetic resistance to major disease, insect, and nematode pests causing economic losses in potato production in North Dakota and the Northern Plains.

3) Identify and develop enhanced germplasm with resistance to environmental stresses and improved quality characteristics for adoption by consumers and the potato industry.

In 2012, 248 families were created using 139 parental genotypes. Of these families, 59% included late blight resistance breeding, 38% Colorado potato beetle (CPB) resistance breeding, 28% chip processing and 47% frozen processing with cold sweetening resistance breeding. Two hundred families from botanical seed (TPS) were grown in the summer and fall greenhouse crops. The North Dakota Agricultural Experiment Station Greenhouse Complex is allowing a crop in two months, with larger seedling tuber size and more tubers per individual seedling.

In 2012, at Langdon, 94,580 seedlings, representing 458 families, were evaluated; 581 selections were retained. Unselected seedling tubers from cooperating programs in Colorado, Idaho, Texas and Maine were grown at Larimore, ND; 167 were retained. Unselected seedlings were shared with the breeding programs in Idaho, Maine, Colorado and Texas as in past years. In 2012, 938 second, 123 third year, and 345 fourth year and older selections, were produced in maintenance and increase lots at Absaraka, ND, and Baker, MN. All were submitted for certification through the North Dakota State Seed Department and the Minnesota Dept. of Agriculture.

Yield and evaluation trials were grown at eight locations in North Dakota and Minnesota, five irrigated (Inkster, Larimore, Oakes, Park Rapids and Williston) and three non-irrigated locations (Crystal, Grand Forks and Hoople). At Crystal, 28 entries were grown in the fresh market trial, including 20 advancing selections and nine named cultivars. In the preliminary fresh market trial 57 entries were evaluated, including 50 advanced selections and seven industry standards. Four trials were grown at the NPPGA Research Farm south of Grand Forks. They included seedling family evaluation for Colorado Potato Beetle (CPB) resistance (information used during selection at Langdon in September), along with three others where individual clones were assessed for defoliation twice weekly throughout the summer. Two were projects by graduate students, assessing germplasm with two different mechanisms for CPB control, glandular trichomes and glycoalkaloid mediated resistance. Twenty-four entries were grown in the chip trial at Hoople, including 15 advancing selections from the NDSU program, and nine standard chipping cultivars. In the preliminary chip trial 120 entries were grown; these are chipped in order to more efficiently determine what to maintain and what to perhaps fast track, and what to drop from further consideration. The National Chip Breeders Trial (NCBT), with the goals to rapidly identify and develop clones to replace Atlantic for southern production areas, and Snowden from storage, initiated by the USPB and regional chip processors, had 107 entries in the unreplicated and 56 in the replicated trials.

Trials at Inkster ranged from the chip processing yield trial with 30 entries, the regional trials (irrigated), and evaluation of genotypes for resistance to Verticillium wilt in collaboration with Dr. Neil Gudmestad and Julie Pasche (21 clones across all market types). Twenty-four selections and commercially acceptable cultivars were grown in the Larimore processing trial, 24
in the Oakes processing trial, and 24 in the Williston processing trial; 16 advanced NDSU selections in each, compared to 8 commercially acceptable check cultivars. The preliminary processing trial at Larimore had 79 entries. As with the preliminary chip trial, this trial gives a rapid assessment providing the breeding program with information on processing quality so that lines may be continued, fast tracked if exceptional, or discarded from further evaluation. The NFPT is an industry driven trial with evaluations in WA, ID, ND, WI and ME. There were 87 clones evaluated (12 lines from NDSU); clones are evaluated for sugar, asparagine and acrylamide levels. Seventy-nine clones selected from out-of-state seedlings in 2011 and prior were grown in maintenance plots. A processing trial with 28 entries, including 12 NDSU advancing selections) was grown at Park Rapids, in collaboration with RDO/Lamb-Weston. The acrylamide trial was also grown at this site. It includes five cultivars and five nitrogen rates and is in collaboration with Carl Rosen. Funding for our programs is via the Specialty Crop Block Grant Programs in MN and ND. Four entries from NDSU were evaluated in the North Central Regional Potato Variety Trial (NCRPVT), including ND7519-1 and ND8305-1, two cold chipping selections, and ND8068-5Russ and AND00618-2RussY, both dual-purpose russets. NCRPVT locations are Crystal (fresh market), Hoople (chip processing), Larimore (processing), and Inkster (fresh market, chip and processing). Our efforts continue to identify chip and frozen processing genotypes that will reliably and consistently process from long term cold storage. As we grade, chip processing selections are sampled, ‘field chipped’, stored at 42F and 38F (5.5C and 3.3C) for eight weeks, while a fourth set is evaluated the following June from 42F storage. Frozen processing selections are evaluated after grading and from 45F (7.2C) storage for eight weeks and again the following June. All trial entries are evaluated for blackspot and shatter bruise potential.

In 2012, Dr. Gary Secor’s program evaluated seedling families using a detached leaf assay in the greenhouse; resistant selections are retained for field evaluations in 2013. Collaborative field trials for late blight foliar and tuber evaluations with Dr. Secor were lost due to the inability to get late blight established at Prosper. Twenty-eight advancing selections and released cultivars (including resistant and susceptible controls) were evaluated by Dr. Neil Gudmestad’s program for resistance to pink rot, Pythium leak, and P. nicotianae. Many selections were rated as resistant to the latter two. This information is used to select parents in breeding for resistance, and is integral for cultivar releases. Four trials were grown at the NPPGA Research Farm south of Grand Forks. They included seedling family evaluation for Colorado Potato Beetle resistance (information used during selection at Langdon in September), along with three others where individual clones were assessed for defoliation twice weekly throughout the summer. Sucrose rating, invertase/uGPS analysis, and serial chipping of chip and frozen processing selections is conducted by Marty Glynn (USDA-ARS) at the USDA-ARS Potato Worksite in East Grand Forks, MN. Many entries were submitted for cooperative trials with various producers, industry, and research groups across North America.

The NDSU potato breeding program is supported by Dick (Richard) Nilles, research technician, and Dr. Rob Sabba, post doctoral research fellow. Rob’s work involves marker assisted selection work primarily, in addition to other laboratory projects. There are currently four graduated students working with the potato breeding program. Juan Calle-Belido, Ph.D. candidate from Peru, is working on developing a molecular marker for Fusarium dry rot resistance. Adriana Rodriguez, MSc. candidate from Puerto Rico, is working on Colorado potato
beetle resistance, specifically glandular trichome mediated resistance. Irene Roman Martinez, MSc. candidate also from Puerto Rico, is working on glycoalkaloid mediated resistance to Colorado potato beetle. Whitney Harchenko, MSc. candidate and NDSU graduate, is working on marker assisted selection for PVY resistance and is assisting in establishing a ‘fast track’ program similar to the one we have with Potato Pathology for late blight for these genotypes.

The most promising advancing red fresh market selections continue to include ND4659-5R, ND8555-8R, AND00272-1R, ND6002-1R and ND7132-1R. Dual-purpose russet selections, including ND8068-5Russ, WND8625-2Russ, and several hybrids between Dakota Russet and Dakota Trailblazer possess excellent appearance, yield, and processing qualities. An exceptional clone, ND8229-3, was released as Dakota Russet, in 2012. ND7519-1 and ND8304-2, advancing chip processing selections, possess excellent appearance and cold sweetening resistance. Additionally, several specialty type selections with unique colored flesh and skin are of interest for specific market niches.

Goals for 2013 continue to include developing improved potato cultivars for ND, MN, the Northern Plains and beyond, using traditional hybridization, and utilizing early generation selection techniques including emphasis the use of marker assisted selection and greenhouse screening procedures for rapid identification of genetically superior germplasm. Our focus will be on resistance to major insect, disease and nematode pests, and to environmental stresses, with an emphasis on improved quality characteristics, addressing shortcomings of currently commercially accepted cultivars, and with greater emphasis on economic and environmental sustainability. Finally, working with the NDSSD and MN Department of Agriculture we will continue to improve our seed increase efforts in order to produce high quality certified seed. We are grateful for the opportunity to conduct cooperative and interdisciplinary research with members of the NDSU potato improvement team, the USDA-ARS programs in Fargo and East Grand Forks, the North Central and other research programs across the globe, and potato producers and industry in ND, MN, and beyond. A sincere thanks to our many grower, industry, and research cooperators in North Dakota, Minnesota, and beyond. Your support of our research program is wonderful, making our work fun and a stimulating challenge.
ND8068-5Russ
- ND2667-9Russ × ND4233-1Russ
- Medium vine size
- Very early vine maturity
- Medium to high yield potential
- Dual-purpose
- High specific gravity
- Good storability with low sugar accumulation and excellent frozen processing quality after 7 months storage
- Russet Norkotah fertility regime

ND070927-2Russ
- AH66-4 × ND860-2
- Medium vine size
- Medium-late vine maturity
- Medium to high yield potential
- Dual-purpose
- High specific gravity
- Good storability with low sugar accumulation and good French fry processing quality
- Early in evaluation process for cultivar specific management information, including fertility rates, within row spacing and disease resistance evaluations
ND071079-2Russ

- ND6242-10Russ x Dakota Russet
- Medium-large vine size
- Medium-late vine maturity
- High yield potential
- Dual-purpose
- High specific gravity
- Good storability with low sugar accumulation and excellent processing quality
- Early in evaluation process for cultivar specific management information, including fertility rates, within row spacing and disease resistance evaluations

WND8625-2Russ

- W2699-1Russ x Silvertown Russet
- Medium-large vine size
- Medium vine maturity
- Medium to high yield potential
- Dual-purpose
- High specific gravity (+1.087 across ND and MN irrigated locations)
- Good storability with low sugar accumulation and good frozen processing quality after 7 months storage
- Early in evaluation process for cultivar specific management information, including fertility rates, within row spacing and disease resistance evaluations
**AND97279-5Russ**

- A92001-2 x Ranger Russet
- Medium-large vine size
- Medium-late vine maturity
- Medium to high yield potential
- Dual-purpose
- High specific gravity (about 1.087 across ND and MN irrigated locations)
- Good storability with low sugar accumulation and good frozen processing quality
- Early in evaluation process for cultivar specific management information, including fertility rates, within row spacing and disease resistance evaluations

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**Dakota Russet x Dakota Trailblazer Hybrids**

- Hybrids include ND049546B-10Russ, ND049546B-15Russ, ND049546B-27Russ, ND050032-4Russ, and ND060735-3Russ
- Yield potential for all is medium to high
- Maturity is medium for all
- Specific gravity is midpoint between parents
- All are dual-purpose
- All have excellent French fry quality and low sugar accumulation in storage
- Early in evaluation process for cultivar specific management information
ND4659-5R
- NorDonna x ND2842-3R
- Suited for the fresh market
- Medium vine with red-purple flowers
- Medium maturity
- Medium yield potential
- Bright red, round, smooth tubers with white flesh and shallow eyes
- Medium specific gravity
- No outstanding disease or pest susceptibilities
- Stores well

ND8555-8R
- ND7188-4R x ND5256-7R
- Suited for the fresh market
- Medium maturity
- Medium-large vine size
- High yield potential
- Bright red, round, smooth tubers with white flesh and shallow eyes
- Very uniform tuber size profile
- Medium specific gravity
- Stores well
ND6002-1R

- NorDonna x Bison
- Medium sized vine
- Medium maturity
- Medium yield potential
- Round, smooth, bright red tubers with smooth eyes and bright white flesh
- Medium specific gravity
- Early in evaluation process

ND7132-1R

- ND5002-3R x ND5438-1R
- Medium maturity
- Medium yield potential
- Bright red skinned, oval to oblong tubers with white flesh
- Early in evaluation process
AND00272-1R

- MN17922 x A92653-6R
- Suited for the fresh market
- Medium vine with red-purple flowers
- Medium-late maturity
- Medium yield potential
- Bright red, round to oval, tubers with white flesh, shallow eyes and smooth tuber type.
- Low to medium specific gravity
- No outstanding disease or pest susceptibilities
- Stores well

ND7519-1

- ND3828-15 x W1353
- Medium sized vine
- Medium-late maturity
- High yield potential
- High specific gravity (+1.090 average in ND)
- Chips from 42F storage
ND8304-2

- ND860-2 x ND7083-1
  - Medium early maturity
  - Small to medium sized vine
  - Medium yield potential
    - Nice tuber type, smaller size profile
  - High specific gravity
  - Chips from 42F storage
    - Excellent cold chipping selection

ND7799c-1

- Dakota Pearl x Dakota Diamond
  - Medium vine size
  - Medium-late maturity
  - High yield potential
    - Nice tuber type and tuber size profile
  - Medium to high specific gravity (1.086 average)
  - Chips from 42F storage