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Growing Flax in South Dakota

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AGRICULTURAL EXPERIMENT STATION
of the
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Brookings

DIGEST

1. Flax has been a profitable crop during the past three years. This has resulted in a great increase in flax acreage. Consumption of flax in the United States has also increased greatly. But if the present good prices are to continue, a balance between production and consumption of flax in this country must be maintained.

2. Secure flax seed of a disease resistant strain. There are several strains of flax in this and other states that have proven their ability to resist disease and to yield well.

3. Avoid sowing any great area of flax on poorly adapted land. This might at once overdo the market and result in loss to the producer.

4. Seed flax seasonably early, not delaying until summer seeding as has occasionally been practiced,—as nearly as possible to April 15.

5. Seed not less than 20 quarts of seed per acre. Experiments to date seem to indicate that this quantity results in the best yield and that lesser amounts are insufficient to give maximum returns from the land.

6. Growers have occasionally favored the practice of seeding flax and wheat in mixture. Experiments at Brookings, under the conditions of eastern South Dakota point to some possible advantages, without assuming that this should become the universal practice.

Flax Growing in South Dakota

A. N. HUME, E. W. HARDIES, AND CLIFFORD FRANZKE

From 1909 to 1921, the production of flaxseed in the United States decreased both in total quantity and in proportion to consumption. In the last three years of that period, production was scarcely one-third of our requirements. The relatively low price of wheat in 1921 and 1922, and the recognized need for diversification in the spring wheat belt led to an increase in the acreage of flax, beginning in 1922. Without regard to any effect of the wheat situation, seed flax has been a profitable crop during the past three years.

The result of these conditions has been a great increase in flax acreage in the principal producing states. The area was increased from 1,113,000 acres in 1922 to 2,014,000 acres in 1923, and 3,289,000 acres in 1924. The increase was 81 per cent in 1923 and 63 per cent in 1924. In 1922, the acre yield was 9.3 bushels and the total production 10,375,000 bushels. In 1923, the acre yield was 8.5 bushels and the total production 17,060,000 bushels. The average acre yield in 1924 was 9.2 bushels, producing 30,173,000 bushels, the largest crop ever harvested in the United States. The average acre yield in the three years from 1922 to 1924, inclusive, was 9 bushels. In the five years from 1920 to 1924, inclusive, it was 8.1 bushels; and in the 10 years from 1915 to 1924, inclusive, it was 7.7 bushels.

Flax Consumption

The average annual consumption of flax seed, including imports of linseed oil in terms of seed, during the 10-year period from 1911 to 1920, inclusive, was 26,733,000 bushels. The quantity consumed has increased greatly during the past four years. Consumption in 1921 (the year ended June 30, 1922) was 30,507,807 bushels. It increased to 38,242,000 bushels in 1922 and was 37,448,000 bushels in 1923.

It is estimated by commercial agencies that 40 million bushels of flaxseed will be consumed in the United States in 1924, the consumption year ending June 30, 1925. As shown in Table I, the domestic production in 1924 was 30,173,000 bushels and the imports from July 1 to December 31, 1924, were 5,124,033 bushels, a total of 35,297,033 bushels. These imports cover only the first half of the import year. In addi-

tion, it is reported that about 700,000 bushels are now (January, 1925) enroute from Argentina and that more than 2 million bushels are in terminal storage in Canada awaiting import to the United States by water next spring. Linseed crushers and large users of linseed oil are of the opinion that in the future the industry will require approximately 40 million bushels of flaxseed annually if present conditions of consumption continue. The production, net imports including linseed oil in terms of flaxseed, and the net supply available for consumption each year from 1911 to 1924 are shown in Table I.

TABLE I.

FLAXSEED PRODUCTION, NET IMPORTS, INCLUDING LINSEED OIL IN TERMS OF SEED, AND NET SUPPLY IN THE UNITED STATES FROM 1911 TO 1924, INCLUSIVE.

Year Beginning July 1	Production	(a) Net Imports	Net Supply
	Bushels	Bushels	Bushels
1911	19,370,000	7,011,381	26,381,381
1912	28,073,000	4,653,131	32,726,131
1913	17,853,000	8,328,577	26,181,577
1914	13,749,000	10,328,301	24,077,301
1915	14,030,000	14,411,013	28,441,013
1916	14,296,000	11,956,672	26,252,672
1917	9,164,000	12,888,312	22,052,312
1918	13,369,000	8,368,020	21,737,020
1919	7,256,000	24,706,304	31,962,304
1920	10,774,000	16,743,049	27,517,049
1921	8,029,000	22,478,807	30,507,807
1922	10,375,000	27,867,514	38,242,514
1923	17,060,000	20,388,044	37,448,044
1924	(b) 30,173,000	(c) 5,124,033	(c) 35,297,033

(a) Of linseed oil, 18¾ pounds are equivalent to 1 bushel of flaxseed.
(b) Preliminary estimate.
(c) Six months, July 1 to Dec. 31, 1924.

Flax Seed Prices and The Tariff

The tariff act of 1922 provides an import duty of 40 cents per bushel on flaxseed (par. 760) and of 3.3 cents per pound on linseed oil (par. 54). A drawback (sec. 313), or refund, is provided, however, in case linseed cake or oil made from imported seed is exported. As the bulk of linseed cake is exported, the drawback usually amounts to about 10 cents per bushel on imported flaxseed. Deducting this drawback, the net duty on flax seed is approximately 30 cents per bushel. In a general way, this duty is reflected in the higher price paid to producers in the United States, as shown by comparing the average prices of flaxseed at Minneapolis and Winnipeg.

The effect on the price of flaxseed of a domestic crop approaching the domestic demand was apparent during the fall months of 1924. The price at Minneapolis during Sep-

tember averaged only about 5 cents per bushel higher than that at Winnipeg. This slight spread was due in part to speculative activity in the latter market, but it was in part a reflection of the fact that the 1924 production promised to equal the average consumption of the country for the past several years. As the season advanced, the spread between the two markets gradually increased, Minneapolis averaging 8 cents higher than Winnipeg during October, 27 cents higher during November, and about 41 cents higher during December, when the demand for flaxseed was very keen.

The World Outlook

World production of flaxseed has been on the increase since 1921. Pre-war production, 1909 to 1913, averaged about 111 million bushels annually. The production of 1923 was estimated at about 125 million bushels and that of 1924 at 133 million bushels. World consumption is also increasing. Argentina, India, and Canada are the chief surplus-producing countries. The 1924-25 Argentina crop now (January, 1925) being harvested is forecast at 51,966,000 bushels, or some 6½ million bushels less than the crop of last year. This smaller Argentine crop and the present strong world demand for flaxseed should tend to keep the world price up. It must be remembered, however, that the present high prices for flaxseed are likely to stimulate the seeding of a larger acreage in Canada and Argentina as well as in the United States, which might cause reduced world prices. Even should the world price drop, the large estimated consumption in the United States should provide a favorable home market for the domestic flax crop of 1925, if production does not too closely approach the domestic requirements.

The foregoing statements concerning the apparent flax situation are abstracted without much alteration from United States Department of Agriculture Circular 341.*

GROWING FLAX IN SOUTH DAKOTA

The flax grower will do well to seed the crop with the most careful consideration of such factors as choice of suitable land, disease resistant seed, seasonable seeding, and optimum amounts of seed. Any grower who cannot get good seed to put on land well adapted to flax, and who cannot seed seasonably, should avoid flax as a crop.

The present statement concerning flax growing in South Dakota offers additional information to that which has been

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published on three phases of the subject, namely, rate of seeding, date of seeding, and comparative production from seeding alone and in mixtures. The latter subject has not previously been published upon by this experiment station. However, it is a subject that has been recently discussed and in South Dakota and elsewhere many inquiries have been made concerning it.

Varieties of Flax

Results of tests with flax varieties were published in 1916 in Bulletin 169 which contained a summary on tests of ten varieties and strains. It is increasingly evident that flax varieties which have the highest yielding capacity are those which are most disease resistant. Several strains of flax in this and other states have proven their superiority in this respect. Among these are Immune No. 52, S. D. 29;

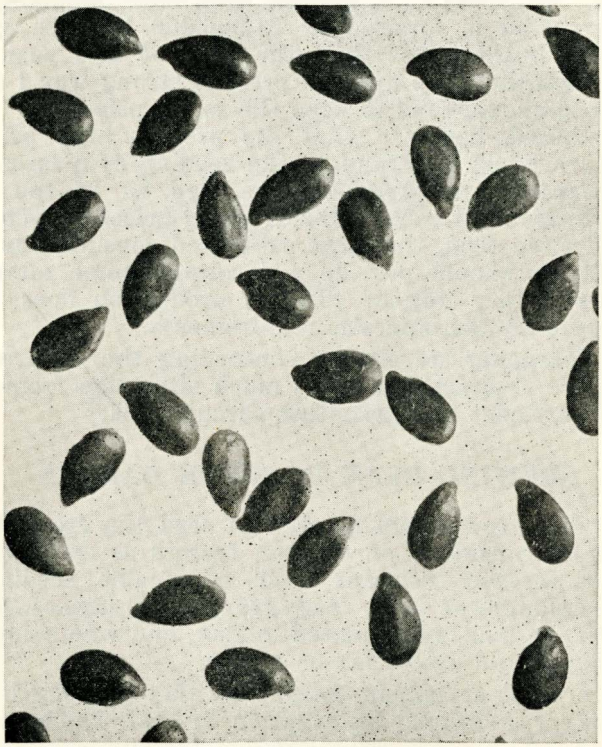

Fig. 1.—Clean, plump flaxseed is necessary for best results.

North Dakota 114, S. D. 688; and Primost, Minn. 25, S. D. 25. At the present time, the Agronomy Department has about 30 strains selected, some of which give evidence of being resistant and of having yielding power. At the present date, they are not ready for distribution in quantity.

It is important that flax growers should secure a supply of good seed early from seed stocks that are known to be resistant. One of the important factors in successful flax production is the use of clean, plump, healthy seed. Especially is this true in the older sections which are infected with flax diseases. The fanning mill is a valuable aid in this connection. With it, one can remove the dirt, chaff, broken seed and the light, immature or shrunken seeds. In this way, many of the seeds which are internally diseased are blown out.

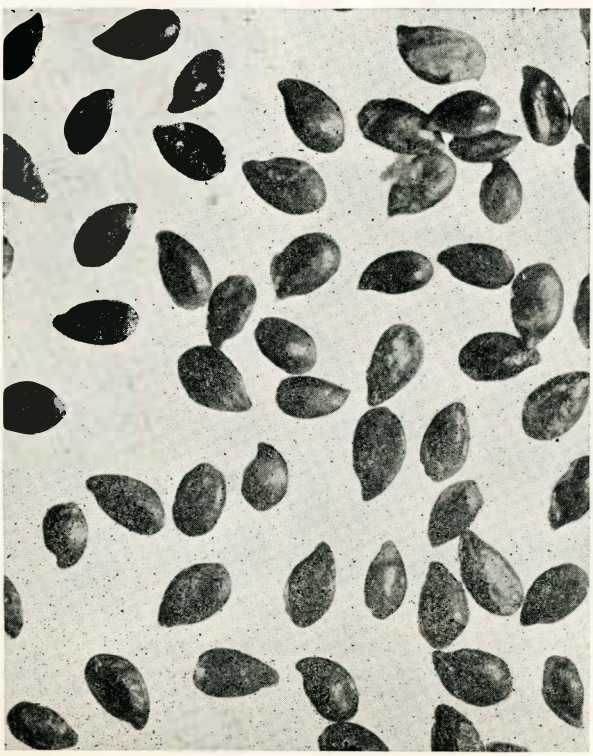

Fig. 2.—Shriveled, diseased seed should be eliminated by thorough cleaning and grading.

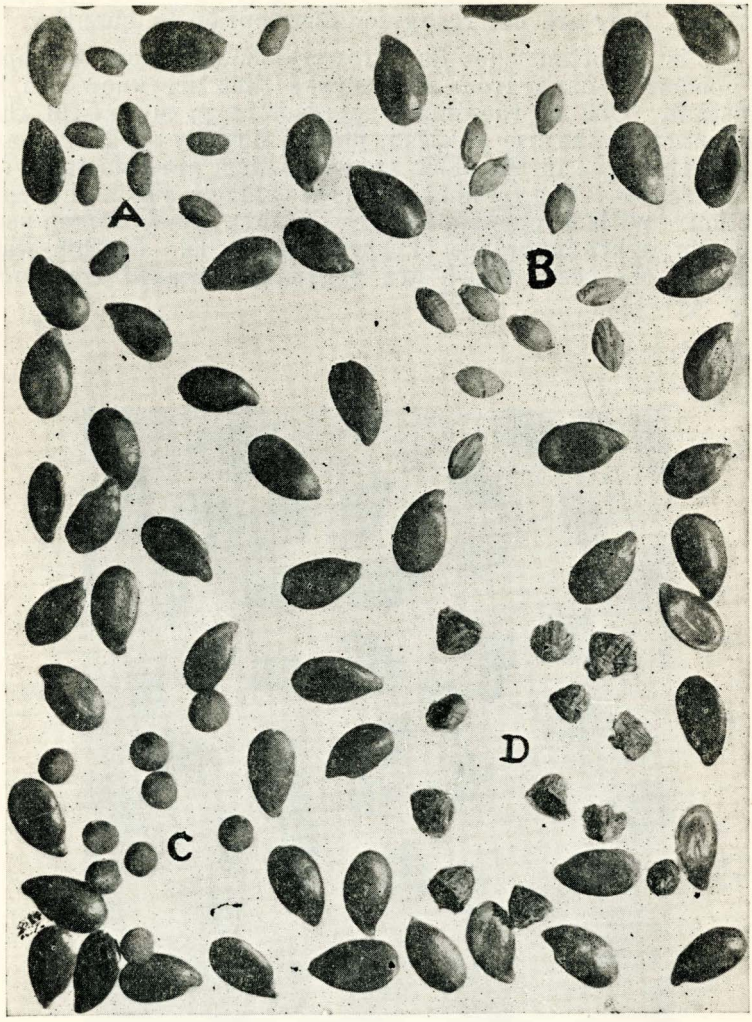

FIG. 3.—UNCLEAN FLAXSEED

Flaxseed is more difficult to clean than larger grain. Some common impurities shown in Figure 3 are: a.—false flax; b.—foxtail; c.—dodder; d.—Russian thistle.

Date of Seeding

After the question of seed supply of a resistant strain has been taken care of, the next question is the date of seeding.

In South Dakota Experiment Station Bulletin No. 169, experiments were reported from Highmore, Eureka, and Cottonwood, giving conclusions from seeding flax at earlier and later dates. The results indicated that the common practice of seeding flax as late as May and June brought lower yields than would be secured from earlier seeding. The following statement first issued in 1916 in Bulletin No. 169 has presumably increased the returns from flax, not only in South Dakota, but throughout the flax growing area of the country:

"Flax has been considered a tender plant, and is not usually seeded until after all danger of frost is past. It is not uncommon for a farmer to seed flax as late as June 15 and even then get a good crop. **This is possible, not because of the late seeding, but in spite of it. Furthermore, flax is not as tender as is commonly believed, and seeding as early as April 15 is not only possible but is very desirable.** Flax plants are able to withstand a considerable degree of cold after they have passed the two-leaf stage."

Since the publication of this statement and the data upon which it was based, additional results from several seasons have been secured. Table II includes yields previously published from dates of seeding at Highmore and additional yields secured since.

TABLE II.

ANNUAL AND AVERAGE YIELDS FROM SEEDING FLAX IN TESTS AT HIGHMORE

Date	Yields in Bushels per Acre in Given Years											*
Seeded	1914	1915	1917	1918	1919	1920	1921	1922	1923	1924	Ave.	
March 1.	.....	.....	.....	0.0	.....	.....	0.0	.....	.....	.....	0.0	0
March 15	.....	.....	.....	0.9	.....	.....	0.0	.....	.....	.....	0.45	0
April 1..	9.6	.....	.....	6.0	7.1	10.8	3.1	11.6	6.2	12.0	8.3	2
April 15.	2.7	29.9	8.3	6.0	7.8	.....	2.2	12.5	16.0	10.0	10.6	4
May 1...	6.3	23.2	7.6	8.0	4.0	15.8	4.5	10.7	3.6	8.2	9.19	2
May 15..	2.3	26.8	14.7	9.8	7.6	8.1	.....	6.3	1.1	8.6	9.47	2
June 1..	.....	.....	3.4	3.7	1.1	.....	.....	3.4	3.6	.....	3.04	0
June 15.	.....	.....	.....	1.3	.....	.....	.....	.....	.....	.....	1.3	0

*Frequency of securing the highest yield from seeding on given date.

In observing these results, it is well to note not only the average yields from seeding at earlier and later dates, but likewise the number of times, in the total of ten seasons,

when the maximum yield occurs from a given date of seeding. Accordingly, in the last column of the table the frequency of securing the highest yield from seeding on a given date is recorded. Out of the total ten seasons reported, the highest yield in four instances was secured from seeding April 15 rather than on any other date earlier or later.

Examination of Table II also makes it evident that the **highest average yield** of flax at Highmore was secured from seeding April 15, which is in agreement with the results for 1914-15 recorded in Bulletin No. 169. Variations are evidently within the limit of error, and do not reverse this outstanding fact.

Attention is called to the fact that the dates put down for seeding are in no case more than a very few removed from the day the flax seed was put into the ground. If a storm occurred on the proposed date of seeding, seeding was postponed until a day or two following; but if seeding proved impossible until the next date, the space in Table II is left blank. It has always proven possibe to seed flax at Highmore close to April 15 with the highest average yield resulting.

Accordingly, the evidence available to date substantiates the former conclusion published in 1916 in Bulletin No. 169 that, so far as time of seeding is concerned at Highmore, the optimum date is as nearly as possible April 15.

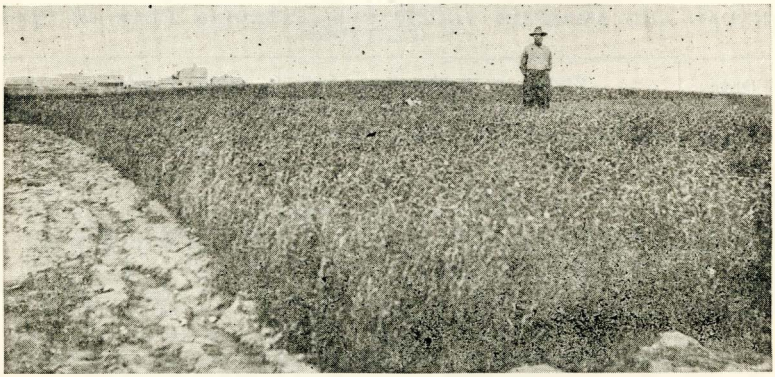

FIG. 4.—EARLY SEEDED FLAX

This field of Resistant, N. D. 52 flax was seeded on potato ground April 15 at Eureka Station. Compare with flax shown in Figure 5 seeded on same preparation on June 1. Both pictures taken June 28.

Date of Seeding Flax at Cottonwood

Plots of flax have also been seeded at different dates at Cottonwod; the results for 1913-1915 inclusive having been put down in Experiment Station Bulletin 169. Table III includes not only the data obtained up to 1916, but also the results secured in more recent years.

TABLE III.
YIELDS OF FLAX FROM SEEDING AT EARLIER AND LATER DATES AT COTTONWOOD

	Yield of Flax in Bu. per Acre for Given Date of Yr.											
Date of Seeding	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	Av.
April 15	1.7	1.6	8.4	2.4	3.1	....	3.1	6.1	....	2.1	8.6	4.1
May 1	0.8	1.4	7.1	2.1	2.9	5.4	....	2.0	....	0.8	8.7	3.5
May 15	0.0	1.5	5.9	1.4	1.3	3.9	0.5	0.4	....	1.4	6.8	2.3
June 1	0.0	0.0	8.9	2.4	3.0	4.1	0.0	....	0.1	1.2	14.3	3.4
June 15	0.0	0.0	10.9	2.4	3.7	6.2	0.0	....	0.2	0.7	15.4	3.9

An inspection of the Table III will reveal the fact that the location of flax plots at Cottonwood has been unfavorable and resulted in yields evidently below normal for the locality. However, the indications favor seeding on the date of April 15 rather than on any later date, recognizing whatever variation occurs in plot yields.

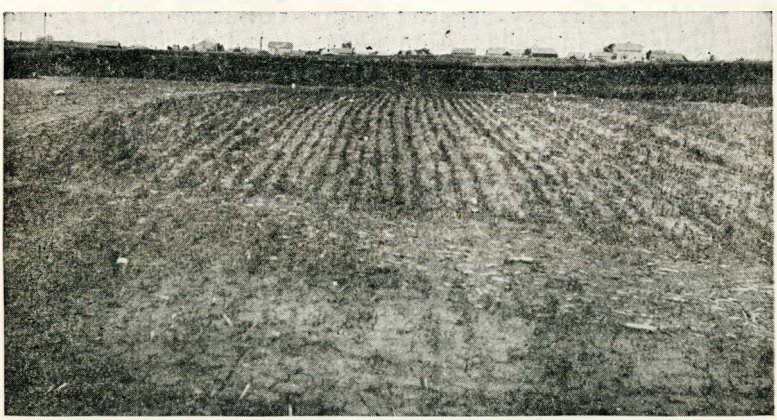

FIG. 5.—LATE SEEDED FLAX

This field of Resistant N. D. 52 was seeded on the same preparation as that shown in Figure 4 but was seeded June 1.

Dates of Seeding Flax at Eureka

Experiments have likewise been conducted at Eureka with seeding flax at earlier and later dates beginning as early in the season as March 1, when season permitted, and terminating June 15.

Results for 1913-1915 were also reported in Experiment Station Bulletin 169. Recent results are included in Table IV along with those previously reported.

TABLE IV.

YIELDS OF FLAX FROM SEEDING AT EARLIER AND LATER DATES AT EUREKA.

Date of	Yield of Flax in Bu. per Acre for Given Date of Year													
Seeding	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	Av.	*
April 15 ..	0.4	11.6	18.5	18.4	5.8	0.4	3.7	10.3	3.9	17.7	13.9	10.0	9.6	6
May 1	2.0	9.3	11.4	18.2	5.5	0.2	4.4	13.5	5.0	16.2	12.1	11.4	9.1	1
May 15 ...	2.1	5.0	8.6	14.8	5.5	1.1	4.8	8.9	9.8	14.2	8.9	13.3	8.1	3
June 1	2.7	4.5	6.4	12.8	0.4	0.1	0.0	0.4	10.3	9.6	6.8	7.1	5.1	2
June 15 ...	0.2	1.0	4.6	12.1	0.4	0.1	0.0	0.0	8.7	4.6	8.7	3.0	3.6	0

*Frequency of highest yield from given date.

The results of the experiments at Eureka as well as at Cottonwood and Highmore indicate that the highest average yields of flax are secured from seeding as early as April 15. Variation in yields from plots seeded at different dates are small enough so that a regular diminution has resulted in

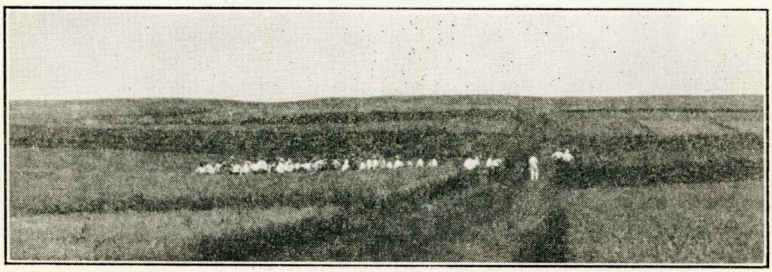

FIG. 6.—FARMERS INSPECTING FLAX PLOTS
Picture taken at Field Day at Eureka Station on July 13, 1923.

average yields of twelve seasons from seeding on dates beginning April 15 and following successively on May 1, May 15, June 1, and June 15. The last column of the table shows that the highest yield in the several years occurred from the seeding of April 15 only six times out of the twelve. However, no other date of seeding resulted in the highest yield oftener than three times out of twelve. Eureka is the farthest point north at which this Experiment Station has made trials with date of seeding flax. The results at this station indicate that not only the highest average yields were secured from seeding April 15, but seeding at that date has not resulted in absolute loss of crop due to freezing in any one year out of twelve.

The evidence from Eureka thus substantiates the results from Highmore and Cottonwood to the effect that the date of seeding flax in order to secure the highest yield is probably April 15.

The Best Date of Seeding Flax

It seems evident from the data put down in Tables II, III and IV, that the conclusions previously published in Bulletin 169 were well taken. It was pointed out in that earlier bulletin that flax should be seeded in April. At the time of its first publication, such a statement was somewhat revolutionary. In rare instances flax seeded in April is killed by freezing. Thousands of acres of flax have been seeded earlier following the advice published in Bulletin 169, and thousands of bushels of increase in flax yield have resulted.

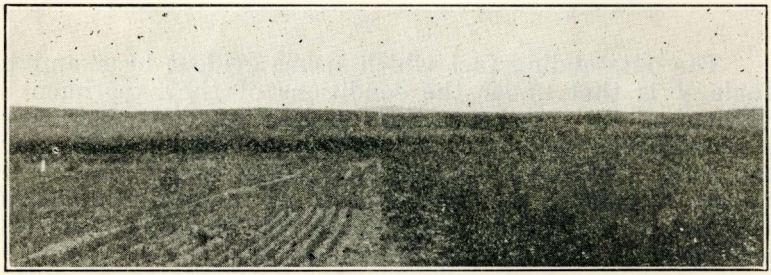

FIG. 7.—COMPARISON OF SEEDING DATES

Flax at left seeded June 1; at right seeded April 15. Photograph taken at Cottonwood Station on July 9, 1923.

If any change in statement on the basis of later experimental results were made, it would be in the line of emphasizing the desirability of seeding flax on April 15 or as near to that date as immediate weather conditions and arrangement of work will permit.

Rate of Seeding

One of the immediate questions of concern to flax growers is that of the amount of seed to sow per acre. Experiments with seeding smaller and larger amounts varying from 10 to 20 quarts per acre have been conducted at Highmore, through the years 1917-1924. The results from this project are tabulated in Table V.

TABLE V.

YIELDS FROM SEEDING FLAX AT SEVERAL RATES AT HIGHMORE.

Year	Yield in Bushels per Acre from Seeding at Several Rates in Given Year				
	10 quarts	12 quarts	15 quarts	17 quarts	20 quarts
1917	4.3 Bu.	5.6 Bu.	4.7 Bu.	4.0 Bu.	3.6 Bu.
1918	3.4	3.4	4.2	2.7	5.5
1919	1.3	1.3	2.0	1.8	1.7
1920	6.8	8.9	7.6	10.8	14.3
1921	1.8	2.2	2.2	2.2	4.0
1922	16.1	15.9	14.3	11.3	13.4
1923	6.3	8.0	8.0	8.0	8.0
1924	6.2	6.2	9.8	10.2	7.8
Av.	5.8	6.4	6.6	6.4	7.4

The outstanding fact which seems evident by examining Table V is that under the conditions of the experiment at Highmore, the returns from seeding smaller and larger amounts of flax per acre increased up to seeding of 20 quarts per acre. This was the largest amount seeded in any instance. Evidently the seeding of 10 or 12 quarts is insufficient, and in the future experiments will be carried out with seeding more heavily than 20 quarts.

In the meantime, it is suggested that growers use not less than 20 quarts per acre as an amount of flax to seed.

Flax and Wheat—Clear or Mixture

A comparison of results from seeding wheat and flax, either clear or in a mixture, has been carried through two seasons, 1923 and 1924, at Brookings. It is now possible to put down yields from these tests.

Manner and Rate of Seeding

In both years, the amount of land at Brookings, which could be devoted to these trials consisted of three one-tenth acre plots. One plot each year was seeded to clear flax, one to clear wheat, and one to flax-wheat mixture.

In both years, the rate of seeding for clear wheat was 5 pecks per acre, and for clear flax 28 pounds per acre. When the wheat-flax mixture was seeded, the amount of seed in the mixture put on per acre was 2½ pecks of wheat and 14 pounds of flax. The kind of wheat seeded was Marquis and the flax was N. D. 114.

Table VI summarizes the yields of clean wheat and flax respectively harvested from the plots seeded by the several methods:

TABLE VI.

ACTUAL YIELDS OF FLAX AND WHEAT FROM PLOTS AT BROOKINGS SEEDED (a) WITH CLEAR FLAX (b) WITH CLEAR WHEAT (c) WITH FLAX-WHEAT MIXTURE

Year	Yield in Bushels per acre from Plot Seeded as Indicated			
	Clear Flax	Clear Wheat	Flax-wheat Mixture Flax	Wheat
1923	7.0	5.0	2.6	4.8
1924	15.9	19.3	6.9	15.5
Av.	11.4	12.1	4.7	10.1

It may be readily seen from Table VI that the yield per acre of both wheat and flax was reduced in both years, 1923 and 1924, on a basis of bushels per acre, when yields from flax sowed clear or from clear wheat are compared with yields of the same from mixtures. This was the result in both 1923 and 1924, and was also the result expressed in the average yields for the two years. The average yields per acre of both flax and wheat seeded alone were reduced as compared with the yield of either seeded in the mixture.

The significance of this statement may become clearer by attempting to make comparison of yields of both flax and wheat from equivalent areas of land; producing in the first instance clear flax and clear wheat separately, and in the second instance, flax and wheat seeded in mixture, under the conditions of this experiment.

Assume two acres of land or multiple thereof in each of two fields for comparison. Assume further that the first field was seeded by putting in one acre of clear flax and one acre of clear wheat; and that the second field was seeded with flax-wheat mixture, both acres alike. The question is what amounts of flax and wheat will be produced from each of the two equivalent fields.

The figures of production based on this assumption are put down in Table VII for easier comparison:

TABLE VII.

CALCULATED TOTAL AMOUNTS OF FLAX AND WHEAT PRODUCED FROM TWO ACRES OF LAND BY SEEDING (1) ONE ACRE OF CLEAR FLAX PLUS ONE ACRE OF CLEAR WHEAT AND (2) TWO ACRES OF FLAX AND WHEAT IN MIXTURE.

	Yield of Flax or Wheat Produced from Land Seeded as Indicated.					
Year	Produced from one acre seeded to		From two acres total of mixture	Produced from two acres seeded in flax-wheat mixture		From two acres total of mixture
	Clear Flax	Clear Wheat		Flax	Wheat	
1923	7.0	5.0	12.0	5.2	9.6	14.8
1924	15.9	19.3	35.2	13.8	31.0	44.8
Av.	11.4	12.1	23.6	9.5	20.3	29.8

Certain facts are evident by examining the yields set down in Table VII.

1. Under the conditions of the experiment in both years a larger total yield of flax was produced from one acre seeded to clear flax than from two acres seeded in a mixture with wheat.

2. Simultaneously, the reverse was true with wheat. A larger total yield of wheat was produced from two acres of flax-wheat mixture than from one acre of clear wheat.

3. Moreover, the increase indicated for wheat was evidently greater in number of bushels than the decrease in flax which must explain the following fact.

4. The combined production from two acres in bushels per acre of flax and wheat taken together was greater in both years where flax and wheat were seeded in mixture than where flax and wheat were seeded separately, each covering one acre.

It would seem impossible to make an interpretation of these facts relative to the yields put down in Table VII which would invariably be applied to general conditions. This is due to the fact that a given amount of flax and wheat are not

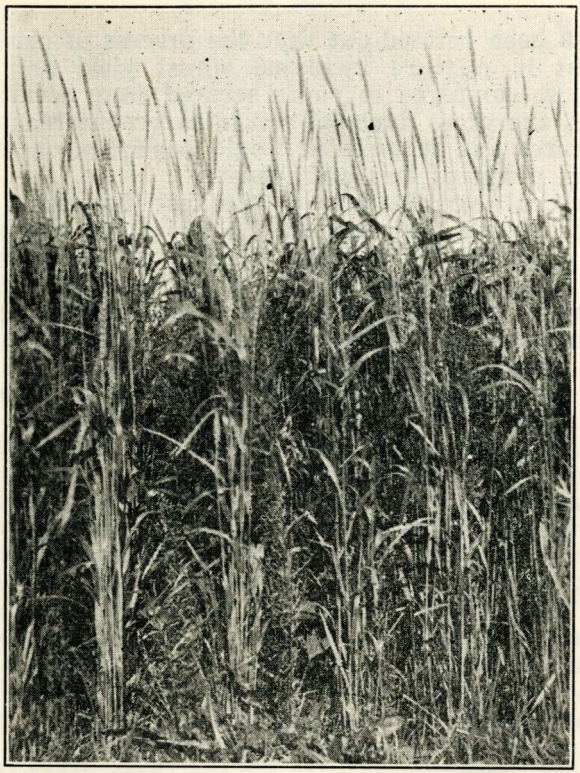

Fig. 8.—Flax-wheat mixture on College plots at Brookings, July 4, 1924.

equivalent, and there is no common denominator whereby production of one may be compared to production of the other. The comparison of total number of bushels produced from two acres of land, whether flax or wheat, may seem to be a sort of measure of total producing capacity of land; indicating in a very general way that flax and wheat seeded in mixture are capable of taking more complete possession of land as a crop, than either one growing alone.

The relative returns of each crop and consequent total returns are bound to be subject to modification due to rela-

tive amounts of flax and wheat in the mixtures harvested; this would doubtless be modified by relative amounts of flax seeded on land and to environmental factors. Some of these are not considered in the present brief report.

Financial Returns

It has been pointed out that the process of seeding flax and wheat in mixture increased wheat yield and reduced flax yield as compared to yields secured from seeding alone. Obviously, the gross financial return to producers, under the circumstances and in general, would depend upon yield and upon farm prices of flax and wheat.

A critical examination of the last horizontal line of Table VII reveals that the flax in two acres of flax-wheat mixture produced 9.5 bushels, which was 1.9 bushels less than the amount produced on the one acre of clear flax. On the contrary, two acres of wheat in the mixture produced 20.3 bushels which was 8.2 bushels more than the amount produced by the acre of clear wheat.

The question is whether the loss of 1.9 bushels of flax would be offset by the gain of 8.2 bushels of wheat.

Such a consideration makes it evident that farm prices of flax and wheat will not only be a factor, but that the relative prices of flax and wheat will be very important in determining whether the seeding of flax-wheat mixtures will yield greater or less return than seeding clear flax or clear wheat. Assuming that the average yields for 1923 and 1924 put down in Table VII will obtain for the future, the margin of 8.2 bushels of wheat, for covering a loss of 1.9 bushels of flax, seems sufficiently wide to warrant a thorough trial of the method of seeding flax-wheat mixtures by growers.

Future prices of flax and wheat cannot be predicted with certainty. It is possible to record the prices which have obtained for these commodities for the three years just past. These prices, as secured from the United States Department of Agriculture, are indicated in Table VIII.

TABLE VIII.
SOUTH DAKOTA FARM PRICES RECEIVED FOR WHEAT AND FLAX FOR YEARS 1922-1924 INCLUSIVE.

Commodity	South Dakota Farm Price for Given Year		
	1922	1923	1924
Flax	2.01	2.08	2.23
Wheat	0.92	0.81	1.25

With the use of the crop yields in Table VII and these prices one may compute gross returns, which in some sense represent amounts received for crops of flax and wheat whether clear or mixed in 1923 and 1924. These computations are made and the results appear in Table IX.

TABLE IX.

GROSS RETURNS FROM LAND IN DOLLARS, FROM FLAX AND WHEAT SEEDED CLEAR AND IN MIXTURES; BASED ON YIELDS IN TABLE VII AND PRICES IN TABLE VIII.

Year	Gross return from Land Seeded to Flax or Wheat, or Mixture					
	From 1 acre seeded to		Total from one acre flax and one acre wheat	From 2 acres flax-wheat mixture		
	Clear Flax	Clear Wheat		Flax	Wheat	Total
1923	14.56	4.05	18.61	10.82	7.78	18.60
1924	35.46	24.12	59.58	30.77	38.75	69.52
Av.	25.01	14.09	39.10	20.79	23.26	44.05

Certain facts may be observed from the foregoing table.

1. Greater gross receipts for flax were received from one acre of clear flax seeded along with one acre of clear wheat than from the flax in two acres of flax-wheat mixture.

2. Exactly the opposite was true of wheat; the gross receipts from the wheat on two acres of flax-wheat mixture was greater than from one acre of clear wheat.

3. The highest gross return in dollars from any land in the experiment was received from that seeded into flax-wheat mixture in 1924; and the highest average return, in dollars, in the two years was secured from land seeded in flax-wheat mixture.

Deductions

The statement made in the paragraph immediately preceding may be the most significant fact that appears from the present project of growing flax and wheat clear and in mixtures. Not only did the highest gross return in dollars from land seeded to flax and wheat come from that seeded in flax-wheat mixture, but it appears that this was due to the factor of high production from such land as it appears from Table VII.

It is difficult and perhaps futile to attempt to draw further deductions than this one which may be of assistance to

growers and prospective growers of flax and wheat. Further deductions should probably be termed "speculation" rather than anything else. Nevertheless, inquiries have come and doubtless will continue to come from growers who inquire briefly whether they should seed clear flax or clear wheat or whether they should sow flax and wheat in mixtures. The statement just made would be equivalent to making reply that those who seeded flax-wheat mixtures under the conditions of the present experiment secured larger gross returns than those who seeded clear flax and clear wheat in equal amounts.

Is it possible to determine whether such will be the case in the future?

A careful examination of the tables in this bulletin seems to indicate that the relative return from flax is reduced by seeding it in a mixture with wheat, but that the relative return from wheat is increased by seeding it in a mixture with flax. This situation has been true throughout the two years of the present experiment. If one were to judge the future by the past, growers who plan to produce equal amounts of flax and wheat might well seed them in mixture, so far as the factor of total production is concerned.

Apparently in the present project, the relatively higher return from land due to seeding flax and wheat in mixtures resulted from an increased return from wheat, rather than from and in spite of a decreased return from flax.

In the past two years, even though the price of flax has been relatively high as compared with the price of wheat, there has been some advantage to wheat growers from seeding flax with wheat as a mixture in case wheat growers wish to grow flax at all. One may hazard a guess that the farm price of flax will not become relatively higher as compared with the price of wheat, but rather that the price of wheat is more likely to become relatively higher as compared with the price of flax. If such proves to be the case so far as price is concerned, the procedure of mixing flax into wheat in the future will be as desirable as ever from the standpoint of wheat growers who desire to produce some flax.

Economists point out that there is some danger of overproduction of flax. If such be the case, it may be desirable to have whatever total reduction in flax output that might be incurred, by seeding flax with wheat, at the same time increasing the total area of flax. This same procedure of mixing flax into wheat might help control the total output of the cereal assuming that its area were not increased at the same time.

ANNUAL RAINFALL BY MONTHS AT THE SEVERAL STATIONS

BROOKINGS

	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	0.22	0.17	1.06	0.26	1.20	1.07	0.61	0.28	0.02	0.22	0.18	1.47	1.54	0.19	0.07	0.34	0.09	0.40	0.27	0.10
Feb.	1.00	0.02	0.28	1.80	1.57	0.40	0.53	0.24	0.09	0.40	1.12	0.32	0.47	0.14	0.63	0.24	0.05	1.73	0.07	0.31
March ..	0.68	0.58	0.55	1.16	0.37	0.35	0.53	0.26	0.45	0.42	0.18	0.50	1.09	0.44	0.73	1.85	1.49	0.79	0.29	1.34
April ...	1.01	1.40	1.67	2.10	1.16	2.34	1.62	3.36	2.24	1.64	2.03	2.95	3.09	1.28	1.90	2.95	1.42	0.42	3.00	1.82
May	6.14	3.51	2.36	6.46	4.85	0.87	1.90	6.98	3.60	4.16	2.12	3.72	3.08	3.40	3.87	3.84	2.99	1.82	2.59	1.32
June	6.09	4.89	5.65	6.35	2.29	1.85	3.78	2.09	1.96	6.67	3.28	4.27	3.49	1.85	9.30	7.27	0.85	3.75	5.74	6.88
July	0.98	1.86	3.77	4.69	2.44	1.68	3.32	2.52	2.99	1.62	3.04	0.40	2.03	3.95	5.60	5.45	3.44	2.81	1.94	1.22
August .	4.54	4.28	1.41	2.37	3.39	2.46	3.81	4.68	1.33	3.16	3.52	2.03	1.20	4.19	1.48	2.15	2.11	1.70	3.03	3.89
Sept. ...	2.16	5.13	1.28	3.89	1.67	0.96	3.08	1.61	1.55	3.32	2.68	0.84	2.89	0.72	1.69	1.99	4.25	0.36	1.73	1.02
October .	1.50	3.01	0.96	1.43	1.71	0.38	5.12	0.96	1.18	2.21	1.37	0.45	0.12	1.56	1.14	0.66	0.27	0.81	1.41	0.84
Nov.	2.45	0.89	0.10	1.30	0.65	0.17	0.23	0.00	0.81	T	0.28	0.03	0.04	1.61	1.35	1.30	0.50	3.08	0.23	0.11
Dec.	T	0.52	1.12	0.42	1.14	0.10	0.42	0.20	0.09	0.33	0.62	0.36	0.31	1.09	0.10	0.30	0.10	0.20	0.23	0.15
Total .	22.77	26.26	20.21	32.17	22.44	12.63	24.95	23.18	16.31	24.15	20.42	17.34	19.35	20.42	27.86	28.34	17.56	17.87	20.53	19.20

COTTONWOOD

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	0.66	T	0.17	0.16	0.03	0.39	0.04	0.45	0.32	0.04	0.27	0.17	0.94	0.00	0.00
February	0.97	0.15	0.05	0.10	1.18	1.57	0.02	1.50	1.50	0.29	0.54	0.10	0.32	T	0.00
March	0.76	T	3.00	0.43	0.35	0.46	0.04	0.31	0.34	0.71	0.58	0.17	0.00	0.00	0.32
April	1.06	0.85	3.32	1.15	2.26	2.80	0.81	0.80	2.27	3.57	2.80	0.40	1.25	0.66	0.06
May	2.54	1.10	1.18	2.95	2.35	6.61	3.87	3.30	2.78	1.29	5.83	2.91	2.87	2.41	0.29
June	1.30	0.64	0.95	0.59	1.64	4.79	1.83	0.62	1.37	4.97	4.02	0.78	5.43	4.87	3.03
July	1.11	0.59	2.42	0.81	1.04	4.58	1.80	0.90	2.29	2.05	0.67	3.58	6.48	5.28	1.78
August	0.48	2.41	3.42	1.84	1.88	2.51	2.22	2.00	3.43	0.20	1.87	1.10	0.72	3.08	1.48
September	0.82	3.59	1.30	1.15	1.19	2.42	0.18	1.17	1.43	0.25	1.63	0.41	0.16	3.05	1.00
October	0.32	1.15	0.11	0.76	2.23	0.90	0.57	0.14	0.28	2.03	0.93	0.78	0.92	1.89	0.85
November	0.53	0.20	T	0.14	0.02	T	0.15	0.39	0.11	0.71	0.36	0.29	2.32	0.18	0.31
December	3.00	0.42	0.12	0.38	0.84	0.10	0.14	0.50	0.25	0.20	0.18	0.21	0.00	4.00	0.17
Total	12.65	11.10	16.04	10.46	15.28	27.31	11.67	12.08	16.37	16.31	19.68	10.90	21.41	25.42	9.29

EUREKA

	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	0.10	0.60	0.50	0.25	0.10	0.22	0.90	0.79	0.40	0.14	0.07	0.16	0.44	0.16	0.13	0.02
February	0.45	1.70	0.73	0.40	0.03	0.05	1.08	0.13	0.20	0.50	1.04	0.08	0.05	0.94	0.17	0.24
March	0.14	1.23	0.62	1.05	0.09	0.13	0.23	1.78	1.46	0.58	0.52	0.27	1.27	0.30	0.35	0.48
April	0.50	0.82	2.24	1.29	0.68	2.07	1.83	0.88	2.18	1.98	1.28	1.63	3.74	0.89	1.31	1.28
May	2.65	0.42	0.97	3.37	1.97	2.20	2.58	3.57	1.30	1.97	3.68	1.82	3.31	3.39	3.55	0.44
June	3.35	3.80	1.29	1.50	2.91	4.28	4.66	4.16	1.61	0.93	2.29	4.26	0.52	3.38	4.17	5.24
July	2.21	0.53	0.43	2.19	2.16	1.25	3.38	—	1.04	1.03	4.08	2.49	4.57	1.66	3.67	3.29
August	1.39	2.60	3.27	3.27	1.53	2.11	2.47	4.62	0.93	1.77	0.77	2.05	4.45	0.45	1.72	1.35
September	1.25	3.65	1.15	1.43	0.54	0.70	3.74	1.05	0.67	0.36	0.04	3.90	3.29	0.54	2.56	2.65
October	0.17	0.18	0.61	0.07	1.52	0.87	3.10	0.29	0.06	0.55	1.13	0.36	1.64	0.63	1.52	2.16
November	0.60	T	0.88	T	0.06	T	0.56	0.14	2.00	0.53	0.12	0.54	0.36	3.90	0.22	0.00
December	2.40	0.25	0.80	0.11	0.52	0.53	0.36	0.06	0.75	0.20	0.32	0.09	0.24	0.23	0.20	0.27
Total	15.21	15.78	13.79	14.93	12.11	14.41	24.89	17.47	12.60	10.54	12.62	16.42	23.88	16.47	19.57	17.42

HIGHMORE

	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	T	0.26	0.82	0.11	0.13	0.05	0.13	0.43	1.40	1.12	0.60	0.10	0.27	0.25	0.45	0.42	0.07
February	0.53	0.34	0.19	0.39	0.11	0.30	0.62	1.28	0.27	0.52	0.25	1.35	0.53	T	0.93	0.01	0.01
March	0.00	0.13	0.58	2.54	0.27	0.87	0.45	0.37	0.74	1.27	0.45	1.24	1.20	0.49	1.05	1.01	1.63
April	1.35	0.30	1.40	0.32	1.05	1.27	3.65	2.50	0.89	2.79	2.57	1.96	2.56	1.78	0.93	1.63	1.40
May	2.68	4.72	0.94	2.31	2.20	4.56	2.23	3.48	4.15	2.04	3.57	6.63	6.04	2.60	2.78	2.04	0.50
June	5.78	1.69	3.74	0.09	1.31	0.97	4.09	4.87	4.54	2.04	1.59	1.95	7.35	0.55	3.60	5.15	5.66
July	2.49	1.81	0.85	2.69	1.44	1.79	2.01	5.55	2.10	1.91	5.26	2.65	3.56	3.14	2.85	3.81	2.11
August	3.53	3.74	0.66	2.52	3.39	1.20	1.16	0.78	4.10	0.68	1.88	0.82	2.47	3.68	0.41	5.01	1.13
September	0.62	1.70	0.89	3.06	0.71	0.53	1.01	2.36	2.75	2.03	0.62	0.54	1.51	4.79	0.48	1.17	2.69
October	2.19	1.04	0.24	1.05	0.20	0.61	1.92	1.15	0.58	0.06	0.49	2.16	0.75	1.20	0.39	0.87	1.10
November	1.39	0.71	0.40	0.35	0.00	0.03	—	0.32	0.13	0.07	1.10	1.80	0.84	0.33	2.83	0.21	0.34
December	0.31	1.41	0.44	0.44	0.35	0.28	0.25	0.20	0.47	0.27	0.86	0.15	0.20	0.20	0.35	0.19	0.32
Total	28.87	17.85	9.05	15.87	12.00	12.46	17.52	23.29	22.12	14.80	19.24	21.35	27.08	18.97	17.10	21.56	17.46

VIVIAN

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	0.50	1.00	1.35	1.10	——	——	0.19	0.47	0.03	0.00
February	1.77	0.04	0.18	0.50	0.32	0.58	0.01	0.40	0.03	0.70
March	1.19	0.29	1.00	0.50	0.66	1.52	0.68	0.75	0.00	0.85
April	2.62	1.08	2.38	3.92	4.14	4.55	1.53	0.71	1.47	0.90
May	3.02	3.46	5.20	3.33	3.23	7.51	4.23	2.49	1.59	0.05
June	4.31	4.49	1.18	1.70	5.01	5.54	1.22	5.85	4.04	4.44
July	6.76	3.53	1.02	2.07	4.00	3.42	4.34	3.44	1.98	2.14
August	1.12	3.52	2.01	3.32	0.94	1.86	0.44	3.86	3.19	1.16
September	3.16	0.90	2.64	0.75	1.70	0.80	3.55	0.27	1.03	1.79
October	1.12	0.57	0.00	0.82	1.95	2.09	1.68	0.45	1.03	1.17
November	0.38	0.12	——	0.22	1.91	1.32	0.63	2.32	0.33	0.28
December	0.03	0.04	0.32	0.90	0.13	0.28	0.28	0.15	1.50	0.40
Total	25.98	19.04	17.28	19.13	23.99	29.47	18.78	20.66	16.22	13.88

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208. Flowers Every Day in the Year.
209. Potatoes as a Feed for Fattening Pigs.
210 Some Chemical Characteristics of Soft Corn.

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