CRAMBE AS A POTENTIAL CROP FOR WESTERN NORTH DAKOTA

Ben K. Hoag and G. N. Geiszler

North Dakota farmers need new crops to grow on land taken out of production by federal acreage reductions of wheat and feed grains. Crambe (**Crambe abyssinica** Hochst), a new oil seed crop in the United States, is one of the crops under study. The crop, which is much like mustard and rape and is planted and harvested the same way, had its origin in the Mediterranean area and was imported into the United States in the 1940's. The seed contains a glyceride oil rich in erucic acid, which is used in many industrial products. There are no local markets for crambe seed at the present time.

Crambe flowers are white, and the fruits are one-seeded, with the seed enclosed in a hull or pod which remains on most of the seeds after they are harvested.

Fig. 1. Yield of bushels per acre, dry land plots with various levels of applied nitrogen fertilizer.

Research (2) in North Dakota, Minnesota, Montana and South Dakota has shown crambe to be adapted to the climate and soil of this region. The main problems of production in North Dakota are marketing and agronomic performance of the crop, including problems of shattering, fertilizer response and weed control. Previous research (1, 2) report studies with fertilizer responses, with changes from area to area; row spacings, in which generally narrow spacings of 7 to 10 inches have been best; and seeding rates, with around 15 pounds per acre recommended. Yields in excess of one ton per acre have been produced.

Research dating back to 1958 has been conducted at the North Dakota Agricultural Experiment Station in Fargo (2), and at the branch stations beginning in 1965. All data up to this point have been limited mainly to yield potential trials.

The North Central Agricultural Experiment Station at Minot has conducted a three year study of crambe in a trial where three practices were studied, and it is this study, with additional results from Dickinson and Williston, that is reported here. Practices studied at Minot were variable fertilizer rates, chemical weed control, and stage of maturity at harvest. The tests were duplicated on fallow and stubble land.

Crambe seed was planted with a common double disc drill with 7-inch spacing at the rate of 15 pounds per acre. The fertilizer was applied with the seed at the rate used on small grains. On fallow, 23 pounds per acre of P_2O_5 were applied. On stubble, 16 pounds of nitrogen and 20 pounds per acre of P_2O_5 were applied. Treflan* was applied pre-emergence at the rate of 0.5 pounds per acre and tilled into the soil, with check plots without the herbicide application left for comparison. The crambe was harvested at four maturity stages, when approximately 5, 25, 50 and 75 per cent of the pods were ripe. At each harvest stage, a few plants were threshed immediately to obtain small seed samples for moisture content. The remainder of the harvested plants were left to air dry and then threshed for yield data.

Observations were taken on days to emergence, days to 50 per cent bloom, plant height, test weight, oil content in seed with pods, and seed yield. The experimental design was a split block.

RESULTS AND DISCUSSION

Climatic conditions varied during the three year study. The 1966 crop season was near average, with short drouth periods in early June and again at filling stage in late July. Planting was completed

Hoag is agronomist and Geiszler is superintendent, North Central Agricultural Experiment Station, Minot.

*Trifluralin (a, a, a-Trifluoro -2, 6 dinitro -N, N-dipropyl -P-Toluidene)

on May 9. The 1967 crop season began wet and then turned dry. The soil was dry on the surface when the crambe was planted on May 15. Warm dry winds soon after planting dried the soil on the stubble land to below the seed. Emergence was poor and uneven, so the stubble land test was abandoned.

The 1968 season started out with adequate surface soil moisture, and the crambe, planted May 16, emerged evenly. Early June drouth hastened maturity and reduced the height of crambe grown on stubble land. Late July and August rainfall resulted in new growth of the crambe grown on stubble. This new growth continued to bloom and produce seed, causing difficulty in determining harvest times. This problem was reported by Papathanasiou, et al (1).

Throughout the growing season the crop was more vigorous where fertilizer was applied. Plots treated with Treflan had fewer weeds than those without herbicide treatment. Plant height was not influenced by herbicide application, fertilizer application or maturity stage. The plants on fallow were 35 inches tall and those on stubble were 25 inches tall in 1966 and 1969. The number of days from planting to 50 per cent bloom was not influenced by fertilizer or herbicide; average time on both stubble and fallow was 60 days. The crop reached the 5 per cent maturity stage 86 days after planting. One hundred days after planting the crambe was 75 per cent ripe.

Moisture content of the seed harvested was highest at the 5 per cent maturity stage and decreased with each successive maturity stage (Fig. 2). Data obtained from stubble land was more variable because of the regrowth and new growth in 1968, which upset the general moisture trend shown in the more normal years. Only small variations in seed moisture content occurred between fertilizer versus no fertilizer or herbicide application versus no herbicide.

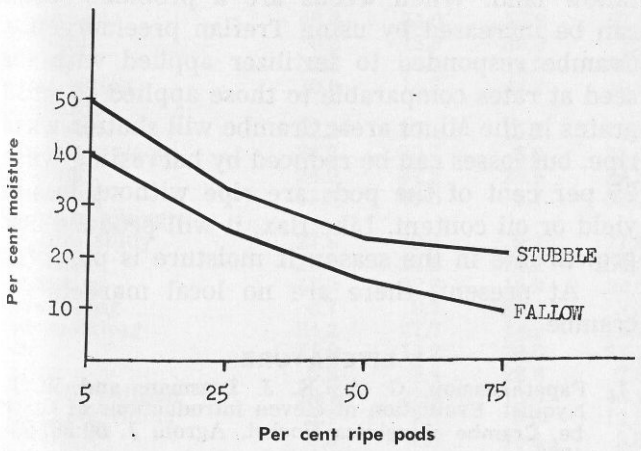

Fig. 2. Moisture per cent in crambe seed in pods when cut at four maturity levels - Minot, North Dakota (1966-1968).

The test weight of crambe seed was not influenced by fertilizer or weed control treatment variables. Seed from the 5 per cent maturity stage was one or more pounds lighter than at the other three maturity stages on both stubble and fallow. In 1966 and 1968 bushel weight on fallow averaged 24.5 pounds compared to 23.4 pounds on stubble.

Yield results were obtained in three years on fallow and two on stubble. The three variables studied each had some significant effect on yield. Fertilizer increased yields over unfertilized plots on both fallow and stubble (Table 1). Yield response to fertilizer was similar at all harvest stages. Both fallow and stubble plots where herbicide was applied produced the highest yields. One half pound per acre of Treflan increased yields on fallow but did not significantly increase them on stubble (Table 1). It also increased yields at each fertility level on fallow.

Table 1. Effect of cropping, weed control and fertilizer on crambe yields in pounds per acre at Minot, North Dakota, 1966-1968.[1]

Fertilizer lbs./acre		Pounds of Treflan applied/acre		Av. Yield
N	P_2O_5	No herbicide	½ lb.	av. yield
		Fallow, 1966-1968		
0	0	1166a	1333c	1247a
0	23	1252b	1435d	1344b
Weed control av.		1209a	1384b	1295
		Stubble, 1966 and 1968 only		
0	0	757ab	670a	749a
10	20	839b	931c	868b
Weed control av.		804a	813a	808

[1]Yield averages (means) within treatments followed by the same letter are not significantly different at the 5% confidence level. (Duncan's Multiple Range test). Fertilizer averages vertically and weed control averages horizontally are not significantly different if followed by the same letter.

Yield response to herbicide application did not change at any of the harvest stages, and harvesting at various maturity stages had little effect on yields (Table 2). On fallow and at the 75 per cent maturity stage, crambe yielded much less than at other stages in 1966 because of shattering of the ripe grain by strong winds. Stubble plots were harvested earlier and did not suffer a yield loss.

Table 2. Effect of harvesting at various crop maturities on yield of crambe at Minot, N. Dak., 1966-1968.[1]

Crop Land	Per cent pods ripe	Yield in pounds per acre 1966	1967	1968	3 yr. av.
Fallow	5	1457b	1087a	1546b	1363b
	25	1496bc	1089a	1501b	1362b
	50	1580c	1131a	1366a	1359b
	75	835a	1124a	1346a	1102a
					2 yr. av.
Stubble	5	639a	([2])	858a	749a
	25	737ab		930a	833a
	50	807b		839a	823a
	75	776ab		878a	827a

[1]Yield averages followed by the same letter do not differ from each other at the 5% level.
[2]Stubble data is only a two year average (poor emergence in 1967). Trial abandoned.

Yield averages for 1966 and 1968 averaged 1,391 pounds on fallow and 808 pounds on stubble. After the crambe emerged on stubble, it appeared to do well even under near drouth conditions.

Oil content in the seed was determined for each treatment on both fallow and stubble. Crambe seed from fallow contained 32.3 per cent oil compared to 27.9 per cent from stubble (Fig. 3). On fallow, the crambe harvested at the 5 per cent maturity stage had less oil than seed from the more mature harvesting stages. This was not true on stubble. None of the other treatment variables had a significant influence on oil content.

Crambe was grown on fallow land and fertilized at six levels at Williston in 1966. With one year's results, crambe from the 0-30-0 treatment yielded more than the check (no fertilizer) treatment. Additions of 10 pounds of nitrogen did not increase yields (Table 3).

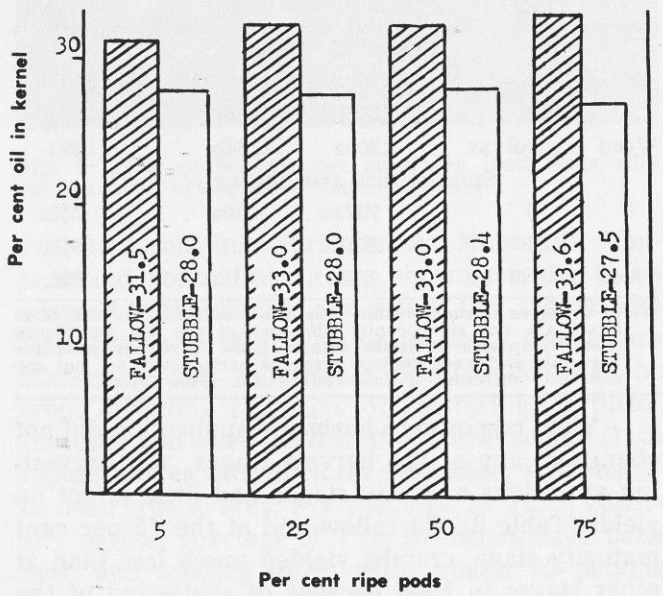

Fig. 3. Per cent oil harvested crambe seed in pods at four maturity levels — Minot, North Dakota (1966-1968).

Table 3. Effect of fertilizer on the yield of crambe grown on fallow, Williston, 1966.[1]

lbs./acre of N + P_2O_5 + K_2O	Test wt. lbs/bu.	Yield lbs./acre 1966
0 + 0 + 0	28.0	1080 a
0 + 20 + 0	28.0	1118 ab
0 + 30 + 0	27.0	1179 b
0 + 40 + 0	26.0	963 a
10 + 20 + 0	27.0	1028 a
10 + 30 + 0	26.5	1095 ab

[1]See Table 2 for explanation.

Yields at Dickinson, Minot, and Williston

Crambe yields at Dickinson (one test year), Minot and Williston varied widely in the five years tests have been made. Establishing good stands was a problem at Williston and one year at Minot. With adequate moisture, crambe can produce high yields, as shown by the yields recorded under irrigation at Williston and the 1969 yields at Minot.

Table 4. Crambe yields at western experiment stations.[1]

		Yield in pounds per acre 1965	1966	1967	1968	1969	5 yr. av.
Dickinson	Fallow	1679	([2])				
Minot	Fallow	1766	1066	1029	1403	2315	1516
	Stubble		614	([3])	877		
Williston	Dryland	894	895	488	665	416	752
	Irrigation	1900					

[1]Dickinson data supplied by Superintendent Thomas Conlon. Williston data supplied by Superintendent Ernest French and Ass't. Agron. Neil Riveland.
[2]Crop lost to hail.
[3]Crop lost due to poor emergence.

SUMMARY

Under western North Dakota conditions, crambe can be planted, grown, harvested and handled like mustard and rapeseed oil crops. Crambe grows well after emergence even under near drouth conditions. More dependable yields are produced on fallow land. When weeds are a problem, yields can be increased by using Treflan preemergence. Crambe responded to fertilizer applied with the seed at rates comparable to those applied to small grains in the Minot area. Crambe will shatter when ripe, but losses can be reduced by harvesting when 25 per cent of the pods are ripe without loss in yield or oil content. Like flax, it will produce new growth late in the season if moisture is plentiful.

At present, there are no local markets for crambe.

LITERATURE

1. Papathanasiou, G. A., K. J. Lessman, and W. E. Nyquist. Evaluation of eleven introductions of Crambe, **Crambe abyssinica** Hochst. Agron. J. 58:587-589. 1966.
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3. Crambe, USDA-ARS. Agr. Res. 11:6-7. 1962.