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Keys to Profitable Flax Production in Texas

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Flax was first grown commercially in Texas in 1938, and production peaked in 1949 with 330,000 acres. The first flax varieties grown in Texas were introduced from Canada and the northern United States. These early varieties were not winter hardy, so most of the flax industry developed in South Texas. From the 1940s through the 1960s the major flax-growing counties were Karnes, Jim Wells, Bee, Wilson, Atascosa, Live Oak and Nueces. As more cold-tolerant varieties were developed, the acreage spread into the southern Blackland Prairie counties.

Flax production never rebounded after the droughts of the 1950s, and as many of the industrial uses of flaxseed oil were replaced by cheaper petroleum-based products, flax acreage dwindled. Very little flax has been produced in Texas for the last 40 years.

Today, however, there is renewed interest in oil-seed crops such as flax because of their potential use as bio-fuels, as replacements for petroleum products, and for human consumption.

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Fig. 1. Flax at early bloom growth stage (photo by Blair Fannin).

Uses of Flax

Flax seed normally yields 36 to 41 percent oil based on dry weight. Linseed oil (flaxseed oil) can be used in many products, including paint, varnish, linoleum, oilcloth, printer's ink, patent and imitation leather products, and many others. Linseed oil also was used on concrete pavement and bridges as a protective seal against freeze-thaw damage and the deterioration caused by de-icing salts. Although linseed oil was replaced by petroleum products in many industrial uses, the current instability of petroleum prices and the push for "green" fuels and chemicals has renewed interest in adapted crops such as flax.

There is also an emerging market for flaxseed (a source of omega-3 oil and anti-carcinogenic lignin) for human consumption. Flax oil can be consumed as whole seed, in bakery products, or as a concentrated pill. Flax meal, also called linseed meal, is a high-quality livestock feed that can be used as a protein supplement. It contains approximately 35 percent protein and 3 percent oil. Eggs from chickens fed flaxseed are currently being marketed as "omega eggs" for their high omega-3 oil content.

Fiber flax is grown in Europe and Asia to make fine linen cloth. Fiber flax varieties are very tall, have few branches, and produce little seed. The fiber in flax stems is used to make fine papers, including cigarette paper, and padding for upholstered furniture. For all practical purposes, the flax varieties in North America are grown for their seed value, oil and meal.

Flax Production

Cropping Sequence

In South and Central Texas, flax is sown in the fall and fits well in a rotation with cotton, corn or grain sorghum. When moisture is sufficient, a 1-year rotation of flax and a summer legume may be used. Crop rotation helps control plant diseases and weeds. Flax should not be planted continuously because some diseases, such as Pasmo, are carried over in the crop residue.

Soil and Climatic Conditions

Flax should be planted on the same type of land as wheat or oats, where good soil drainage is very important. Flax is adapted to most soil types, but especially to deep, fertile, loam soils. In South Texas, flax production was concentrated on soils varying from fine sandy loams to sandy clay loams, but it has also been grown successfully on the heavy clay soils of the Coastal Prairie.

Because flax has not been grown in Texas for a long time, the only seed currently available is for spring-type flax varieties from the northern U.S. and Canada. Although frost seldom kills flax seedlings, it may injure them. Seedlings plants just emerging can withstand temperatures down to 28 degrees F for a few hours. After seedlings have a second leaf, they can withstand temperatures in the low 20s.

During the 1950-60s, Texas A&M University released several cold-tolerant varieties adapted to South Texas and Central Texas as far north as Waco. These varieties could be increased relatively quickly if demand for them develops.

Seedbed Preparation

Seedbed preparation for flax is similar to that for small grains. Harvest the previous crop as early as possible. Shred and incorporate the crop residue. Do any necessary deep plowing early in the summer. Preparing the seedbed early increases the possibility of having adequate moisture for planting and crop establishment. A burn-down herbicide application before planting will minimize early-season weed problems. Preplant or pre-emergent herbicides may also be applied at this time. See the Weed Control section for herbicides labeled for flax production. The seedbed should be firm and free of weeds and excess residue.

Seeding Rate

The rate of seeding per acre varies with the size of seed, germination and row width. The seeding rate for large-seeded varieties with good germination should be 25 to 45 pounds per acre when using a grain drill. The smaller seeded varieties can be planted at a lower seeding rate. Seed should be clean and treated with an approved fungicide.

Time of seeding

Sow flax early enough that the plants will become well established before freezing temperatures occur. After plants have branched at the crown, cold-hardy varieties can withstand much lower temperatures without serious injury. Avoid sowing flax too early in the fall, or late spring frosts may damage the crop at the bloom stage. In South Texas, when moisture conditions permit, plant between November 10 and December 10. In this area, flax seeded after January 1 usually produced lower yields than December seedings. If moisture is available, October 15 to October 30 is an ideal time for planting flax in the Temple area. See Fig. 2 for an example of the effect of planting date on flowering date.

Fig. 2. Impact of planting date on flax flowering and maturation. Planting dates of Nov. 8, Nov. 30, Dec. 4, Dec. 18, Jan. 3, Jan. 18, Jan. 30 and Feb. 15 from right to left. Picture taken on April 4, 2008 in College Station.

Method of Planting

Flax should be planted with a grain drill into a level, firm seedbed free of excess crop residue and clods. A relatively shallow planting depth is recommended, but the depth depends somewhat on soil texture and moisture conditions. In fine-textured soils of good tilth, ¾ to 1 ¼ inches usually is deep enough. On lighter soils, a depth of 1 to 1 ½ inches may be necessary. Using a culti-packer or drill with press wheel attachments promotes rapid germination and good stands.

If rainfall is normal, planting flax at a 7- or 8-inch drill spacing generally results in the highest yields. In dry years or on weed-infested soils, flax may be planted in 28- to 38-inch rows. Planting on wide rows makes it possible to control weeds by cultivation.

Fertilizers

The way flax responds to fertilizer applications depends on moisture conditions, the previous crop, and the fertility status of the soil. Experimental data generally show that fertilizer applications are profitable with good management and favorable moisture.

When large amounts of low-nitrogen residue, such as grain sorghum stubble, are returned to the soil before planting flax, apply 3 pounds of nitrogen per expected bushel of yield. However, the nitrogen rate should not exceed 80 pounds per acre. This fertilizer recommendation is based on information from North Dakota State University publication A-1038. Further research is needed to identify the best nitrogen rates for flax in Texas. A split fertilizer application may be made if moisture is limited at planting. Splitting the nitrogen application may also reduce freeze damage due to early, lush growth. When the fertilizer application is split, apply all the phosphorus and 15 to 20 pounds of the nitrogen before or at planting; topdress the remainder of the nitrogen before blooming if moisture is adequate. Flax is very efficient at extracting phosphorus from the soil. Research in North Dakota showed that flax has very little response to phosphorus applications unless the soil is low to very low in phosphorus. The best guide for fertilizer application is always a soil analysis. Refer to the soil analysis for recommendations on other nutrients the soil may require.

Zinc deficiency can limit flax yield. Symptoms may include stunting, yellowing out, and terminal die-back. If these symptoms are widespread, an application of 15 pounds of zinc sulfate per acre should suffice to maintain yield. Chelated or other zinc material can be used at equivalent rates. Zinc also may be applied as a foliar spray. Apply 15 to 30 gallons per acre of one-fourth to one-half percent solution (made by putting 1 to 2 pounds of zinc sulfate in 50 gallons of water) to minimize chances of leaf burn. Excessive amounts of phosphorus may induce zinc deficiencies. A soil test is useful in keeping the soil phosphorus level within allowable limits.

Weed Control

Weeds can be troublesome in flax because of the limited number of herbicides available. Henbit, clover, mustard, wild carrot and several grasses are the important winter weeds that reduce flax seedling growth and development. Summer weeds such as sunflower, lambsquarter and Johnsongrass may compete with flax late in the season and also interfere with harvest.

Labeled herbicides include bromoxynil, Curtail M, MCPA, and trifluralin for broadleaf weeds. Poast and Select herbicides are labeled for managing many grass weeds in flax. See the labels for rates and application timings.

Insects

Insects have not been a real problem in Texas flax production, except as the carrier of curly top disease. Armyworms and cotton bollworms sometimes damage late-sown fields by eating the flowers and green bolls. False chinch bugs occasionally migrate from adjoining fields after blooming and suck the juice from developing seeds. In a few instances, white grubs have been observed in damaging numbers. If the populations of these insects increase to damaging size, effective insecticides are available.

Diseases

The important diseases of flax in Texas were identified by plant pathologists during the years of highest production, from the 1940s through the 1960s. In recent years, small-scale plantings of flax in different parts of Texas have been relatively free of disease. Increasing the scale of production will eventually lead to economically damaging levels of disease. Although there are at least a dozen infectious diseases of flax reported world-wide, only a few pathogens pose serious risks to production in Texas.

Pasmo – a fungus, *Septoria linicola.* This disease can cause substantial leaf damage in a matter of days (Fig. 3). It starts as circular, yellow to brown spots on the cotyledons and lower leaves. Stems later become infected, starting at the point of attachment to the leaf.

Brown bands on stems alternate with non-infected, green tissue. These bands combine as the infected plant ripens prematurely. The disease causes defoliation, damages fibers, reduces seed size and yield, and reduces the quantity and quality of the oil. Bolls may fall off and plants are prone to lodging. Wet weather late in the growing season increases the disease's severity. The fungus survives on residue from the crop.

Control: Rotate crops and plow under crop residue. Some varieties are more tolerant to the disease than others.

Fig. 3. Pasmo symptom: brown bands on stems alternating with green bands.

Damping-off and seedling disease – various fungi, *Rhizoctonia solani, Pythium* sp., *Fusarium* sp. This disease can occur in patches in the field. Plants are killed before or after emergence. Seedlings turn yellow, wilt and die. Roots are rotted. Historically, stand losses in South Texas have ranged from 10 percent to 50 percent. Cracked seeds are more likely to become infected (Fig. 4). The disease is more severe when weather conditions are cool and wet.

Control: Use high-quality seed treated with fungicides. Do not plant seed any deeper than necessary and provide a firm seedbed

Fig. 4. Cracked seeds are more prone to infection by fungi.

Rust – a fungus, *Melampsora lini.* Yellow pustules are produced on all plant parts above ground (Fig. 5). Plants lose their leaves and the yield and quality of seed and fiber are reduced. The disease is more severe with rainy weather. Later in the season, pustules turn black, which signals the production of spores that can overwinter on crop residue.

Control: Use resistant varieties. Do not follow flax with flax. Plow under crop residue. Use clean seed that is free of crop residue.

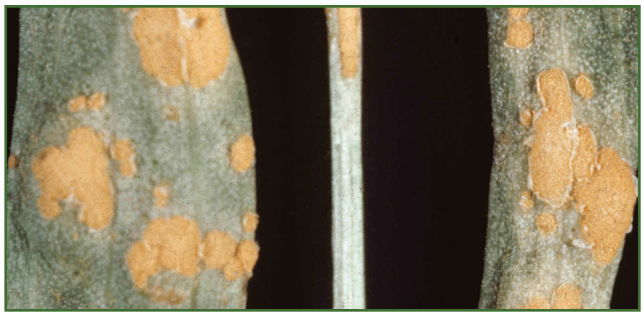

Fig. 5. Rust symptoms on leaves and a stem.

Curly top – a virus. Plants infected as seedlings have distorted, wavy leaves that are bunched at the growing point (Fig. 6). The plant yellows and dies. Older plants that become infected also have distorted leaves. In addition, the tip of the stem is coiled and branches grow laterally rather than upright. The flowers are small or the buds do not open. Petals are twisted and puckered. The number of tillers is reduced, as is the seed set. Curly top was especially prevalent in South Texas during the drought of the 1950s, possibly because conditions favored the beet leafhopper, *Circulifer tenellus.* Curly top has also been a problem with early planting dates, which may be associated with greater leafhopper activity.

Control: Caldwell, a variety developed in Texas, may have some tolerance to this disease.

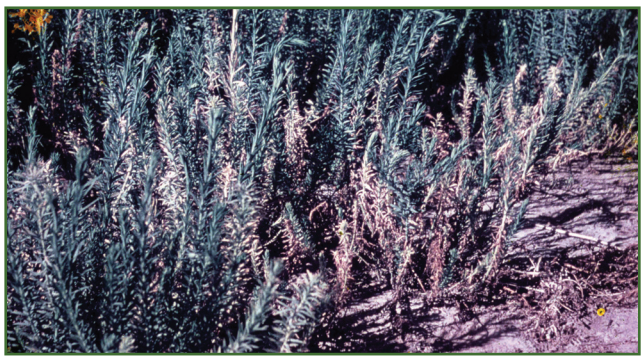

Fig. 6. Appearance of curly top.

Aster yellows – a phytoplasma. The apical leaves of stems turn yellow. Secondary shoots grow from axils of leaves (Fig. 7). There is a proliferation and greening of flowers, but the petals are small or absent. Bolls fail to develop. Plants may occasionally be partially infected, with normal looking branches that produce normal bolls. Severe epidemics have reduced seed yield by two-thirds. This pathogen is vectored by the aster leafhopper, which is also known as the six-spotted leafhopper (*Macrosteles quadrilineatus*). The pathogen and vector have a wide host range.

Control: There are no resistant varieties.

Fig. 7. Plants with aster yellows.

Cotton root rot – a fungus, *Phymatotrichopsis omnivora*. Flax is susceptible to infection, but because it is usually grown during the cooler part of the year, it usually escapes the disease.

Recommended Varieties

Flax is a self-pollinated crop, and the seed is produced in a boll or capsule. A complete boll can have ten seeds, although the average is about six. Seeds can be brown, golden or yellow (Fig. 8). Yellow-seeded varieties are more susceptible to seed decay and seed damage because of their thinner seed coat. For this reason, yellow-seeded varieties usually have less seedling vigor. Most flax varieties have blue flowers, though some have white flowers.

Fig. 8. Brown-seeded (left) and yellow-seeded flaxseed (center and right) (photo by Daniel Hathcoat).

Very little information is currently available on variety selection for South Texas. A wide range of maturities is available. Variety trials are underway at numerous locations in South and Central Texas to identify the best adapted and highest yielding varieties. Once multiple years of data are collected, the results will be available at *http://varietytesting.tamu.edu/*

Harvesting

Begin harvesting flax only when the bolls and upper plant parts have turned brown and the straw is yellow (Fig. 9). Flax can be harvested safely at moisture levels up to 18 percent, but seed with more than 8 percent moisture must be dried before storage. Harvesting flax at a high moisture content, while some bolls and plants are immature, can result in dockage at the selling point.

Fig. 9. Flax at harvest time (photo by Blair Fannin).

Harvesting can be done with a regular grain combine when the crop is mature, or by windrowing and later using a pick-up attachment. Harvesting should be done promptly, as flaxseed is easily damaged by wet weather. The seed is covered with a mucilaginous coating that becomes sticky when wet. During a wet harvest, this coating may discolor, giving the seed a weathered appearance and a reduced test weight (Fig. 10). It may be advisable to hasten harvest by windrowing if high-quality planting seed is the objective.

Based on research conducted in 2008 and 2009 at College Station and Beeville, a yield of 30 to 40 bushels per acre is realistic under limited irrigation. At College Station, yields ranged from 33 to 42 bushels per acre, with an average yield of 39 bushels per acre for 15 varieties. At the Beeville location, the yield range was 22 to 42 bushels per acre and the average was 32 bushels per acre for 15 varieties.

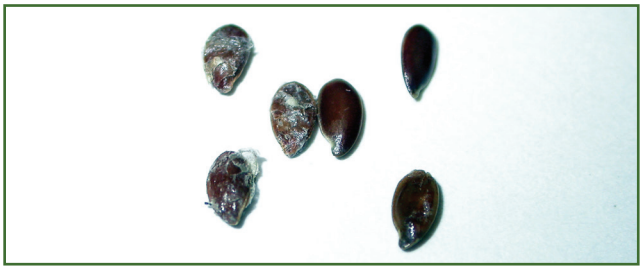

Fig. 10. Weathered flaxseed (left) due to exposure to wet conditions before harvest (photo by Aaron Turner).

Flax harvested for seed must be handled more carefully than most other crops because cracking frequently reduces germination. Concaves and cylinder speed should be adjusted as frequently as necessary to prevent cracking and injuring the seed. Yellow-seeded varieties are more susceptible to seed damage because of their thinner seed coat. To minimize damage, rubber roller attachments are available for harvesting planting seed. Flax seeds are small and slippery, so equipment and storage facilities must be free of holes and cracks. As with other high oil content crops, storage time should be minimized.

Marketing

Western Europe purchases most South Texas flax. It competes with flax produced in Canada and the northern U.S. The volume of flaxseed produced and marketed is a major consideration for South Texas export terminals, because when there are limited supplies it is difficult to make volume commitments for forward deliveries.

Market grades help determine the price the producer receives. Major considerations in determining grade are moisture content and test weight. Premiums are offered to growers for No. 1 or No. 2 grade, which contain less than 9.5 percent moisture. Discounts for lower grades reflect the market's need in terms of value.

Farm Program, Marketing and Production Economics Considerations

Flax is considered a minor oilseed for farm program purposes, which makes the crop eligible for price support and disaster assistance through the programs administered by the Farm Service Agency (FSA) of USDA. To participate in price support and disaster programs, the acreage reports for flax should be filed with the FSA, as with other program crops. The planting of flax on base acres is permitted, and would have no affect on any current DCP payments for farms that were otherwise eligible. Flax is eligible for CCC loan support, and the national average CCC loan rate for flax is currently $9.30 per hundredweight. It will increase to $10.09 per hundredweight in 2010. However, county loan rates are currently at $7.29 per hundredweight for areas in South Texas that were producers of flax. The availability of crop insurance would be limited until the producer could establish a production history for flax.

North Dakota is the largest producer of flax in the U.S., with more than 90 percent of the acreage planted since 2006. Montana is the second leading producer, followed by South Dakota and Minnesota. U.S. producers planted 354,000 acres of flax in 2008, which was 56 percent less than the 2006 acreage. The sharp drop in flax acreage was a response to the decrease in the price received by farmers; the price dropped from a season average of $8.07 per bushel in 2005-2006 to $5.80 per bushel in 2006-2007, while prices for alternative crops such as corn and soybeans increased dramatically. Flaxseed prices responded to the drop in production, and prices ranged from $12.55 to $13.35 per bushel in 2008. The U.S. has crushed more flaxseed for oil than it has produced in 7 of the last 10 years, and imports have ranged from 21 percent of domestic production to 124 percent of domestic production over that time span. Exports of flax have ranged from 15 percent of domestic production to 34 percent of domestic production in the same period.

The market for flaxseed in South Texas is not well developed at this time. Any flax produced in this region should be grown under contract with an elevator or end user. Some crushing facilities are being planned that might be able to use flaxseed as an input. There are also existing plants in northern Mexico that use alternative oilseeds such as canola, and that might also be feasible markets in the future.

See Table 1 for estimated costs and returns for dryland flax production in the northwest Coastal Bend region.

Additional information can be found in the North Dakota State University publication, A-1038.

Table 1. Estimated costs and returns for dryland flax production in the northwest Coastal Bend.

Item	Unit	Price	Quantity	Total amount	Your farm
Income					
Flax seed	bu	$ 13.35	15	$ 200.25	
Total income				$ 200.25	
Direct expenses					
Custom					
Fert. application	acre	$ 5.00	1	$ 5.00	
Herbicides					
Glyphosate (generic)	qt	$ 4.25	0.5	$ 2.13	
2,4D LV6	pt	$ 1.56	0.67	$ 1.05	
Seed					
Flaxseed	lb	$ 0.48	20	$ 9.60	
Fertilizer					
32-11-3 6S	ton	$ 415.80	0.095	$ 39.50	
Hauling and handling					
Custom haul	bu	$ 0.35	15	$ 5.25	
Other					
Pickup vehicle charge	acre	$ 2.80	1	$ 2.80	
Operator labor					
Tractors	hour	$ 11.00	0.2632	$ 2.90	
Self-propelled	hour	$ 11.00	0.103	$ 1.13	
Diesel fuel					
Tractors	gal	$ 2.00	2.8985	$ 5.80	
Self-propelled	gal	$ 2.00	1.398	$ 2.80	
Repair & maintenance					
Implements	acre	$ 2.72	1	$ 2.72	
Tractors	acre	$ 3.64	1	$ 3.64	
Self-propelled	acre	$ 6.87	1	$ 6.87	
Interest on operating capital	acre	$ 3.85	1	$ 3.85	
Total direct expenses				$ 95.04	
Returns above direct expenses				$ 105.21	
Fixed expenses					
Implements	acre	$ 5.37	1	$ 5.37	
Tractors	acre	$ 6.52	1	$ 6.52	
Self-propelled	acre	$ 11.82	1	$ 11.82	
Total fixed expenses				$ 23.71	
Total specified expenses				$ 118.75	
Returns above total specified expenses				$ 81.50	
Residual items					
NWCB land charge	acre	$ 35.00	1	$ 35.00	
Management charge	%	$ 200.25	5%	$ 10.01	
Residual returns				$ 36.00	

Note: cost estimates are based on producer and specialist input and are not to be used without updating after 8/15/2008.

Acknowledgements

This publication is based on the 1970 publication "Keys to Profitable Flax Production," (MP-967, Texas AgriLife Extension Service) by R. J. Hodges, Jr., E. C. Gilmore, Lucas Reyes, W. P. McNally and Richard R. Hoverson.

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