MONTGUIDE

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Oilseed Flax: A Montana Specialty Crop

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History and Use

Flax is harvested for two products, seed and fiber, with two different plant types to produce them. Fiber flax, used in the manufacture of linen, is not grown in the U.S.A. It is a tall plant with few branches, producing straw with long fibers and only a small amount of seed. Oilseed flax is a shorter and bushier plant, producing much more oilseed. The shorter fibers are of limited use. For the purposes of this Montguide, the term "flax" shall be used to refer to the oilseed type.

Flax seeds contain from 32 percent to 44 percent oil by dry weight, and are processed into linseed oil and cake. Linseed oil is valued in industry as a high-quality drying agent. The cake, left after oil extraction, is processed into livestock feed. It is a popular feed because it is palatable, high in protein (about 34 percent), and has a slight laxative effect.

Fiber from flax straw is used to make fine paper. In areas with a market, custom operators will pay to harvest the straw. There is no data indicating a market for flax straw in Montana. The straw can be fed to animals, but it is very high in fiber. There is a very great risk of prussic acid poisoning of livestock fed green straw or pastured on flax immediately after a freeze.

Cultural Considerations

Flax requires adequate moisture and relatively cool temperatures, particularly during the period from blooming to maturity. There should be at least 5 inches of plant-available moisture in the soil before seeding flax. Trials from 1976 to 1979 at Fort Benton showed a dryland yield of 890 pounds per acre, with 41.2 percent oil content, rooting depth of 5 feet, and soil water depletion of 7 inches. During these trials the average May through August precipitation was 7 inches. Any Montana cropland with similar conditions that is suitable for small grains should be suitable for flax. If drought and/or high temperatures occur during the 25 or so days when the seed is filling, yield will be diminished and oil content and quality will be lowered. Flax should not be planted in poorly drained land, and it is not very tolerant of salinity.

Flax is an annual plant. Seedflax grows to a height of 12 to 36 inches, with a main stem and numerous branches. Some of its characteristics favor using it as a companion crop with small seeded grasses and legumes. It is short, without extensive leaves, which allows sunlight to reach other seedlings. It is an early emerging and maturing crop. It does not have an extensive root system to compete with the other crop.

The flax flower has five petals. The seeds develop in five-celled bolls, which may contain up to 10 seeds. Varietal differences include bolls that range from tightly closed to those split open at the apex. The tighter bolls suffer less weather damage to ripe seeds and resist shattering better. Most popular varieties have semi-tight bolls.

Fertilizer

Fertility programs should be based on soil tests and yield goals. Testing labs should be able to provide recommendations for flax, or the data in Table 1 below may be used as a guide. Caution should be exercised to assure that the expected value of any yield increase exceeds the cost of the additional inputs designed to obtain it. Flax seed is susceptible to damage from being placed too closely with fertilizer.

Experienced local flax growers or the MSU Cooperative Extension Agronomist may be able to assist in estimating a reasonable yield goal. Variety trials at the Eastern Montana Agricultural Experiment Station indicate an average dryland yield of about 15 bushels per acre. (A bushel of flax weighs approximately 56 lbs.)

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During a cold wet spring, young flax may suffer iron deficiency and appear chlorotic (yellow). These symptoms will show up sporadically over the field and will disappear as the soil warms and dries. Zinc deficiency also leads to a chlorotic condition with dying of the growing tips of the plant, called "chlorotic dieback." It can be corrected with an application of zinc sulfate.

Table 1. Nitrogen, phosphate and potash recommendatons for flax in North Dakota. NDSU Soils Department.

Yield Goal-		P soil test levels (1 b/A)				K soil test levsl (1b/A)			
		L	M	H	VH	L	M	H	VH
Flax	No_3-N*	0-9	10-19	20-29	30+	0-99	100-199	200-299	300+
Bu/ acre	lb/ acre-2'	P_2O_5 lb/acre broadcast				K_2O lb/acre broadcast			
10	30	15	10	0	0	50	40	0	0
15	45	15	10	0	0	60	40	0	0
20	60	20	15	0	0	75	45	0	0
25	75	20	15	0	0	85	55	0	0
30	90	30	20	10	0	100	65	25	0
35	110	30	20	10	0	115	75	25	0
40	125	40	25	15	0	125	85	35	0
45	150	45	30	15	0	135	90	40	0
50	170	50	35	20	0	165	110	50	0

*Subtract amount of NO_3-N in top 2 feet of soil from these figures to determine the amount of N fertilzer to apply. These figures are for soil samples taken in the fall and early winter; for samples taken after the first of April add 10 to 20 lb. of N to these figures.

Seedbed and Planting

There are four interwoven aspects to be considered in preparing the seed bed; stubble management, conservation of moisture, weed control, and formation of a firm seedbed. In Montana, stubble is needed to help control erosion and hold snow. Working the seedbed with a harrow or packer immediately after spring cultivation can firm the seedbed and prevent some moisture loss. In loose soil, firm it by packing or harrowing before planting. No-till drilling is reported to work well.

Flax should be planted 3/4 to 1-1/2 inches deep in 6 to 7 inch rows. A press drill will press moist soil around the seed and promote prompt and even germination. If the drill does not have a press attachment, the soil should be roller packed immediately after sowing.

Flax seeds vary in size and weight, but for average seeds the dryland seeding rate ranges between 20 and 30 pounds per acre.

Flax germinates at a lower soil temperature than many troublesome weeds. Early planting in a firm seedbed can give it a head start on weeds. Tests in Minnesota and the Dakotas attained the best stands and yields by sowing flax early. The Minnesota tests indicated that delays of 10, 20 and 30 days after the first practical sowing date resulted in yield losses of 22 percent, 23 percent, and 47 percent respectively. This was attributed to the incidence of hot dry weather during the time from flowering to seed maturity.

Varieties

Variety selection can be crucial, particularly when sowing late. Earlier maturing varieties seem to be more consistent in the time required to mature, regardless of sowing date. Later maturing varieties seem to require progressively longer times to mature with delays in sowing. The Eastern Montana Agricultural Experiment Station also reports that yield differences between varieties tend to be small, but that there are significant differences in time to maturity and disease resistance, as well as in oil content and quality.

Montana State University does not currently make variety recommendations for flax. The Eastern Montana Agricultural Research Center at Sidney reports that Linott, Wishek, Flor, and Dufferin have performed well in dryland tests. The Central Montana Research Center at Moccasin obtained good results with Linott on fallow test sites in Conrad, Power, and Sunburst, while Culbert did better on recrop at Conrad. The Extension Agronomist can help obtain further information on variety trials.

Weather

The concern over hot weather during the time between blooming and seed maturity has been described. With early seeding, there is also the potential for frost damage. Light frost can injure seedlings, particularly the younger ones. However, even the youngest may withstand frost injury if they have otherwise good conditions, such as sufficient moisture and no drying wind. After seedlings grow 2 or 3 inches and harden by exposure, they can survive temperatures as low as 25°F for brief periods.

Flax is extremely susceptible to cold during the time from flowering through early boll stages. The immature seeds can be killed without apparent damage to the stems and leaves. Again, the extent of this loss will depend on factors other than the low temperature, factors such as plant condition, available moisture, and the weather before and after the freeze.

Pests

Clean, uninjured, disease-free seed is a major factor in assuring a good stand with few problems. Seed treatment has been shown very effective in improving stands and yield; it has reportedly even reduced some of the losses that might otherwise occur when planting damaged seed. Fungicides offer protection against seed- and soil-borne diseases. Treat with insecticide in areas where wire worms are a problem.

Flax is not a good weed competitor. It has a small root structure and does not shade out weeds very well. A field must be relatively weed-free to obtain optimum yields. Perennial weeds might persist at maximum approved application rates of some herbicides, and require control elsewhere in the rotation. Check a recent weed control guide or contact the Extension Weed Specialist for current information.

There are big differences in resistance to diseases among flax varieties, which is an important consideration in choosing a variety to plant. The most prevalent diseases attacking flax are wilt, rust, aster yellows, and pasmo. Less common are anthracnose, stem break (browning), damping off, seedling blight, curly top, and boll blight. Further information on any disease problems can be obtained from the Plant Disease Clinic, Dept. of Plant Pathology, Montana State University, Bozeman.

Heat canker is not a disease, but rather stem tissue damage caused by high temperature at the soil surface. If this occurs with young plants, stems may become constricted causing the plants to fall over and die. With older plants it results in brittle stems which may break in the wind. Early sowing, sufficiently high seeding rates, and surface mulch are effective control measures.

There is a potential for insect damage and fields should be routinely inspected so that timely control can be implemented. Insects are more active in hot, dry weather and early seeding is an important defense. The more important pests are armyworms, cutworms, aster leafhopper, lygus bugs, grasshoppers, and the beet webworm. Care should be taken to protect beneficial insects. Producers should consider the full range of possible control measures (cultural and chemical) for all pests, weeds, insects or disease. Information on currently recommended control measures is available from the MSU Extension Office of Integrated Crop and Pest Management (ICPM).

Harvesting

Maturity of flax should be gauged by the color of the bolls. The plant may continue to bloom and produce seed for an extended time, but seeds from late flowers seldom mature. Flax should be combined when 90 percent of the bolls have turned brown. Delay increases the risk of weather, disease or insect losses, and allows weeds to grow, becoming more of a problem.

Direct combining reduces expense and is satisfactory when the crop is uniform, dry and weed-free. However, a more uniform ripening can be obtained by swathing. It is possible to cut it a few days earlier than direct combining without yield loss. The swathed windrows should be ready to combine after a couple days of dry weather. Swath rollers can reduce the risk of wind damage to the windrows.

Manufacturer's recommendations should be consulted when adjusting swathers and combines. Flax seedcoats are easily damaged, which reduces germination. Some combines have special angle bars or other devices to reduce this problem. Peripheral cylinder speed should be 5,000 to 6,000 fpm. Concave cylinder clearance should be adjusted to the widest spacing that will remove seed from the bolls. Cylinder speed may be reduced if the seed is very dry. Flax rolls, one of steel and one of rubber, mounted ahead of the cylinder will help fracture tight bolls.

For storage, flax seeds should contain no more than 10.5 percent moisture.

Table 2. Oilseed Flax
Varieties with Good Oil Quality

Variety	Origin	Year Released	Relative Maturity	Plant Height	Resistance to disease* Wilt	Rust	Relative yield Ability	Oil Yield
Linott	ND	1985	early	med.	R	R	v.good	med.
McGregor	Can.	1980	late	tall	R	R	v.good	good
Dufferin	Can.	1975	late	tall	R	R	v.good	good
Wishek	ND	1979	early	med.	MS	R	good	good
Culbert 79	SD	1979	early	med.	MR	R	good	good
Flor	ND	1981	early	med.	MS	R	v.good	good
Foster	ND	1969	late	short	MR	R	fair	v.good
NorLin	Can.	1982	early	med.	MS	R	v.good	good
Clark	SD	1983	early	med.	MR	R	v.good	good
NorMan	Can.	1984	mid	med.	MR	R	good	good
Rahab	SD	1984	mid	med.	MR	R	good	good
Vimy	Can.	1985	early	med.	MR	R	good	good
Verne	MN	1987	early	med.	R	R	v.good	good

*R = resistant, MR = moderately resistant, MS = moderately susceptible

Marketing

Not much flax has been grown in Montana in recent years and, as a result, markets are liable to be thin. Extension Bulletin #41, "Montana Specialty Crop Dealer Resource List," reports the results of a survey to find grain dealers willing to handle the crop or supply the seed. Most flax seed will be transported to other areas for processing, and this cost will be reflected in prices.

Those producers not in a financial position to accept substantial price risk should consider producing flax only under contract from a reputable organization. Anyone entering a contract should read and understand every detail before signing, and legal assistance is advised with any new contract or terms. Following is a list of some points that need to be included in a contract:

A. Identities: names of all parties to the contract and their contractual positions
B. Variety requirements: variety, quality or source of the seed and, if supplied by a contractor, the seed's price, treatment and delivery
C. Fields: acreage and location of the field
D. Cultivation: special requirements such as the use of organic methods
E. Price, quality, and quantity: minimum quality and quantity, method of grading, time and location for grading, price adjustments for quality or quantity, and provisions for crop failure (if the grower is liable in case of failure, insurance is recommended)
F. Payments: time and method of payment
G. Delivery: location, shipping and handling expenses

Farm Program

Producers and others considering investment in a specialty crop need to be aware of the ramifications of the farm program provisions upon non-program crops. Most specialty crops are grown on cropland that, under program requirements, cannot be planted to wheat, barley, oats or other program crops. The 1985 Food Security Act (farm bill) initiated a series of changes aimed at reducing the government's role in stabilizing commodity prices and farm incomes. As these and future changes take place, the relative attractiveness of various crops can change, possibly leading to large fluctuations in supply with significant price effects. These uncertainties increase market risk for all substitutable crops, and investors should consider any investment only if the anticipated returns are sufficient to compensate for all risks involved.

References

This material closely follows information published in Northcentral Regional Extension Publication #167, "Growing Seed Flax in the North Central States." For other references for this or other specialty crops see "Specialty Crop Bibliography," Montana State University Extension Service Bulletin #42.

Suggested Partial Budget for Dryland Flax (Recrop)

The following budget is for illustrative purposes only. The Montana Cooperative Extension Service Bulletin #1329, "Costs of Owning and Operating Farm Machinery in Montana for Profitability Considerations; 1984," was used in its preparation. These estimates do not represent actual costs or returns. They are simply averages and should be used only as a guide for individual estimating. Each operator should plan production strategies step-by-step and estimate costs and returns based on individual yield goals, and current cost and price information. Those wanting guidance in enterprise budgeting should consult the Montana Cooperative Extension Service manual, "Enerprise Budgeting: Crop Production," by James B. Johnson and Alan E. Baquet (available summer 1989).

Table 3. Illustrative Budget

Item Description	Cost/Acre		
	Machine Operating Costs	Input Costs	Sum of Costs
Field Operations			
Soil test		.20	.20
Fertilizer 20 lb N @ $0.22	.85	4.40	5.25
Chisel Plow	2.20		2.20
Herbicide & Sprayer	.45	7.00	7.45
Harrow Packer & Drilling	4.45		4.45
Treated Seed 25 lb @ $0.30		7.50	7.50
Swather	2.15		2.15
Combine & Truck	8.40		8.40
Hired Labor (if used)	---		---
Direct Production Costs	18.50	19.10	37.60
Interest on on production costs (14%/yr/8mo)		3.40	3.40
Equipment ownership costs			
Depreciation (by hours of use)*		13.15	
Other ownership costs (not by usage)		3.80	16.95
Total Production Costs			57.95
Returns per Acre			
Gross value of crop 15 bu @ $5.00/bu			75.00
Returns to land, risk, management, labor, and other factors not specifically included above			17.05

*Real depreciation, assuming that equipment will be used at a constant rate throughout its economic life.

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FILE UNDER: FIELD CROPS
D8 (Alternate and Misc. Crops)