

Agronomic Studies on Spice Crops

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Introduction

The continuing low farm gate prices for the traditional cereals and oilseeds in western Canada have stimulated interest in crop diversification and value-added processing. Pea, lentil, mustard and canaryseed have been the most recent examples of successful crop diversification and are no longer considered specialty crops. Chickpea and dry bean are two new pulse crops that are well on their way to losing their specialty crop status since over 140,000 ha and 150,000 ha, respectively, were planted in western Canada in 1999. Sunflower production fluctuates each year, but it, too, has become an established crop in western Canada with over 80,000 ha planted, mostly in southern Manitoba. Buckwheat is still a specialty crop with about 13,000 ha planted in Manitoba in 1999.

Various spice crops are still considered specialty crops in western Canada. Furthermore, the area devoted to spice crop production in western Canada is increasing each year. Provincial statistics are rather sketchy, but coriander (*Coriandrum sativum*) is the most important spice crop in Saskatchewan. In 1991 coriander was planted on only 800 ha in Saskatchewan (Table 1). This increased to 13,000 ha in 1998, but dropped to 10,000 ha in 1999, due primarily to low prices. The average yield of coriander was 825 kg/ha for the 1997-99 period. Biennial caraway (*Carum carvi*) is the second most important spice crop in Saskatchewan. In 1991 biennial caraway was planted on only 320 ha in Saskatchewan. This increased to 4,800 ha in 1998, but dropped to 4,000 ha in 1999. The average yield of caraway was 680 kg/ha for the 1997-99 period.

Table 1. Area devoted to coriander and biennial caraway in Saskatchewan 1991 - 1999.

Year	Coriander (ha)	Biennial caraway (ha)
1991	800	320
1992	1200	600
1993	1900	?
1994	2600	320
1995	4900	2700
1996	1400	3200
1997	8000	5000
1998	13000	4800
1999	10000	4000
Av. yield (97-99) (kg/ha)	825	680

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Other spice crops grown in Saskatchewan in 1999 were: anise (*Pimpinella anisum*), 200 ha; fenugreek (*Trigonella foenum-graecum*), 100 ha; and dill (*Anethum graveolens*), 40 ha. All of these spice crops, except fenugreek, are members of the carrot family (Umbelliferae or Apiaceae). Fenugreek is a legume.

Objectives

The objectives of this presentation are to report the results of research on 1) the adaptation of various annual spice crops in the Brown soil zone, 2) the feasibility of dormant seeding of various annual spices and 3) the breeding of coriander.

Materials and Methods

Five annual spices were planted in replicated, standard-sized research plots at two sites in the Brown soil zone (Swift Current and Assiniboia) in 1993 to 1995. Anise, small-fruited coriander, cumin (*Cuminum cyminum*), dill and fenugreek were planted in the first two weeks of May in each year, using recommended seeding rates for each crop. Yellow mustard (*Sinapis alba*) was included as the standard. The plots were fertilized according to soil test recommendations, and weeds and insects were controlled.

Large-fruited coriander, dill, annual caraway, anise and ajowan (*Carum copticum*) were planted in small, replicated plots at Saskatoon and Outlook during the last week of October in 1996 to 1998.

The coriander breeding program was initiated in 1995. A collection of coriander genotypes was assembled and performance evaluated under Saskatchewan conditions for the next 4 years. A small-fruited line and a large-fruited line were selected as the most promising and 100 individual plants of each were planted and performance of the individual plant rows evaluated. The outliers were eliminated and, after a second generation of increase, seed from the remaining plant rows was bulked to form pre-Breeders seed of the two new varieties.

Results

Spice Adaptation Trials in the Brown Soil Zone

The highest yielding spice crop in the Brown soil zone was fenugreek (Table 2), which yielded 101 % of yellow mustard. Seed yield of fenugreek ranged from 600 to 2460 lb/ac (673 to 2758 kg/ha). It must be emphasized that yields from small, hand-weeded plots are usually higher than yields from commercial fields. Fenugreek is a late-maturing crop, requiring 110 days to mature, relative to 98 days for yellow mustard. Fenugreek seedlings can only tolerate a few degrees of frost, and, thus, fenugreek should not be seeded earlier than about April 26 in the Brown soil zone and later in the Dark Brown soil zone.

Small-fruited coriander was the second highest yielding spice crop in the Brown soil zone (Table 2). Seed yield of coriander averaged 94 % of that of yellow mustard and ranged from 1010 to 1450 lb/ac (1132 to 1625 kg/ha). Small-fruited coriander is a late-maturing crop, even later than fenugreek, requiring 120 days to mature relative to 98 days for yellow mustard. However, seeds of coriander and other members of the carrot family have immature embryos. Thus, the seeds must imbibe water and undergo physiological maturation before they start to germinate and emerge. This process takes 2 to 3 weeks, depending on the soil temperature. The net result is that seed of coriander and other members of the carrot family can be seeded extra early without concern for frost damage. Extra early seeding (as soon as the soil is dry enough to plant) can be used to partially

compensate for the long growing season requirement of most members of the carrot family.

Table 2. Spice crops grown in 1993-95 at Assiniboia and Swift Current.

Crop	Height (cm)	Maturity (days)	Yield (% of mustard)	Yield range (lb/ac)
Mustard, Yellow	89(3)	98(2)	100(3)	880-2280
Anise	55(2)	134(1)	43(2)	450-1110
Coriander, small	94(3)	120(2)	94(3)	1010-1450
Cumin	25(2)	97(1)	17(2)	70-530
Dill	95(3)	124(2)	46(3)	320-950
Fenugreek	48(3)	110(2)	101(3)	600-2460

The number in brackets is the number of years data were included for that entry.

The third highest yielding spice crop in the Brown soil zone was dill (Table 2), which yielded 46 % of yellow mustard. The seed yields of dill ranged from 320 to 950 lb/ac (359 to 1065 kg/ha). Again, dill is a late maturing crop, requiring 124 days to mature. This late maturity is further compounded by the easy shattering characteristic of dill, which helps explain some of the low yields.

The fourth highest yielding spice crop in the Brown soil zone was anise (Table 2), which yielded 43 % of yellow mustard. The seed yields of anise ranged from 450 to 1110 lb/ac (504 to 1244 kg/ha). Anise is the latest maturing of these spice crops, requiring 134 days to mature. This, alone, makes anise an extremely risky crop for any part of Saskatchewan.

The lowest yielding spice crop in the Brown soil zone was cumin (Table 2), which yielded only 17 % of yellow mustard. The seed yield ranged from 70 to 530 lb/ac (78 to 594 kg/ha). Many other plantings of cumin throughout Saskatchewan have resulted in serious disease problems during the early flowering stages and the crop has been devastated. The disease problem must be overcome before cumin becomes a viable crop for Saskatchewan.

Dormant Seeding

Results from four years of research on dormant seeding of various spice crops have shown that coriander is uniquely adapted to dormant seeding. The crop established well with a minimum of gaps in the row; it matured two weeks earlier than from early spring seeding and the seed yield was equal to or exceeded that from early spring seeding. The earlier maturity should result in higher quality seed in most years since late maturing coriander seed crops are often subjected to rain, resulting in darkened seed of lower quality, and a lower price.

Coriander Breeding

The coriander breeding program has resulted in the release of the small-fruited variety CDC Minor and the large-fruited variety CDC Major in the spring of 2000. Limited amounts of Breeder seed will be available. CDC Minor is lower yielding, later maturing and has a higher percentage of essential oil than CDC Major (Table 3).

Table 3. Yield and quality characteristics of CDC Minor and CDC Major coriander at Saskatoon.

Trait	CDC Minor	CDC Major
Yield (kg/ha)	1717	2030
1000 fruit wt. (g)	7.2	8.9
Essential oil (%)	1.22	0.91
Linalool (% of essential oil)	68.4	65.6
Fixed oil (%)	18.9	16.7
Petroselinic acid (% fixed oil)	66.1	67.5

Summary

1. Coriander is the spice crop that is best adapted to the Brown (and Dark Brown) soil zones of Saskatchewan.
2. Dormant seeding shows great promise with coriander.
3. Breeder seed of CDC Minor, the first small-fruited coriander variety in Canada, will be released by the Crop Development Centre in the spring of 2000.
4. Breeder seed of CDC Major, the first large-fruited coriander variety in Canada, will be released by the Crop Development Centre in the spring of 2000.

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