Crambe Production

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Crambe

*(Crambe abyssinica* Hochst.)

Crambe is native to the Mediterranean region. It was introduced into the U.S. during the 1940s and has been grown intermittently at North Dakota Research Extension Centers since 1958. Commercial production of crambe in North Dakota began in 1990.

Its seed yields an industrial oil that contains a high level of erucic acid. Inputs and management practices are similar to small grains, and its unique use as a nonfood crop makes crambe a potentially profitable alternative enterprise for North Dakota farmers.

Crambe may be grown by farmers who participate in U.S. Department of Agriculture farm programs. Contact the local Farm Service Agency office for information on the current farm program policies regarding crambe.

Description

Crambe is an erect annual herb with large pinnately lobed leaves approximately 4 inches long and 3 inches wide. Leaf petioles are about 8 inches long, channeled and hairy. Plant heights typically vary between 24 and 40 inches, depending on the season and plant density.

The crop exhibits an indeterminate flowering habit and may continue to set seed late in the season. The flowers are white, numerous and small. The round seeds are borne singly and are about ⅛ inch in diameter. Each seed is enclosed in a hull or pod, which usually remains on the seed after harvest. The hulls are typically light brown.

Crambe is also referred to as Abyssinan mustard, Abyssinian kale, colewart or katran.

It is a member of the mustard (*Cruciferae*) family, which includes crops such as rapeseed (canola and industrial oilseed rape) and tame mustard.
Adaptation

Crambe is a cool-season crop that is well-adapted to environmental conditions in North Dakota. Crambe requires an average of 54 days (range of 42 to 64 days) between planting and flowering. The flowering period usually ends about 12 to 15 days before physiological maturity. Present cultivars of crambe require 83 to 106 days from the date of planting to reach physiological maturity.

Crambe is well-adapted to fertile, well-drained soils with a pH of 6 to 7.5. When crambe is grown on soil with poor internal drainage, good surface drainage is essential.

Crambe seed is moderately tolerant to saline soils during germination in soil temperatures from 50 to 86 F. As soil temperatures decrease below 50 F in saline soils, the crambe seed germination rate decreases. Established crambe plants are similar to wheat in saline soil tolerance.

This crop is best suited to silt-loam soils that do not crust. Soils that have potential for crusting problems need to be managed carefully to prevent emergence problems. If a harrow or rotary hoe is used to break up soil crusting, crambe stands can be reduced if the seedling hypocotyl arch is immediately below the soil surface or the seedlings have emerged. The use of an empty press drill across a crusted soil has been successful in breaking the crust and minimizing crambe stand losses.

While crambe requires adequate soil moisture for flowering, pod set and filling, a dry period as the plant approaches maturity is beneficial. Crambe’s tolerance to drought conditions is equal to or slightly less than for small grains. It is more drought tolerant than corn, canola, mustard or soybean at all stages of growth.

Rotations

Rotation of crambe with other crops is recommended to avoid a buildup of insects, diseases and weeds. In crop rotation, crambe should not succeed itself or closely related crops such as canola or mustard.

Crambe should follow small grains, corn, grain legumes or fallow. These crop options provide a break in pest cycles and provide soil conditions that can be managed easily to prepare for crambe production. Crambe also is suitable as a companion crop for alfalfa or other biennial or perennial forage-type legume establishment.

Small grains should perform well following crambe. Crambe stubble provides an acceptable cover for trapping snow, controlling erosion and establishing fall-seeded crops in a no-till production system.

When planting fall-seeded crops, take care to minimize stubble disturbance because crambe residue is brittle and easily destroyed. Also, volunteer crambe is managed easily in succeeding crops using tillage and/or herbicides.

Varieties

Agronomic characteristics and seed yield of several crambe varieties tested during 1990 to 1993 and 2009 at research sites across North Dakota are listed in Tables 1, 2 and 3. Statewide commercial crambe yields averaged about 1,200 pounds per acre during 1990 to 1993. Yield on individual fields has ranged from 300 to 2,500 pounds per acre during this same period.

Table 1. Agronomic characteristics of crambe varieties, North Dakota, 1992-93.¹

<table>
<thead>
<tr>
<th>Variety</th>
<th>Plant Height</th>
<th>Planting to First Flower</th>
<th>Planting to Maturity</th>
<th>Test Weight</th>
<th>Oil Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(inch)</td>
<td>(days)</td>
<td>(days)</td>
<td>(lb/bu.)</td>
<td>(%)</td>
</tr>
<tr>
<td>BelAnn</td>
<td>46</td>
<td>57</td>
<td>100</td>
<td>33</td>
<td>29.9</td>
</tr>
<tr>
<td>BelEnzian</td>
<td>57</td>
<td>57</td>
<td>99</td>
<td>33</td>
<td>29.7</td>
</tr>
<tr>
<td>Meyer</td>
<td>42</td>
<td>55</td>
<td>99</td>
<td>33</td>
<td>31.2</td>
</tr>
</tbody>
</table>

¹ Plant height from Williston, Minot and Langdon.
• Planting to first flower from Minot, Carrington, Prosper and Langdon.
• Planting to maturity from Carrington.
• Test weight from Williston, Hettinger, Minot, Carrington, Prosper and Langdon.
• Oil from Hettinger and Langdon.
Seedbed Preparation and Planting

A critical phase of successful crambe production is stand establishment. A vigorous stand that emerges early will take advantage of cooler temperatures and available soil moisture, and be more competitive with weeds.

The seedbed for crambe should be firm to place seed at a uniform and shallow depth. Seedlings are damaged easily by drifting soil. The seedbed should be prepared to avoid wind erosion. Crambe should be sown 1 inch deep.

Crambe should be sown in late April to early May when the greatest risk of frost has passed. The seedling crop can tolerate temperatures in the low 20s for several hours. If the crop is injured by frost, allow sufficient time (one to two weeks) to determine if damage warrants destruction of the crop. A significant decrease in seed yield and oil content can be expected if seeding is delayed until late May or June.

Small-grain seeding equipment, including double disc opener press drills and air seeders, can be used to seed crambe. However, uniform stand establishment may be more difficult with air seeders. Successful yields have been obtained with row widths ranging from 6 to 36 inches. However, row widths of 6 or 7 inches generally give the highest yields.

A crambe seeding rate of 15 to 20 pounds of live seed per acre is recommended. At 60,000 to 80,000 seeds per pound, this seeding rate should provide a targeted stand of 1 million plants per acre or 23 plants per square foot. Seeding rates as low as 8 pounds of live seed per acre have resulted in low plant densities (10 to 12 plants per square foot) but good yields due to increased plant branching and an extended flowering period.

However, using the recommended seeding rate will result in crambe plants being more competitive with weeds and maturing more uniformly. The recommended seeding rate also is suggested if soil crusting is anticipated. Seeding rates greater than 20 pounds per acre will result in greater seed costs, earlier maturity, less plant branching, increased lodging and possibly lower yield compared with the recommended seeding rates.

Table 2. Crambe variety seed yield, North Dakota, 1990-93.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BelAnn</td>
<td>2,870</td>
<td>1,216</td>
<td>2,575</td>
<td>1,658</td>
<td>3,314</td>
<td>2,138</td>
<td>1,521</td>
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<tr>
<td>BelEnzian</td>
<td>2,975</td>
<td>1,920</td>
<td>2,421</td>
<td>1,566</td>
<td>2,968</td>
<td>2,119</td>
<td>1,202</td>
</tr>
<tr>
<td>Meyer</td>
<td>2,363</td>
<td>1,744</td>
<td>1,877</td>
<td>1,224</td>
<td>2,600</td>
<td>2,083</td>
<td>1,408</td>
</tr>
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</table>

Table 3. Crambe variety seed yield, North Dakota, 2009.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Carrington</th>
<th>Hettinger</th>
<th>Minot</th>
<th>Williston fallow</th>
<th>Williston recrop</th>
<th>2009 Average</th>
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<tbody>
<tr>
<td>BelAnn</td>
<td>1,757</td>
<td>1,802</td>
<td>3,139</td>
<td>1,768</td>
<td>1,559</td>
<td>2,005</td>
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<tr>
<td>Galicita</td>
<td>2,129</td>
<td>1,826</td>
<td>3,279</td>
<td>1,873</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Meyer</td>
<td>1,832</td>
<td>1,550</td>
<td>2,841</td>
<td>1,626</td>
<td>1,449</td>
<td>1,860</td>
</tr>
<tr>
<td>Nebula</td>
<td>1,835</td>
<td>1,513</td>
<td>3,259</td>
<td>1,552</td>
<td>1,236</td>
<td>1,879</td>
</tr>
<tr>
<td>Westhope</td>
<td>2,063</td>
<td>—</td>
<td>3,759</td>
<td>1,792</td>
<td>1,427</td>
<td>—</td>
</tr>
<tr>
<td>Mean</td>
<td>1,972</td>
<td>1,733</td>
<td>3,255</td>
<td>1,722</td>
<td>1,418</td>
<td>1,915</td>
</tr>
<tr>
<td>CV%</td>
<td>14</td>
<td>15</td>
<td>12</td>
<td>—</td>
<td>—</td>
<td>8</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>411</td>
<td>NS</td>
<td>582</td>
<td>222</td>
<td>185</td>
<td>NS</td>
</tr>
</tbody>
</table>
Fertility Management
Crambe’s response to soil fertility is similar to that of small grains, mustard and canola. A soil test should be conducted to determine the need for primary nutrients.

About 5 pounds of nitrogen is required for each 100 pounds of seed yield per acre. Avoid using more than 10 pounds of actual nitrogen with the seed because germination injury can occur. Crambe is responsive to phosphorus fertilization rates of 25 to 50 pounds per acre.

A vigorous stand should be established ahead of weed development to provide optimum competition. Seeding early and using recommended seeding techniques will help establish a crambe stand that is competitive with weeds.

Refer to NDSU Extension Service publication SF882, “North Dakota Fertilizer Recommendation Tables and Equations,” for more information.

Weed Control
Weed control is a critical management factor in crambe production. The crop is not a strong competitor with weeds during early vegetative development. Typically, three to four weeks is required for a 100 percent crop canopy to be formed after emergence. The biggest challenge for weed control exists during this period.

Crambe must be seeded on relatively weed-free fields. Fields that contain perennial weeds such as Canada thistle, perennial sowthistle, field bindweed and quackgrass should be avoided. Also, avoid fields where crops grown the previous year, such as buckwheat, corn and sunflower, may produce volunteer plants.

Diseases
Few disease problems associated with crambe have been observed in North Dakota. Crambe is susceptible to sclerotinia (white mold), but less so than sunflower and dry bean. However, if excessive moisture is present during flowering, sclerotinia infection and seed yield loss may be high.

Excessive moisture conditions throughout the 1993 growing season in North Dakota resulted in significant yield loss due to sclerotinia and alternaria. Other potential diseases include blackleg and pythium root rot.

Carefully plan crop rotations to keep disease pressure to a minimum. Producers should maintain a four-year rotation with crambe as well as other crops susceptible to sclerotinia such as canola, dry bean, mustard, soybean and sunflower.

Seed treatment generally is not required on high-quality crambe seed. Use seed from disease-free fields, excluding areas where blackleg or alternaria were present.

Insects
Insects that have potential for causing economic damage to crambe include aphids, cabbage maggots, grasshoppers, diamondback moth, leafhoppers and lygus bugs. Of these, only grasshoppers have caused significant injury to crambe (typically in field margins).

Crambe is most susceptible to grasshopper damage at the seedling stage. Grasshoppers tend to choose other crop foliage as crambe develops.

Harvesting
After flowering, crambe matures rapidly (one to two weeks). Timely harvest is important to avoid high shattering losses. During warm, dry weather, the crop should be monitored frequently (daily or every other day) to determine the correct harvest stage.

Crambe is physiologically mature when 50 percent of the seeds have turned brown. At maturity, the appearance of the plant may vary from leaves turning yellow and dropping, to the plant (stems and leaves) remaining green. Attention should be directed to the seeds and seed-bearing branches to determine the onset of harvest.

Crambe may be swathed or straight cut. Both harvest methods have been successful, but the choice depends on acreage, harvest equipment, weather conditions, uniformity of maturity and weed density.
Straight combining is recommended for a mature, clean and low-moisture crop. If the majority of seed pods are brown, straight combining is recommended because swath-ing may cause excessive shatter-ing. If approximately 100 crambe seeds per square foot are present on the ground from shattering, a 60-pound-per-acre yield loss occurs.

Crambe seed moisture should be 14 percent or less for straight combining. Crambe seed containing greater than 14 percent moisture will cause harvest problems due to difficulty moving the green plant material through the combine. At seed moisture less than 12 percent, high shattering potential exists.

Swathing may be necessary if maturity is variable and some plants are beginning to shatter while others are still slightly green. If a sufficient number of green weeds are present, swathing may be required.

Crambe should be swathed when at least 50 percent of the seeds have turned brown. If the majority of the seed turns brown before swathing, the swathing and combining operations may cause excessive shattering. When swathing, the reel speed should be reduced to one-half to two-thirds of that for small grains. Seed shatter can be minimized by swathing during a time of day when humidity is high.

Swathing should be done just below the lowest seed pods, leaving the stubble as high as possible. This will allow the windrow to settle into the stubble and reduce loss from wind. Crambe will dry quickly after a rain (compared with small grain) in a swath or if the crop is standing.

The combine must be adjusted correctly when harvesting crambe. The first priority should be to harvest as much of the seed as possible with a minimum of seed damage. The seed should be harvested with the hulls intact.

A combine cylinder speed of 400 to 500 revolutions per minute (rpm) is recommended. Concave clearance may range from ½ inch to near wide open, depending on the combine type and crop characteristics.

Excessive cylinder speed or narrow, concave clearance can cause an increase in hulled or split seed. Rarely will hulls be found in the combine hopper because they normally are blown out the back of the combine. Splits can be detected by looking for bright yellow flecks on the ground behind the combine.

The conventional combine fan speed should be set at about 500 rpm, while rotary combines are set at about 600 rpm. Never disconnect the fan to completely shut off the air. Placing cardboard over a portion of the air intake to the fan may be necessary if seed is being blown out the back of the combine at low fan settings.

The sieve settings for small grains should be appropriate to begin harvest, then adjusted for crambe seed. When straight combining, set the reel to move only slightly faster than the ground speed of the combine. This is essential to reduce seed shattering.

Conditioning and Storage
Crambe seed is small, round and very light weight (25 pounds per bushel). Because crambe has a low test weight and is a relatively bulky crop, transportation costs are greater than for small grain and corn but similar to sunflower. Equipment for transportation and facilities for storage must be tight to avoid loss of the seed. Before drying and storage, the seed should be passed through a roller screen or scalper to remove excess foreign material.

Crambe seed should be stored and marketed at a moisture content of 10 percent or less. Calibrations are being developed to determine crambe seed moisture with electronic moisture testers. A tentative conversion chart was developed in 1993 for the Motomco moisture meter. When moisture testing
Crambe and using oil sunflower standard charts, the moisture tester reading will be about 1 to 2 percentage points low, depending on the brand and moisture range.

If seed is harvested at high moisture, natural air or artificial drying can be used. Do not dry seed with unheated air if seed moisture content exceeds 20 percent. To maintain seed quality, a maximum drying temperature of 110°F is recommended. Bin-drying with unheated air requires a minimum airflow of 1 cubic foot per minute (cfm) per bushel.

During storage, the seed should be checked at regular intervals for heating or other problems. To prevent heating, aerate the seed with a minimum airflow of 0.1 cfm per bushel. Aeration should be continued until seed moisture and temperature equilibrium have been maintained throughout the bin.

**Utilization**

Primary products from crambe seed produced in North Dakota include oil (28 to 33 percent), meal (64 to 69 percent) and hulls (3 percent).

The oil is a valuable raw material that can be used for numerous industrial products. Oil from crambe seed ranges from 50 to 60 percent erucic acid by weight. Erucic acid is used for slip agents, plasticizers, surfactants, antistats, flotation agents and corrosion inhibitors.

Other derivatives from crambe oil can be used for lubricants, rubber additives, new types of nylon, a base for paints and coatings, high-temperature hydraulic fluids, dielectric fluid, pharmaceutical products, cosmetics, waxes and other products. Also, a high-erucic acid oil derivative called “caprenin” may be used as a low-fat cocoa butter substitute in candy and other foods.

Crambe meal may be used primarily as livestock protein but also can be used for protein isolates and fertilizer. The protein content of defatted, dehulled crambe meal may be as high as 45 percent, but if processed with the hull, the protein content drops to about 30 to 32 percent. Seed normally is dehulled (during processing) to produce a higher-protein, lower-fiber meal.

Crambe meal contains glucosinolates, which are sulfur-containing substances. Single-stomached animals such as swine and poultry can develop toxicity problems from ingesting glucosinolates, while ruminant animals such as cattle and sheep exhibit greater tolerance. The Food and Drug Administration has approved the use of defatted crambe meal as a beef cattle protein supplement at levels up to 4.2 percent of the total weight of rations.

**Marketing**

Markets are limited or not available. Crambe should be grown only under contract.

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