North Dakota State University
NDSU Extension Service

Lentil

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Lentil is one of the oldest known food crops. It is a protein/energy crop first cultivated more than 8,500 years ago in the Near East. Lentil production then spread to the Mediterranean, Asia, Europe, and eventually to the Western Hemisphere. It was probably introduced to the United States in the early 1900s. The United States produces a small proportion of the world lentil supply with most of the lentils being exported (70 percent). This publication provides agronomic information that is useful in producing lentils in North Dakota, provides insight into marketing lentils and develops a budget for lentil production in North Dakota.

Agronomic Information

The lentil is a slender, semi-erect, annual legume. It has compound leaves with four to seven pairs of leaflets per leaf and a tendril at the leaf tip. Plants may be multibranched or have single stems, depending on plant density. Lentil plants range in height from 12 to 24 inches at maturity. Maximum plant height occurs with cool growing conditions, good fertile soil and adequate moisture. The lentil has a slender tap root with a mass of fibrous roots. The tap root may grow to a depth of 15 inches, while the majority of the roots will usually be found in the top 7 inches of the soil profile.

Lentil plants flower from the bottom of the plant, and the flowering progresses upward. The flowers range in color from white to pale blue. Seed pods usually hold one or two seeds. Lentil seeds come in a range of sizes and colors (the word "lentil" is derived from the Latin word "lens"). They are lens shaped, generally from 2 to 9 millimeters in diameter, and vary from 15,600 to 100,000 seeds per pound. Seeds produced in North

America are generally larger than seeds produced in the Near East and India. Seed color can be tan, brown, black, or purple and black mottled. The seed sur-face is generally smooth but on some large seeds may be wrinkled.

Lentils are a protein/energy pulse (legume) crop. Protein can range from 22 to 35 percent; however, lentils are deficient in two essential amino acids, methionine and cystine. Lentils are a good animal feed supplement because of their high protein/carbohydrate content. Lentils are sometimes used in soups, stews and salad dishes, but lentils produced in extremely dry conditions generate a hard seed coat which may make them difficult to cook.

Lentils are well adapted to semi-arid, cool conditions. In fact, lentils will not produce acceptable seed yields in hot, wet areas. Excessive humidity or high rainfall will promote vegetative growth and reduce seed yield. Annual rainfall of 10 to 12 inches will produce good yields of high-quality lentil seed. Young lentil plants are tolerant of light frost, which makes early spring planting possible in North Dakota. Lentil plants are adapted to a wide variety of soil types, providing they have good internal drainage. Short exposure of plant's roots to waterlogged soil conditions will result in plant death. Lentils are more tolerant of slightly acidic soils than alkaline soils, with best production usually resulting at a soil pH of about 7.0.

Planting

Lentil seeds should be inoculated if they are planted on a field which has not had nodulated field peas or lentils on it in the past three years. They should be inoculated with *Rhizobium leguminosarum* within 24 hours of seeding. Follow inoculant manufacturer's directions. Avoid exposing the seed to high temperatures and wind before seeding. Seed treatment with insecticides and fungicides is not recommended because these compounds can interfere with the nodulation process.

Lentils should be seeded in late April or early May into a firm, level seedbed. An uneven or rocky seedbed can make harvesting difficult, because the low height at which lentils are cut. Lentil seeds should be planted from 1.5 to 2.5 inches deep depending on the depth of soil moisture. Some varieties are more sensitive to planting depth and soil crusting because of smaller seed size and reduced stored energy. Best yields result when a grain drill is used to seed lentils in 6- to 7-inch rows because of the fragile growth habit and inability to compete with weeds. The relatively narrow rows allow lentils to shade the ground quicker and result in more erect plant growth. Ideal planting density is about 400,000 plants per acre, spaced about 10 plants per square foot. Seeding rates vary considerably because of differences in seed size; they may vary from 30 to 80 pounds of seed per acre. Because of vast differences in seed size, great care must be taken to properly calibrate the grain drill.

Weed Control

Lentil seedlings are not competitive with many broadleaf and grass weeds. Therefore, lentils should be planted on land which is not likely to have a large amount of weed competition. Also, tillage and chemical control before seeding is helpful. Harrowing or rotary hoeing lentil fields after the lentil seedlings have emerged is not advised because seedlings are fragile and more easily injured than weeds. Glyphosate can be used as a preplant weed burndown treatment. Glyphosate, at recommended rates, is especially effective for quackgrass control. Sethoxydim can be used to control grasses after lentils have emerged. Sethoxydim must be applied at labeled rates for problem weed species and used with one quart of crop oil per acre.

Diseases and Insects

Lentils are generally not affected by crop diseases. Some diseases which may affect lentils include *Sclerotinia*, *Fusarium* root rot and *Rhizoctonia* root rot. The only effective method of controlling these pests is crop rotation. It is recommended that fababean, field bean, field pea, mustard, canola, rapeseed, soybean, sunflower, sugar beet and potato not be produced in consecutive growing seasons, because they are susceptible to the same diseases. Corn and small grains work well in rotations with lentils.

Lentils generally do not suffer enough damage by insects to warrant pesticide application. Some insects which may damage lentils include aphids, thrips, Lygus bugs, seedcorn maggots and wireworms.

Fertilizer

Lentil production should not require nitrogen application if the correct *Rhizobium* bacteria are present in the soil. However, if the soil contains less than 2 percent organic matter, it may be necessary to apply 20 to 30 pounds of nitrogen per acre to get the plants off to a healthy start. Lentils will not fix atmospheric nitrogen if excess nitrogen is available in the soil. Also, excess nitrogen will cause excessive vegetative growth, reducing seed yield. To attain optimum yields, 30 to 60 pounds per acre of phosphorus and 180 to 240 pounds of potassium should be available to the plants.

Harvest

When planted early, most varieties of lentils should reach maturity within 85 days of emergence. Lentils may be combined directly with a flexible cutterbar if the fields are uniformly ripe, but should be combined between 18 and 22 percent moisture to prevent harvest losses and cracked seed coats. Most lentils are swathed when pods on lower branches are brown to yellow-brown in color. Lentils should not be swathed during the hot part of the day as this will result in excessive shattering losses. Instead, they should be swathed when there is a dew or at least during the cooler portions of the day.

Because the lentil has a weak stalk, it tends to lodge. Whether the crop is combined directly or swathed, pickup guards on the cutterbar and a pickup reel should be used. Depending on the weather, lentil windrows may take about a week to dry down. Lentil seeds may be stored in a bin at 14 percent moisture; however, they should be combined at 18 to 22 percent moisture to decrease the number of cracked seeds. Natural air drying works best. If artificial heating is used, lentil seeds should not be heated above 110 F, to reduce seed coat cracking.

Compared to wheat, lentils are easy to thresh. Cylinder speed should be slower than that used for wheat, and concaves should be set wider. Approximately the same fan and sieve settings may be used for lentils as for wheat.

Markets

During the 1980s, North America's lentil industry grew substantially, but world market share shifted between Canada and the United States. Canada tripled its share of the world lentil market from 1.2 percent in 1977 to 3.9 percent in 1985. During the same time frame, the U.S.'s world share of lentil production fell from 5.2 percent to 2.8 percent, and Turkey surpassed India as the world leader in lentil production, increasing its world share of production from 18.8 percent in 1977 to 36.6 percent in 1985. Despite the relatively small share of the world market controlled by the United States, the lentil industry generated $26 million in gross sales in Washington and Idaho in 1986. Nearly all lentils are produced in a six-county area of Washington and Idaho; counties include Whitman and Spokane in Washington and Benewah, Kootenai, Latah and Nez Perce in Idaho.

Several important issues concern U.S. lentil producers. Prices for lentils are among the most variable of any field crop grown in Washington and Idaho. Also, most U.S. consumers are unaware of lentils and, as a result, consume very little. Thus, a high percentage of U.S. production must be exported, forcing producers to rely on the volatile export market. The price for lentil seed ranges from $14 to $32 per hundredweight.

Total lentil acreage has ranged from 70,000 to 250,000 acres during the period from 1976 to 1992. The United States produced 130,000 acres of lentils in 1992, about 9,000 of which were in North Dakota. Recently, lentil acreage in North Dakota has increased, while total acreage in the U.S. has remained relatively stable.

Economics

Lentils may represent a good opportunity for North Dakota farmers to diversify their farm income and crop rotations. Farmers who may be interested in producing lentils on their farm need to investigate profitability and cash flow of this alternative crop. Production coefficients used to develop the budgets are shown in Table 1, while the economic and cash flow budgets are shown in Table 2.

Lentil yields at crop experiment stations in North Dakota, averaged across varieties, have ranged from 404 to 2,765 pounds per acre. The yield used to calculate the example budgets was 1,000 pounds per acre. The contracted selling price was $14 per hundredweight. Lentils may be contracted with Continental Grain Company (see endnotes). Lentils were assumed to be transported 90 miles one way to be marketed. The seeding rate was 50 pounds per acre, although seeding rates will vary from 30 to 80 pounds per acre depending on seed size. Seed cost was assumed to be $27 per hundredweight.

The machinery complement for a typical farm in North Dakota would not need to be changed to accommodate lentil production. Therefore, machinery complements developed by the NDSU Extension Service were used to estimated machinery operating and ownership costs. Opportunity cost of equity capital was 5.5 percent while the interest rate on debt capital was 9.5 percent. The lentil operation was assumed to be financed with 34 percent debt capital.

Table 1. Production coefficients for producing dryland lentil in North Dakota, 1993.

Land value per acre	$292
Property tax per acre	$2.89
Seeding rate (lb/acre)	50
Phosphorus price per pound	$0.18
Yield per acre (lb)	1,000
Seed price per hundredweight	$27
Selling price per hundredweight	$14
Debt-to-asset ratio	.34
Interest rate on debt capital (%)	9.5
Interest rate of equity capital (%)	5.5

Table 2. Economic and cash flow budgets for lentil in North Dakota, 1993.

	Profitability $/acre	Cash Flow
Gross Return	$140.00	$140.00
Variable Costs		
Seed	$13.50	$13.50

Herbicide	11.40	11.40	
Fertilizer	1.56	1.56	
Fuel and lubrication	6.14	6.14	
Repairs	8.64	8.64	
Miscellaneous	2.60	2.60	
Operating interest	2.08	2.08	
Total Variable Costs	$45.92	$45.92	
Fixed Costs			
Miscellaneous overhead	$4.02	$2.13	
Machinery depreciation	16.06	xx.xx	
Machinery investment	7.98	16.24	
Land taxes	2.89	2.89	
Land ownership	22.77	9.67	
Total Fixed Costs	$53.72	$30.93	
Total Listed Costs	$99.64	$76.85	
Return over variable costs	$94.08	$94.08	
Return to owner labor and management	$40.36	xx.xx	
Cash flow (debt service, family living)		xx.xx	$63.15

The economic budget is generated by charging market rates for all resources needed for production. It helps answer the question "Is this enterprise profitable?" The bottom line represents a return to labor and management.

The cash flow budget is an estimate of the out-of-pocket cash needed to run the enterprise, including not only direct costs but indirect cash costs such as principle and interest payments, insurance and taxes. It helps answer the question "Can I meet my cash obligations if I go into this enterprise?" Total cash expenses are subtracted from total cash receipts to calculate the net cash which is available for family living and other needs.

For further information contact:

Continental Grain Company, C/O Joe Blooms, Box 188, Ray, North Dakota. Phone (800) 543-5561.

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North Dakota Dry Pea and Lentil Association. Michael Young, Secretary, HRC 1, Box 82, Roseglen, North Dakota 58775. Phone (701) 743-4255.

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