## Breeding great northern and pinto beans for multiple disease resistance with high performance, and screening exotic dry bean germplasm in western Nebraska

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Nebraska is a leader in dry edible bean production, ranking third in the U.S. during 2008 with 2.9 million cwt. of dry edible bean (11% of the U.S. crop) produced on 134,945 acres. Nebraska production was 50% great northern (86% of the U.S. crop), 39% pinto (second in the U.S.), and 11% light red kidneys (first in the U.S.) (USDA-ERS, 2008). To maintain the competitiveness of Nebraska's dry bean industry, the University of Nebraska dry bean breeding program is committed to developing improved varieties and germplasm with high yield potential, disease resistance, and good seed quality. This is accomplished through our own research efforts, as well as collaborative research through the Mid-western Regional Bean Nursery (Nebraska, Colorado, North Dakota, and Michigan), the Western Regional Bean Trial (Nebraska, Washington, Idaho, and Colorado), and a shuttle breeding program with USDA-ARS, TARS, Puerto Rico. Several great northern and pinto bean lines identified through these efforts are being incorporated into our elite Nebraska germplasm. Here we report our accomplishments for 2008 and our plans for 2009.

Great northern breeding line ABC-Weihing and cultivar 'Coyne' were released in 2008. ABC-Weihing was bred for enhanced resistance to common bacterial blight (CBB) and will be useful for improving CBB resistance in great northern and pinto bean market classes while maintaining rust and bean common mosaic virus (BCMV) resistance, seed quality, and yield potential. Coyne, named in honor of Dermot P. Coyne, was bred for adaptation to Nebraska growing conditions and for enhanced resistance to CBB and common bean rust. It is also resistant to all non-necrotic strains of BCMV. Coyne has bright white seed, blooms 44 days after planting, and is a midseason bean, maturing 91 days after planting.

During 2008, several early, intermediate, and late generation great northern (25, 375, 29, respectively) and pinto (12, 185, 22, respectively) lines were evaluated in replicated yield trials at the Panhandle Research & Extension Center (PHREC) at Scottsbluff and Mitchell, NE. These lines were also evaluated for resistance to CBB (West Central Research & Extension Center, North Platte), bean common rust (Beltsville, MD), white mold (WM) (PHREC-Scottsbluff), and BCMV(PHREC-Scottsbluff ). Top yielding lines with multiple disease resistance and desirable agronomic characteristics (90 days to maturity, semi-upright to upright plant architecture, and good seed quality) were selected for further evaluation. Four late generation great northern (NE1-08-9, NE1-08-10, NE1-08-16, and NE1-08-29) and one pinto (NE2-07-10) line are being increased for testing in growers' fields during 2009. Early and intermediate generation lines continue to be evaluated for yield, desirable agronomic characteristics, disease resistance, and seed quality.

Development of new hybrid combinations is ongoing in the PHREC greenhouse facilities. During winter 2008, elite Nebraska-adapted great northern and pinto lines were crossed with several sources of germplasm possessing disease resistance, drought tolerance, and desirable agronomic traits (earliness, and plant architecture). Hybridizations were preformed to transfer specific genes, broaden the Nebraska genetic base, and obtain desirable combinations.

One hundred twenty new combinations were produced, including great northern, pinto, small reds, black, and light red kidney bean market classes. These hybrids will continue to be evaluated during 2009.

We continue screening exotic dry bean germplasm to identify new sources of disease resistance, drought tolerance, and other desirable traits. During 2008, exotic rust resistant germplasm (Beltsville, MD) and CBB resistant lines (USDA-Prosser) were identified and are being incorporated into elite Nebraska great northern and pinto bean lines. In addition, the best adapted germplasm from the 2008 Mid-western Regional Performance Nursery and the Western Regional Bean Trail is being incorporated into the elite Nebraska lines. New lines will be evaluated during 2009.

During 2008, we evaluated selected late generation great northern (NE1-06-11, NE1-06-12, NE1-06-13, NE1-07-2 and NE1-07-12), and pinto (NE2-06-8 and NE2-07-10) lines as potential germplasm/cultivar releases in on-farm trials. Participating growers were Rodney Loose, Jerry Mackie, Craig Henkel, Mark Buskirk, and Mark Watson. During these 'Mother and Baby' trials, the experimental lines were compared to the cultivars currently used by the growers. Great northern lines NE1-06-12 (Coyne) and NE1-07-12 show promise based on yield, disease resistance/tolerance, and seed quality. Pinto line NE2-06-8 showed promise based on yield, but because it was only grown in one field, further evaluation is needed.

Molecular DNA activities initiated in 2006 continue. Use of molecular DNA markers associated with traits of interest increases the efficiency of our breeding program. Screening breeding lines for markers aids in determining which hybrid combinations to make. Markers are then used to verify whether the trait of interest is present in the new hybrids. Marker-assisted selection complements disease screening and is being used to incorporate disease resistance into commercial great northern and pinto beans.

During 2008, we initiated two studies to address issues arising from the impact of the recent prolonged drought and restrictions on irrigation. We began a shuttle breeding program between Puerto Rico and Nebraska to identify sources of drought and heat tolerance. Several lines produced well under both irrigated and restricted moisture conditions and will be further evaluated. To help growers optimize dry bean production under limited irrigation, we evaluated the combined effect of variety selection, irrigation scheduling, and level of soil compaction on dry bean yield and quality. Preliminary results suggest that yield declined with increasing compaction and decreasing irrigation and varied with variety. In addition, compaction reduced seed size and delayed flowering and maturity. Both of these trials will be repeated during 2009.