Development and Management of Winter Canola for the Great Plains Region

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The goal of the winter canola breeding and management program is to advance winter canola as a viable oilseed and/or grazing crop for producers in the Great Plains of the United States. Objectives include breeding and evaluating varieties with appropriate traits for the region, conducting crop production studies with adapted varieties to develop suitable management systems, and extending production and marketing information on canola to interested growers. A multifaceted technology transfer program is ongoing in cooperation with industry personnel, grower organizations, and producers. A unique opportunity exists to increase acres because monoculture wheat production is common in the area. The program relies heavily upon U.S. and international germplasm sources to increase the genetic diversity of the cultivars grown in the region. Traits of interest include improved winter survival of adapted canola cultivars, sulfonylurea herbicide carryover tolerance to allow planting after wheat, yield potential, oil quality, glyphosate resistance, forage quality, disease and pest tolerance, and shatter resistance. In addition, coordination of the National Winter Canola Variety Trial (NWCVT) is a significant activity of the program.

The winter canola breeding and production management program, established at Kansas State University (K-State) in 1991, has been supported by the National Canola Research Program (NCRP) for almost two decades. The NCRP provides a structure to encourage multidisciplinary research networks that enhance limited state and industrial resources, and it is funded through the Supplemental and Alternative Crops Competitive Grants Program (SACC). The Great Plains Canola Research Program (GPCRP), administered by K-State, fits the defined role of the NCRP as it links together researchers interested in increasing winter canola from the states of Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Texas.

Multiple academic institutions participate in the GPCRP, growing advanced winter canola variety trials containing genetics tailored to environmental conditions of the Great Plains. Local administration gives the institutions the ability to divide funding among production-related projects and advanced variety trials. K-State provides greenhouse, experiment field, and equipment necessary to maintain the canola breeding efforts. Outside cooperators provide equipment and land area necessary at their respective institutions.

In the past 20 years of breeding winter canola, K-State has released the germplasm lines KS3579, KS1701, and KS7436. Six adapted, winter canola cultivars have been released including ‘Plainsman’, ‘Wichita’, ‘Abilene’, ‘Sumner’, ‘Kiowa’, and ‘Riley’. Riley is the newest variety, released in 2010. It is a conventional variety averaging 1.2% higher oil content and yielding 257 kg/ha more than Wichita, analyzed across 32 site/years from 2008 to 2010 on the Great Plains (P=0.05).

Sumner was released in 2003 as the first winter canola possessing carryover tolerance to the sulfonylurea class of herbicides. These herbicides are used on nearly 50% of all regional winter wheat acres and exhibit residual periods of more than one year. The long “plant-back period” excludes canola from the crop rotations of many potential canola growers. Sumner can be safely planted in the fall following application of these herbicides, making canola a viable option on many wheat acres. This trait is being bred into numerous populations developed by the program. Future cultivar releases with this trait are pending.

Coordination of the National Winter Canola Variety Trial (NWCVT) is one of the most significant activities. In 1982 K-State began testing national panels of oilseed rape cultivars. Since 1994, the NWCVT has been coordinated by K-State and includes 30 to 60 entries annually. Entries were planted at 59 locations in 23 states across the USA in 2010-2011. The NWCVT permits testing of commercial cultivars and advanced germplasm in the widest set of geographic settings possible. Information from this trial facilitates identification of experimental lines for release as new cultivars in areas where they can be profitably marketed. For some domestic and international canola breeding

and marketing groups, it is the only yield testing program available to them in the USA. Domestic producers use the research results to make variety selections.

The blackleg fungus (*Leptosphaeria maculans*), common in canola production worldwide, is the most devastating disease and a serious threat. In fall 2009, blackleg lesions were observed in several producers' fields throughout the region. Resistant varieties are one of the most effective ways to minimize yield loss. Most public varieties grown in the region have at least one parent with partial resistance. However, newer, more robust varieties are needed.

Production management studies support improved canola production recommendations to meet the challenges of the Great Plains environment. Results may direct future breeding objectives, enhancing genetic components of local germplasm and improving crop adaptation.

Stand establishment affects all other periods of the growing season, especially winter dormancy. Quality stands provide the best opportunity for winter survival, which is crucial for a high-yielding crop. Observations in the High Plains area of the Great Plains indicate planting dates as little as two weeks after the optimum (September 20) saw reduced stands, and less than 25% stand and 98% winterkill occurred four weeks beyond optimum. Determining the optimum planting date of canola is crucial for successful stand establishment and yield in southwest Kansas. Winter canola can be established at multiple planting dates in the fall; however, planting winter canola with tillage around September 1 provides the best chance of winter survival and obtaining a successful spring stand. Producing winter canola in western Kansas is difficult; moisture in the seed zone at planting is critical and appears suited best for irrigation.

Winter stand loss in no-till canola over several years led to a series of experiments examining the influence of residue and tillage on stand establishment, winter survival, and grain yield. On-farm observations indicated that residue increased the crown height of canola plants, perhaps making them more susceptible to cold injury. Several sites were established to address residue management, tillage effects, and equipment differences. A double disk opener with coulter or hoe opener compared to a double disk opener without coulter increased stand establishment, winter survival, spring vigor, stand density, and yield in no-till. Conventional till compared to no-till increased winter survival, spring vigor, stand density, plant height, and yield. Narrow rows (20 cm) compared to wide rows (30 and 40 cm) increased stand establishment, winter survival, and final stand density.

Winter canola producers in the Great Plains employ the harvest management strategy that best fits their operations. A harvest management study including four cultivars, four replications, and two harvest treatments at three locations was conducted from 2007 to 2009. In Stillwater, OK, swathing prior to harvest increased grain yield by 617 kg/ha over direct combining ($p=0.05$). Near Hutchinson, KS, direct combining yielded 318 kg/ha more than swathing prior to harvest ($p=0.05$). In Manhattan, KS, swathing prior to harvest and direct combining were not significantly different for grain yield ($p=0.05$). Minimal differences were observed in test weight and total oil content.

Many producers are interested in winter canola as a dual-purpose forage and grain crop. A simulated grazing study was conducted at Manhattan, KS and Hutchinson, KS from 2006 to 2009. Wet forage yields at Hutchinson ranged from 11.8 to 13.7 metric tons per hectare and have ranged from 2.7 to 15.9 metric tons per hectare in Manhattan. Simulated grazing had a significant negative effect on winter survival and yield. Experimental line KS4022 has been identified as a potential dual-purpose canola cultivar because of its prostrate growth habit.

The High Plains area of the Great Plains averages over 5 million wheat acres annually and 30% is irrigated. Alternative crops like winter canola are needed. Dry falls often limit establishment of canola and the extremely dry winter months (50 to 80 mm of precipitation from November to February) make winter survival difficult. Canola typically consumes 500 mm of water during a growing season, one-half that of irrigated maize, and uses as much as 8 mm per day during critical periods. Multiple canola experiments under limited irrigation (380 mm supplemental water) and sub-service drip (135 mm supplemental water) have yielded greater than 3,300 kg/ha. Understanding the effect of water availability on reproductive efficiency aids management decisions.

A high level of expertise exists among faculty involved with this project. Collaboration across the region is multidisciplinary, including plant breeding, crop performance testing, cropping systems,

alternative crops and oilseeds, and crop physiology expertise. Several faculty have extension appointments emphasizing winter canola production.

A coordinated, multifaceted technology transfer program across the region includes extension and research faculty in cooperation with industry personnel, grower organizations, and producers. Extension meetings across the Great Plains have increased sharply as producers ask for more information on how to grow canola profitably. The need for educating a broad spectrum of producers increases as acceptance of winter canola spreads.