

Flax Production Guidelines for Iowa

Overview

Growing flax for grain is much like growing oats, barley or spring wheat. Flax is planted early in the spring and is harvested in mid summer. Although most oilseed flax (*Linum usitatissimum* L.) in North America is grown in Canada and North Dakota, flax was fairly commonly grown in Iowa in the late 1800s and early 1900s. Flax production declined in the state after World War II and almost none was grown after 1960. In 2005, however, approximately 1,000 A of flax was planted in Iowa.

Crop Rotation

It is not clear where flax fits best in crop rotations. Organic growers in North Dakota often plant flax following alfalfa, both for the N contribution from the legume and because weed pressure is the lightest in that year. In 2005 on a demonstration site in southeastern Iowa, flax was grown following three previous crops: barley with a red clover underseeding, soybeans and corn. Flax grain yield was highest following barley and lowest following corn. Conversely, a commercial farm documented higher yields when flax followed corn compared with following soybeans. Research is needed to answer this question for flax rotation options in Iowa.

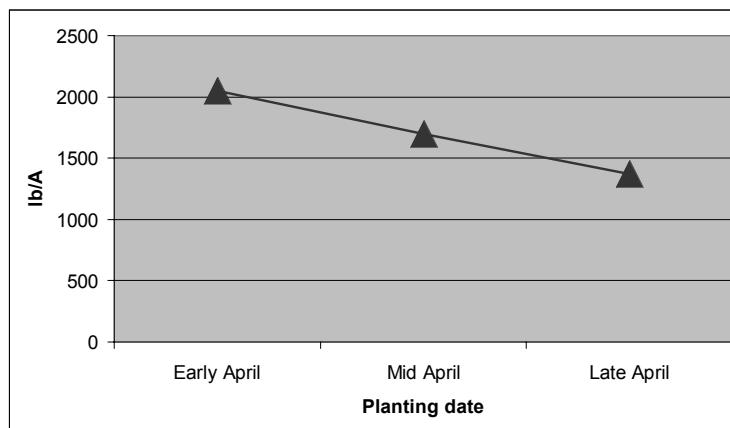
Flax fields should be rotated to other crops to aid in weed, disease and insect management. Flax should not be grown in the same field more than once every three or four years.

Planting

Plant flax as early in the spring as possible. Based on frost survival in the spring of 2005, it appears that flax is as cold tolerant as oats. Research was conducted at two Iowa sites in 2005 to evaluate the effects of planting date on flax grain and oil yield. Flax grain yield was highest with early planting (Figure 1). Grain yield was reduced an average 34 lbs/A for each day that flax planting was delayed. Oil content of the flaxseed averaged 41.9% and was not affected by planting date.

Complete flax planting by March 20 in southern Iowa and by April 1 in northern Iowa.

Figure 1. Flax grain yield response to planting date averaged over two Iowa locations in 2005.



Soil Preparation

Plant either conventional or no-till. If planting too deep following conventional tillage, you may need to cultipack before drilling.

Planting Depth

Plant flax seed shallow, from 1/2 inch to no deeper than 1 inch. Drilling is preferred to maintain uniform seeding depth. Cultipacking after drilling improves seed-to-soil contact, although this may be more important for a companion seeding than for the flax. Some organic growers suggest that cultipacking is not necessary and gives small-seeded weeds a head start on the flax.

Seeding Rate

Drill 50 pounds of flax per acre. Some growers have speculated that higher seeding rates may better help suppress early weed growth in organic production systems. Research in northwestern Iowa in 2005, however, showed no signifi-

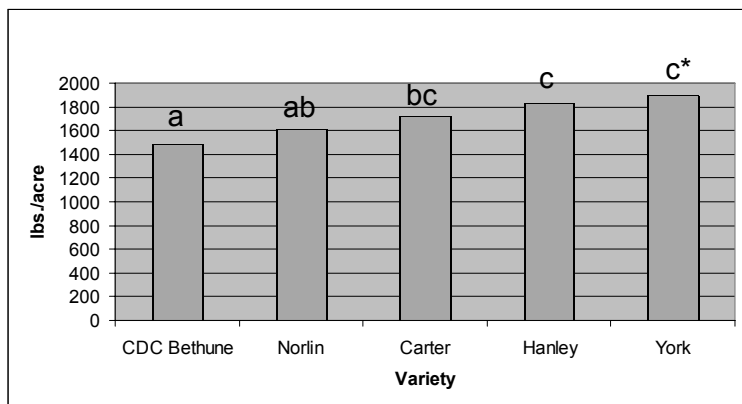
Flax Production Guidelines for Iowa

cant difference in flax grain yield with seeding rates ranging from 25 to 75 lbs/A. Flax in this study was drill planted, without herbicide, and in a field with low weed pressure. Broadcast seeding is not recommended, due to inconsistent seeding depth. However, if broadcast seeding flax is the only option, increase the seeding rate to 55 to 60 lb/A.

Cultivars

Flax cultivars differ in grain yield potential. Five flax cultivars were evaluated at two sites in Iowa in 2005. Four brown seeded cultivars were: 'Norlin', 'Hanley', 'CDC Bethune', and 'York'. 'Carter', a golden-seeded cultivar was also included. Grain yields were similar at two locations. Hanley and York had highest yields; Norlin and CDC Bethune had the lowest yields of the cultivars grown (Figure 2). Oil content of the flaxseed averaged 41.9 % and was not different among the cultivars.

Figure 2. Flax grain yield for five cultivars averaged over two Iowa locations in 2005.



*Flax cultivar yields with the same letter are not statistically different.

Plant brown-seeded cultivars for the oilseed and feed markets. Desirable cultivars for organic oilseed contracts for 2006 are 'Norlin' and 'CDC Bethune'. Golden-seeded flax varieties are typically used in the food market. Check with your projected market for cultivar suggestions and about seed supply. Seed is also available from Albert Lea Seedhouse in Albert Lea, MN (telephone: 800-352-5247).

Row Spacing

Narrow rows planted with a grain drill---7-inch spacing or less---are best to achieve early shading of the soil surface. Cross planting, where seed is split between two drill passes made at a 30 to 45 degree angle to each other, has been suggested to improve shading of the soil surface, especially important in organic production systems. Field trials in 2004 in two years and at two locations showed no yield advantage to cross planting (Table 1). Broadcast seeding resulted in lower grain yields near Ames in 2005.

Table 1. Flax grain yields with three planting patterns for three site-years in Iowa.

Flax Planting Pattern	Year and Location		
	2004 Northwest ISU Research Farm	2005 Northwest ISU Research Farm	2005 Ames ISU Research Farm
Drilled, straight rows	1865a	1709a	1478a
Cross planted (diamond pattern)	1828a	1613a	1394a
Broadcast	---	1618a	907b
	NS*	NS	

*Numbers in a column followed by the same letter are not statistically different.

Fertility

Flax requires moderate levels of N to maximize yields, similar to spring oats. The University of Minnesota has developed N recommendations for flax based on yield goal, soil nitrate test results, previous crop history and soil organic matter levels that range from 0 to 100 lb N/A. In central Iowa in 2005, 50 lbs of N fertilizer/A resulted in a significant yield increase of 463 lbs of flax grain/A. With limited information in Iowa for flax response to N, the recommendation of 50 to 75 lbs. N/acre for flax is an estimate. This will vary with previous crop and soil organic matter levels.

The University of Minnesota also provides P and K recommendations for flax based on soil test levels (Table 2.)

Value Added Agriculture Program

Table 2. University of Minnesota P and K recommendations for oilseed flax*.

Phosphorus Recommendations		Potassium Recommendations	
<u>P Soil test</u>	<u>P₂O₅ to apply</u>	<u>K soil test</u>	<u>K₂O to apply</u>
---ppm---	---lb/A---	---ppm---	---lb/A---
0-5	40	0-50	80
6-10	30	51-100	40
11-15	20	101-150	20
16+	0	151+	0

*adapted from AG-BU-0519, Soil Test Recommendations for Field Crops in Minnesota

For organic production, plow down a legume or apply manure. Field research in southwestern Iowa in 2005 showed a significant yield increase of 250 lbs of flaxseed /A when 4 T/A of composted swine manure with an analysis of 18+36+39 lb/T was applied to the flax in an organic rotation.

Weed Management

Flax is not as competitive with weeds as are oats, barley, or spring wheat.

Conventional Production

A companion underseeding may help suppress weeds in flax.

Hay seeding or a legume cover crop can both be seeded with flax. Where an underseeding will not be planted, several herbicides are labeled for use. Treflan may be applied preplant, but is recommended only for fall application. Flax will be damaged by spring applications of Treflan. Options for postemergent weed control include Buctril, Curtail M, and MCPA for broadleaves and Poast, Select, and Prism for grassy weeds. In 2005 at the Ames research site, MCPA stunted flax growth for a short period, but grain yield was not reduced. Additional information from University of Minnesota is at <http://appliedweeds.coafes.umn.edu>.

Organic Production

For organic production, place flax in the crop rotation where weed pressure is low. Preplant tillage; previous cover crop; and a small-seeded, close-growing companion seeding will aid in weed management. For example, fall-planted rye

cover tilled the following spring before flax planting may help suppress weeds. Forage legume and legume/grass mixtures offer the best underseeding options. Several underseeding and planting options for weed suppression were evaluated in 2005 in northwestern and central Iowa, and on four commercial farms. None of the underseedings affected flax grain yield (Table 3). The underseedings did not have an effect on weed weight up to the time that flax was harvested in late July and early August. But 60 days following harvest, both the red clover and alfalfa had a positive effect of suppressing weed growth (Table 4).

Table 3. Underseeding effects on Flax Grain Yield, 2005.

<u>Underseeding Treatment</u>	<u>Average for Two ISU Research Farms</u>	<u>Average of Four Commercial Farms*</u>
	-----lb/A-----	-----lb/A-----
No underseeding	1593a	1681a
Alfalfa	1574a	1609a
Red Clover	1469a	1531a
Grass/legume hay seeding	1535a	-----
	NS#	NS

*Farms were near Sutherland, Harlan, Hampton and Mt. Pleasant, IA
Numbers in a column followed by the same letter are not statistically different.

Table 4. Underseeding effects on Weed Biomass, 2005.

<u>Underseeding Treatment</u>	<u>Harvest Time and Location</u>		
	<u>At Flax Harvest Average for Two ISU Research Farms</u>	<u>At Flax Harvest Average of Four Commercial Farms*</u>	<u>60 Days After Harvest Average of Two Commercial Farms**</u>
	-----lb/A-----	-----lb/A-----	-----lb/A-----
No underseeding	670a	1884a	1183a
Alfalfa	789a	1445a	697b
Red Clover	962a	1665a	200b
Grass/legume hay seeding	777a	-----	-----
	NS#	NS	

* Farms were near Sutherland, Harlan, Hampton and Mt Pleasant, IA
** Farms were near Sutherland and Hampton, IA
Numbers in a column followed by the same letter are not statistically different.

Insects/Diseases

In 2005, a few diseased plants were notice in several flax fields. Powdery mildew (*Oidium lini*) and rhizoctonia (*Rhizoctonia solani*) were identified. The flax cultivar 'Norlin'

expressed the greatest incidence of disease. No insect pests were observed in Iowa in 2004 or 2005.

Harvest

Timing

Harvest when 90-95% of the seed bolls are tan to brown. At this time, some of the stems will still be green.

Equipment

Windrow the crop before combining. Producers report that draper-type windrowers work the best with flax. Attempts to windrow flax with sickle bar mowers, rotary disc mowers and mower-conditioners were unsuccessful in 2005. Flax stems are tough and wiry, so use new sickles or newly sharpened blades on the windrower. Growers had success with a variety of types of knives (both smooth and serrated) and configurations (serrations facing upward, serrations facing downward, and knives alternating with upward and downward facing serrations). The key factor in cutting success appeared to be the sharpness of blades. Cut 8 to 10 inches above the soil surface, higher than is typical for small grains, to allow for good air movement within the windrow and facilitate drying. Flax stems wrapping on the windrower reel presented a problem for some growers. Pitching the reel teeth forward as much as possible and covering the reels with drainage tile sections helped in some instances.

The windrow is easiest to harvest with a pickup attachment on your combine. Some growers have managed to pick up the windrow with their platform head, but this was less successful.

Combine settings will vary with make and model of equipment. Generally, the cylinder or rotor should run as fast as for oats, 900-1200 rpm, and the concave adjusted as tightly as possible, with 1/8" to 1/4" clearance. Plates covering the front portion of the concave may help with threshing. Some

growers have purchased these and others have manufactured them at home. Check with your combine manufacturer about availability of these plates. Because the flax seeds are small and dense, the separator openings should also be small and the fan set at 500+ rpm. Some growers operated with fan speeds up to 1000 rpm. Experimentation will be required with your combine to fine-tune these settings. Combines, wagons, bins, etc. will need to be free of holes and cracks to contain the small, slippery seeds.

Grain Moisture

Most buyers prefer flax delivered at 7.5 to 8.5% moisture. Check with your market for specifications for delivery. In 2005, flax ranged from 7.8 to 9.2 % moisture coming from the field and did not require supplemental drying. You should, however, be prepared to use a screw-in type aerator for flax in wagons or bins immediately following harvest.

Storage

North Dakota Extension recommends storage at 11% moisture or below.

Caution

Do NOT stand on stored flax; you may sink and suffocate.

Other Production Resources

North Dakota State University Extension (Publication A-1038) <http://www.ext.nodak.edu> Tel: 701-231-7882

Thomas Jefferson Agricultural Institute
<http://www.jeffersoninstitute.org>
Tel: 573-449-3518

IOWA STATE UNIVERSITY
University Extension

Publication prepared by:

Margaret Smith, Extension Program Specialist in Value Added / Sustainable Agriculture
Sarah Carlson, Iowa State University graduate student in Agronomy and Sustainable Agriculture

Additional contributors include:

Paul Mugege, Doug Alert, Ron Rosmann, and John Veith, Practical Farmers of Iowa research cooperators; Iowa flax growers in the Flax Working Group, part of the Value Chain Partnerships program of Practical Farmers of Iowa and the Leopold Center for Sustainable Agriculture; Mary Wiedenhoef, Associate Professor of Agronomy; Kathleen Delate, Associate Professor of Horticulture and Agronomy; Dave Haden, station manager, Iowa State University Northwest Research Station, Sutherland; Daniel Rosmann, 2005 agronomy student intern.

... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture.
Jack Payne, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.