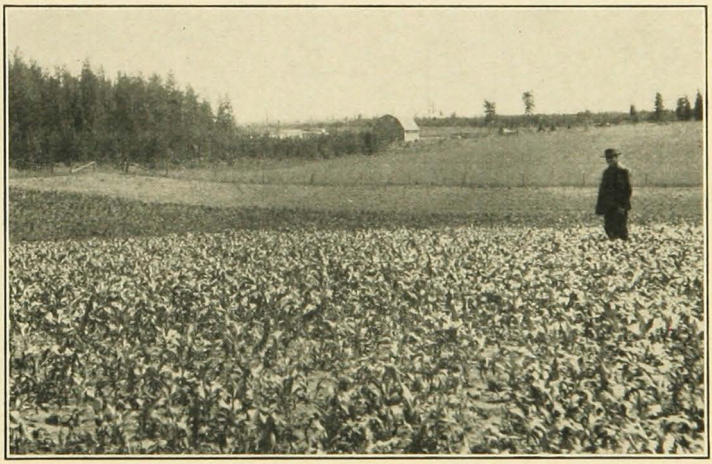
Bulletin 292 November, 1932

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

CROP INVESTIGATIONS ON PEAT LANDS

H. K. HAYES, A. C. ARNY, H. K. WILSON, LeROY POWERS
DIVISION OF AGRONOMY AND PLANT GENETICS



UNIVERSITY FARM, ST. PAUL

CONTENTS

CROP INVESTIGATIONS ON PEAT LANDS

H. K. HAYES, A. C. ARNY, H. K. WILSON, AND LEROY POWERS[1]

INTRODUCTION

Minnesota has more peat land than any other state in the Union, the total being estimated at 7,000,000 acres. The largest areas are found in the northern part of the state, especially in Lake of the Woods, Beltrami, Koochiching, and St. Louis Counties, but there is much in the central counties, as illustrated by the counties of which detailed soil surveys have been made. Thus, Anoka County has 103,000, Mille Lacs 87,000, Wadena 78,000, and Ramsey 11,000 acres of peat.

In 1917 the University of Minnesota leased three tracts of land with peat soil for experiments designed to determine what methods of soil management and fertilization would give the most profitable returns as well as what crops and what crop varieties would give the highest yields. One tract was located at Coon Creek, in Anoka County; another at Golden Valley, in Marshall County; and a third at Fens, in St. Louis County. After some years of experiments the work at Golden Valley and Fens, where the peat, like that at Coon Creek, is of the high-lime type, was discontinued, it being considered that these fields had served their purpose. A field of low-lime peat near Page, in Mille Lacs County, was leased for experimental purposes.

Variety trials were carried on at Coon Creek from 1919 to 1932; at Golden Valley, Fens, and Page for shorter periods.

On the fields at Coon Creek, Golden Valley, and Fens the peat is of the high-lime type and needs no application of lime to make it productive. At Golden Valley a regular addition of phosphate is necessary; at Coon Creek and Fens, of both phosphate and potash. Under ordinary conditions small grains and cultivated crops at both Coon Creek and Golden Valley give as high yields without any application of nitrogen fertilizer as they do with it. At Page liming is indispensable, as ordinary crops prove a complete failure, even when given liberal applications of phosphate and potash, unless the land is first limed, 2 or 3 tons per acre of ground limestone being sufficient. Regular additions of phosphate and potash are necessary; in addition a moderate application of nitrogen fertilizer is at times necessary for small grains and cultivated crops.

It is unwise to go to any expense in draining, clearing, and breaking peat land for crop production unless the owner is able and willing to

[1] Acknowledgment is made to Dr. F. J. Alway, Chief of the Division of Soils, for many helpful suggestions regarding the preparation of this manuscript and the interpretation of the data. G. H. Nesom, of the Soils Division, also made helpful suggestions.

bear the added expense of the necessary chemical treatment, fertilization only, or both liming and fertilization according to the character of the peat. The general character of Minnesota peat soils and the methods necessary for their reclamation and later management are dealt with in Bulletins 188 and 194 of the Minnesota Agricultural Experiment Station.[2]

The studies reported in this bulletin are a continuation of the report given in Bulletin 228, which contained a summary for the crop years 1919 to 1925, inclusive, for Coon Creek.[3] The present bulletin, however, deals only with the small grains and other crops grown for seed.

METHODS

The Division of Soils had charge of the experimental fields and has been responsible for the experiments in fertilization and soil management, and has had entire charge of the preparation of the land, including fertilization and cultivation, as well as the harvesting of the crops. The Division of Agronomy selected the varieties to be tested and computed the yields.

For the variety trial plots a good seedbed was prepared by means of a disk, a harrow, and a heavy concrete roller. The phosphate and potash fertilizers were applied shortly in advance of seeding and were mixed with the soil by disking; the nitrogen fertilizer used at Page was applied as a top dressing after seeding. At each place enough fertilizer was applied every spring to furnish sufficient available plant food for a full yield in order to avoid any risk of a lack of plant food becoming responsible for poor yields.

A grain drill was used to seed the small grain crops, including spring and winter wheat, rye, oats, barley, and flax, in plots 8 feet wide and either 66, 82.5 or 132 feet long. The usual rates and times of seeding were followed and each variety was sown in two or three regularly distributed plots. Seeding rates of the different crops are the same on peat as on the ordinary mineral soil. Six square yards were harvested from each plot, brought to University Farm, St. Paul, threshed, and the yields computed. Previous studies have led to the conclusion that this method of obtaining yields gives satisfactory results.

The corn plots were checked four rows wide and either 22 or 44 hills long. Hills were 42 inches apart. Planting was done by hand and the plots were seeded thickly to insure a stand. When the plants were approximately 6 inches high, the corn was thinned to four or

[2] Alway, F. J. Agricultural Value and Reclamation of Minnesota Peat Soils. Minn. Agr. Expt. Sta. Bull. 188. 1920. (Out of print.) Report of Golden Valley Peat Experimental Fields. Minn. Agr. Expt. Sta. Bull. 194. 1920. (Out of print.)

[3] Arny, A. C. and McGinnis, F. W. Field Crop Variety Trials on Coon Creek Peat Experimental Fields. Minn. Agr. Expt. Sta. Bull. 228. 1926. (Out of print.)

three plants in each hill. Throughout the growing period the plots were thoroly cultivated. When the corn reached maturity the middle two rows of each plot were cut and shocked. When the shocks became thoroly dry the ears were husked, and the ear corn was weighed. From each plot ten pounds of ear corn was taken in bags for determination of the moisture content. The samples were placed in crates and stored in a steam-heated room until January. By this means it was possible to place the yields on a comparable basis.

The plots of soybeans and field beans were four rows wide and either 66 or 82.5 feet long. The rows were 30 inches apart and the plants approximately two inches apart in the rows. The seeding in all cases was done with a grain drill. The drill cups, except those leading to every fifth shoe, were closed with burlap. A uniform stand of each variety was obtained by so adjusting the drill that the seed was spaced at approximately two inches in the rows. The small-seeded varieties required about 30 pounds to the acre and the large-seeded varieties 45 pounds, to obtain the desired stand. The bean plots were cultivated with corn-cultivating machinery. As each variety reached maturity, yields were determined by harvesting six uniformly distributed rod rows from the middle two rows of each plot.

In 1920 and 1921 field peas were seeded in plots four rows wide and 18 feet long. The rows were 12 inches apart. Only the middle two rows were harvested to determine seed yields. In 1924 and 1925 they were grown in plots 8 feet wide and 66 feet long. Peas were harvested and threshed as were beans and soybeans.

RESULTS

While the primary purpose of the studies was to determine the varieties best adapted to peat soils, the data have been used also to compare the desirability of various crops on such soils.

The data obtained have been used to answer the following questions: What crops have succeeded best on Coon Creek peat soils? What varieties are best adapted for peat and are the same varieties recommended for well fertilized mineral soils?

Comparative Yields and Values of Crops at Coon Creek

Data are available for yield trials at Coon Creek from 1919 to 1932, except for 1927, when small grains were destroyed by floods. Oats and barley were grown for the entire period; spring bread wheat from 1919 to 1926 and in 1928; durum wheat from 1919 to 1923, inclusive; winter wheat from 1922 to 1926 and from 1928 to 1932, inclusive; rye for all years except 1919 and 1927; flax, corn, soybeans, and field beans from 1919 to 1925, inclusive; and field peas were grown in 1920, 1921, 1924, and 1925.

The summary of yields is given in Table 1 in bushels of seed per acre. The yields for each year are the averages for all varieties of the crop for the season.

Table 1

Yields per Acre of Different Crops Grown in 1/40-Acre Trials at Coon Creek

Crop	1919	1920	1921	1922	1923	1924	1925	1926
	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Oats (midseason)	35.5	53.3	7.2	31.7	15.7	44.6	56.4	35.6
Oats (early)	...	64.2	15.2	54.5	14.3	74.2	63.9	62.9
Barley	16.2	25.6	9.7	18.8	9.4	39.6	39.3	...
Spring wheat	8.0	2.5	0.0	2.1	1.0	12.4	17.0	8.6
Durum wheat	14.5	15.7	0.0	1.8	4.4	...	...	...
Winter wheat	...	...	...	7.2	6.3	8.2	11.5	7.8
Winter rye	...	18.7	28.2	38.5	26.6	41.2	27.7	30.6
Flax	3.5	11.5	9.6	11.4	5.6	4.0	12.9	...
Corn	51.1	34.7	53.0	55.0	44.9	0.0‡	40.6	0.0‡
Soybeans	20.4	14.2	31.7	46.4	7.2	9.9	17.9	...
Field peas	...	35.1	9.3	...	...	26.7	10.3	...
Field beans	13.9	13.8	17.8	34.9	8.9	0.0	16.1	...

Crop	1927*	1928	1929	1930	1931	1932	Average yield	Weighted yield†
	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Oats (midseason)	...	24.5	41.3	41.4	44.9	61.4	38.0	38.0
Oats (early)	...	22.2	35.2	45.2	47.2	52.4	46.0	46.0
Barley	...	16.4	23.8	28.0	36.3	42.5	25.5	25.4
Spring wheat	...	8.7	...	...	...	12.4	7.3	7.6
Durum wheat	...	...	...	...	...	16.6	8.8	9.8
Winter wheat	...	0.0	17.2	20.8	39.2	32.3	15.1	14.4
Winter rye	...	0.0	19.9	22.2	34.3	44.7	27.7	27.6
Flax	...	...	...	...	...	...	8.4	9.1
Corn	32.0	28.1	37.9	33.9	18.6	0.0‡	30.7	30.7
Soybeans	...	...	...	...	...	...	21.1	23.0
Field peas	...	...	...	...	...	...	20.4	19.2
Field beans	...	...	...	...	...	...	15.1	16.4

* Small grains failed as a result of floods.

† The yield of midseason oats for the period each of the crops was grown was compared with the yield of oats from 1919-26, 1928-32, inclusive, and a weighted yield used for each crop.

‡ No corn matured.

The averages for midseason oats include all varieties except Gopher and Iowar, which comprise the early group. In the trials on the adjacent sandy land, previously reported in Bulletin 291, the differences were slightly in favor of the midseason varieties. On peat soil, however, there is a distinct advantage for the early varieties, the average yields being 38 and 46 bushels per acre for the midseason and early groups, respectively. In some seasons stem rust reduced the yield and in other cases lodging led to low production.

With the exception of 1927, the midseason oats were grown each year from 1919 to 1932 and were used as a standard of comparison for other crops. The weighted yield given in Table 1 is an average for the years that each crop was grown, corrected on the basis of the yield of midseason oats for the same period in relation to the yield for the

entire period. The proportion used in computing this average is illustrated as follows:

Average yield of midseason oats 1919 to 1923: Average yield 1919 to 1926, 1928 to 1932 = Average yield of flax 1919 to 1923: weighted yield of flax 1919 to 1926, 1928 to 1932.

It is realized that there is some danger in making such a correction. Climatic conditions in a certain year may be favorable to one crop, such as corn, but less favorable to the small grains and vice versa. The corrections make little relative difference in the average yields.

Low yields of barley were obtained in 1926 because birds ate the grain and no yields are given for the year. There was severe winter injury to the winter wheat and rye in the spring of 1928 and the yields were very low. No ripe corn was obtained in 1924, 1927, or 1932.

Yields of the various crops grown are compared with midseason oats as a standard. The years in which each group was grown, the range in yields, and the average yield per acre in bushels and pounds are given in Table 2.

Table 2

Average Yield per Acre of Different Crops Grown in 1/40-Acre Plots at Coon Creek in Comparison with Midseason Oats as 100

Crops	Years grown	Range in yield	Average yields	
		bu.	bu.	lb.
Oats	1920-26, 1928-32	7.2-61.4	38.1	1,219.2
Oats (early)	" "	10.8-74.2	46.0	1,472.0
Oats	1919-25, 1928-32	7.2-61.4	38.2	1,222.4
Barley	" "	9.4-42.5	25.5	1,224.0
Oats	1919-26, 1928, 1932	7.2-61.4	36.6	1,171.2
Spring wheat	" " "	0.0-17.0	7.3	438.0
Oats	1919-23, 1932	7.2-61.4	34.1	1,091.2
Durum wheat	" "	0.0-16.6	8.8	528.0
Oats	1922-26, 1928-32	15.7-61.4	39.8	1,273.6
Winter wheat	" "	0.0-39.2	15.1	906.0
Oats	1920-26, 1928-32	7.2-61.4	38.1	1,219.2
Winter rye	" "	0.0-44.7	27.7	1,551.2
Oats	1919-25	7.2-56.4	34.9	1,116.8
Flax	"	3.5-12.9	8.4	468.0
Corn	"	0.0-55.0	34.1	1,909.6
Field beans	"	0.0-34.9	15.1	903.4
Soybeans	"	7.2-46.4	21.1	1,266.0
Oats	1920-21, 1924-25	7.2-56.4	40.4	1,292.0
Field peas	" "	9.3-35.1	20.4	1,221.0

The average yield of barley in pounds for all years from 1919 to 1925 and 1928 to 1932 was practically identical with the yield of oats. Spring bread wheat and durum wheat gave low yields, producing less than half as many pounds of grain as oats. Spring wheat appears not well adapted to peat soil. Winter wheat, the variety grown being Minturki, gave a fair yield, averaging 15.1 bushels per acre, high yields being obtained in several years when there was no winter injury. Winter

rye yielded somewhat more per acre than winter wheat. Flax gave an average yield of 8.4 bushels per acre for the eight-year period that it was grown. Corn, field beans, and soybeans gave good average yields and seem fairly well adapted to peat soils. In some years, as has been already mentioned, corn may fail to produce mature grain. In seasons such as 1924, when summer frosts occurred, corn and field beans failed and soybeans averaged only 7.2 bushels per acre.

Field peas thrive in a cool growing period and yielded an average of 20.4 bushels with nearly the same number of pounds per acre as midseason oats. In 1924, when there were summer frosts, field peas yielded an average of 26.7 bushels. In 1920 and 1925 yields averaged only from 9 to 10 bushels per acre.

It must be remembered that the value of the various crops differs. For example, 10 bushels of field peas may be worth more than a larger number of bushels of oats. This is illustrated in the following sections of the bulletin.

Yield of digestible nutrients.—The yield of digestible nutrients per acre, given in Table 3, is based on the percentages of digestible crude protein, carbohydrates, and fats given by Henry and Morrison[4] for the various crops and computed for the average yields in pounds of seed for the years that the crops were grown. In each case the particular crop is compared with midseason oats for the same period.

Table 3

Digestible Nutrients Produced per Acre by Different Crops at Coon Creek Compared with Midseason Oats as 100

Crop	Years grown	Average yield	Nutrients per acre			
			Crude protein	Carbo-hydrates	Fat	Total
		lb.	lb.	lb.	lb.	lb.
Oats	1920-26, 1928-32	1,219.2	118.3	635.2	46.3	858.3
Oats (early)	" "	1,472.0	142.8	766.9	55.9	1,036.3
Oats	1919-25, 1928-32	1,222.4	118.6	636.9	46.5	860.6
Barley	" "	1,224.0	110.2	817.6	19.6	971.9
Oats	1919-26, 1928, 1932	1,171.2	113.6	610.2	44.5	824.5
Spring wheat	" " "	438.0	43.8	290.4	6.6	349.1
Oats	1919-23, 1932	1,091.2	105.8	568.5	41.5	768.2
Durum wheat	" "	528.0	52.8	350.0	7.9	420.8
Oats	1922-26, 1928-32	1,273.6	123.5	663.5	48.4	896.6
Winter wheat	" "	906.0	90.6	600.7	13.6	722.1
Oats	1920-26, 1928-32	1,219.2	118.3	635.2	46.3	858.3
Winter rye	" "	1,551.2	153.6	1,061.0	18.6	1,265.5
Oats	1919-25	1,118.2	108.5	582.6	42.5	787.2
Flax	"	468.0	96.4	79.6	135.7	481.1
Corn	"	1,909.6	143.2	1,294.7	87.8	1,636.5
Field beans	"	903.4	169.8	463.4	7.2	649.5
Soybeans	"	1,266.0	420.3	312.7	203.8	1,191.3
Oats	1920-21, 1924-25	1,292.0	125.3	673.1	49.1	909.6
Field peas	" "	1,221.0	232.0	681.3	7.3	930.4

[4] Henry and Morrison—Feeds and Feeding.

Early oats yielded more than the midseason varieties and consequently averaged higher in pounds of protein, carbohydrates, and fat than midseason oats.

Barley gave a somewhat higher calculated amount of total digestible nutrients than midseason oats, being slightly higher in carbohydrates but 26.9 pounds less in fat per acre, and 8.4 pounds less in protein.

Spring bread wheat and durum were low in pounds of digestible nutrients because they gave low average yields.

Winter wheat produced an average of 722.1 pounds of total digestible nutrients per acre, compared with 896.6 pounds for midseason oats during a comparable eleven-year period; winter rye proved much better than oats, producing 398.2 more pounds of digestible nutrients per acre than midseason oats on an average for a comparable thirteen-year period. Winter rye gave a calculated yield per acre of 35.0 pounds more of digestible protein and 425.8 pounds more of digestible carbohydrates, but the yield of fat was low compared with that of midseason oats.

Soybeans gave good yields of seed, and early maturing varieties may be planted as late as June 1 and still produce a good yield of seed. They gave a high yield of digestible crude protein per acre, averaging 420.3 pounds in comparison with 108.5 for midseason oats. Soybeans are also high in fat. Field peas appear to be a desirable leguminous crop for peat, yielding 232 pounds of crude protein and 681.3 pounds of carbohydrates per acre.

Market Value of Seed of Small Grain Crops and Corn

The calculated value of the marketable seed is given in Table 4. The data are based on the average price per bushel for 1921 to 1930, inclusive, using the average price for the three months that the greatest amount of each crop was sold and the average yields obtained for the period that the crop was grown. The value per acre is given on two bases, the actual computed value compared with midseason oats for the same period, and the average value for the period corrected on the basis of the yield and value of midseason oats for the same period. The correction is made as explained for the results given in Table 1.

The corrected value per acre, based on midseason oats as a standard, placed the small grains and flax on the basis of their average value in the following order: rye, $20.17; flax, $19.02; winter wheat, $15.42; early oats, $14.72; barley, $12.69; midseason oats, $12.16; durum wheat, $10.50; spring wheat, $8.11. Corn with a calculated value of $22.64 per acre excelled all other crops tested, leading rye by $2.47 per acre.

Table 4

Average Yield and Values per Acre of Different Crops at Coon Creek*

Crop	Years grown	Yield	Price 1921-30	Value per acre	Corrected value compared with oats
Oats	1920-26, 1928-32	38.1	$0.32	$12.19	$12.16
Oats (early)	" "	46.0	0.32	14.72	14.72
Oats	1919-25, 1928-32	38.2	0.32	12.22	12.16
Barley	" "	25.5	0.50	12.75	12.69
Oats	1919-26, 1928, 1932	36.6	0.32	11.71	12.16
Spring wheat	" " "	7.3	1.07	7.81	8.11
Oats	1919-23, 1932	34.1	0.32	10.91	12.16
Durum wheat	" "	8.8	1.07	9.42	10.50
Oats	1922-26, 1928-32	39.8	0.32	12.74	12.16
Winter wheat	" "	15.1	1.07	16.16	15.42
Oats	1920-26, 1928-32	38.1	0.32	12.19	12.16
Winter rye	" "	27.7	0.73	20.22	20.17
Oats	1919-25	34.9	0.32	11.17	12.16
Flax	"	8.4	2.08	17.47	19.02
Corn	"	34.1	0.61	20.80	22.64

* Average prices for small grains, flax, and corn for 1921-28, inclusive, are from Minn. Tech. Bull. 72, Indexes of Prices, Quantities, and Cash Incomes, 1910-27, by A. G. Black and Dorothea Kittredge. 1930. Prices for 1929 and 1930 are from Minn. Ann. Crop Rept., Minn. State Dept. of Agr. Bull. 6.

Variety Trials

The studies of varieties were made to determine which varieties of crops are best adapted to peat soils. The method of work consisted of comparative trials of many varieties in nursery plots sown by hand in rows one foot apart and 18 feet long. The results of these studies will not be given in detail. Varieties yielding best in these small plots were included in 1/40 acre plot trials. The summarized data for individual years are given in the appendix. A generalized probable error in percentage is included for the benefit of the scientific investigator. The yields are compared with a variety accepted as a standard and grown for all years that the trials were carried. The years that the variety was grown, the average yield compared with the standard, and the percentage yield in comparison are given in the tables.

Oats

A brief history of the varieties of oats tested is given here.

Victory, Minn. Acc. No. 514. Originated at Svalöf, Sweden. First introduced into the nursery at University Farm in 1908. A later introduction by the Department of Field Husbandry, University of Saskatchewan, was made in 1915. It was used for tests reported in this bulletin.

Common type; open panicle; awnless or few weak awns; large, white grain; tall, midstrong straw; susceptible to stem rust; midlate to late.

Anthony, Minn. No. 686. Progeny of a cross between White Russian and Victory. Developed by the Minnesota Agricultural Experiment Station. First seed was distributed to growers in 1929.

Common type; open panicle; awnless to weakly awned, white grain; midtall, midstrong straw; highly resistant to stem rust; midseason.

Minrus, Minn. No. 693. Developed by the Minnesota Agricultural Experiment Station from a cross of Minota by White Russian.

Common type; open panicle; white, weakly awned grain; short, stiff straw; resistant to stem rust; early midseason.

Irish Victor, Minn. Acc. No. 533. An Irish Victor pure line obtained from the Maine Agricultural Experiment Station in 1916 as Maine No. 340.

Common type; open panicle; awnless; white grain; tall, stiff straw, susceptible to stem rust; late.

Lincoln, Minn. Acc. No. 505. Introduced from the Cornell Agricultural Experiment Station in New York in 1914.

Common type; open panicle; awnless; white grain; tall, strong straw; susceptible to stem rust; midlate to late.

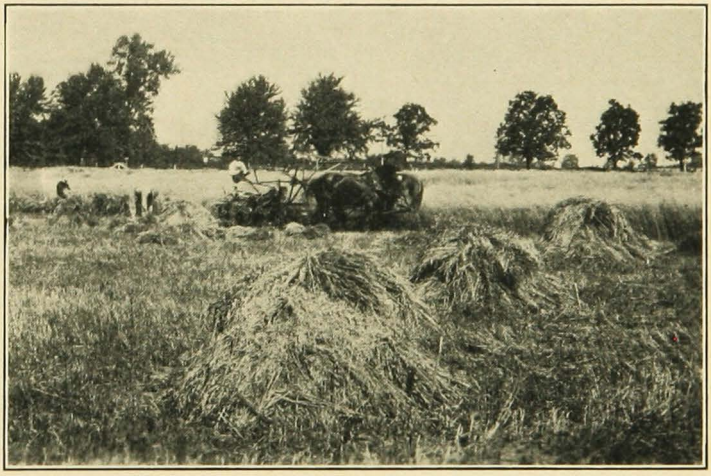


Fig. 1. Minrus Has Been One of the Highest Yielding Oats Tested on Peat Soils

Gold Rain, Minn. No. 669. Introduced from Svalöf, Sweden, in 1915.

Common type; open panicle; awnless; yellow grain; midtall, midstrong straw; susceptible to stem rust; midseason.

Improved Ligowa, Minn. No. 281. Originated through a head selection made at University Farm in 1895 from the Swedish Select group.

Common type; open panicle; heavy to light awned; white grain; midtall, midstrong straw; susceptible to stem rust; midlate.

White Russian (White Tartar), Minn. Acc. No. 339. Seed was secured from a local seed company in 1905.

Orientalis type; side panicle; awnless; white to yellowish white grain; midtall, strong straw; highly resistant to stem rust.

Fulghum, Minn. Acc. No. 537. An introduction from the Alabama Agricultural Experiment Station in 1916.

Byzantina type; open panicle; awned; red grain; midtall, stiff straw; resistant to stem rust; early to midseason.

North Dakota No. 22005, Minn. Acc. No. 709. A pure-line selection from Green Russian by the North Dakota Agricultural Experiment Station.

Common type; open panicle; nearly awnless, yellowish white grain; short to midtall; midstrong straw; resistant to stem rust; early to midseason.

North Dakota No. 20014, Minn. Acc. No. 708. A pure-line selection from Green Russian by the North Dakota Agricultural Experiment Station.

Common type; open panicle; awned, white grain; midtall, midstrong straw; highly resistant to stem rust; early midseason.

Rainbow, North Dakota No. 22006, Minn. Acc. No. 710. A pure-line selection from Green Russian by the North Dakota Agricultural Experiment Station. Distributed in North Dakota in 1929.

Common type; open panicle; nearly awnless, yellowish white grain; midtall; midstrong straw; highly resistant to stem rust; early to midseason.

Iowar, Minn. Acc. No. 670. A selection from Kherson by the Iowa Agricultural Experiment Station.

Common type; open panicle; awnless, white grain; midtall; strong straw; susceptible to stem rust; early.

Gopher, Minn. No. 674. A pure-line selection from Sixty Day by the Minnesota Agricultural Experiment Station.

Common type; open panicle; awned, white grain; short, stiff straw; susceptible to stem rust, but earliness often enables it to escape damage; very early.

Silvermine, Minn. No. 337. Selected in 1914 by the Minnesota Agricultural Experiment Station from seed obtained from a local seed company.

Common type; open panicle; awnless, white to yellowish white grain; midtall to tall; midstrong straw; susceptible to stem rust; late.

Yields in bushels per acre and in percentage, with Gopher as a standard, are given in Table 5.

Gopher, an early, stiff-strawed variety, is recommended particularly for heavy rich soils in southern Minnesota. It has proved desirable for peat soils, also, but is undesirable for sandy soils. It proved much superior in these trials to the standard midseason varieties, such as Victory, Silvermine, Improved Ligowa, Fulghum, and the late-matur-

ing variety White Tartar; and somewhat superior to Anthony, Lincoln, and Gold Rain. Gopher yielded less than the North Dakota varieties, North Dakota 22005, North Dakota 20014, and Rainbow, the latter being on the recommended list of the Minnesota Experiment Station. Minrus, the new stem-rust-resistant variety of the Minnesota Experiment Station, produced from a cross of Minota and White Russian, yielded 29.9 per cent more than Gopher during the three-year period 1929-31, inclusive, and yielded more than any other variety in 1928, 1930, and 1931. It appears promising for peat soils. It is intermediate in maturity between Gopher and midseason varieties like Victory and Anthony. Iowar, a variety of early oats produced at the Iowa station, appears somewhat superior to Gopher for peat soils, altho not the equal of Minrus in the three years, 1928, 1929, and 1931, in which they were compared.

Table 5

Average Yield per Acre of Oat Varieties at Coon Creek, Years Grown, and Percentage Yields Compared with Gopher as 100

Variety*	Years grown	Average yield	Average yield
		bu.	per cent
Gopher	1920-26, 1928, 1929, 1931	42.5	100.0
Iowar	" " " "	48.3	113.5
Gopher	1920-24, 1926, 1931	30.9	100.0
Victory	" " "	20.6	66.7
Gopher	1924-26, 1928-31	49.5	100.0
Anthony	" "	40.8	82.4
Gopher	1929-31	41.5	100.0
Minrus	"	53.9	129.9
North Dakota 22005	"	49.0	118.1
North Dakota 20014	"	47.0	113.3
Rainbow	"	45.9	110.6
Gopher	1920-21	35.6	100.0
Irish Victor	"	36.7	103.1
Lincoln	"	33.0	92.7
Gold Rain	"	34.1	95.8
Silvermine	"	27.7	77.8
Improved Ligowa	"	28.4	79.8
White Tartar	"	24.2	68.0
Fulghum	"	26.6	74.7

* Minnesota numbers have been omitted from many of the tables. They will be found, however, in the accompanying text.

Table 6

Average Yield per Acre of Oat Varieties at Page

Variety	Years grown	Average yield
		bu.
Anthony	1928-31	44.6
White Russian × Victory 696	"	47.4
Minrus	"	51.5
Anthony	1928, 1929, 1931	39.7
White Russian × Victory 696	" " "	41.7
Iowar	" " "	48.0
Gopher	" " "	46.4
Minrus	" " "	51.5

Average yields of oat varieties at Page are given in Table 6.

Of the oat varieties tested at Page, Minrus made the best record. These results are in line with those obtained on the Coon Creek fields and emphasize the promise of the Minrus variety for peat soils.

The results of limited trials of oat varieties at Golden Valley, in Marshall County, are presented in Table 7.

Table 7
Average Yield per Acre of Oat Varieties at Golden Valley, 1920-22

Variety	Minn. No.	Average yield
		bu.
Minota	512	30.8
White Tartar	339	43.8
Victory	514	36.0
Irish Victor	533	37.9
Selection	358	32.3
Gold Rain	669	31.0
Silvermine	506	31.6
Iowar	670	49.2
Garton	784	23.5
Iowa 103	531	45.1
Fulghum	537	22.1

In the trials at Golden Valley, Iowar and Iowa 103 were the leading varieties. These tests were made before the development of Gopher and Minrus, both of which have performed well on the peat soils at Coon Creek and Page.

The data from the oat trials at Fens, in St. Louis County, are presented in Table 8. These data serve to substantiate the fact that early oat varieties are best suited to peat soils.

Table 8
Average Yield per Acre of Oat Varieties at Fens, 1920-21

Variety	Minn. No.	Average yield
		bu.
Minota	512	13.6
White Tartar	339	8.0
Victory	514	5.5
Iowa 103	531	10.0
Iowa 105	532	12.8
Iowar	670	10.1
Garton	784	8.0
Fulghum	537	9.1
Silvermine	506	11.2
Gold Rain	669	7.5
Irish Victor	533	12.9

Spring Wheat

Spring wheat has not been tested extensively. It seems to be very poorly adapted to peat soils and in several years the plants died.

A brief history of the varieties tested is given here.

Marquis, Minn. Acc. No. 1239. A selection by Dr. C. E. Saunders, of Ottawa, Canada, from a cross between Hard Red Calcutta and Red Fife made by Dr. A. P. Saunders in 1892.

Awnless; white to yellowish, glabrous glumes; strong straw; susceptible to stem rust; midlate; desirable milling and baking qualities.

Kota, Minn. Acc. No. 2151. Distributed by the North Dakota Agricultural Experiment Station from wheat introduced from Russia in 1903.

Awned; white, glabrous glumes; weak straw; resistant to stem rust, susceptible to smuts; not a good milling wheat.

Marquillo, Minn. No. 2202. Produced by the Minnesota Agricultural Experiment Station from a cross between Marquis and Iumillo, a rust-resistant durum variety.

Resembles Marquis; awnless; strong straw; resistant to stem rust; matures slightly earlier than Marquis; excels Marquis in yield when stem rust is a factor; not well adapted to dry conditions; milling and baking tests have shown the variety equal to Marquis in size and texture of loaf produced, altho yellow in color.

N. D. 1656-84, Minn. Acc. No. 2244. A selection from the cross of Marquis × Kota, N. D. 1656 produced at the North Dakota Experiment Station.

Awned; glabrous, white glumes; medium weak straw; resistant to stem rust; as early maturing and about equal in milling and baking qualities to Marquis; well adapted for dry conditions; outyields Marquis; susceptible to scab, bunt, and loose smut.

Mindum, Minn. No. 470. A selection made by the Minnesota Agricultural Experiment Station in 1896. Named Mindum, a contraction of Minnesota and durum, in 1918.

Yellowish, glabrous glumes; amber-colored kernels, midweak straw; fairly resistant to stem rust; has high quality for macaroni.

Emmer, Vernal, Minn. Acc. No. 1165. A species of wheat often erroneously referred to as speltz. Glumes are retained in threshing. Of little value as a crop but offers great possibilities as breeding material, as it is highly resistant to black stem rust and certain other important diseases menacing spring wheat in Minnesota.

H-44, Minn. Acc. No. 2297. Produced by McFadden, in South Dakota, from a cross of emmer and Marquis. A bearded variety resistant to stem and leaf rust but susceptible to black chaff. Of interest chiefly to the breeder.

Comparative yields are given in Table 9. The trials are not extensive but indicate that spring wheat is not well adapted to peat soils. Marquis was severely injured by rust and other diseases from 1919 to

1923, inclusive, but yielded 9.8 bushels in 1928. Kota and Marquillo yielded 13.7 bushels and 11.6 bushels, respectively, from 1924 to 1926, inclusive, perhaps because of their ability to withstand rust. Vernal emmer, a hulled variety, yielded 14.6 bushels per acre from 1919 to 1923, inclusive. In calculating yields, 20 per cent of the weight was deducted for hull. It appears desirable as a stock feed.

Table 9

Average Yield per Acre of Spring Wheat Varieties at Coon Creek

Variety	Years grown	Average yield
		bu.
Marquis	1919-23	2.7
Emmer	" "	14.6
Mindum	" "	7.3
Kota	1924-26	13.7
Marquillo	" "	11.6
Marquis	1928	9.8
N. D. 1656-84	"	8.3

From 1920 to 1922 a few spring wheat varieties, including emmer, were tested on the peat soils at Golden Valley. The results are given in Table 10.

As at Coon Creek, spring wheat has not yielded well on the peat soils at Golden Valley.

Table 10

Average Yield per Acre of Spring Wheat Varieties at Golden Valley, 1920-22

Variety	Minn. No.	Average yield
		bu.
Marquis	1239	5.9
Preston	924	6.5
Acme	1967	7.7
Mindum	470	7.7
Emmer*	1165	13.0

* 20 per cent deducted for hull.

Barley

A brief history of the varieties tested is given here.

Improved Manchuria, Minn. No. 184. Developed from an individual plant selection from the Manchuria group.

Six-rowed; hulled; white hull; rough-awned; average strength of straw.

Svansota, Minn. No. 440. Resulted from a cross between U. S. Dept. No. 456 and Svanhals.

Two-rowed; hulled; white hull; rough-awned; average strength of straw.

Velvet, Minn. No. 447. Developed from a cross between a smooth-awned selection and Luth.

Six-rowed; hulled; white hull; smooth-awned; midstrong straw.

Trebi, Minn. No. 448. Developed from a plant selection.

Six-rowed; hulled; white hull; rough-awned; weak straw.

Glabron, Minn. No. 445. Developed from a cross between a smooth-awned selection and Manchuria. Distributed to Minnesota farmers in 1929.

Six-rowed; hulled; white hull; smooth-awned; strong straw.

Minsturdi, Minn. No. 439. Produced from a cross between South African and Manchuria.

Six-rowed; hulled; white hull; rough-awned; very stiff straw; susceptible to barley stripe disease; adapted to heavy soils where most varieties lodge.

Peatland, Minn. No. 452. A plant selection from a variety called "Switzerland."

Six-rowed; hulled; white hull; very rough awned; strong straw; resistant to spot blotch and black stem rust. Has been recommended primarily for peat soils.

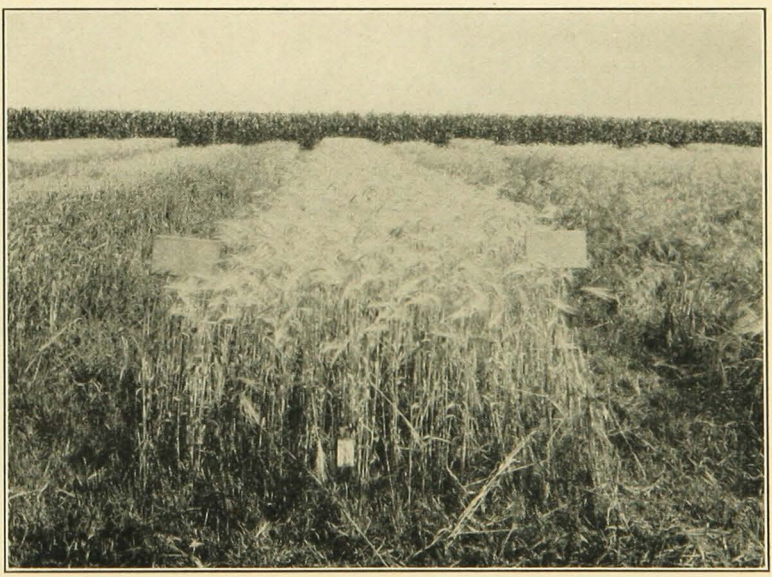


Fig. 2. Stiff-Strawed Varieties of Barley Are Necessary for Peat Soils
The variety Peatland is especially suited to the peat soils of Minnesota.

Yields of barley varieties in comparison with Manchuria as a standard are given in Table 11.

Minsturdi yielded about as well as Manchuria and is desirable for peat soils. It is susceptible to the disease known as barley stripe and

should be treated with Ceresan. For directions see Special Bulletin No. 135, Agricultural Extension Division.[5]

Svansota is a two-rowed variety recommended especially for northeastern Minnesota. It proved less desirable than Manchuria.

Velvet and Glabron, the smooth-awned varieties that have yielded more than Manchuria on mineral soils, appear undesirable for peat soils.

Table 11

Average Yields per Acre of Barley Varieties at Coon Creek, Years Grown, and Percentage Yield in Comparison with Manchuria as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Manchuria	1919-25	23.3	100.0
Minsturdi	"	23.1	99.1
Manchuria	1919-23, 1928-31	21.1	100.0
Svansota	" "	18.6	88.2
Manchuria	1924-25, 1929-31	35.6	100.0
Velvet	" "	29.8	83.7
Peatland	" "	35.0	98.3
Manchuria	1928-31	28.0	100.0
Trebi	"	30.1	107.5
Glabron	"	23.5	83.9

Trebi, which yields well in other sections of the state, gave an average yield during 1928-31 of 7.5 per cent more than Manchuria. It should be grown only for feed, as it is undesirable for malting.

Yields for the trials at Page are given in Table 12.

Table 12

Average Yield per Acre of Barley Varieties at Page, 1928-31

Variety	Average yield
	bu.
Manchuria	24.8
Peatland	22.7
Glabron	21.6
Svansota	24.7
Trebi	24.3

In these trials differences between varieties are small. As at Coon Creek, the smooth-awned variety Glabron was low in yield.

Altho the yields in Table 12 may not support the statement that Peatland has proved an exceptionally fine variety for peat soil, that it does well on this type of soil is substantiated by observations of members of the Division of Soils and the enthusiastic reception this variety has received by farmers who have given it a trial.

The yields of barley varieties tested at Golden Valley and Fens are given in Tables 13 and 14, respectively.

[5] Stevenson, F. J., Bridgeford, R. C., Crim, R. F. Barley in Minnesota. Minn. Agr. Extension Special Bull. 135. 1931.

Table 13

Average Yield per Acre of Barley Varieties at Golden Valley, 1920-22

Variety	Minn. No.	Average yield
		bu.
Manchuria	184	28.9
Chevalier	230	38.1
Aker's Russian	442	28.5
Svansota	440	33.7
Minsturdi	439	28.3

Table 14

Average Yield per Acre of Barley Varieties at Fens, 1920-21

Variety	Minn. No.	Average yield
		bu.
Improved Manchuria	184	7.2
Minsturdi	439	7.7
Aker's Russian	442	7.0
Svansota	440	4.1
French Chevalier	230	5.6

Chevalier and Svansota yielded the highest in the three years of the Golden Valley trials. Svansota is still recommended for that section of the state when the grower desires a two-rowed barley. At Fens, results were more variable and the low yields make it difficult to draw conclusions from the tests.

Rye

Rye is more winter hardy than winter wheat and has yielded somewhat better on peat soil at Coon Creek than winter wheat. Several varieties of rye have been tested.

Swedish, Minn. No. 2. Selected for its winter hardiness at the Minnesota station. Variable seed color.

Wisconsin Pedigree, Minn. Acc. No. 84. Obtained from Wisconsin. Similar to Minn. No. 2.

Rosen, Minn. Acc. No. 82. Developed at the Michigan station but less winter hardy in Minnesota than No. 2.

Dakold, Minn. Acc. No. 93. A North Dakota selection that has replaced Minn. No. 2 on the Minnesota station's recommended list. Excels in winter hardiness.

Midsommerog, Minn. Acc. No. 87. A Swedish variety, more susceptible to winter injury than Minn. No. 2.

Colorless, Medium Green, Dark Green, and Synthetic. Four Minnesota selections of uniform seed color.

Prolific Spring, Minn. Acc. 89. Will head when sown in the spring. Sown only as a spring crop.

A summary of yields is given in Table 15.

Table 15

Average Yield of Rye Varieties at Coon Creek, Years Grown, and Percentage Yield in Comparison with No. 2 as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Swedish	1920-23	27.0	100.0
Wisconsin Pedigree	"	27.1	100.4
Rosen	"	30.0	111.1
Swedish	1924-26	35.8	100.0
Midsommerog	"	34.6	96.6
Colorless	"	31.5	88.0
Medium Green	"	34.2	95.5
Swedish	1924 and 1926	39.2	100.0
Dark Green	" " "	30.9	78.8
Swedish	1930-31	29.3	100.0
Dakold	"	27.1	92.5
Prolific Spring	"	12.4	42.3
Swedish	1931	35.0	100.0
Synthetic No. 91	"	34.4	98.3

The results of the variety trials of rye are not very extensive and need little comment. Dakold, a very winter hardy variety produced at the North Dakota Station, has yielded more on mineral soils than Minnesota No. 2 but somewhat less on peat soils. Rosen, a less winter hardy variety than Minnesota No. 2, which often yields well in southern Minnesota, gave 11.1 per cent higher yield during 1920-23 than Minnesota No. 2, indicating that during these years winter killing was not especially severe.

Winter Wheat

Only one variety of winter wheat was tested, and yields are given in Table 1 for the years it was grown. Winter wheat yielded less than winter rye and is not recommended for growing on peat. Minturki, Minn. No. 1507, was developed by the Minnesota Agricultural Experiment Station from a cross between Turkey and Odessa in 1902. The variety was named and distributed in 1902. Awned; white glabrous glumes; strong straw; red kernels; resistant to stem rust and covered smut; good milling and baking qualities; early maturing; winter hardy; high yielding. Minturki is the popular variety in southern Minnesota, where winter wheat is grown extensively.

Flax

The flax variety trials were made several years ago and the two new varieties, Buda and Bison, produced at the North Dakota station, have not been tested at Coon Creek. Redwing, the new Minnesota variety, was grown only in 1925. As no new yields have been obtained since Bulletin 228 was published,[6] the results of the flax trials are summarized in Table 16 for comparison with other crops. Flax succeeds fairly well on peat soils. Varieties should be grown that are resistant

[6] See footnote 3, p. 4.

to rust as well as wilt. Both Bison and Redwing are satisfactory in this respect. Bison is highly resistant to rust and Redwing only slightly less resistant. Redwing matures earlier and for this reason is probably superior to Bison for peat soils.

Table 16

Average Yield per Acre of Flax Varieties at Coon Creek, Years Grown, and Percentage Yield in Comparison with North Dakota 114 as 100

Variety	Minn. No.	Years grown	Average yield	Average yield
			bu.	per cent
North Dakota Resistant 114 ..	Acc. 179	1920-21	10.5	100.0
North Dakota Resistant 52 ..	Acc. 173	"	11.1	105.7
North Dakota Resistant 73 ..	Acc. 174	"	10.2	97.1
North Dakota Resistant 114 ..	Acc. 179	1923 and 1925	7.8	100.0
Chippewa	181	" " "	7.7	98.7
Winona	182	" " "	6.8	87.2
North Dakota Resistant 114 ..	Acc. 179	1922 and 1924	7.9	100.0
Blue Dutch	98	" " "	6.9	87.3
North Dakota Resistant 114 ..	Acc. 179	1925	12.6	100.0
Redwing	188	"	14.0	111.1

Corn

Results are given here for several varieties grown during the seasons fom 1919 to 1925, inclusive. Short descriptions of the varieties grown are included here.

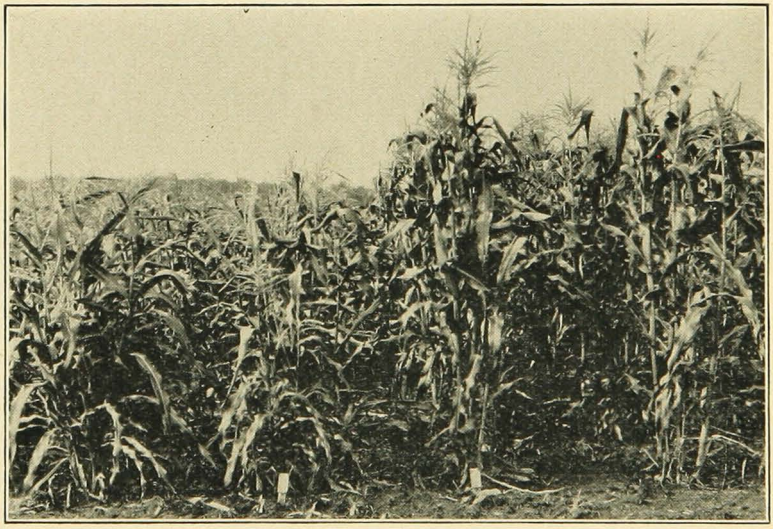


Fig. 3. Minn. No. 13 Corn on Peat (on Right)

Minn. No. 13 corn averaged 31.5 bushels an acre for a five-year period. Rustler outyielded Minn. No. 13 by three bushels an acre in the same period.

Minn. No. 13. Developed from seed obtained from a firm in St. Paul in 1893. Several strains have been developed through selection. Medium maturing strains, requiring 100 to 120 days to mature, such as those developed at University Farm and the Morris Station,

are adapted to central Minnesota. The Morris selection is several days earlier than the University Farm selection. The ears are 14- to 16-rowed, yellow, comparatively smooth, with kernels of medium depth, and with a red cob. Two early maturing strains of this variety, the Haney, developed by J. G. Haney of East Grand Forks; and the Moccasin, developed by the station at Grand Rapids, mature in favorable years in northwestern and north central Minnesota.

Rustler. Similar to the medium maturing strains of Minnesota No. 13 in plant characters and maturity. Ears white, comparatively smooth, 12- to 16-rowed. Kernels of medium depth, cobs white. A high-yielding strain has been developed at University Farm.

Northwestern Dent. The Crookston strain, developed at the Crookston Station, matures 7 to 10 days earlier than later strains of the variety. Recommended for the northwestern and north central parts of the state. Ears comparatively smooth, 12- to 14-rowed; kernels not deep, yellow capped red dent, with considerable variation in shade of color.

Longfellow. Eight-rowed yellow flint with long ears. Matures at about the same time as Minnesota No. 13.

Results of varietal trials of corn are given in Table 17.

Table 17

Average Yield per Acre of Corn at Coon Creek, Years Grown, and Percentage Yield in Comparison with Minn. No. 13 as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Minn. No. 13	1919-25	34.9	100.0
Longfellow	"	28.1	80.5
Minn. No. 13	1921-25	31.5	100.0
Longfellow	"	22.7	72.1
Northwestern Dent	"	28.3	89.8
Rustler	"	34.5	109.5

Rustler yielded somewhat better than Minn. No. 13 on peat soil. This is similar to the results of the trials on sandy soil and also on mineral soils at University Farm where the average yields are better than the University Farm strain.

Longfellow flint and Northwestern Dent both yielded somewhat less than Minn. No. 13.

Corn can not be planted as early on peat as on adjoining mineral lands. The yields on peat, however, have been relatively good. In many seasons fair yields of mature corn can be obtained if early maturing strains are used. Even in years when corn does not mature it can be used for silage.

Soybeans

Short descriptions of the soybean varieties tested are given here.

Minsoy, Minn. No. 139. Developed from a selection made at University Farm. Low-growing, averaging 22 to 25 inches; fine stemmed, leafy, non-shattering; seeds small, light yellow with brown hilums. Recommended as a seed and hay crop in northern Minnesota and for early hogging-off in central and southern Minnesota.

Wisconsin Black, Minn. Acc. No. 164. Matures in 90 to 100 days; height 28 to 30 inches, seeds of medium size and black. Recommended for seed and hay production in northern Minnesota.

Chestnut, Minn. No. 110. Developed from a selection made at University Farm. Matures in 100 to 120 days, is leafy, fine-stemmed; average height 35 inches; seeds light brown, kidney shaped. Desirable seed and hay variety in central and southern Minnesota.

Mandarin, Minn. Acc. No. 182. Matures in 100 to 110 days. Erect; height 29 to 30 inches; seeds yellow with yellow hilums. Leaves are not retained at maturity and seeds shatter readily.

Soysota, Minn. No 142. Developed from a selection made at University Farm. Matures in 110 to 120 days; erect; height averages about 35 inches.

Elton, Minn. No. 167. Developed from a selection made at University Farm. Matures in from 110 to 120 days; erect; height about 36 inches; seeds light yellow with yellow hilums. Leaves not retained at maturity.

Manchu, Minn. Acc. No. 195. Matures in 115 to 125 days; erect; leafy. Seeds round, yellow with black hilums. Desirable for southern Minnesota.

No new tests have been made on peat in recent years. Results of earlier tests are summarized in Table 18.

Table 18

Average Yield per Acre of Soybeans at Coon Creek, Years Grown, and Percentage in Comparison with Chestnut as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Chestnut	1919-25	18 0	100.0
Minsoy	"	24.8	137.8
Chestnut	1920-21	20.3	100.0
Soysota	"	23.1	113.8
Elton	"	21.9	107.9
Chestnut	1924-25	9.6	100.0
Mandarin	"	14.6	152.1

In the earlier part of this bulletin the value of soybeans as a source of protein has been emphasized. In this respect soybeans have proved even more desirable than field peas. The seed of soybeans should be inoculated.

Minsoy, an early maturing variety, is outstanding in its ability to give high yields of seed, averaging 24.8 bushels of seed per acre for a seven-year period. It appears to be the most satisfactory variety to use for seed on peat soil and can be sown as late as June 1 and produce a good yield of seed.

Field Beans

Yields of field beans are available for the period 1919-25, inclusive. A short description of each variety grown follows.

Robust, Minn. Acc. No. 76. Trailing habit of growth and resistant to the diseases anthracnose and blight. Medium early, maturing in about 100 days. Flowers white. Seeds white and of medium size.

Brown Swedish, Minn. Acc. No. 74. Bush habit of growth, susceptible to anthracnose and blight. Early, maturing in about 85 days. Flowers lilac. Seeds rounded, ocher yellow.

Arikara Yellow (Yellow Indian), Minn. Acc. No. 117. Trailing habit of growth, resistant to anthracnose and blight. Flowers white. Seeds yellow and kidney shaped. Medium early, maturing in about 95 days.

Snowflake, Minn. Acc. No. 75. Plant short, with trailing habit of growth, medium early, maturing in about 95 days. Flowers white. Seed rounded, small, white.

Yields in bushels per acre are given in Table 19.

Table 19

Yield per Acre of Field Bean Varieties at Coon Creek, Years Grown, and Percentage Yield in Comparison with Robust as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Robust	1919-25	15.7	100.0
Brown Swedish	"	15.7	100.0
Robust	1920-21	15.2	100.0
Brown Swedish	"	21.3	140.1
Arikara Yellow	"	13.7	90.1
Snowflake	"	13.1	86.2

Robust and Brown Swedish yielded more than Yellow Indian and Snowflake in 1920-21 and both Robust and Brown Swedish gave an average of 15.7 bushels per acre for the seven-year period 1919-25, inclusive.

Field beans are not cold resistant and may fail in seasons when a summer frost occurs, as in 1924. Field beans have yielded on an average as well on peat as on mineral soils. The hazard is much greater on peat, owing to the danger from frost.

Field Peas

Yields of some of the varieties of field peas are available for the period 1919-25, inclusive, and of others for shorter periods. A short description of each variety grown follows:

Golden Vine, Minn. No. 95. Tall, maturing in 95 to 100 days. Flowers white, pods short, narrow, and curved. Seeds light yellow and small.

Marrowfat, Minn. Acc. No. 174. Tall, late, maturing in 110 to 115 days. Flowers white, seeds light yellow, large.

Meyer, Minn. Acc. No. 315. Midtall, maturing in about 90 days. Flowers white, pods short, seeds light yellow and small.

Solo, Minn. Acc. No. 237. Tall, maturing in 95 to 100 days. Flowers purple, seeds gray speckled with purple, medium size.

Chang, Minn. No. 234. Tall, maturing in 105 to 110 days. Flowers white, seeds yellow with black hilums, medium size.

No tests have been made since those reported in Bulletin 228. (See footnote 3, p. 4.) A brief summary of yields is given in Table 20.

Table 20

Average Yield per Acre of Field Pea Varieties at Coon Creek, Years Grown, and Percentage Yield in Comparison with Golden Vine as 100

Variety	Years grown	Average yield	Average yield
		bu.	per cent
Golden Vine	1920-21; 1924-25	23.5	100.0
Marrowfat	"	19.5	83.0
Golden Vine	1920-21	29.6	100.0
Marrowfat	"	19.6	66.2
Chang	"	18.2	61.5
Meyer	"	17.0	57.4
Solo	"	26.6	89.9

Golden Vine, formerly on the recommended list of the Minnesota station, yielded the highest in these trials. Field peas are a desirable seed crop for peat soils, as they produce a high-protein feed suitable for both livestock and poultry.

Crop Varieties for Peat Soils

In general, the varieties of crops recommended for the loam and sandy soils are successful on the peat soils of the state. There are, however, a few exceptions.

The smooth-awned barleys so well suited to mineral soils have performed poorly on peat. Peatland and other rough-awned types have given higher yields under these conditions.

Gopher oats have yielded well on peat in all parts of the state. An early variety seems better adapted to the peat soils. Minrus is resistant to black stem rust and does very well on peat. It is better suited to peat than Anthony, which yields well on the mineral soils of central and northern Minnesota.

With other crops the recommendations are the same for peat, sand, and loam.

SUMMARY AND CONCLUSIONS

1. Varietal experiments in 1/40-acre plot trials have been conducted on the peat experimental fields at Coon Creek from 1919 to 1932, inclusive, and on those at Golden Valley, Fens, and Page for much shorter periods. Data for the small grain crops at Coon Creek are available throughout the entire period. Flax, corn, soybeans, field peas, and field beans have been grown from 1919 to 1925. On all the peat experimental fields the plots were under the supervision of the Division of Soils and received applications of whatever fertilizers were necessary.

2. Yields of the various crops were compared with midseason oats for the same period and a comparative computed weighted yield was obtained for each crop. Corn excelled with an average production of 1,909.6 pounds per acre; rye produced 1,495.2 pounds, and early oats 1,363.2 pounds. Early oats averaged 227.2 pounds more per acre than midseason varieties. The yield of spring wheat was low—396.0 pounds per acre. It appears that neither spring nor winter wheat is satisfactory for peat soils.

3. The average production of digestible nutrients of each crop, based on standards given by Henry and Morrison, was compared with midseason oats. Because of its higher yield, corn excelled all other crops. Winter rye excelled the other small grain crops in crude protein and carbohydrates. Oats ranked second to rye, with barley, winter wheat, durum wheat, and spring wheat following in order. Soybeans yielded 420.3 pounds of crude protein per acre, which makes the crop rank high for peat soils. Field peas and field beans, also, appear to be satisfactory crops.

4. The value per acre of small grains and corn was determined by the average price for the ten years from 1921 to 1930 for the three months in which the largest amount of the crop was marketed and the average yield corrected on the basis of that of oats. On the basis of this computation the crops are placed in the following order for value per acre: corn, $22.64; winter rye, $20.17; flax, $19.02; winter wheat, $15.42; barley, $12.69; oats, $12.16; durum wheat, $10.50; spring wheat, $8.11. The cost of producing corn is somewhat greater than for the other grain crops.

5. The variety trials with the different crops indicate the varieties most suitable for peat soils as represented at Coon Creek, Page, Golden Valley, and Fens.

(a) Minrus, an early midseason oat, is somewhat taller than Gopher, has stiff straw, and has been one of the highest yielding varieties tested. Iowar, an early selection produced by the Iowa station, has performed well in the trials. Rainbow, North Dakota 22005 and 20014 have yielded well.

(b) It appears that the spring wheat varieties now available are not suited to peat. Emmer, a wheat which retains its glumes in threshing and is suitable only for stock feed, has given higher yields than the common spring wheats.

(c) Winter wheat is a hazardous crop on peat soils, being more subject to winter injury than rye.

(d) Peatland barley has yielded about the same as Manchuria during a six-year trial at Coon Creek. Trebi has outyielded all other varieties, excelling Manchuria by 7.5 per cent for a four-year period. It should be grown only for feed. Neither Velvet nor Glabron has yielded well in the trials at Coon Creek.

(e) Rye is better suited to peat soils than winter wheat. Rosen, altho not winter hardy on mineral soils, has ranked high in the limited trials. Swedish No. 2 and Dakold are less subject to winter injury than is Rosen.

(f) Flax does fairly well on peat soils. Redwing, because of its earliness, should be a satisfactory variety.

(g) Rustler has yielded somewhat more than Minn. No. 13 at Coon Creek. Longfellow flint and Northwestern Dent both yielded less than Minn. No. 13. Corn must be planted later on peat soils than on adjacent mineral lands. Even tho late planting is resorted to, it is frequently necessary to replant because of frost.

(h) Minsoy is a desirable early variety of soybeans for peat soils. The high yield of protein per acre makes soybeans a valuable crop, if the soil is properly inoculated.

(i) Field beans are easily injured by frost and are hazardous on peat soils. However, good yields have been grown over a period of years. Robust and Brown Swedish have been the highest yielding. Field peas are suitable for peat soils as a source of protein feed for both livestock and poultry. Golden Vine has given highest yields in the Coon Creek trials.

(j) In general, the same varieties of crops are recommended for peat as for mineral soils. The smooth-awned barleys are not so well suited to peat as are Peatland and other rough-awned types. Gopher and the early midseason Minrus are recommended for peat in all sections of the state.

Table 21

Yield in Bushels per Acre and in Percentage of Oat Varieties in 1/40-Acre Plot Trials at Coon Creek, with Gopher as 100*

Variety	Minn. No.	1920	1921	1922	1923	1924	1925	1926	1928	1929	1930	1931	1932	Years grown	Per cent of Gopher
Minota	512	59.9	6.1	39.9	13.3	...	64.9	...	...	37.0	48.9	...	...	7	102.2
Victory	514	60.5	4.4	24.0	18.0	44.0	...	31.4	...	...	...	23.9	...	7	66.8
Anthony	686					45.1	47.8	39.7	24.7	37.7	47.1	43.6	...	7	82.7
Minrus	693								32.2	36.6	65.2	59.8	61.4	5	128.1
Irish Victor	593	59.2	14.1											2	103.1
Lincoln	505	58.6	7.3											2	92.7
Gold Rain	669	55.0	13.2											2	95.9
Silvermine	506	49.8	5.6											2	77.9
Improved Ligowa	281	54.8	1.9											2	79.7
Joanette		45.7	7.0											2	74.1
White Tartar	339	41.6	6.8											2	68.1
White Russian x Victory	696								25.2	44.5	50.2	42.9		4	110.9
White Russian x Victory	694								19.6	35.8	38.7			3	89.7
White Russian x Victory	697								18.9	43.4	44.7			3	102.0
White Russian x Victory	699								26.1	42.1	53.6			3	116.1
North Dakota 22005	Acc. 709									45.8	49.4	51.7		3	117.7
North Dakota 20014	Acc. 708									47.4	49.6	44.1		3	113.2
Rainbow	Acc. 710									43.0	46.5	48.2		3	110.5
Fulghum	537	47.8	5.4											2	74.8
Average midseason oats		53.3	7.2	31.9	15.7	44.6	56.4	35.6	24.5	41.3	49.4	44.9			
Gopher	674	60.3	10.8	42.8	11.1	79.1	56.6	62.9	22.2	37.5	45.2	41.9	52.4	..	100.0
Iowar	670	68.0	19.5	66.1	17.5	69.2	71.1	62.9	22.2	32.8	...	53.2		10	113.5
Average early oats		64.2	15.2	54.5	14.3	74.2	63.9	62.9	22.2	35.2	45.2	47.6			
Probable error in per cent		4.1	5.4	11.0	14.7	4.2	6.7	6.3	7.9	5.8	6.7	5.1			

* Floods destroyed the crop in 1927.

Table 22

Yield in Bushels per Acre and in Percentage of Spring Wheat Varieties in 1/40-Acre Plot Trials at Coon Creek with Marquis as 100

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1932	Years grown	Per cent of Marquis
Marquis	Acc. 1239	8.0	2.5	0.0	2.1	1.0	...	...	...	*	9.8		5	100.0
Kota	Acc. 2151						13.8	17.5	9.9		..			
Marquillo	2202						11.0	16.5	7.2		7.9			
Komar	Acc. 2244										8.3			
Ceres	Acc. 2223											12.4		
Average		8.0	2.5	0.0	2.1	1.0	12.4	17.0	8.6		8.7			
Mindum	470	14.5	15.7	0.0	1.8	4.4						16.6	5	267.6
Emmer†	Acc. 1165	31.5	25.6	0.0	3.4	12.3	25.1	22.9						535.3
Probable error in per cent		6.6	17.3	..	20.8	9.0	5.7	5.2	11.7	*	6.8			

* No grain yields.

† 20 per cent deducted from yields for hulls.

Table 23

Yield in Bushels per Acre and in Percentage of Barley Varieties in 1/40-Acre Plot Trials at Coon Creek with Manchuria as 100*

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925
Manchuria	184	18.3	19.6	9.9	20.3	10.0	42.5	42.5
Minsturdi	439	17.1	29.4	16.7	16.0	9.1	39.0	34.2
Svansota	440	13.9	17.0	5.4	18.8	9.4	...	...
Velvet	447	...	...	...	...	...	32.9	39.0
Peatland	452	...	...	...	...	...	44.0	41.3
Svansota	440	...	...	...	...	...	...	...
Trebi	448	...	...	...	...	...	...	...
Glabron	445	...	...	...	...	...	...	...
Average		16.2	25.6	9.7	18.8	9.4	39.6	39.3
Probable error in per cent		6.5	5.9	11.2	12.4	9.7	6.1	5.1

Variety	Minn. No.	1928	1929	1930	1931	1932	Years grown	Per cent of Manchuria†
Manchuria	184	19.0	23.7	29.9	39.3	...	11	100.0
Minsturdi	439	...	...	...	...	...	7	99.0
Svansota	440	...	...	...	...	...	5	82.6
Velvet	447	...	21.9	20.7	34.3	...	5	83.6
Peatland	452	15.9	21.9	30.4	37.3	47.3	6	96.9
Svansota	440	16.1	24.5	24.2	37.7	...	4	91.6
Trebi	448	15.5	27.7	38.4	38.6	37.6	4	107.4
Glabron	445	15.5	23.2	24.6	30.7	...	4	84.0
Average		16.4	23.8	28.0	36.3			
Probable error in per cent		7.3	8.1	7.1	6.4			

* Floods destroyed crop in 1927.

† 1932 not included..

Table 24

Yield in Bushels per Acre and in Percentage of Flax Varieties in 1/40-Acre Plot Trials at Coon Creek with North Dakota Resistant 114 as 100

Variety	Minn. No.	1919	1920	1921	1922
North Dakota Resistant 114	Acc. 179	2.7	10.8	10.1	11.1
North Dakota Resistant 52	Acc. 173	4.2	12.5	9.7	...
North Dakota Resistant 73	Acc. 174	...	11.3	9.0	...
Chippewa	181	...	...	...	...
Winona	182	...	...	...	...
Blue Dutch	Acc. 98	...	...	...	11.7
Redwing	188	...	...	...	...
Average		3.5	11.5	9.6	11.4
Probable error in per cent			4.6	10.4	

Variety	Minn. No.	1923	1924	1925	Years grown	Per cent of North Dakota Resistant 114
North Dakota Resistant 114	Acc. 179	6.2	4.7	12.6	..	100.0
North Dakota Resistant 52	Acc. 173	...	5.0	...	4	111.0
North Dakota Resistant 73	Acc. 174	...	...	...	2	97.1
Chippewa	181	5.8	4.4	13.0	3	98.7
Winona	182	4.8	3.8	11.8	3	86.8
Blue Dutch	Acc. 98	...	2.0	...	2	86.7
Redwing	188	...	...	14.0	..	....
Average		5.6	4.0	12.9		
Probable error in per cent		25.1				

Table 25

Yield in Bushels per Acre and in Percentage of Rye and Winter Wheat Varieties in 1/40-Acre Plot Trials at Coon Creek with Swedish No. 2 as 100*

Crop and variety	Minn. No. 1919	1920	1921	1922	1923	1924	1925	1926	1928	1929	1930	1931	Years grown	Per cent of Swedish
Winter rye varieties														
Swedish	2	18.4	26.9	35.8	26.7	49.3	29.1	29.0	0.0	19.1	23.6	35.0	4	100.0
Wisconsin Pedigree	84	17.0	28.2	36.5	26.7								4	100.6
Rosen Acc.	82	20.8	29.6	43.2	26.5					20.6			4	111.4
Midsommerog	87					37.3	30.0	36.4					3	96.6
Colorless	90					41.6	24.4	28.4					3	87.8
Medium Green	91					45.6	27.4	29.6					3	95.5
Dark Green	92					32.1		29.6					2	78.8
Dakold Acc.	93										20.7	33.5	2	92.5
Synthetic	107											34.4		
Average		18.7	28.2	38.5	26.6	41.2	27.7	30.6	0.0	19.9	22.2	34.3		
Prolific spring rye	89										13.0	11.7	2	42.2
Winter wheat														
Minturki	1507			7.2	6.3	8.2	11.5	7.8	..	17.2	20.8	39.2	8	47.7
Probable error in per cent		5.0	3.0	6.4	7.6	4.8	10.4	5.7	..	3.0	4.5	9.4		

* Floods destroyed crop in 1927.

Table 26

Yield in Bushels per Acre and in Percentage of Ear Corn in 1/40-Acre Plot Trials at Coon Creek with Minn. No. 13 as 100

Variety	1919	1920	1921	1922	1923	1924	Years grown	Per cent of Minn. No. 13
Minn. No. 13	48.8	38.0	54.0	63.8	39.9	0	6	100.0
Longfellow	51.0	32.0	40.1	38.1	35.5	0	6	80.4
Rustler			59.2	66.9	46.2	0	4	109.3
Northwestern Dent			49.7	48.6	43.0	0	4	89.6
Average	49.9	35.0	50.8	54.4	41.2			

Table 27

Yield in Bushels of Seed per Acre and in Percentage of Soybeans in 1/40-Acre Plot Trials at Coon Creek with Chestnut as 100

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	Years grown	Per cent of Chestnut
Chestnut	110	19.8	13.8	26.8	42.0	4.2	6.7	12.4	7	100.0
Minsoy	139	20.9	16.2	40.3	50.8	10.1	9.6	25.7	7	138.1
Wisconsin Pedigree	118		13.6	29.0					2	104.9
Soysota	142		14.0	32.1					2	113.5
Elton	167		13.3	30.4					2	107.6
Mandarin	182						13.5	15.7	2	152.9
Average		20.4	14.2	31.7	46.4	7.2	9.9	17.9		

Table 28

Yield in Bushels per Acre and in Percentage of Field Peas in 1/40-Acre Plot Trials at Coon Creek with Golden Vine as 100

Variety	Minn. No.	1920	1921	1924	1925	Years grown	Per cent of Golden Vine
Golden Vine	95	51.6	7.6	23.7	11.0	4	100.0
Marrowfat		30.1	9.0	29.7	9.0	4	82.9
Chang	234	30.9	5.4	...	10.8	3	67.1
Meyer		20.7	13.2	...	...	2	57.3
Solo	237	42.0	11.1	...	...	2	89.7
Average		35.1	9.3	26.7	10.3		

Table 29

Yield in Bushels per Acre and in Percentage of Field Beans in 1/40-Acre Plot Trials at Coon Creek with Robust as 100

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	Years grown	Per cent of Robust
Robust	76	9.0	13.5	16.8	34.4	10.1	0.0	26.4	7	100.0
Brown Swedish	74	18.8	17.5	25.0	35.4	7.7	0.0	5.7	7	99.9
Arikara Yellow		...	10.4	16.9	...	...	0.0	...	3	90.1
Snowflake	75	...	13.8	12.4	...	...	0.0	...	3	86.5
Average		13.9	13.8	17.8	34.9	8.9	0.0	16.1		