

The Agricultural Experiment Station

FORT COLLINS, COLORADO

FLAX GROWING

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The demand for flax seed production arises because of the demand and use of linseed oil in the industries. The normal consumption of flax seed in the United States is around 25,000,000 bushels. If a constant supply were available it is probable that the industries could utilize the oil from as much as 30,000,000 bushels. By-products of the oil mills, such as oil meal and oil cake, make excellent stock feeds, and sell at high prices. With mills located close enough to feeding communities, the by-products would be much cheaper to stock feeders on account of lower transportation rates. Unfortunately, most Colorado buyers have to ship flax meal and oil cake from Minneapolis, Sioux City, Kansas City or Fredonia.

In times past, flax seed has been produced in Russia, in Argentine and in Canada. The large areas which have produced flax recently in the United States have been located principally in the two Dakotas and in Montana. Much of Colorado is adapted to flax production, but it is quite probable that the area of production for market purposes must be confined to the adapted sections east of the Rocky Mountains. The reason for this is largely one of transportation. Flax grown in the mountain valleys and in the inter-mountain country will probably be largely consumed for feed, because of high transportation cost.

On the plains the best adapted regions found in two or three rather large localities. The first and most important of these is located in Weld county, and includes Weld county as the chief producer, with Morgan county, Lincoln county, Sedgwick and Phillips counties as minor producers. The second larger district might be enlarged to include Adams and Arapahoe counties, which are also adapted to flax production and favorably located as to transportation. The territory on the plains lying south of the Arkansas-Platte Divide is not especially adapted to flax production because of the hot, dry conditions which prevail in most of that section.

The largest acreage ever grown in Colorado was produced in 1912 when Weld county had 5,390 acres; Lincoln county 2,790 acres; Cheyenne county 1,816 acres; Morgan county 1,525 acres; Logan county 1,255 acres; with smaller acreages distributed in the contiguous counties. Flax can be produced under irrigation, but such production is not profitable ordinarily. As a consequence, flax is limited to the dry land farms of the region mentioned. Most Colorado flax has been shipped to Sioux City and Fredonia oil mills. Kansas City has taken occasional shipments. Owing to the favorable conditions usually prevailing for maturing the crop, Colorado produces a high quality of flax. With good market conditions which would return prices of about \$1.50 per bushel, it is probable that flax would be one of the best dry land cash crops, ranking second to winter wheat.

SOILS ADAPTED FOR FLAX PRODUCTION.

Where climatic conditions are favorable, flax will grow upon almost any fertile soil. Owing to the fact that it does best upon well compacted soil, loams and loamy clays will give the best growth. Sandy soils will produce a shorter straw and usually much lower seed yields. The yield on sandy soils will depend a great deal upon the frequency of rains during the season. Profitable yields can rarely be obtained upon poor soils, thus it is usually unwise to plant flax on anything but good soils, because profitable yields will not be obtained except in seasons of unusual rainfall.

Flax is not particularly hard on land. It does dry the surface out quite completely, and as a consequence is liable to leave the surface soil in bad condition for easy preparation for succeeding crops. The belief that flax was hard on land arose from the fact that the so-called "flax sickness" occasionally appeared when flax was grown more than one year upon the same land. This flax sickness is due to a specific disease known as "flax wilt." Our ordinary farm crops, such as the small grains and corn are just as hard on land as flax. They, however, are not troubled with the same disease that affects flax. On account of the danger of this disease getting into the land, flax should only be grown in a rotation and should not occupy the land more than one year in every four to six years. The disease is capable of living in the soil for several years. The only way to kill it out is to grow crops upon the land upon which the disease will not live. The danger of getting the disease into the land can be greatly reduced by properly treating the seed. This process will be described later.

PREPARATION OF THE SOIL.

Most of the failures in COLORADO in flax production can be traced to the method of preparing the land. Flax requires a well

prepared seedbed and does best on one smoothly and compactly prepared. The exact procedure of such preparation will vary on new and old lands.

Preparation of New Land.—In the spring of 1912 Mr. J. W. Adams visited most of the farms in the larger flax producing districts in order to make a survey of flax growing conditions. He found growers generally favorable to the growth of flax upon new lands. Some men who were experienced in flax production went so far as to say that new land was the only place fit for flax growing. The results of the experiments and observations made at that time, however, showed that while new land was well adapted for flax production, the advantage which new land possessed was largely one of freedom from weeds. Properly worked, clean, old lands produced higher yields than the new lands.

In breaking up new lands, if a heavy sod covers the soil, the sod should be broken from two and one-half to three and one-half inches deep. The furrow slice should be turned over as flatly as possible and rolled down flat with a heavy roller immediately after the breaking plow. Much better results may be obtained by breaking very early in the spring when the sod is moist. Rolled sod can usually be made into a proper "new land" seedbed by harrowing. Occasionally very light disking with the disk set nearly straight is necessary. Every care should be taken to leave the sod smooth and tightly rolled down if good results are expected from this method of preparation. When such land is prepared for other crops after the flax has been removed, deeper plowing is advisable.

On many new lands, if the plowing can be done a long time previous to seeding, it is advisable to plow deeply at first, especially if the plowing is done with a tractor. On such lands, if the surface can be disked and then the land deep plowed long enough before the land is needed for planting, the deep plowed furrow slice can be put into proper shape for planting by disking and harrowing. Preferably the plowing should be done long enough ahead of planting time to insure the land receiving rains. In that case an almost ideal seedbed can be prepared. Where this method of treatment was used, our observation and experiments showed it to be the one giving highest results. For success, however, the plowing must be done a considerable time before planting.

Preparation of Old Land. The most important thing to consider in preparing old land for flax is to have it clean and free from weeds. Weeds cause more failures on old land than any other one cause. It must be remembered that flax covers the soil thinly, consequently weeds have a good opportunity to grow unless the soil is very clean. Deep plowing, where rains came after the land

was plowed or where the deep plowing was done a long time previous to seeding, gave higher yields than shallow plowing. Careful observation in the field showed this was due probably to two causes. The deeply plowed land was clean and the soil was also in better shape to take up moisture. In some cases where the land was deep plowed and no rains came afterwards, the flax crop was a failure because there wasn't moisture enough to germinate the crop and keep it going until rains did come. Weed seed in the crop not only decreases the value of the flaxseed, but weeds in the crop take valuable moisture that should go to the production of flax. Clean corn stubble may be prepared for seeding flax by simply disking the surface, followed by thoro harrowing. All plowed land should be thoroly compacted, either by disking and heavy harrowing; by the use of the packer; or by rainfall. The flax seedbed should be well compacted and have a good amount of stored moisture. If this is the case the flax crop is almost certain. Winter wheat, or other grain stubble can be prepared by simply disking the surface of the stubble, plowing, and then rolling, pulverizing and compacting immediately after plowing. None of the plowed land should be left unharrowed longer than a half a day at a time. It would be much better to allow only a quarter of a day to elapse before compacting and harrowing.

Upon a seedbed prepared as indicated for new lands or old lands, the flax should be planted with a press drill. Fifteen to twenty-five pounds of seed per acre is an abundant supply for the dry land if the seed is good. The crop should be planted with just as near absolute uniformity of depth as possible. The shallower the planting the better, providing there is moisture enough in the soil to germinate the seed and start the crop off vigorously. From one inch to two and one-half inches deep is about right for most conditions. Owing to the greater ease of obtaining a uniform depth and uniform conditions of planting, a press disk drill should be used.

TIME TO PLANT

Flax will mature in a short season. However, it grows best in the cool of the season when moisture conditions are best. This is especially true of the crop in its young stages. For this reason planting should be relatively early in the spring. There is very little danger of frost injury, because flax will stand a considerable amount of frost without harm. Flax may be successfully seeded from April 10th to May 15th. In our experimental work on different farms, successful plantings were found varying from April 1 to July 10th. In general the earlier seedings are to be preferred

because usually the moisture conditions for early development are best early in the season.

THE SEED.

In order to obtain uniform ripening, it is absolutely essential to have uniform germination and uniform and early growth of the crop. A great deal can be accomplished towards obtaining this result by using only the best, brightest, and plumpest seed obtainable. Shrunken and shriveled seed germinates slowly and starts out a weak plant which does not ripen at the same time as the plants from plump seed. There is an additional reason for discarding the shrunken and shriveled seed. The shrunken condition may be due to the flax wilt disease. Consequently all seed flax should be thoroly fanned to get rid of small, shrunken and light seed. The remaining bright, sound, good-sized seed should be treated with formaldehyde to destroy any flax wilt spores that might be carried into the soil by the seed.

According to Professor C. P. Bull of the Minnesota Station, only two varieties are commonly grown in America. The most generally grown variety is the Russian Riga. It is scarcely likely that any other seed will be obtained by growers. The North Dakota Experiment Station has bred up some very disease resistant flax. The price of this, however, is so high, that it is doubtful if Colorado growers can afford to introduce such seed at the present time. If growers in a community would cooperate in the purchase of seed, it is probable that they could send to some of the better producing seed centers and get a start of the very best quality of resistant seed at a cost not very much greater than what they would have to pay for ordinary seed by the usual methods of independent buying. Such cooperative buying is essentially a pooling of interests. Seed purchased in quantity may be distributed among local growers according to their several individual needs.

TREATMENT OF FLAXSEED.

Many flax diseases may be carried by the seed, the worst of these being flax wilt. Flax wilt affects the crop by working on the roots at about the time the plant is coming thru the ground or very soon after that time. By proper fanning and later treatment of the seed with formaldehyde, the danger of introducing disease with the seed can be almost completely eliminated. Colorado lands are not immune to flax wilt. In several of the plains sections, flax wilt exists. It can only be controlled by proper rotation and seed treatment.

For treating flax a treating solution should be made by using one pound (16 ounces) of 40 per cent formaldehyde in 40 gallons

of water. The solution should always be made up fresh. One-half gallon of this solution is sufficient for one bushel of seed. Forty gallons will treat about 100 bushels. One ounce of formaldehyde in two and one-half gallons will make a solution of the above strength. It is worth while repeating again, that the solution has to be made up just before the seed is to be treated.

After the seed has been cleaned, the cleaned seed may be treated by putting the seed in a wagon box and sprinkling with a treating solution. After the surface is well sprinkled the seed should be thoroly mixed with a shovel or rake. The sprinkling and mixing should be continued until all of the seed is thoroly dampened with the treating solution. It is possible to treat the seed by piling the flax up in piles of about five bushels on a tight floor or on a canvas. A wagon box, however, is nearly always convenient, and makes an exceedingly handy place for doing this work. It is usually wise to sprinkle the wagon box, the floor, or the canvas where the seed is to be treated with the formaldehyde solution. In sprinkling the seed with the solution, a common garden sprinkling pot or spray pump may be used. If neither of these utensils are at hand, a spray nozzle for an ordinary pail can be made out of an old tin fruit can or lard pail, by punching holes in the bottom with a small nail. After the seed is treated it should be covered with sacks or blankets and left for about two hours. At the end of that time the covering should be removed and the seed spread out to dry.

There are machines now on the market which permit the treating of the seed in a much shorter time. Some of them can be taken to the field and the seed treated immediately before planting. These machines, however, are more or less expensive equipment, and just as good results can be obtained by the methods outlined above.

HARVESTING.

The method of harvesting will vary somewhat with the conditions. Where the seed ripens up well and uniformly and where the weather is clear, a good way is to use a header and then stack in high, narrow stacks. Some growers use a self rake. Some times a binder is used with a buncher attachment. By far the best method, however, is to bind and shock, because this method will keep the flax in good condition under a greater variety of weather and cropping conditions. It is a wasteful practice to leave flax in the field in loose bunches. Hail may destroy a considerable amount; rains may rot and mold the seed; high winds may blow the crop away. All of these conditions should be guarded against. In the observations made by the Experiment Station, stacking as soon as the straw is dry enough in rather nar-

row stacks kept the flax in the best condition for thrashing. The proper time to cut flax if it has matured evenly, is when the straw is brown ripe and the balls ripe.

SAVE SEED.

On account of the very great advantage of clean pure seed of good quality, it is advisable for the regular grower to save a seed patch. A portion of the regular field may be saved, all volunteer weeds and mixtures can be rogued out by pulling out all weeds and foreign materials and a clean patch can be obtained so that the most of the cleaning will be done with the thrashing machine. The increased results which can be obtained from the care of the seed patch will more than pay for the extra labor in caring for such a patch. On such a patch it would be possible not only to have clean seed, but to get the seed properly ripened and of good quality. In the larger fields the very acreage itself may make it necessary to cut some flax at a time when conditions are not best for the very highest quality of seed.

ROTATION.

With a reasonably sure market flax might well become a part of the regular farming system upon the dry lands, since it would furnish a cash crop next to winter wheat in certainty. A rotation is absolutely essential in a permanent system in order to keep the land clean and to keep down the ravages of disease. Any rotation practiced should be at least five years in length. Four possible rotations are suggested herewith. Any other rotation which will get different crops upon the land and which will have a tendency to keep the land free from weeds might be used as successfully. The best rotation is the one which accomplishes these results, as well as makes the best distribution of labor on the individual farm, together with maintenance of soil fertility. In order to reduce trouble with weeds, flax should always follow corn, potatoes, wheat, or some other clean cultivated crop, or summer tillage upon the old lands. Of course, on new lands flax may be used as a sod crop, because the sod is usually free from weeds.

Rotation No. 1.

1. New land breaking—Flax.
2. Wheat.
3. Green manure with partial summer tillage.
(Plant wheat in fall.)
4. Wheat.
5. Summer tillage.
6. Flax.

Rotation No. 2.	<ol style="list-style-type: none"> 1. New land breaking—Flax. 2. Wheat. 3. Corn or Milo. 4. Wheat. 5. Green manure, plow in July. 6. Corn, potatoes or Milo. 7. Flax.
Rotation No. 3.	<ol style="list-style-type: none"> 1. Corn (old land). 2. Flax. (Disk stubble in spring, harrow, plant.) 3. Sweet Clover in rows. 4. Same. (Fall plow.) 5. Corn. 6. Flax.
Rotation No. 4.	<ol style="list-style-type: none"> 1. Alfalfa (in rows). 2. Same. 3. Same. 4. Same (plow in fall). 5. Corn. 6. Flax. 7. Wheat. 8. Alfalfa (in rows) or Corn, Feterita or Milo.

SUMMARY.

1. Flax is well adapted to Colorado conditons.
2. The plains region is probably the only place where flax will become a market crop, because of transportation conditions.
3. Flax can only properly be grown on clean land.
4. Flax should be planted as early in the spring as possible and escape early killing frosts.
5. Flax may be grown as a sod crop or on clean old land.
6. Plant from 15 to 25 pounds of seed per acre, depending upon moisture conditions.
7. Plant clean, plump, heavy seed only, and drilled with uniform depth, to insure uniform ripening.
8. Treat the seed with formaldehyde.
9. Flax must be grown in a rotation if it becomes a permanent crop in any community.