PRODUCTION OF CANOLA AND RAPESEED IN THE U.S.

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INTRODUCTION

Six cultivars of winter rapeseed and Canola (Brassica napus L. ssp. oleifera (Metzg) Sinsk.) were evaluated at selected sites across the U.S. from 1986 to 1990 to identify areas where Canola could be grown as a commercial crop. The cultivars were selected to represent a broad range of potential adaptation and were grown as controls in the U.S. Winter Rapeseed Variety Trial established by the University of Idaho.

MATERIALS AND METHODS

During the 1986-87, 1987-88, 1988-89 and 1989-90 growing seasons, seed was harvested at 10, 11, 10, and 17 locations, respectively (Mahler et al. 1987, 1988, 1988 and 1990.) At each location, commercial cultivars were compared to six check cultivars for seed yield and percent oil. These trials used a randomized complete block experimental design with four replications. The six cultivars averaged in the 1987, 1988, and 1989 trials were Bienvenu, Bridger, Cascade, Dwarf Essex, Glacier, and Jet Neuf. The six cultivars averaged in the 1990 trials were Bienvenu, Bridger, Cascade, Humus, Glacier, and Tapidor. Percent oil was determined by the University of Idaho using a Newport MKIIIA Nuclear Magnetic Resonance (NMR) instrument on 12 g of oven-dried, open-pollinated seed obtained from each plot. The NMR was calibrated using the cultivar Bridger as the standard with a 32 second integration period.

RESULTS AND DISCUSSIONS

These trials identified five production zones where Canola could be grown as a commercial crop (Fig. 1). In the northern tier of states, Canola will be primarily grown as a spring annual since existing biennial cultivars have failed to survive the extreme winters of this region (Mahler and Auld 1987, 1988, 1989, 1990). Across much of the central U.S., Canola can be grown using either the very hardy biennial cultivars of turnip rapeseed (B. campestris L.) or conventional biennial cultivars of B. napus. In the southern portions of the U.S., Canola will be most competitive if grown as a winter annual using either cultivars with specific vernalization requirements and cold tolerance or by fall planting, spring cultivars with high levels of frost tolerance.

Spring Annual Zone:

The severe winters characteristic of the northern tier of states, with minimum temperature of -30°F or lower, have consistently killed even well established winter rapeseed (Fig. 1) (Mahler and Auld 1987, 1988, 1989, 1990). Commercial rapeseed and Canola production in this zone will require the production of spring planted cultivars of Canola. Insect infestation, high summer temperatures and moisture stress have historically limited commercial production of spring Canola across much of this zone. Exotic species of oilseed Brassicas such as B. juncea (L.) Cross and B. hirta Moench, which are more tolerant of insects, heat and drought, could expand the spring production area if Canola quality cultivars were developed in these species (Gareau et al. 1991).

HARDY BIENNIAL ZONE:

Existing cultivars of winter rapeseed and Canola have consistently survived the winters in the northern U.S. only in those areas in which the climate has been moderated by proximity to large bodies of water or where consistent snow cover protects the seedlings during the most severe part of the winter (Fig. 1) (Mahler and Auld 1987, 1988, 1989, 1990; Wright 1989). Across much of this zone, minimum winter temperatures can often approach -20°F. The very hardy cultivars of turnip rapeseed (B. campestris) may be adapted to some areas of the northern U.S. where B. napus does not normally survive. Canola quality cultivars of winter hardy turnip rapeseed with both low levels of erucic acid and low levels of glucosinolates may be commercially available in the near future.

BIENNIAL ZONE:

The biennial cultivars of B. napus currently grown across much of Northern Europe appear to be well adapted to the Pacific Northwest, the lower Plains States and the Northeast where minimum winter temperatures seldom exceed -10°F (Fig 1) (Mahler and Auld 1987, 1988, 1989, 1990). Most of these cultivars require from six to eight weeks of vernalization to initiation flowering and utilize the whole growing season to produce a crop. Across nineteen trials in this area, seed yields have averaged 2401 kg ha^{-1} (Table 1). Areas with limited moisture and severe winters, such as the High Plains, have produced relatively low seed yields but these yields may be economically competitive with cereal crops currently grown in this area (Brotemarkle et al.).

FACULTATIVE WINTER ANNUAL ZONE:

The mild winters, adequate winter rainfall and potential to double crop make the southern U.S. a promising site for Canola production (Fig 1) (Mahler and Auld 1987, 1988, 1989, 1990). One of the major factors presently limiting Canola production across much of the southeastern U.S. is the lack of adapted cultivars. Above 33° N latitude in Tennessee and Virginia, conventional biennial cultivars are well adapted, but mature too late to allow double cropping (Fribourg et al. 1989). Existing cultivars of biennial rapeseed and Canola when grown at many sites below 33° N latitude have produced relatively low seed yields of 1752 kg ha^{-1} and low oil contents of 38.6% (Table 1). Conventional biennial cultivars grown in this region are often not exposed to sufficient cool weather to satisfy stringent vernalization requirements and subsequently flower and mature during warm summer temperatures which limit seed production (Duncan and Hoveland 1986, Hairston et al. 1989, Raymer et al. 1990, Sojka and Karlen 1988). Canola and rapeseed cultivars with minimal vernalization requirements, good cold tolerance and early maturity are needed to optimize seed yield potential of Canola and rapeseed across much of the southern U.S.

Winter Annual Zone:

In extreme southern regions of the U.S., Canola and rapeseed cultivars developed for spring planting in more northern latitudes can be successfully grown as a winter crop (Fig. 1). Seed yield in the eight trials in this area have averaged only 1060 kg ha^{-1} with average oil contents of 38.6% (Table 1) (Mahler and Auld 1987, 1988, 1989, 1990). Cultivars selected for this area will need to have good frost tolerance to prevent damage from occasional cold periods which can occur in December and January and good pest resistance (Raymer et al. 1990).

All Canola and rapeseed cultivars grown in the U.S. will need to have several characteristics to ensure successful Canola production. These cultivars will need to have proven adaptation and produce seed yields that are economically competitive with other crops grown in the same area. Commercial Canola and rapeseed cultivars should have high oil contents with a minimum of 40 to 43% for spring types and from 42 to 45% for winter types. These cultivars must also produce defatted seed meals which have less than 30 μmoles per gram of defatted meal in all production environments to ensure the meal residue remaining after oil extraction can be marketed as a premium quality animal feed supplement. Canola cultivars should also produce oils with low chlorophyll contents and have total saturated fatty acid contents of less than 6%. In addition, commercial cultivars will also need to carry multiple pest resistance since only a limited number of pesticides are currently registered for use on rapeseed and Canola in the U.S.

Flea beetles, aphids, cabbage seedpod weevil and a broad range of foliar feeders represent the greatest potential insect threats to Canola and rapeseed production in the U.S. (Mahler and Auld 1987, 1988, 1989, 1990; Auld et al. 1989; Gareau et al. 1991). Flea Beetles (Phyllotretra spp.) attack the cotyledons of emerging Canola seedlings causing severe stand reductions. Economic damage has been most extensive on spring Canola in the northern U.S. The cabbage aphid (Brevicoryne brassicae L.) and turnip aphid (Lipaphis erysimi (Kaltenbach)) have caused economic damage in both spring and winter Canola. The cabbage seedpod weevil (Ceutorhynchus assimilis Paykull) will be a major pest in many areas of the U.S. where Canola is grown.

Potential diseases that could limit Canola and rapeseed production in the U.S. include Sclerotinia white mold, powdery mildew, and blackleg (Mahler and Auld 1987, 1988, 1989, 1990; Auld et al. 1989). Severe infestations of Sclerotinia white mold, caused by the fungus Sclerotinia sclerotiorum (Lib.) de Bary, can reduce seed yields of both spring and winter Canola by 50%. Crop rotations with non-susceptible hosts, avoiding dense stands and applying the proper amounts of nitrogen can minimize the impact of this disease. Powdery mildew (Erysiphe communis Wallr.:Fr.) has caused economic losses in both southern Texas and southern Georgia. Since no fungicides are registered to control this pathogen in the U.S., the development of resistant cultivars offers the greatest potential to control this disease. The most serious disease of Canola in the U.S. is blackleg caused by the fungus Phoma lingum (Tode ex Fr.). This seedborne pathogen can reduce seed yields in excess of 50%. Blackleg was introduced into the U.S. in the fall of 1988 and is expected to spread rapidly to all areas where Canola and rapeseed are grown. The use of resistant cultivars will be the most economical means of controlling blackleg. As the production of Canola and rapeseed increases, other plant pathogens could become increasingly important.

If appropriate cultivars of Canola and rapeseed can be developed, production of these oilseed crops will increase rapidly in the U.S. Commercial production could increase from less than 40,000 hectares in 1991 to several million by the year 2000. Much of this production could be utilized to satisfy domestic demand for both Canola and industrial oil within the United States.

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Table 1. Latitude, average annual rainfall, average seed yield, and oil content of six cultivars of winter rapeseed grown as part of the U.S. national winter rapeseed variety trial from 1986 to 1990.

Northern Locations	Latitude	Average Annual Rainfall	Average Seed Yield					Oil Content				
			1987	1988	1989	1990	Ave.	1987	1988	1989	1990	Ave.
	--- N---	---mm---	-------------kg/hl-1 ----------					--------------%--------------				
Biennial & Hardy Biennial Zones:												
Kalispell, MT	48.1	548	3133	2054	--	3884	3023	37.7	38.8	--	39.1	38.5
Moscow, ID	46.4	616	1011	5747	4925	2905	3647	35.4	39.5	39.3	38.5	38.1
Prosser, WA	46.2	180	4325	4044	3289	4789	4111	45.5	42.8	44.4	44.6	44.3
Corvallis, OR	44.6	916	3626	3027	--	1193	2615	41.9	42.7	--	34.7	39.7
Ithaca, NY	42.3	--	--	--	2661	--	2661	--	--	43.5	--	43.5
Lincoln, NE	40.5	667	--	--	--	194	194	--	--	--	34.6	34.6
Urbana, IL	40.1	1009	--	--	--	1912	1912	--	--	--	38.5	38.5
Colby, KS	39.2	296	--	1400	--	685	1042	--	39.2	--	33.1	36.1
Zone Average			3024	3254	3625	2223	2401	40.1	40.6	43.5	37.6	39.2
Facultative Winter Annual Zone:												
Orange, VA	38.1	900	171	3103	1685	1511	1617	35.0	39.3	38.2	40.1	38.1
Milan, TN	35.9	1359	--	--	2471	2111	2291	--	--	39.7	41.0	40.3
Plymouth, NC	34.6	819	--	--	--	1349	1349	--	--	--	41.8	41.8
Clinton, NC	34.6	819	1121	--	1253	2193	1522	41.0	--	39.9	39.1	40.0
MS. State, MS	34.2	628	--	2488	--	--	2488	--	40.5	--	-	40.5
Clovis, NM	34.1	178	--	--	436	678	557	--	--	33.1	36.1	34.6
Vernon, TX	34.1	1280	--	--	--	2246	2246	--	--	--	35.4	35.4
Blackville, SC	33.2	739	2461	1183	1812	2478	1983	41.1	37.6	35.2	39.2	38.2
Griffin, GA	33.1	874	1394	2031	1686	1740	1712	34.2	41.4	38.8	38.9	38.3
Zone Average			1287	2201	1557	1788	1752	37.8	39.7	37.5	39.0	38.6
Winter Annual Zone:												
Tifton, GA	31.7	864	1352	976	907	1972	1301	37.6	36.5	33.7	38.5	36.5
College Station, TX	30.6	760	1001	727	741	804	818	--	--	--	--	--
Zone Average			1177	852	824	1388	1060	37.6	36.5	33.7	38.5	36.5

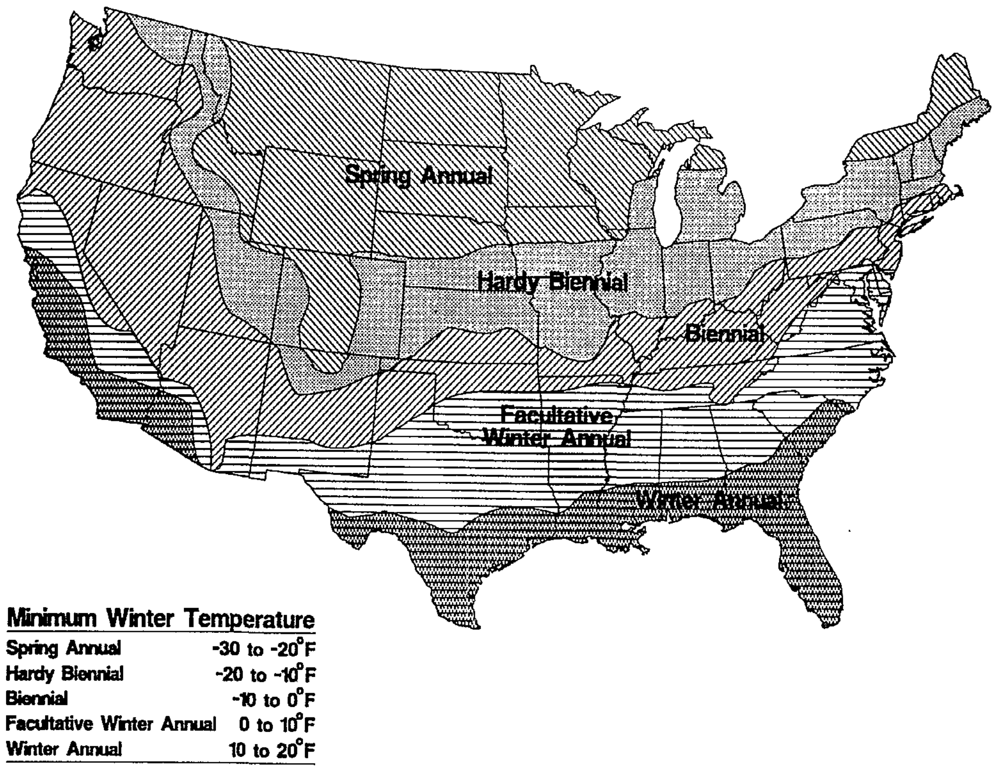

Figure 1. Five major production zones where Canola and rapeseed can be grown in the United States.