

JANUARY, 1934

CIRCULAR 173

AGRICULTURAL EXPERIMENT STATION

KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

MANHATTAN, KANSAS

DEPARTMENT OF AGRONOMY

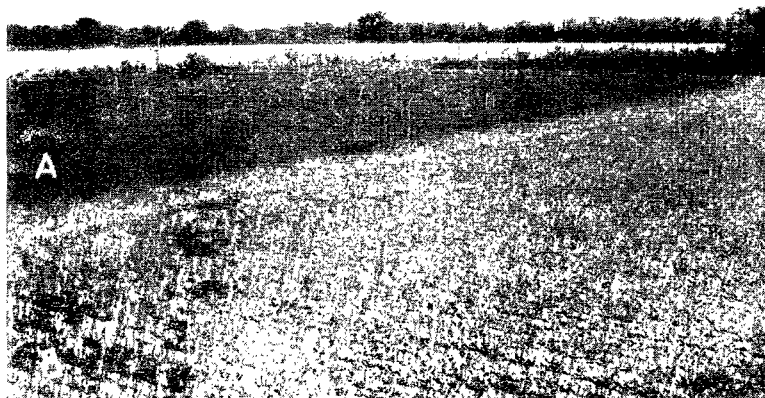


FIG. 1.—FIELDS OF FLAX SHOWING EFFECT OF
PREVIOUS CROP ON PRODUCTION

(A) Flax following soybeans; land plowed in December.
(B) Flax following oats; land plowed in December.

FLAX PRODUCTION IN KANSAS¹

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INTRODUCTION³

Flax is not a new crop in Kansas. The records of the Kansas State Board of Agriculture show that 63,478 bushels of flaxseed were raised in the state in 1873. After this date the production of flax increased rapidly until 1890, in which year 2,173,800 bushels were produced on 228,839 acres. This year marked the peak of flax production in Kansas, but for

1. Contribution No. 229 from the Department of Agronomy.
2. The author is superintendent of the Southeastern Kansas Experiment Fields.
3. See page 16 for "Outline and Index."

another twelve years, or until 1902, the Kansas crop continued to exceed one million bushels annually. The acreage decreased rather gradually until the World War, when the appeal for increased wheat production caused a sharp drop in the flax acreage. The smallest crop since 1873 was raised in 1919 when 85,048 bushels were produced on 13,926 acres, according to the reports of the Kansas State Board of Agriculture.

During the 10-year period, 1923 to 1932, the average flax acreage was 38,000 acres and the average production, 253,000 bushels. More than 80 per cent of this was produced in Allen, Neosho, Linn, Wilson, and Bourbon counties. The remainder was grown south of the Kaw river and east of the Flint Hills. During this period flax was not a crop of major importance even in these five principal flax-producing counties. However, the soils and climate of the southeastern part of Kansas are well adapted to flax production and with the adoption of improved practices that will raise the average yield of 6 or 7 bushels per acre to 10 or 12 bushels, flax might well assume an important place in the agriculture of this part of the state.

Flax is the only important grain crop grown in the United States which is on an import basis at the present time. Each year since 1909, the United States has consumed more flaxseed and flaxseed products than it has produced. The peak of consumption was reached in 1929 when 42,000,000 bushels were crushed. The domestic production was less than half of this amount so that more than 23,000,000 bushels were imported.

Since 1929 the reduction in the amount of new construction and delayed repainting has materially reduced the consumption of linseed oil, but the United States is still on a flax-importing basis. In this connection it is interesting to note that the domestic production in recent years has decreased to a point where the 1933 crop in this country was only 7,500,000 bushels as compared with an average annual yield of over 20,000,000 bushels between 1924 and 1929.

With the resumption of a normal schedule of building and repairing, the consumption of linseed oil should again increase so that a moderate expansion of flax production would be possible without creating a surplus. The tariff on flax is now 65 cents per bushel with a compensatory duty on linseed oil, its chief product. This gives the flax producers in the United States a very real market advantage over foreign flax producers, which advantage they will continue to enjoy as long as the domestic production does not exceed the consumption.

The linseed oil mill at Fredonia, in Wilson county, has an annual crushing capacity of 1,500,000 bushels of flaxseed or about six times the amount of the average Kansas flax crop. This furnishes a local market for Kansas-grown flax.

Flax is grown primarily as a cash crop and it is on this basis that it must compete with other crops for a place in the agricultural program. There are, however, some other features of flax production that should be given consideration.

INCIDENTAL FEATURES OF FLAX PRODUCTION

FLAX AS A NURSE CROP

Flax is considered superior to other small grains as a nurse crop for clovers or grasses because it does not shade the ground so densely and also because the leaves fall off gradually as the plant matures, allowing the sunlight to reach and harden the clover before the nurse crop is removed. This makes the shock to the clover less severe than when wheat or oats are used as a nurse crop. In order not to smother out the clover it is usually necessary to seed oats at only one-half to one-third the cus-

tomary rate per acre, which reduces the yield of grain. Flax can be seeded at the optimum rate without seriously interfering with the clover.

FLAX STRAW AS FEED

The tow or flax straw, with the chaff included, is superior to wheat or oats straw as a feed for live stock. Practically all feeders consider it superior to prairie hay. The value of the tow as feed is governed very largely by the stage at which it is cut and by the amount of seed blown into the straw. When the amount of seed in the straw is large, care should be taken to limit the amount fed, because of the laxative effect of the oil in the seed.

INFLUENCE OF FLAX ON THE SOIL

Flax leaves the soil in a very loose, mellow condition, similar in many respects to the after effects of soybeans or cowpeas. This is particularly noticeable on the tight, heavy soils that are inclined to puddle when handled wet. It is frequently possible to plow flax stubble during dry periods in the summer when oats or wheat stubble on similar soils is too hard to plow.

DAMAGE FROM INSECTS

Flax has no serious insect pests. The only insect damage to the Kansas flax crop reported has been by grasshoppers in occasional years. They do not eat the flax but do cut off the bolls before maturity. This is particularly true of late flax that is still green after the other small-grain crops have ripened.

FLAX DISEASES

Flax wilt, flax rust, and pasmo are the only diseases of flax that cause appreciable losses in the United States. Of these, flax wilt is the only one that has ever been a factor in Kansas flax production. Flax wilt is a fungous disease that attacks only the flax plant. When once introduced, usually on the seed or in manure which contains infected flax straw, it persists in the soil for several years, ready at any time to attack any flax that might be sown there. The damage from flax wilt can be lessened by early planting and may be somewhat reduced by rotation. The use of wilt-resistant varieties is unquestionably the best means for reducing wilt losses.

In communities where flax has been produced regularly over a long period of years, it has become the accepted custom not to plant flax on the same ground oftener than once in seven years. This practice has generally controlled the wilt.

At present there are several varieties of flax that are resistant to both wilt and rust. Among these varieties are the Bison, which is the most disease-resistant, Buda, Linota, and Redwing. It is possible to grow these varieties continuously on wilt-infected land but it is not good farm practice to do so.

IS FLAX HARD ON THE LAND?

There is a very prevalent opinion that flax is hard on the land. Flax is not any harder on the land than any other small-grain crop. In fact, the average flax crop removes from the soil less phosphorus and potash and only slightly more nitrogen than an average crop of wheat or oats. This prejudice against flax probably gained its popularity before the cause of flax wilt was discovered. At that time it was known that successive crops of flax could not be grown on even the best land. The disease which caused the failure of the later flax crops being unknown, the erroneous conclusion was reached that flax was hard on the land.

Some rotations comparing wheat and flax preceding corn were run for

a few years at the Parsons Experiment Field. The yields of corn in these rotations are shown in Table I.

TABLE I.—YIELDS OF CORN IN ROTATIONS AT PARSONS.
(Bushels per acre.)

ROTATION	1931	1932	Av.	Difference
Soybeans, flax, corn.....	28.0	33.4	30.7	8.5
Soybeans, wheat, corn.....	20.6	23.8	22.2	
Oats, flax, corn.....	28.8	27.6	28.2	5.5
Oats, wheat, corn.....	23.8	21.6	22.7	

FLAX PRODUCTION MAY AID LABOR DISTRIBUTION

Flax is seeded a little later than oats and before corn planting. It is harvested from one to two weeks later than wheat and oats. This spreading of the season at which these operations can be done increases the efficiency of the farm labor. If the acreage of oats is increased beyond what one drill can handle, either another drill must be used or some of the oats will be seeded too late. If flax is substituted for the late oats it will mean both oats and flax seeded at the proper time. If more wheat and oats are to be harvested than can be handled in a reasonable time with one harvesting unit, it means either more machinery or part of the crop must stand too long. Flax substituted for part of the excessive wheat acreage will prolong the harvesting period.

CLIMATIC REQUIREMENTS OF FLAX

Flax is a reasonably dependable crop in localities that have a rainfall of more than 30 inches annually and that are not subject to hot, dry winds or extremely high temperatures during the period that the flax is blooming, filling, and ripening. This limits the territory in Kansas in which it is advisable to grow flax to the region east of the Flint Hills. It is possible to grow good crops of flax west of this region in some years but the greater probability of drought and high temperatures in June and early July make flax production rather hazardous.

Table II shows the yields of Linota flax in comparison with Kanota oats in central and northeastern Kansas. Flax has proved less well adapted at the Colby, Tribune, and Garden City Agricultural Experiment Stations.

TABLE II.—YIELDS OF LINOTA FLAX COMPARED WITH KANOTA OATS IN CENTRAL AND NORTHEASTERN KANSAS.

LOCATION	County	Number of years compared	Bushels per acre	
			Linota flax	Kanota oats
Kingman.....	Kingman	2	3.7	26.1
Wichita.....	Sedgwick	2	7.7	28.5
Hays.....	Ellis	(a) 9	9.3	41.4
Manhattan.....	Riley	4	13.1	67.4
McLouth.....	Jefferson	2	11.1	34.7

(a) Two failures each of flax and oats in nine years.

Flax does not compete well with weeds and for that reason should not be sown except on fields that are known to be reasonably free from weeds. Creek and river bottoms that occasionally overflow are not generally recommended for flax on this account. Flax production has been and probably should be confined to upland where the yields of wheat and oats are less profitable.

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Flax does better on heavy, tight lands that are slow to warm up in the spring than on the looser, sandy soils that are quick to warm up. Flax does best under cool growing conditions and any circumstance that increases the amount of growth before the soil becomes warm is favorable for flax production.

FLAX COMPARED WITH OTHER CROPS

Flax competes with oats and wheat for a place in the rotation since it has about the same labor distribution and requires the same machinery and field operations.

In comparing the incomes from the different crops it is hardly fair to take the state or county average yields. Flax is produced almost wholly on the less productive uplands while wheat and oats are frequently grown on the more fertile creek and river bottoms and are often fertilized. It would be fairer to compare the yields or incomes from the different crop when grown on the same land with equally good farming practices.

In Table III are shown the four-year average yields of kafir, corn, oats, and flax at the Rest Experiment Field in Wilson county, Kansas. Kafir

TABLE III.—COMPARATIVE YIELDS OF KAFIR, CORN, OATS, AND FLAX ON THE REST EXPERIMENT FIELD (WILSON COUNTY, KANSAS). (Yields, bushels per acre, in a rotation of red clover, kafir, corn, oats, and flax.)

CROP	1927	1928	1929	1930	Av.
Kafir	38.17	41.34	17.15	11.94	27.15
Corn	49.90	45.79	26.25	7.38	32.33
Oats	15.56	42.77	29.00	46.24	33.39
Flax	12.06	11.17	10.33	13.54	12.07

and corn utilize a different part of the growing season and so the yields of these crops, even on the same field, are not strictly comparable with the yields of oats and flax. At the Rest field the average yield of oats was 33.39 bushels per acre which was a little less than three times the average yield of flax, 12.07 bushels. As the average price of flax is approximately six times the price of oats per bushel, the gross income per acre of flax was about twice that of oats on the same field and under equally good conditions. No wheat was grown in this rotation.

The comparative average yields of wheat, oats, corn, soybeans, and flax on the Columbus Experiment Field in Cherokee county, are shown

TABLE IV.—COMPARATIVE YIELDS OF WHEAT, OATS, CORN, SOYBEANS, AND FLAX ON THE COLUMBUS EXPERIMENT FIELD (CHEROKEE COUNTY, KANSAS).

(Yields, bushels per acre, on lime and superphosphate plots in a rotation of wheat, oats and sweet clover, corn, soybeans, and flax.)

CROP	1932	1933	Av.
Wheat	33.12	15.08	24.10
Oats	(a) 24.21	(a) 30.50	(a) 27.35
Corn	42.60	(b) 45.90	44.25
Soybean seed	13.75	19.00	16.37
Flax	12.41	14.82	13.61

(a) Oats seeded lightly as a nurse crop for sweet clover.
(b) Kafir instead of corn in 1933.

in Table IV. Except for the oats which were seeded at a very light rate to serve as a nurse crop for sweet clover, these yields are far above the

average of the county, but since they were produced under the same circumstances the comparison is fair. The average yield of wheat for the two years in which wheat was compared with flax, was 24.1 bushels per acre as compared with 13.61 for flax. Since the average price of a bushel of flax is about twice that of a bushel of wheat, the gross income per acre from flax is equal to or a little greater than that from wheat.

The comparative market values of these various grain crops will vary from year to year but as long as there is a surplus of all other grains and flax is being imported in the face of a 66-cent tariff, flax production should be relatively profitable, provided satisfactory yields can be obtained.

In order to produce profitable yields of flax it is essential that a satisfactory stand be obtained. The stand is affected not only by the weather conditions, over which the grower has no control, but also by the germination of the seed, the rate of seeding, the condition of the seed bed, the method of seeding, and date of seeding, all of which are more or less under the control of the grower.

SEEDING FLAX

GERMINATION OF SEED

The germination of flaxseed is usually high but in some years the weather conditions at the time of ripening are such that seed of low germination is produced. To be safe, the germination of the seed to be used should be determined, either at home or at the state seed laboratory. Good flaxseed should have a germination of more than 95 per cent.

RATE OF SEEDING

Most Kansas flax growers have been in the habit of seeding at the rate of about two pecks of good seed per acre. On a very good seed bed this may be enough seed but for average field conditions, three pecks are recommended. Various rates of planting flax have been compared on the Southeastern Kansas Experiment Fields for six years. In these tests Linota seed was drilled in very good seed beds with a four-inch alfalfa drill at the rate of 20, 30, 40, and 50 pounds per acre. The last four of these years a 60-pound rate of seeding was also included. The yields of flaxseed secured from the various rates of seeding are shown in Table V. The average difference in yield was small but consistently in favor of the heavier rates of seeding up to 50 pounds per acre. Heavier seeding also tends to help control weeds.

TABLE V.—THE EFFECT OF THE RATE OF SEEDING ON THE YIELDS OF FLAXSEED.

(Bushels per acre.)

Pounds of seed per acre	Rest field		Columbus field				Average, 6 years
	1927	1928	1930	1931	1932	1933	
20	9.33	16.80	4.50	6.03	8.85	6.28	8.63
30	9.33	18.40	5.15	6.81	8.86	7.74	9.33
40	9.92	18.06	5.30	6.49	9.59	7.83	9.63
50	11.74	19.90	6.26	7.32	9.43	7.83	10.41
60	.....	.....	5.46	7.58	8.95	7.93	(a)

(a) The four-year average yield of flax seeded at the rate of 60 pounds per acre was 7.48 bushels per acre compared with 7.71 bushels for the 50-pound rate in the same tests.

The three-year average weight of 1,000 seeds of Kansas-grown Linota flax has been 3.93 grams. Bison flax grown in the same tests has averaged

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6.9 grams per 1,000 seeds. When a larger-seeded variety like Bison is planted the pounds of seed per acre should be increased approximately 50 per cent to obtain the same number of plants per acre.

SEED BED REQUIREMENTS

Flax, like other small-seeded crops, requires a firm, compact seed bed with sufficient moisture for quick germination and continued growth. If the seed bed is too loose or too dry, some of the flax will not germinate or will perish soon after germination. In either case the result will be a reduced stand.

Good seed beds can be prepared by plowing in the summer or fall, allowing the ground to settle during the winter, and then working the surface with a disk, harrow, drag, or roller until the seed bed is well pulverized, firm, and smooth.

METHODS OF SEEDING

There are two common methods of seeding flax. Both methods have some advantages and some disadvantages. Drilling the flaxseed insures an even distribution over the field, uniform depth of covering, and the placing of the seed in contact with moist soil if the surface soil is dry. The force feed type of grain drill is suited for seeding flax although chokes may be inserted in some of the other types of drills to adapt them to seeding flax.

When flax is seeded on unplowed corn land, the stalks frequently interfere with drilling so that broadcasting followed by disking is the only feasible method of seeding. This has been the most common method of seeding flax in spite of the fact that broadcasting does not distribute the seed so evenly as drilling and that disking or harrowing in the seed does not cover it so evenly as the drill.

On the other hand, if heavy beating rains occur just after the flax is seeded, the drilled flax is in greater danger of being buried too deep by the washed soil. If the soil is inclined to run together and bake, there is less danger of the flax being smothered under a crust when broadcast than when drilled.

With either method of seeding, the flax should not be covered deeper than one inch. One-half to three-quarters of an inch is preferable where possible. When all factors are considered drilling is preferable to broadcasting.

DATE OF SEEDING

Flax is quite sensitive to frost injury when in the two-leafed stage. After the plants have attained some size they will withstand considerable

TABLE VI.—THE EFFECT OF THE DATE OF PLANTING ON THE YIELDS OF FLAXSEED.

(Bushels per acre.)

DATE PLANTED	Rest		Columbus		Average
	1928	1930	1932	1933	
3-10 to 3-25	17.30	5.36	12.43	13.86	12.24
3-26 to 4-10	19.10	5.27	8.95	5.57	9.72
4-11 to 4-25	16.80	5.04	6.00	3.13	7.74

The acre yields for three dates of planting in 1931 were: Feb. 11, 5.11 bus.; Mar. 1, 7.38 bus.; Mar. 10 to 25, 8.59 bus.

freezing. Since the date of the last freeze in the spring cannot be accurately predicted, there is some risk in seeding early. On the other hand, if

flax is planted too late, the crop is forced to mature seed in the hot dry weather in July. This lowers the yield very materially.

Linota flax has been planted at various dates on the Southeastern Kansas Experiment Fields for each of five years. The yields of flaxseed secured by planting on similar seed beds at different dates are shown in Table VI. The 1931 data show that the yield of flax increased with later plantings from February 11 to the middle of March, after which no more plantings were made that year. Since no data comparable to these were obtained the other years, they are not included in the averages. The data for the other four years show a decrease in the average yield of flax planted after the middle of March. These data and the opinions of experienced flax growers agree that in southeastern Kansas flax should be seeded as soon after the middle of March as possible.

FLAX VARIETIES⁴

Some wilt-resistant varieties and the wilt-susceptible Southwestern or "native" flax, which has been grown for years in Kansas, have been tested for nine years on three of the southeastern Kansas experiment fields. The yields obtained in these variety tests are shown in Table VII. Of the varieties tested, Linota has the highest average yield. Since it is a resistant variety and has the highest average yield, it is recommended for southeastern Kansas flax growers.

North Dakota Resistant No. 114, Redwing, and Winona have slightly lower average yields than Linota in the tests which included these varieties. Bison, Southwestern, and Rio have average yields that are appreciably less than Linota. Since Bison is perhaps the most disease-resistant variety and since it is being grown commercially to a certain extent, its performance should be carefully compared with that of Linota. Bison has been grown with Linota in nine tests in the past six years. In these tests its average yield has been 1.4 bushels per acre less than Linota. In one of these tests it yielded one-fourth of a bushel more than Linota, in one test the yields were equal, and in two tests the Linota was less than one bushel better than the Bison. In the other five tests the Linota yield was from one to five bushels better than the Bison. The largest difference was due in part to a poor stand secured as a result of one lot of Bison seed being low in germination. Bison has been seeded at the rate of one bushel per acre because of its larger seed, while Linota has been seeded at three pecks per acre.

In the 1929 test at Rest and the 1931 test at the Moran field in Allen county, the plots of Bison showed noticeably more lodging than any of the other varieties tested. While this trait has been manifested in only two of the nine tests, until the cause for it can be determined it remains a drawback to the variety. Another handicap to the Bison is that it is later-maturing than any of the other varieties tested. This increases the danger of injury by hot weather.

Bison, being larger seeded, requires approximately 50 per cent more pounds of seed to get an equal stand, is later-maturing, is more prone to lodge, and has generally yielded less seed than Linota. On the other hand it is more resistant to wilt and rust and has a higher oil content as is indicated by data in Table VII. It would seem advisable therefore to grow Linota at least until the market price of Bison rises sufficiently above Linota to justify the expense of the heavier rate of seeding and the possibility of lower yields.

4. The flax variety work was conducted in cooperation with the Division of Cereal Crops and Diseases, United States Department of Agriculture.

TABLE VII.—YIELDS AND PERCENTAGE OF OIL (BASED ON DRY WEIGHT) OF VARIETIES OF FLAX.
(Grown on Southeastern Kansas Experiment Fields located as follows: Moran (M), Columbus (C), and Rest.)

Variety	Rest					C	M	C	M	C	M		Av.	Av. of Linota in same tests	Difference compared with Linota
	1924	1925	1927	1928	1929	1930	1930	1931	1931	1932	1932	1933			
Yields in Bushels per Acre															
Linota	9.04	7.29	9.81	16.56	7.84	9.55	13.48	6.25	15.52	15.38	17.99	14.72	11.95	.....	0
N. D. R.	7.90	6.58	7.87	14.91	9.92	6.82	12.78	.....	.....	.....	.....	.....	9.54	10.51	- .97
Redwing	8.25	6.81	.....	14.79	9.02	.....	.....	6.25	16.15	14.54	16.02	14.53	11.81	12.28	- .47
Winona	.....	6.63	10.21	15.62	.....	8.77	13.44	6.25	13.33	14.78	18.18	13.84	12.11	12.65	- .54
Bison	.....	.....	.....	16.81	7.56	8.19	12.14	5.35	10.83	13.67	15.40	14.72	11.62	13.02	-1.40
S. W.	6.84	4.12	.....	15.74	7.95	7.66	11.02	7.00	14.17	12.96	14.87	14.14	10.61	12.18	-1.57
Rio	4.48	6.85	5.54	11.24	7.76	7.01	12.56	5.50	9.79	12.20	15.27	15.11	9.44	11.95	-2.51
Percentage of Oil															
Linota	39.3	38.0	40.9	37.3	39.6	37.8	38.3	37.2	36.0	37.2	37.3	.....	38.1	38.1	.....
N. D. R.	37.0	38.0	40.9	37.8	40.0	.....	35.7	.....	.....	.....	.....	.....	38.2	38.9	-0.7
Redwing	37.5	37.7	.....	38.6	41.0	.....	.....	38.6	38.1	38.0	38.3	.....	38.5	37.7	+ .8
Winona	.....	37.5	40.4	38.1	.....	39.3	36.0	37.6	36.3	.....	37.5	.....	37.8	37.9	- .1
Bison	.....	.....	.....	39.5	40.6	40.2	40.6	40.4	39.3	41.0	40.5	.....	40.3	37.6	+2.7
S. W.	37.9	38.4	39.6	36.0	37.8	36.7	37.1	37.6	37.6	.0
Rio	40.3	41.4	44.5	42.1	43.3	41.1	43.0	41.7	40.1	42.5	40.5	41.9	38.1	+3.8

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The relative oil content of the seed reported in Table VII shows that Rio and Bison, the two large-seeded varieties, have the highest oil content, averaging a little more than 40 per cent. Redwing contained a little more oil than Linota, which had an average oil content of 38.1 per cent. The other varieties averaged only slightly less than Linota.

The supply of available plant food is another factor in determining the yields of flax. There are at least four farm practices that may affect the supply of available plant food.

FERTILIZERS FOR FLAX

COMMERCIAL FERTILIZERS

Phosphate and potash applied directly to the flax crop have not noticeably increased the yield of flaxseed. Lime and phosphates applied in the rotation with alfalfa or clover have increased the yield of flax but apparently the increase was an indirect one resulting from the more vigorous growth of the legumes and consequent greater fixation of nitrogen. Phosphates have in some seasons hastened the maturity of the flax by several days but all significant increases in yield have been attributable to an increased supply of available nitrates.

Several nitrogenous fertilizers were applied with flax at the Parsons Experiment Field for two years. The yields and increases obtained in these tests are shown in Table VIII. The largest increase obtained was only 1.14 bushels per acre, from applying 100 pounds of cyanamid per acre about two weeks before seeding flax. The total yields were fairly large and the seasons were quite dry. This may account for the small increases obtained. It may be that on fields very deficient in available nitrates or in seasons of more ample rainfall some of these fertilizers would pay, but the results secured so far do not justify the use of commercial fertilizers on flax.

TABLE VIII.—EFFECT OF NITROGENOUS FERTILIZERS ON YIELDS OF FLAXSEED AT THE PARSONS EXPERIMENT FIELD.

(Bushels per acre. Average of four replications each year.)

TREATMENT	1932	1933	Average	Increase
No fertilizer.....	11.80	10.26	11.03	....
Nitrate of soda.....	12.69	11.06	11.87	0.84
Ammonium sulphate.....	13.13	10.91	12.02	.99
Cyanamid.....	13.57	10.77	12.17	1.14

MANURE

Barnyard manure noticeably increases the vegetative growth and also the yield of flax. Since most manure contains weed seeds, if it is applied just before seeding the flax the weeds may seriously choke out the flax. Flax will not compete with weeds so well as will other small grains. It is usually advisable to apply the manure to some cultivated crop ahead of the flax in the rotation.

Flax was grown in a rotation with red clover, kafir, corn, and oats at the Rest Experiment Field. In this rotation the manure was applied to the corn crop, two years ahead of the flax. The yields of flax from the various soil treatments in this rotation are shown in Table IX. Eight tons of manure applied before corn and oats increased the average yield of flax by 2.26 bushels per acre. Similar applications of manure in addition to lime increased the average yield only 1.18 bushels.

Flax was grown on the Columbus Experiment Field in a rotation with wheat, oats and sweet clover, corn, and soybeans. The flax yields from the various soil treatments on this field are shown in Table X. An application of eight tons of manure several years ahead in the rotation increased the yield of flax 2.74 bushels per acre.

TABLE IX.—YIELDS OF FLAXSEED IN THE FERTILITY ROTATION AT THE REST EXPERIMENT FIELD.
(Rotation: Red clover, kafir, corn, oats, and flax. Bushels per acre.)

SOIL TREATMENT	1927	1928	1929	1930	Av.
No leg., no tr.	14.46	7.77	8.24	13.00	10.87
No tr.	12.96	11.17	10.33	13.84	12.07
Lime	13.21	14.18	11.85	14.76	13.50
Lime and sup.	13.21	16.65	11.40	15.15	14.10
M.	14.38	15.12	12.14	15.39	14.32
Lime and m.	11.94	17.64	11.56	17.58	14.68
Lime, m., and sup.	13.65	15.08	11.61	17.95	14.57
Lime, m. and r. phos.	14.29	12.86	10.75	18.00	13.97

Leg., legume; tr., treatment; sup., superphosphate; m., manure; r. phos., rock phosphate.

LEGUMES IN THE ROTATION

The supply of nitrates in the soil can also be increased by growing legumes ahead of flax in the rotation.

The flax yields in the rotation of red clover, kafir, corn, oats, and flax at Rest (Table IX) were 1.2 bushels per acre larger than in a rotation in which corn was substituted for the red clover. In this rotation three crops were grown between the clover and the flax.

TABLE X.—YIELDS OF FLAXSEED IN THE FERTILITY ROTATION AT THE COLUMBUS EXPERIMENT FIELD.
(Rotation: Wheat, oats and sweet clover, corn, soybeans, and flax. Bushels per acre.)

SOIL TREATMENT	1932	1933	Average
No treatment	10.18	10.78	10.48
Lime	12.14	12.68	12.41
Lime and superphosphate	12.41	14.82	13.61
Lime and rock phosphate.	12.97	16.81	14.79
Lime and manure	13.98	16.35	15.15
Lime, manure, and superphosphate.	13.71	17.59	15.65
Lime, manure, and rock phosphate.	14.13	16.13	15.13
No legume (kafir instead of soybeans), lime, and superphosphate	8.03	8.53	8.28

In the rotation at Columbus (Table X), flax following kafir yielded 8.28 bushels per acre but following soybeans with the same soil treatment the yield was 13.61 bushels, an increase of 6.33 bushels. Part of this increase was probably due to the effect of the sweet clover grown in rotation with the soybeans but not with the kafir. In this same rotation the average yield of flax on the unlimed plot, on which sweet clover failed, was 1.93 bushels per acre less than on the limed plot which grew sweet clover two years ahead of the flax.

The yields of flax in two-year rotations of corn-flax, soybeans-flax, and oats-flax at Columbus are shown in Table XI. When the flax seed bed was prepared by plowing in the fall, flax after soybeans produced 3.81

bushels per acre more than after corn. When the seed beds were prepared by disking in the spring, flax after soybeans produced 6.89 bushels more than after corn. The better growth of flax after soybeans than after oats on land plowed in December is shown in figure 1. Somewhat the same

TABLE XI.—YIELDS OF FLAXSEED FOLLOWING CORN, SOYBEANS, AND OATS AT THE COLUMBUS EXPERIMENT FIELD.

(Bushels per acre.)

PREVIOUS CROP	Seed bed preparation	1931	1932	1933	Average
Corn	Disked in Mar.	8 88	12 68	3.85	7 80
Corn	Plowed in Dec.	9 25	13 33	7 70	10 09
Soybeans	Disked in Mar.	13 12	15 26	15 40	14 69
Soybeans	Plowed in Dec.	11 18	13 97	15 95	13 70
Oats	Plowed in Dec.	2 80	7 31	1 65	3 92
Oats	Plowed in July (a)	8 82	13 97	13 20	12 00

(a) Plowed August 24 instead of in July.

effect is obtained by sowing flax after a wild or tame grass sod as is obtained following legumes.

EARLY SEED BED PREPARATION

For some time it has been known that early summer plowing increased the yield of winter wheat by increasing the amount of available nitrates in the soil. This same method of seed bed preparation, though seldom used for oats or flax, will increase the yield of these crops.

The data recorded in Table XI show that in Cherokee county, flax has produced an average of 2.29 bushels more per acre on fall-plowed than on spring-disked corn ground. This was not due to better physical condition of the seed bed, as is sometimes the case under field conditions, for both plots were worked down thoroughly and each year the stands obtained were apparently equal. These data also show that flax grown on oats stubble that was plowed in December produced an average of only 3.92 bushels per acre and that flax grown on similar oats stubble plowed in July produced an average yield of 12 bushels, an average increase of over 8 bushels from summer plowing.

It is significant that the average yield of flax in Kansas, produced largely on spring-disked corn ground, is within a bushel of the yield produced by that method in this test. This agreement between the statewide and experimental yields of flax when grown by the customary methods of seed bed preparation, indicates that the higher yields obtained by plowing corn ground in the fall, by plowing small grain land in the summer, or by preceding flax with a legume, might reasonably be expected when these methods are used in commercial flax production.

HANDLING THE MATURE CROP

HARVESTING

Flax should be harvested when the bolls have turned brown, the stems are turning yellow, and the leaves have fallen off. Wet weather in June may cause the flax to put out a late crop of bolls which will not be mature when the major crop is ready to harvest. Sometimes when the main crop is light and the late crop heavy it may be advisable to wait until all the

bolts are ripe. This delay in harvesting will often cause some losses from shattering and weather damage of the first set of bolts. Delayed harvesting also increases the amount of weeds that must be handled with the flax.

Flax may be harvested satisfactorily with the self-rake reaper, the grain binder, or the combine harvester-thresher. Where a self-rake reaper is available it is usually used for flax as the losses from shattering are less than with a binder.

Grain binders are available in practically all communities and are satisfactory machines for harvesting flax. The packers of the binder may cause some shattering if the flax is over-ripe. Many flax growers do not use twine in the binder but let the flax fall from the machine in bunches



Fig. 2.—A portion of the platform canvas of a binder prepared for cutting flax by having a strip of canvas sewed on the front side.

which are matted together enough to be handled with a pitchfork. The flax straw is much tougher than wheat or oats but a sharp sickle will cut it without difficulty. The straw frequently catches under the slats of the platform canvas and is drawn under the platform, eventually stopping the machine. This trouble can be avoided by tacking or sewing a strip of canvas eight to twelve inches wide on top of the slats of the platform canvas at the forward edge as shown in figure 2.

After flax has been bound it should be cured in small shocks. Rain on flax in the field damages it more than it does wheat or oats. If flax cannot be threshed from the fields as soon as it is cured sufficiently, it should be stacked and the stacks covered with long grass or canvas. In handling flax tight-bottomed wagons should be used to save the shattered grain. Flax clings together so that it is not necessary or desirable to tramp it when loading on wagons or when stacking.

When flax ripens evenly a combined harvester-thresher handles it very satisfactorily. When there is a second growth of flax or when there are many green weeds present, the flax cannot be separated or stored if combined directly. In this case a windrower and pickup attachment should be used.

THRESHING

Flax should be threshed only when thoroughly dry. When flax is dry enough to thresh and the grain is dry enough to store without danger, the little points on the end of the bolls will stand slightly apart. When, because of insufficient curing, rain, or atmospheric moisture, the flax is too moist to thresh, the points will be closed.

Flax can be threshed in any separator tight enough to prevent leaking of the grain by using sharp cylinder and concave teeth and the proper screens. Ample reserve power is needed for threshing because of the toughness of the straw. In order to do a good job of threshing it is essential that the flax be fed to the separator evenly. The profit from a flax crop is frequently lost by blowing part of the seed into the straw pile in an attempt to get dockage-free flax. Flax is bought on a dirt-free basis so that there should be no objection to a reasonable amount of trash in the grain as it comes from the separator. In threshing, the straw pile should be watched much closer than the grain spout.

STORING

Flax seed is usually sacked at the thresher or hauled in canvas-lined wagons or trucks. The seed is so small and slick that only the tightest wagon-boxes or bins will hold it. If the flax to be saved for seed is dry, there is little difficulty in storing it, the main requirements being a tight bin with a good roof. Before storing seed flax it is advisable to remove the foreign material. The particles of stem and weed are usually higher in moisture content than the seed.

MARKETING

Most Kansas flax is marketed direct from the thresher in July and

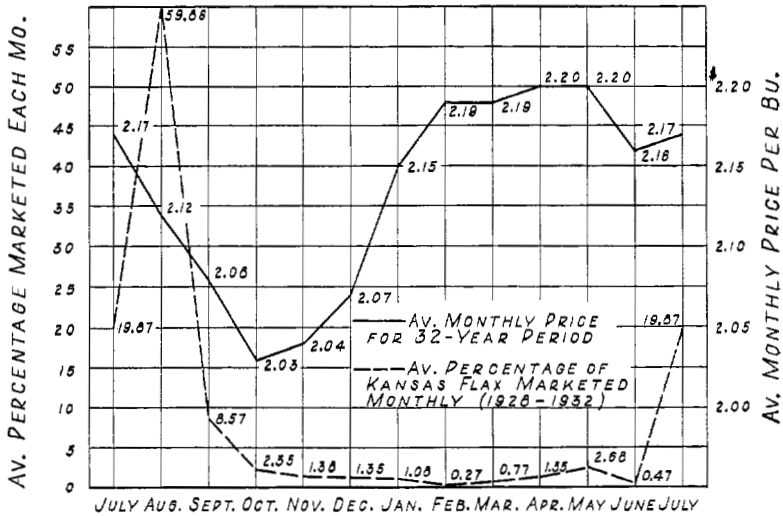


Fig. 3.—Average monthly fluctuations in the Minneapolis price of flaxseed and in the percentage of the Kansas flax crop delivered to market. The average price for each month is the grand average for a 32-year period, taking the average of the daily closing prices for each month as the price for the month. (Data from U. S. D. A. Yearbook, 1932.) The percentage of Kansas flaxseed marketed each month is the average for the 5-year period, 1928-'32. (Data compiled by the Fredonia Linseed Oil Works Company.)

August. There are two reasons for this. Flax is difficult to store on the farm and the price is better at that time of the year than any other time until late the next spring. The 32-year average monthly prices of flax at the Minneapolis market are shown in figure 3. The lowest prices occurred in October when the bulk of the northern crop is coming on the market. Kansas flax is harvested in July and can usually be marketed in July or early August and so advantage can be taken of the old crop prices.

SUMMARY

Since 1909 the United States has consumed more flax than it has produced. This makes the 66-cent tariff effective.

Kansas has been producing about 260,000 bushels of flax annually, which is but one-sixth of the capacity of the linseed oil mill at Fredonia, Kan.

Flax is as profitable as wheat and more profitable than oats in southeastern Kansas. The crop is not hard on the land, the straw is high in feeding value, and its inclusion in small-grain farming systems makes for more efficient labor distribution.

Flax has few disease and insect problems, is an excellent nurse crop, and leaves the soil in good physical condition.

A firm, well-pulverized seed bed should be prepared early for flax. Three pecks of seed should be seeded as soon after the middle of March as possible and should not be covered more than one inch. It may be drilled or broadcast, drilling being preferable.

Linota is well adapted in southeastern Kansas, is wilt-resistant, and has made the highest yield among varieties used.

Commercial fertilizers are not recommended for flax. Manure increases the yield but should be applied to some cultivated crop ahead of the flax.

Flax does best on heavy, cold lands but will not compete with weeds so successfully as other small grains. Legumes in the rotation increase the flax yields. Small-grain stubble plowed in July has produced three times as much flax as similar stubble plowed in December.

Flax can be harvested with a self-rake reaper, binder, or combine. This should be done when the bolls are ripe and the stems are drying. As soon as the flax is cured sufficiently, it should be threshed or stacked. Any good separator can thresh flax with the proper screens and adjustments. It is more important to keep the flaxseed out of the straw pile than to keep the trash out of the seed. Flax should be handled in sacks or very tight vehicles.

Kansas flax should be put on the market before the bulk of the northern crop has depressed the price.

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Other recent publications of the Agricultural Experiment Station of interest to farmers (especially farmers in southeastern Kansas) include the following:

Bul. No.

- 253 Tame Pastures in Kansas. (39 pp., 11 illus.)
- 255 Dairy Farm Organization in Southeastern Kansas. (76 pp., 15 illus.)
- 260 Soil Fertility. (59 pp., 21 illus.)
- 265 Sorghum Production in Kansas. (47 pp., 17 illus.)

Circ. No.

- 150 Accounts for Kansas Farms. (35 pp., 4 illus.)
- 163 Korean Lespedeza. (6 pp.)
- 172 Growing Tomatoes in Kansas. (14 pp., 4 illus.)

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