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Adaptability of irrigated spring canola oil production to the US High Plains

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ABSTRACT

Canola oil is high in oleic acid which is commonly used for food and industrial purposes. To determine adaptability of spring canola (*Brassica napus* L.) to the High Plains for industrial oil production, 26 irrigated trials were conducted from 2005 to 2008. Trials were divided into five regions—1: 36–37°N 108°W; 2: 39–40°N 101–103°W; 3: 41–42°N 102–103°W; 4: 41–42°N 104°W; 5: 43–44°N 106–108°W. Cultural practices were based on site-specific protocols. Four cultivars, Hyola 401, Hyola 357 Magnum, SW Marksman, and SW Patriot, were planted in replicated plots in April or May under standard irrigation and harvested in July to October depending on region. Seed yield Hyola 401 and Hyola 357 Magnum were higher than SW Marksman and SW Patriot across the five regions and within Regions 1, 2, 3, and 5. Regions 1, 2 and 3 yielded significantly greater than did Regions 4 and 5. Samples from 18 trials were examined for their oil content and fatty acid distribution. The four cultivars had greater than 38% oil content; SW Marksman and SW Patriot had higher oil content than Hyola 401 and Hyola 357 Mag. Higher oil content was achieved in Regions 1, 4 and 5. Across and within regions, the percent of oleic acid did not differ for the four cultivars. The mean content of oleic acid decreased going north from Region 2 to Region 5, as did seed yield in the High Plains. Linoleic acid increased going north from Region 1. Linolenic acids showed little variation across regions. Considering yield and total oil content together, growing spring canola would be excellent in the High Plains.

1. Introduction

Dryland cropping systems in the US High Plains have moved from winter wheat-fallow to more intensive systems that include warmer season crops. Adaptation of spring-planted, cool-season broadleaf crops with market opportunities would significantly benefit rotations for producers. Spring canola, a special type of rapeseed (*Brassica napus* L.), could fit into these crop rotations.

Canola originated in Canada through genetic modification of rapeseed by conventional plant breeding (Shahidi, 1990). It emerged in the 1970s as a viable oilseed, able to transform oil and meal from unacceptable to valuable products for both human and animal consumption. Since the 1970s, canola has been accepted by consumers for its unique fatty acid profile. Nutritionists consider canola's fatty acid profile to be the most desirable of all available vegetable oil. Furthermore, canola has less than 30 μg of glucosinolates per gram of oil-free meal and its seed meal can be used as a high-quality protein supplement for livestock (Bhardwaj, 2007).

Canola having over 40% oil content is one of the highest oil-containing crops in the world. Canola has a high oleic acid content (~65%) and low amount of saturates (~6%) which makes this oil desirable for a variety of food (Sakurai and Pokorny, 2003; Beare-Rogers, 2002) and industrial applications (Dyer et al., 2008). High oleic acid varieties of canola will be even more suitable for a wide variety of fuels and lubricants because of the increased oxidative stability of a highly mono-unsaturated oil. The low saturate content of canola oil imparts good cold temperature properties particularly, which makes canola oil desirable as a base stock for biodiesel. In addition, these properties are carried through a cranking process to make green diesel where thermally cracked canola demonstrated

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superior cold temperatures properties in the resultant fuel when compared to soybean oil (Luo et al., 2010).

Growing environments have been reported to impact seed yield and oil quantity as well as quality. In order to make canola a profitable crop in the High Plains, it is important to know how different regions within the High Plains impact seed yield, oil content and fatty acid profile.

2. Materials and methods

2.1. Field trials

From 2005 to 2008, 26 field trials were conducted across the High Plains from northern New Mexico to northern Wyoming (Fig. 1). Sites were divided into five regions based on their map coordinates—1: 36–37°N 108°W; 2: 39–40°N 101–103°W; 3: 41–42°N 102–103°W; 4: 41–42°N 104°W; 5: 43–44°N 106–108°W (Table 1). Trials were planted from early April to early June. The spring canola (*B. napus* L.) cultivars tested in these sites were Hyola 401, Hyola 357 Magnum, SW Marksman, and SW Patriot. Seed planted at all locations each year were from the same seed lot donated by Interstate Seed Co. Trials were designed as RCB with four replicated plots. Plots were four rows spaced 0.3 m apart and 3–6 m long. Seeding rate was 7–9 kg/ha. The most common previous crop was winter wheat while in a few trials, canola followed oat, corn, dry bean, or alfalfa. All trials were irrigated under an overhead irrigation system (center-pivot or linear-move). The amount depended on rainfall and was targeted to that used for growing irrigated wheat. Total precipitation from planting to harvest ranged from 25 to 60 cm with higher amounts applied Yellow Jacket, CO, and Farmington, NM. Cultural practices were site-specific. Fertilization ranged from 45 to 168 kg N/ha. In some sites, N was supplemented with 25–35 kg S/ha and 20–50 kg P/ha. In NM, 60 kg K/ha was also added. Since Hyola 401, unlike Hyola 357 Magnum, SW Marksman and SW Patriot, is not resistant to glyphosate, weed control in trials was accomplished using either trifluralin or ethalfluralin. Insect control depended on local pressure and materials used were esfenvalerate, imidacloprid, or *z*-cypermethrin. No fungicides were applied. Trials were harvested in July and August at all sites in WY and NE, and in Akron, CO, and Colby, KS, but in September or October in Yellow Jacket, CO, and Farmington, NM.

Table 1
Coordinates and years for each site.

Region	Site	Coordinates	Trial years
1. Southwest	Farmington NM	36°45′N 108°10′W	2006c 2008a
	Yellow Jacket CO	37°53′N 108°73′W	2006c 2008c
2. East	Colby KS	39°22′N 101°04′W	2005c 2006b
	Akron CO	40°09′N 103°08′W	2006c 2007a*
3. Central	Sidney NE	41°13′N 103°00′W	2005c 2006c
	Scottsbluff NE	41°50′N 103°41′W	2005c 2006c 2007a 2008c
	Alliance NE	42°08′N 102°51′W	2005c
4. West	Albin WY	41°25′N 104°06′W	2005b 2006c
	LaGrange WY	41°38′N 104°09′W	2008a
	Lingle WY	42°08′N 104°20′W	2007a
	Torrington WY	42°20′N 104°11′W	2006c
5. Northwest	Powell WY	44°45′N 108°45′W	2005c 2006c 2007a 2008c
	Sheridan WY	44°38′N 106°57′W	2006a

*: two trials; a: trials in yield studies; b: trials in oil analyses; c: trials used for both yield determination and oil analyses.

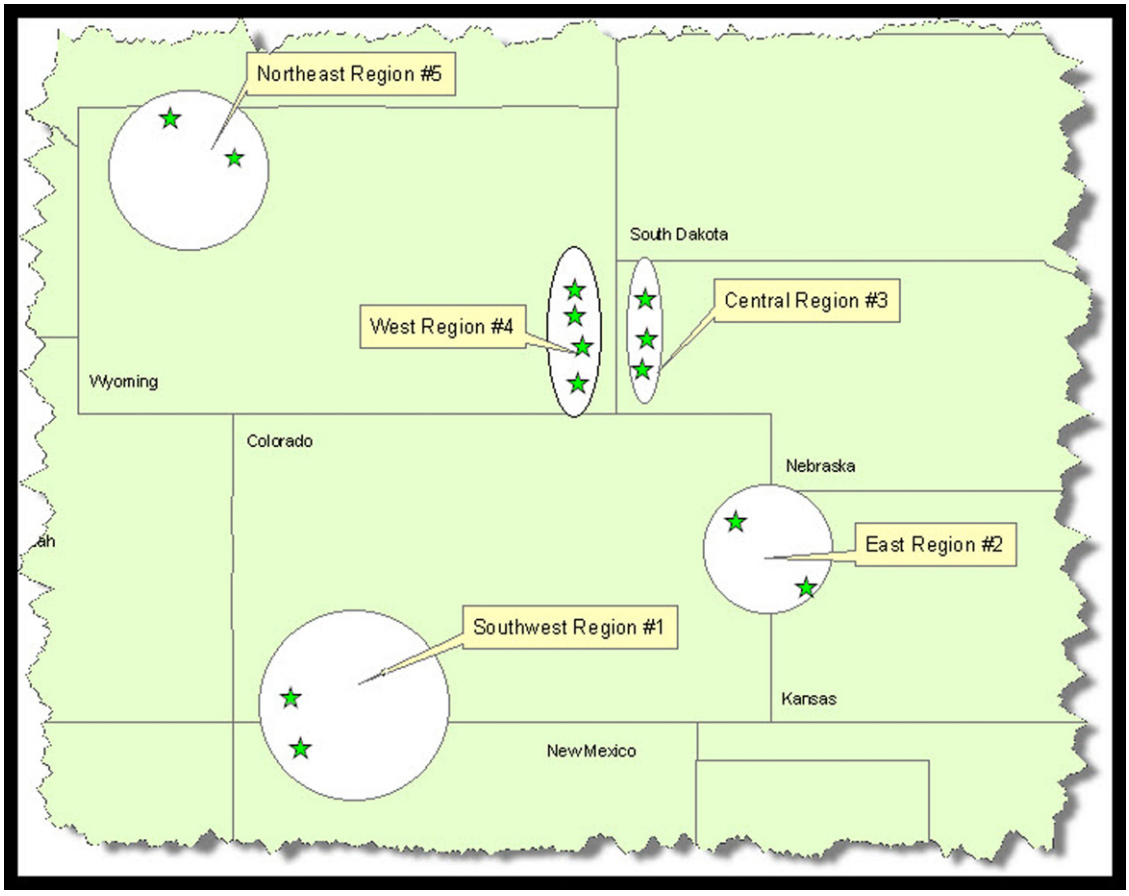

Fig. 1. Map showing geographical location of spring canola trials.