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CORN IN MISSOURI

I. Corn Varieties and Their Improvement

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CORN IN MISSOURI

I. Corn Varieties and Their Improvement

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The average acre-yield of corn in Missouri during the 10-year period 1911-1920 was 27 bushels. Many farmers have made yields two or three times as high in the same period. While it is true that many extremely high yields of corn are produced at less profit than moderately high yields, it is certain that the average yield per acre of the State could be increased at least 25 percent by practices which would not increase the cost of production. The yield of corn or of any other crop may be increased through the use of better seed and better methods of culture. In this bulletin the factors which make for better seed are discussed, including the choice of a variety, the improvement of the variety chosen and the production of pure, live, healthy seed. Methods of culture will be discussed in another bulletin soon to be published.

VARIETIES OF CORN

Tests of varieties of corn have been conducted by the Missouri Experiment Station in all sections of the State since 1905. Over 50 varieties were tested in a preliminary way at Columbia and the best of these were further tested for many years on eight outlying experiment fields and in 467 cooperative tests on farms located in the important agricultural regions of the State. The results of the first five years were reported in Bulletin 87 of this Station and the results of the first 10 years in Bulletin 143. The present bulletin reports the results of 16 years including the season of 1920. The results through this period were consistent and the relative value of the varieties now available to Missouri farmers may therefore be considered fairly well established, although it is possible that future tests of new varieties may discover kinds more valuable than any now being grown.

The object of these tests was to find the most suitable variety for each important agricultural section of the State. The conclusions are, therefore, based chiefly on the results of tests on outlying fields.

The following varieties were tested at Columbia during the years 1905-1915 inclusive:

Boone County White	Cartner
Boone County Special	Cob Pipe
Bloody Butcher	Commercial

*The variety tests reported in this bulletin were planned and begun by M. F. Miller, and have been at various times under the direct charge of Professor Miller, H. D. Hughes, C. B. Hutchison, T. R. Douglass, J. B. Smith and C. A. Helm. Earlier results are reported in Bulletin 87, by M. F. Miller and H D Hughes, and in Bulletin 143, by C B. Hutchison, A. R. Evans, J. C. Hackleman and E. M. McDonald, with a description of the soil areas concerned by H. H. Krusekopf. These bulletins have been drawn on freely in the preparation of this report. Dr. W. C. Etheridge, chairman of the Department of Field Crops, has had general supervision of the work since 1916, and has aided greatly by advice and criticism in the preparation of the present bulletin.

Champion White Pearl
Cocke Prolific
Clay County White
Calico
Clarage
Diamond Joe
Eclipse
Funk Silver King
Funk Yellow Dent
Funk 90 Day
Farmers' Interest
Farmers' Reliance
Golden Beauty
Gold Standard Leaming
Golden Eagle
Graves Yellow Dent
Golden Yellow Dent
Hildreth Yellow Dent
Hogue Yellow Dent
Hoffmeister White
Howard County Yellow
Hickory King
Illinois Silvermine
Iowa Silvermine
Indiana Ear No. 4
Johnson County White
Kansas Sunflower
Leaming
Legal Tender
Lenocher Homestead
McAuley White Dent
McMacken Gourdseed
Missouri No. 7
Marlboro Prolific
Pride of the North
Pride of Nishna
Queen of Nishna
Reid Yellow Dent
Ratekin Yellow Dent
Roseland
St. Charles White
St. Charles Special No. 2
St. Charles Yellow
Smoot 90 Day
Tucker Special
White Superior

Only 14 of these varieties were considered worthy of further trial on outlying experiment fields and on farms of cooperators. The years in which these were tested in cooperation with farmers are indicated in Table 1.

Continued tests eventually eliminated all but six varieties: Boone County White, Commercial White, St. Charles White, Reid Yellow Dent, Leaming, and St. Charles Yellow and these six were very thoroughly tested on outlying experiment fields and in cooperative tests since 1910 to find their relative value in each section. These six varieties are alluded to in the following pages as the standard Missouri varieties.

TABLE 1.—VARIETIES IN CO-OPERATIVE TESTS, 1905–1914.

VARIETIES	1905	1906	1907	1908	1909	1910-14 (Incl.)
Boone County White	*	*	*	*	*	*
Cartner	*	.....	*	*	.....	.....
Champion White Pearl	.....	.....	.....	.....	*	.....
Commercial White	.....	.....	*	*	*	*
Farmer's Interest	.....	*	*	.....	.....	.....
Hildreth Yellow Dent	.....	.....	*	*	.....	.....
Hogue Yellow Dent	.....	*	*	*	*	.....
Johnson County White	.....	*	*	*	*	.....
Leaming	*	*	*	*	*	*
Legal Tender	.....	*	*	*	.....	.....
Reid Yellow Dent	*	*	*	*	*	*
Silvermine	*	*	*	*	*	.....
St. Charles White	*	*	*	*	*	*
St. Charles Yellow	*	*	*	*	*	*

COMPARATIVE SHRINKAGE OF CORN VARIETIES

All yields reported in the following pages are in terms of bushels of ear corn per acre at husking time. Direct comparison of these yields gives a distinct advantage to varieties which at husking contained an abnormally high percentage of moisture or a low percentage of grain. Varieties with large cobs and shallow grain may have considerably less grain per bushel of ear corn than varieties with a deeper grain, such as Reid Yellow Dent. Heavy cobbed and late maturing varieties are also likely to contain a high percentage of moisture. Thus equal yields of ear corn at husking may represent decidedly unequal yields of dry shelled corn. The unequal shrinkage of the different varieties must be considered in comparing yields. Sometimes as much as 25 percent difference betwen two varieties in yield of ear corn at husking is completely overbalanced by difference in shrinkage. The yield of dry shelled corn should be the basis of judgment. Moreover, of two varieties equal in yield of dry shelled corn, the one showing the lower percentage of shrinkage, and consequently the lower yield of ear corn at husking, is to be preferred. The shrinkage is largely caused by high moisture content, and the higher the moisture content the poorer the keeping qualities of the grain. High moisture content is usually caused by late maturity; and the use of late varities greatly increases the danger of soft corn from early freezes and the difficulty of securing good seed corn even in the average season. Furthermore, the expense of handling up to 25 percent more weight in the ear corn at husking to secure the same actual yield of dry shelled corn is an item of some importance.

As determinations of shelling percentage and of moisture content were not made in the early years of the tests reported herein, all yields are expressed in bushels of ear corn for direct comparison. A number of these determinations were made, however, and are reported.

Five years' data on the shrinkage of corn varieties at Columbia are available. Shrinkage was determined by storing the corn in crates over winter in a dry and well ventilated seed house, and shelling it in late winter or early spring. The weight of air-dry shelled corn obtained from one hundred pounds of ear corn at husking time for the principal varieties grown at Columbia during the five seasons is shown in Table 2.

Although the seasonal variation in shrinkage is large, it can be seen that certain varieties always show relatively low shrinkage, while others show relatively high shrinkage. In the averages of the five seasons reported above, the shrinkage of Reid Yellow Dent is less than 30 percent, while that of Cob Pipe, under the same conditions, is more than 45 percent. In other words, 1.14 bushels of Reid Yellow Dent in the ear at husking time was actually equal in dry shelled corn to 1.46 bushels of Cob Pipe under the same conditions; or a 64-bushel yield of Cob Pipe would be required to equal 50-bushel yield of Reid Yellow Dent as measured in ear corn at husking. A difference in yield of 28 percent is fully counteracted by the difference in shrinkage of these two varieties. This difference is extreme but other varieties also show noteworthy difference in rate of shrinkage. The figures given in the last column of Table 2 for each variety indicate equivalent yields of ear corn. Thus 1.26 bushels of Commercial White are equivalent to 1.18 bushels of Leaming, or to 1.34 bushels of Hildreth Yellow Dent.

TABLE 2.—SHRINKAGE OF CORN VARIETIES AT COLUMBIA.

(In Pounds of Air Dried Shelled Corn per 100 Pounds of Ear Corn at Husking.)

VARIETY	1910	1912	1913	1914	1915	Average	Bu. Ear Corn Equivalent to 1 Bu. Shelled Corn
St. Charles White	62.68	68.62	62.22	64.23	76.81	66.91	1.20
Boone County White	61.81	67.40	64.00	52.68	78.48	64.87	1.23
Leaming	59.07	70.86	62.90	64.17	83.02	68.00	1.18
Reid Yellow Dent	64.54	72.02	65.43	67.61	82.52	70.42	1.14
Cartner	62.27	69.34	66.31	65.48	80.62	68.80	1.16
Iowa Silvermine	62.15	69.60	62.60	63.67	82.59	68.12	1.17
Hildreth Yellow Dent	57.74	61.14	64.77	43.49	70.96	59.52	1.34
Johnson County White	61.31	68.45	64.38	54.98	81.20	66.06	1.27
St. Charles Yellow	62.76	68.83	60.00	59.16	80.59	66.27	1.28
Hogue Yellow Dent	65.11	72.54	66.14	64.80	81.79	70.07	1.14
Commercial White	55.93	66.38	63.33	56.04	74.37	63.21	1.26
Cob Pipe	54.61	48.58	63.41	41.10	66.44	54.83	1.46
Illinois Silvermine	64.47	69.97	63.56	68.85	83.22	70.01	1.14
Pride-of-the-North	65.98	79.19	60.00	60.17	87.41	71.55	1.12
Clay County White	61.54	69.63	67.82	63.52	79.73	68.45	1.17
Calico	59.13	71.68	65.00	54.62	82.28	66.34	1.20
Bloody Butcher	56.14	71.07	61.42	50.08	84.05	64.55	1.24

Both factors concerned in shrinkage, as measured in the foregoing—the shelling percentage and the moisture content—are more or less affected by seasonal conditions. Determinations of both have therefore been made for five principal varieties grown in variety tests in different sections of the State and in different seasons. These are summarized in Table 3.

The foregoing data show that in northern and central Missouri the shrinkage varies considerably, while in southern Missouri the shrinkage is slight in degree and varies but little with the variety. In northern and central Missouri the medium early maturing varieties, Reid Yellow Dent and Leaming, show the smallest shrinkage. A 12 percent advantage in weight of ear corn at husking time for Commercial White over Reid Yellow Dent or Leaming is required to offset the lower shrinkage of the latter named varieties. In other words, Commercial White must yield 12 percent more ear corn as measured at husking to equal the yield of dry shelled corn of either Reid Yellow Dent or Leaming in northern or central Missouri. It must yield about 8 percent more ear corn than Boone County White or St. Charles White. Unless it excels these varieties by considerably larger margins than those mentioned, it is to be avoided in northern and central Missouri because of its higher moisture content and consequently poorer keeping quality. However, in southern Missouri, where the growing season is long enough to mature Commercial White, this variety shows but little more shrinkage than the others and practically the same moisture content at husking.

VARIETY TESTS AT COLUMBIA

In the 11 years, 1905-1915 inclusive, 52 varieties of corn were tested at Columbia. The soil on which the tests were conducted is a gently rolling Putnam silt loam, fairly representative of the upland soils of northeastern

TABLE 3.—SHRINKAGE DETERMINATIONS IN NORTHERN, CENTRAL, AND SOUTHERN MISSOURI.

Northern Missouri.

VARIETY	Shelling Percentage					Moisture Content					Bu. Ear Corn Equivalent to 1 Bu. Shelled Corn 12% Moisture
	Maryville Av. 5 Yrs.	Shelbina Av. 2 Yrs.	St. Joseph 1 Yr.	Humphreys 1 Yr.	Wt'd Av.	Maryville Av. 3 Yrs.	Shelbina Av. 2 Yrs.	St. Joseph 1 Yr.	Humphreys 1 Yr.	Wt'd Av.	
Boone County White	81.6	79.7	80.3	80.6	80.9	20.0	19.6	20.8	18.2	19.8	1.09
Commercial	79.1	70.5	77.9	78.7	77.0	21.9	22.4	24.9	22.0	22.5	1.18
St. Charles White	82.0	83.1	82.2	80.0	82.0	21.1	16.8	21.1	21.1	20.4	1.08
Reid Yellow Dent	84.0	80.3	82.7	80.7	82.7	19.0	15.5	20.9	21.3	19.1	1.05
Leaming	83.8	81.2	83.3	81.5	82.9	18.8	17.8	18.6	18.0	18.5	1.04

Central Missouri.

VARIETY	Shelling Percentage					Moisture Content					Bu. Ear Corn Equivalent to 1 Bu. Shelled Corn 12% Moisture
	Warrensburg Av. 3 Yrs.	Columbia 1 Yr.	Farmington 1 Yr.	Conway 1 Yr.	Wt'd Av.	Warrensburg Av. 3 Yrs.	Columbia 1 Yr.	Farmington 1 Yr.	Conway 1 Yr.	Wt'd Av.	
Boone County White	82.8	83.1	78.7	67.1	79.6	17.8	17.2	17.4	17.3	17.6	1.07
Commercial White	79.9	82.2	75.0	63.6	76.8	20.3	19.3	22.8	22.6	20.9	1.16
St. Charles White	83.6	83.2	78.7	68.1	80.1	19.3	19.7	20.6	18.6	19.5	1.09
Reid Yellow Dent	86.0*	85.2	81.8	73.2	81.6	14.6	14.6	18.2	18.1	15.8	1.03
Leaming	86.0*	85.9	80.6	66.0	79.6	15.9	14.9	15.9	16.2	15.8	1.05

*1 year.

TABLE 3. (CONTINUED).—SHRINKAGE DETERMINATIONS IN NORTHERN, CENTRAL AND SOUTHERN MISSOURI.

Southern Missouri.

VARIETY	Shelling Percentage			Moisture Content				Bu. Ear Corn Equivalent to 1 Bu. Shelled Corn 12% Moisture
	Cape Girardeau Av. 3 Yrs.	Charleston 1 Yr.	Wt'd Av.	Cape Girardeau Av. 3 Yrs.	Charleston 1 Yr.	Kennett 1 Yr.	Wt'd Av.	
Boone County White	84.1	82.5	83.7	15.4	14.8	14.8	15.2	0.99
Commercial White	81.6	81.2	81.5	18.9	15.2	14.3	17.2	1.04
St. Charles White	82.2	83.7	82.7	19.2	16.4	14.8	17.8	1.04
Reid Yellow Dent	81.7	83.7	82.2	16.6	14.0	15.4	15.8	1.02
Leaming	82.0	81.2	81.8	17.4	13.0	14.1	15.9	1.02

TABLE 4.—YIELD OF CORN VARIETIES AT COLUMBIA.

(In Bushels per Acre)

VARIETY	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
St. Charles White	53.1	64.1	80.3	53.8	60.6	65.8	41.3	83.3	18.2	36.4	27.4
Boone County White	53.8	62.5	81.2	42.7	54.2	66.0	36.4	78.6	26.7	28.9	35.3
Leaming	46.1	67.9	64.9	36.9	54.5	61.6	37.0	65.1	34.8	33.3	33.2
Reid Yellow Dent	41.7	67.0	64.3	36.5	52.2	78.4	43.6	66.5	31.5	31.3	31.6
Cartner	49.2	44.8	68.3	33.3	51.9	62.8	43.9	81.3	33.9	30.6	30.6
Iowa Silvermine	54.4	59.0	40.8	34.9	46.9	56.5	28.0	72.1	23.4	22.3	29.4
Hildreth Yellow Dent	63.7	.....	92.2	34.9	52.5	91.2	42.0	80.0	19.3	27.2	27.6
Johnson County White	.....	67.1	74.9	42.8	57.1	55.5	41.3	73.2	28.4	32.8	32.1
St. Charles Yellow	.....	67.1	83.9	40.1	.....	62.1	37.7	76.6	31.0	31.6	32.8
Hogue Yellow Dent	.....	51.3	40.9	41.1	53.4	63.9	37.1	70.9	34.1	34.3	33.6
Legal Tender	.....	59.0	75.8	36.7	.....	.....	.....	64.0	30.8	31.5	26.3
Commercial White	.....	.....	86.8	46.1	57.5	82.3	38.5	116.4	24.7	29.3	27.4
Cob Pipe	.....	.....	92.5	.....	65.9	82.2	43.1	92.2	9.3	32.4	29.9
Illinois Silvermine	.....	.....	.....	36.0	63.1	53.6	39.2	43.5	31.2	34.9	32.0
Pride of the North	.....	.....	.....	.....	38.0	28.2	25.4	.....	21.6	17.8	29.0
Clay County White	.....	.....	.....	.....	48.8	62.8	38.0	70.3	24.8	30.7	26.6
Calico	.....	.....	.....	.....	.....	65.5	35.0	70.0	25.3	34.4	23.7
Bloody Butcher	.....	.....	.....	.....	.....	84.3	33.1	67.0	26.9	28.1	24.4
Hoffmeister White	.....	.....	.....	.....	.....	.....	.....	119.4	16.1	29.3	31.7
Tucker Special	.....	.....	.....	.....	.....	.....	.....	58.1	22.1	25.4	30.7

and central Missouri. The plots have received no commercial fertilizer, but crops have been rotated regularly and the soil is fairly productive. The yields of all varieties which were tested four years or more and were not eliminated because of poor yields before 1915 are given in Table 4.

It will be seen from the yields in this table that in a given season there is a great difference between the yields of different varieties grown under the same conditions. Thus in 1907 the yield of Boone County White was more than 100 percent greater than that of Silvermine. The relative value of two varieties, however, may be very different in different seasons. For example, in 1907 Boone County White outyielded Reid Yellow Dent by 17 bushels, while in 1911 Reid Yellow Dent outyielded Boone County White by 12 bushels. Obviously, the best variety for a locality can be fairly determined only by a comparison of the average yields of varieties for a period of several seasons. Futhermore, in comparing two varieties, the average yields compared must represent the same seasons. It would not be accurate to compare the average yield of Boone County White for 1905-1915 with the average yield of Clay County White for 1909-1915. Clay County White can be accurately compared with Boone County White only by comparing the average yields of the two varieties for the years in which both were included in the test. The average yields have been computed for the eleven-year period for the six varieties which were in the test for the full period, and also for shorter periods for varieties which were brought into the test after the first year. The yields of the six original varieties have been computed also for these shorter periods for direct comparison with those of varieties tested less than 11 years. In Table 5 all of the average yields in the same column represent the same period of years and may be directly compared.

Of the six varieties which were tested for 11 years at Columbia, St. Charles White, Boone County White, and Reid Yellow Dent are the leaders, ranking in the order named. Iowa Silvermine is very inferior to the other varieties tested.

In the 10-year averages neither of the two varieties added to the test, Johnson County White and Hogue Yellow Dent, equal the yield of St. Charles White. The yield of Johnson County White is about equal to that of Boone County White, which it closely resembles. These two varieties made almost identical yields in nearly every season. Hogue Yellow Dent, a variety obtained from Nebraska, was inferior to the three standard Missouri varieties, Reid Yellow Dent, Boone County White and St. Charles White.

The two varieties added in 1907, Hildreth Yellow Dent and Commercial White, show well in the nine-year averages, the former equaling the yield of St. Charles White and the latter surpassing it by almost 10 percent. Both of these varieties, however, have a higher shrinkage than St. Charles White, as shown in Table 2. According to this five-year average of shrinkage determinations, 1.34 bushels of Hildreth Yellow Dent or 1.26 bushels of Commercial White are equivalent to 1.20 bushels of St. Charles White; that is, Hildreth Yellow Dent must outyield St. Charles White by about 12 percent and Commercial White must surpass it by about 5 percent in yield of ear corn at husking to equal it in yield of dry shelled corn. In yield of dry shelled corn Hildreth Yellow Dent has not equalled any of

the three standard varieties while Commercial White has outyielded them 5 percent or more.

None of the varieties added to the test after 1907 has outyielded Commercial White. Cob Pipe, tested for seven years, shows an average yield 3 bushels less than that of Commercial White and somewhat greater than those of the other standard Missouri varieties. But its extremely high shrinkage reduces its yield of shelled corn to a point considerably below theirs. St. Charles Yellow, which was added to the test in 1906 but omitted in 1909, made an average acre yield of 51.4 bushels of ear corn during the nine years it has been tested, as compared with a yield of 52.3 bushels for St. Charles White in the same period. Considering relative shrinkage,

TABLE 5.—AVERAGE YIELDS OF CORN VARIETIES AT COLUMBIA.
(In Bushels per Acre)

VARIETY	AVERAGE YIELD						
	11 Yrs. 1905-15	10 Yrs. 1906-15	9 Yrs. 1907-15	8 Yrs. 1908-15	7 Yrs. 1909-15	6 Yrs. 1910-15	4 Yrs. 1912-15
St. Charles White	53.1	53.1	51.9	48.4	47.6	45.4	41.3
Boone County White	51.5	51.3	50.0	46.1	46.6	45.3	42.4
Leaming	48.7	48.9	46.8	44.6	45.6	44.2	41.6
Reid Yellow Dent	49.5	50.3	48.4	46.5	47.9	47.2	40.2
Cartner	48.2	48.1	48.5	46.0	47.9	47.2	44.1
Iowa Silvermine	42.5	41.3	39.4	39.2	39.8	38.6	36.8
Johnson County White	.....	50.5	48.7	45.4	45.8	43.9	41.6
Hogue Yellow Dent	.....	46.1	45.5	46.1	46.8	45.7	43.2
Hildreth Yellow Dent	.....	.....	51.9	46.8	48.5	47.9	38.5
Commercial White	.....	.....	56.6	52.8	53.7	53.1	49.5
Illinois Silvermine	.....	.....	.....	41.7	42.5	39.1	35.4
Cob Pipe	.....	.....	.....	.....	50.7	48.2	41.0
Clay County White	.....	.....	.....	.....	43.1	42.2	38.1
St. Charles Yellow	.....	.....	.....	.....	.....	45.3	43.0
Calico	.....	.....	.....	.....	.....	42.3	38.4
Bloody Butcher	.....	.....	.....	.....	.....	44.0	36.6
Legal Tender	.....	.....	.....	.....	.....	.....	38.2
Hoffmeister White	.....	.....	.....	.....	.....	.....	49.1
Tucker Special	.....	.....	.....	.....	.....	.....	34.1

its yield has been slightly lower than those of St. Charles White, Boone County White and Reid Yellow Dent. Legal Tender, also added to the test in 1906 but omitted in 1909, 1910, and 1911, has averaged during the seven years it was tested, 46.3 bushels, while St. Charles White has averaged 48.0 bushels in the same period. Pride of the North, tested from 1909 to 1915, with the exception of 1912, has yielded an average of 26.7 bushels, in comparison with 43.3 bushels for Commercial White in the same period.

The leading varieties of corn at Columbia were Commercial White and St. Charles White. Boone County White and Reid Yellow Dent also yielded well. Johnson County White gave practically the same results as Boone County White. Extremely early maturing varieties such as Silvermine and Pride of the North were decidedly inferior in yield to the medium late maturing varieties.

VARIETY TESTS ON OUTLYING FIELDS

Variety tests have been conducted on outlying fields distributed over the State throughout the 16-year period treated in this report. For 10 years, 1905-1914 inclusive, they were conducted in cooperation with farmers and were located roughly in proportion to the production of corn in the various sections of the State. The plan in this cooperative work was to test, on all of the important soil types of the State, those varieties most promising for Missouri conditions. Each cooperator was supplied with seed of six to ten varieties, in quantities sufficient for planting at least one-fourth of an acre of each. These were planted side by side on the average corn land of the community, care being taken to select a piece of land as uniform in fertility as possible. Where possible the varieties were planted in long rows rather than in blocks, to gain more uniform conditions of soil. In order to make the test as simple as possible for the cooperators, usually but one plot of each variety was planted, although more accurate results undoubtedly would have been secured if each variety could have been repeated and the average of two or more plots taken as an estimate of its value. In each case the varieties were given the same treatment so that all could have equal chances. As the season advanced each cooperator made careful observations and notes on the growth and development of the varieties and at maturity harvested and weighed each of them separately. These observations and weights were forwarded to the Experiment Station on blanks furnished for the purpose, and the yield of each variety in each case was calculated on the basis of 70 pounds to the bushel. The approximate location of the fields on which the cooperative experiments were conducted is shown in Figure 1.

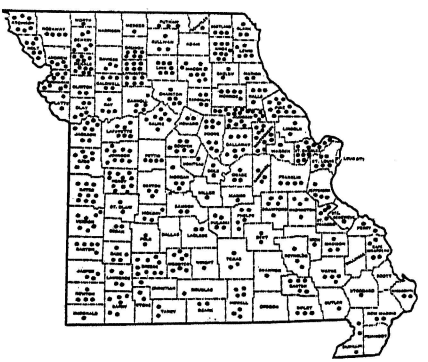

FIG. 1. Approximate location of cooperative tests of corn varieties.

In 1910, in order to simplify the cooperative work and obtain more detailed and reliable information on the better yielding varieties, all except Boone County White, Commercial White, St. Charles White, Reid Yellow Dent, Leaming, and St. Charles Yellow were dropped from the test. The first five years' results had indicated that these six varieties were the leaders in all parts of the State.

The results of the cooperative tests were reported in detail in Bulletin 143 of this Station. In the present bulletin they are reported only in summarized form.

Corn varieties have also been tested on eight outlying experiment fields of the Experiment Station. The location of these fields is shown in Figure 2. The plots used on these fields were usually about one-tenth acre in size and were usually repeated from two to five times.

For the purpose of determining the adaptation of the varieties to different parts of the State, the State has been divided into seven sections,

largely on the basis of soil fertility and physiographic features. These sections are (1) the black prairies of northwestern Missouri (2) the rolling prairies of north-central Missouri (3) the level prairies of northeastern Missouri (4) the gray prairies of southwestern Missouri (5) the Ozark border (6) the Ozark center, and (7) the lowlands of southeastern Missouri. The

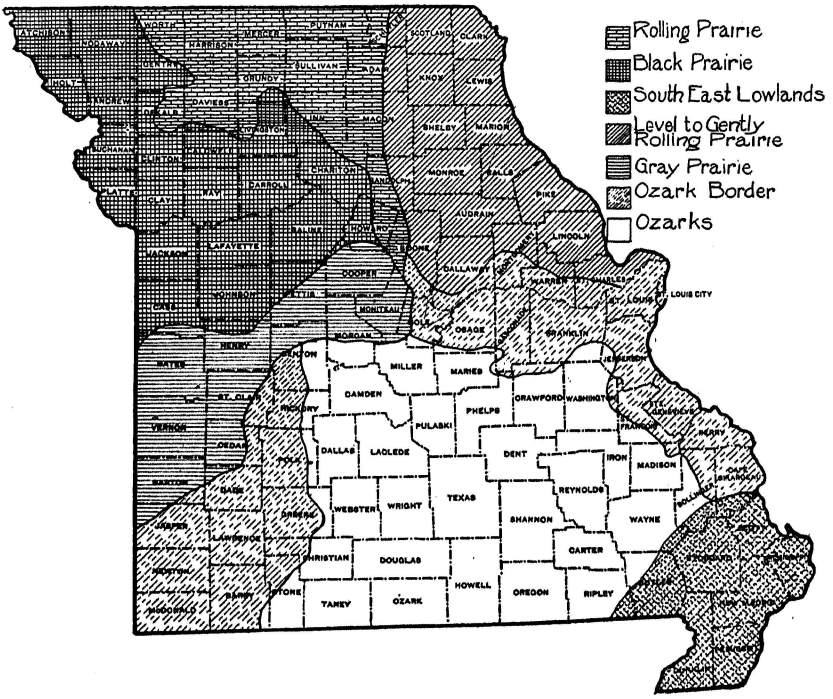

FIG. 2. Agricultural regions of Missouri, and outlying experiment fields on which corn variety tests were conducted.

location of these seven regions is shown in Figure 2. The number of cooperative tests located in each of these regions and in the bottom lands of northern and southern Missouri is shown below.

Black prairies (upland)	110
Rolling prairies (upland)	28
Level prairies (upland)	85
Gray prairies (upland)	39
Ozark border (upland)	66
Ozark center (upland)	29
Southeast lowlands	9
Northern Missouri bottom lands	29
Southern Missouri bottom lands	48
Total number of cooperative tests	467

In the following pages all tests conducted by the Station elsewhere than on the Experiment Station farm at Columbia are summarized sep-

arately for each section. Variety tests on the bottom lands of northern and southern Missouri are also summarized separately.

THE BLACK PRAIRIES OF NORTHWESTERN MISSOURI

In general, the soils of the black prairie region represent the most valuable farming land of the State. They are characterized by their dark color, mellow texture, and high content of organic matter. The surface soil is mostly a mellow, black to dark brown silt loam, and the subsoil a drab silty clay loam, porous and retentive of moisture. Physically, the black prairie soils are almost ideal. The topography of the region is nearly level to gently rolling, except along the Missouri River where the surface is moderately hilly. In this section, 110 cooperative tests were made. These are summarized in Table 6.

Leaming, Reid Yellow Dent, Boone County White and St. Charles White, the only varieties which were tested throughout the 10-year period, show practically no difference in average yield of ear corn. The average yields of Commercial White and St. Charles Yellow are practically equal to those of the first named varieties for the eight years in which all were tested. When relative shrinkage is considered, however, Leaming and Reid Yellow Dent must be considered distinctly superior to the others. Boone County White was the best variety of white corn. In these cooperative tests Silvermine again proved decidedly inferior. Johnson County White, tested in three seasons, made about the same yield as Boone County White. Hogue Yellow Dent yielded well but did not equal Leaming and Reid Yellow Dent. Two of the outlying experiment fields are located in the black prairies region, one at Maryville, Nodaway County, in the extreme northern part, and the other at Warrensburg, Johnson County, in the extreme southern part of the region. There is a considerable difference in latitude between these two stations and the growing season at Warrensburg is, on the average, several days longer than the growing season at Maryville.

The yields of varieties at Maryville for seven seasons are summarized in Table 7.

Of the varieties tested for the full eight years at Maryville, Leaming was the leader by a considerable margin, followed in order by Reid Yellow Dent, St. Charles White, and Boone County White. Hogue Yellow Dent, tested for only five years, slightly excelled the yield of Leaming during that period, and is probably of about equal value. No other variety tested equaled the yield of Leaming or of Reid Yellow Dent. The yields of the late, heavy-cobbed varieties, Commercial White and Hildreth Yellow Dent, were distinctly inferior, while those of early maturing varieties, Silvermine, Funk Ninety Day, and Smoot Ninety Day were fair but not equal to the yield of Leaming.

The yields of varieties at Warrensburg for a six-year period are shown in Table 8.

Commercial White was the outstanding leader at Warrensburg. Of the other important varieties, St. Charles White was next highest in yield and Leaming third. Reid Yellow Dent and Boone County White made

TABLE 6.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Black Prairie Soils of Northwestern Missouri

(Upland Soils Only)

VARIETY	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	Average Yields				
											10 Yrs. 05-14	8 Yrs. 07-14	5 Yrs. 05-09	3 Yrs. 07-09	2 Yrs. 07-08
Boone County White	56.7	61.9	41.5	43.3	39.5	45.6	39.1	52.9	23.4	26.4	43.0	39.0	48.6	41.4	42.4
Commercial White	.....	.....	52.6	45.5	37.3	50.8	35.9	51.5	20.6	27.6	.....	40.2	.....	45.1	49.0
St. Charles White	48.5	74.4	47.0	42.7	36.3	45.3	40.4	46.2	18.6	26.1	42.5	37.8	49.8	42.0	44.8
Leaming	61.1	60.1	51.4	42.3	38.6	39.4	38.1	54.5	25.2	28.3	43.9	39.7	50.7	44.1	46.8
Reid Yellow Dent	58.5	60.7	47.6	45.1	38.4	44.2	35.8	54.5	24.5	26.4	43.6	39.6	50.1	43.7	46.3
St. Charles Yellow	.....	.....	48.5	41.9	36.5	44.6	37.7	48.3	19.6	28.8	.....	38.2	.....	42.3	45.2
Johnson County White	.....	.....	44.1	44.6	38.4	.....	.....	.....	.....	.....	.....	.....	.....	42.4	44.3
Silvermine	45.6	58.1	39.4	38.3	36.3	.....	.....	.....	.....	.....	.....	.....	43.5	38.0	38.8
Hogue Yellow Dent	.....	.....	47.6	40.7	37.3	.....	.....	.....	.....	.....	.....	.....	.....	41.9	44.1
Cartner	.....	.....	46.7	36.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.4
Hildreth Yellow Dent	.....	.....	45.2	40.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43.0
Legal Tender	.....	.....	45.9	37.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.6
Farmers' Interest	.....	.....	46.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 7.—YIELDS OF CORN VARIETIES AT MARYVILLE, NODAWAY COUNTY.

Black Prairie Soils of Northwestern Missouri

VARIETY	1912	1913	1914	1915	1916	1918	1919	1920	Average Yields					
									8 Yrs. 12-16 18-20	6 Yrs. 12-16 & 20	5 Yrs. 12-15 & 20	5 Yrs. 13-16 & 20	5 Yrs. 12-16	3 Yrs. 14-16
Boone County White	75.8	24.7	16.9	45.1	26.2	6.2	43.3	63.3	37.7	42.0	45.2	35.2	37.7	29.4
Commercial White	68.4	18.6	19.0	49.4	25.5	0.7	48.6	65.5	37.0	41.1	44.2	35.6	36.2	31.3
St. Charles White	69.5	29.1	19.2	47.2	26.8	6.5	48.6	59.8	38.3	41.9	45.0	36.4	38.4	31.1
Leaming	82.9	38.6	22.6	50.8	25.5	4.7	56.6	66.2	43.5	47.8	52.2	40.7	44.1	33.0
Reid Yellow Dent	76.1	33.9	18.9	43.9	23.2	5.8	51.7	63.7	39.7	43.3	47.3	36.7	39.2	28.7
St. Charles Yellow	72.2	21.7	16.7	47.3	21.6	.....	.....	63.9	.....	40.6	44.4	34.2	35.9	28.5
Johnson County White	68.0	29.2	18.8	40.7	23.1	.....	.....	.....	.....	.....	.....	.....	34.0	27.5
Silvermine	73.1	37.5	20.7	47.8	.....	.....	.....	62.9	.....	.....	48.4	.....	.....	.....
Hogue Yellow Dent	82.5	39.2	22.3	58.7	26.1	.....	.....	.....	.....	.....	.....	.....	45.8	35.7
Cartner	64.8	28.8	14.0	39.7	27.2	.....	.....	.....	.....	.....	.....	.....	34.9	27.0
Hildreth Yellow Dent	57.4	15.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Golden Yellow Dent	.....	34.7	14.6	44.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tucker Special	.....	24.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Calico	.....	31.0	19.7	42.3	25.6	.....	.....	52.9	.....	.....	.....	34.3	.....	29.2
Early White	.....	.....	.....	.....	.....	.....	55.9	.....	.....	.....	.....	.....	.....	.....
Funk Ninety Day	.....	.....	19.4	41.8	28.2	.....	.....	.....	.....	.....	.....	.....	.....	29.8
Smoot Ninety Day	.....	.....	16.9	43.8	19.6	.....	.....	.....	.....	.....	.....	.....	.....	26.8
Bloody Butcher	.....	.....	12.6	44.2	19.4	.....	.....	.....	.....	.....	.....	.....	.....	25.4
Eureka	.....	.....	.....	.....	23.1	.....	.....	.....	.....	.....	.....	.....	.....	.....

a poor showing in the test at this point. St. Charles Yellow, during the four years it was tested, almost equaled the yield of St. Charles White.

On the black prairie soils of northwestern Missouri the leading varieties were Leaming and Reid Yellow Dent. In the southern part of the black prairie region, however, Commercial White and St. Charles White gave the highest yields.

TABLE 8.—YIELDS OF CORN VARIETIES AT WARRENSBURG, JOHNSON COUNTY.

Black Prairie Soils of Northwestern Missouri.

VARIETY	1914	1915	1917	1918	1919	1920	6 Yrs. 14-15 17-20	5 Yrs. 14-15 17-18 & 20	5 Yrs. 14-15 17-19	3 Yrs. 14-15 & 20
Boone County White	29.6	71.6	45.1	3.4	18.4	34.2	33.7	36.8	33.6	45.1
Commercial White	69.6	86.9	69.3	2.8	27.6	63.6	53.3	58.4	51.2	73.4
St. Charles White	59.1	65.0	58.3	4.9	24.9	38.5	41.8	45.2	42.4	54.2
Leaming	51.3	69.4	47.3	4.4	19.7	25.0	36.2	39.5	38.4	48.6
Reid Yellow Dent	29.3	56.6	42.9	3.9	21.7	.....	.....	.....	32.9	.....
St. Charles Yellow	60.0	64.9	46.2	2.9	.....	46.1	.....	44.0	.....	57.0
Johnson County White	50.8	54.6	.....	.....	.....	.....	.....	.....	.....	.....
Silvermine	52.1	50.1	.....	.....	.....	.....	.....	.....	.....	.....
Hogue Yellow Dent	46.0	64.9	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	52.9	66.4	.....	.....	.....	.....	.....	.....	.....	.....
Calico	31.9	44.7	.....	.....	.....	49.1	.....	.....	.....	42.1
Funk Ninety Day	47.7	48.1	.....	.....	.....	.....	.....	.....	.....	.....
Bloody Butcher	33.6	48.4	.....	.....	29.0	42.8	.....	.....	.....	41.6
Golden Yellow Dent	42.8	60.6	.....	.....	.....	.....	.....	.....	.....	.....
Smoot Ninety Day	.....	52.7	.....	.....	.....	.....	.....	.....	.....	.....

THE ROLLING PRAIRIES OF NORTH CENTRAL MISSOURI

The soils of the rolling prairie region to a depth of six to ten inches are black, dark gray, or grayish brown silt loams or loams.

The lighter colored soils are found on the lower areas or in places exposed to erosion, while the darker soils occur on the more nearly level areas and on the lower slopes where much organic matter has accumulated. The subsoils are yellowish-brown heavy loams or clay loams, which contain an appreciable amount of coarse sand, fine gravel, and lime concretions, and are usually somewhat gritty. They grade downward into compact gritty clay, usually yellow or gray or showing mottlings of these colors. The presence of sand and gravel in both soils and subsoils gives a distinctly loamy texture, and permits the downward percolation of water through the rather heavy soil material. The region is characterized by a rolling topography, more pronounced in the eastern than in the western portion. The production of corn in this region is less than in the other parts of northern Missouri.

In this region 28 cooperative tests were conducted, extending through a period of eight years. They are summarized in Table 9.

No difference in value between the six leading varieties is shown in this table. The yield of Silvermine is again distinctly inferior.

TABLE 9.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Rolling Prairie Soils of North Central Missouri (Upland Soils Only)

VARIETY	1906	1907	1908	1909	1910	1911	1912	1913	Average Yields				
									8 Yrs. 06-13	7 Yrs. 07-13	6 Yrs. 08-13	4 Yrs. 06-09	3 Yrs. 07-09
Boone County White	40.0	59.6	39.5	54.6	33.3	21.3	49.7	16.3	39.3	39.2	35.8	48.4	51.2
Commercial White	.....	.....	43.0	50.0	38.6	18.0	46.0	19.6	.....	.....	36.4	.....	.....
St. Charles White	.....	.....	43.6	51.2	33.2	23.5	47.6	16.8	.....	.....	36.0	.....	.....
Leaming	.....	55.6	43.1	51.8	33.5	32.1	48.5	19.7	.....	39.2	36.4	.....	50.2
Reid Yellow Dent	48.6	55.4	43.0	52.0	39.5	20.8	44.2	20.2	40.5	39.3	36.6	49.7	50.1
St. Charles Yellow	.....	54.7	43.9	54.5	38.6	19.9	43.2	20.0	.....	39.3	36.7	.....	51.0
Johnson County White	.....	53.8	40.0	52.2	.....	.....	.....	.....	.....	.....	.....	.....	48.7
Silvermine	46.4	42.6	33.5	51.6	.....	.....	.....	.....	.....	.....	.....	43.5	42.6
Hogue Yellow Dent	.....	54.7	43.4	54.2	.....	.....	.....	.....	.....	.....	.....	.....	50.8
Cartner	.....	49.1	38.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	58.8	40.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	.....	.....	52.0	43.4	.....	.....	.....	.....	.....	.....	.....	.....	.....
Farmers' Interest	.....	.....	56.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

A test has been conducted during the past three years in cooperation with the First District Normal School at Kirksville, in this region. The yields of varieties tested at this point are shown in Table 10.

These results represent too short a series of seasons to form the basis for definite conclusions. They indicate, however, that the medium early varieties, Leaming in particular, are fully as productive in this region as the later maturing varieties.

It would appear that in the rolling prairie region of north central Missouri there is but little difference in the productivity of the six standard Missouri varieties—Boone County White, St. Charles White, Commercial White, Reid Yellow Dent, Leaming, and St. Charles Yellow—but that the very early maturing varieties, as typified by Silvermine, are of less value. Because of their earlier maturity and lower shrinkage, Reid Yellow

TABLE 10.—YIELDS OF CORN VARIETIES AT KIRKSVILLE, ADAIR COUNTY.

Rolling Prairie Soils of North Central Missouri.

VARIETY	1918	1919	1920	Average Yield 3 Years, 18, 19, 20
Boone County White	15.8	72.3	20.2	36.1
Commercial White	12.7	65.0	21.2	33.0
St. Charles White	14.8	73.9	19.7	36.1
Leaming	21.5	72.7	19.1	37.8
Reid Yellow Dent	16.6	.....	19.6	.....
St. Charles Yellow	18.7	.....	17.5	.....
Early White	.....	51.9	.....	.....
Bloody Butcher	.....	.....	21.3	.....

Dent and Leaming are to be preferred to the other standard varieties in this part of the State. A strip of the rolling prairie region extends through Randolph, Howard, and Boone Counties. In this portion of the region the results obtained in the test at Columbia, reported in Table 3, will probably apply, and the most productive varieties will probably be Commercial White, Boone County White, and St. Charles White.

THE LEVEL PRAIRIES OF NORTHEASTERN MISSOURI

The typical soil of this region is a dark gray or gray friable silt loam to a depth of eight to twelve inches, below which is a light ashy gray layer of somewhat loamy soil from 2 to 9 inches in thickness, commonly referred to as the "gray layer". The subsoil begins abruptly at a depth of from 16 to 20 inches and consists of a tight, stiff brown or drab silty clay or clay loam, locally known as "hardpan". It is not, however, a true hardpan, for water passes through it, although very slowly. The gray layer and the heavy subsoil are the distinguishing characteristics of the prairie land. In general, the soil in the northern part of the level prairie region, in Knox and Scotland Counties, is darker in color, deeper and more productive than in the southern part of the region. On much of the level prairie soil both surface and underground drainage are inadequate, and

TABLE 11.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Level Prairie Soils of Northeastern Missouri (Upland Soils Only)

VARIETY	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	Average Yields				
											10 yrs. 05-14	9 yrs. 05, 06 08-14	9 yrs. 06-14	8 yrs. 07-14	7 yrs. 08-14
Boone County White	73.2	55.2	53.0	43.3	34.3	54.1	37.3	40.3	24.7	17.1	43.2	42.2	39.9	38.0	35.9
Commercial White	.....	.....	.....	43.1	31.1	59.5	38.6	47.3	21.6	29.1	.....	.....	.....	.....	38.6
St. Charles White	47.5	55.6	.....	41.5	34.4	49.1	35.8	37.0	24.1	17.6	.....	38.1	.....	.....	34.2
Leaming	76.1	50.0	48.1	36.9	33.5	44.2	35.0	43.2	27.0	20.8	41.5	40.7	37.6	36.1	34.4
Reid Yellow Dent	.....	49.6	45.6	39.1	36.6	51.3	37.0	41.1	27.6	19.9	.....	.....	38.6	37.3	36.1
St. Charles Yellow	.....	.....	40.7	40.2	33.1	49.1	36.1	38.2	19.8	20.2	.....	.....	.....	34.7	33.8
Johnson County White	.....	.....	51.4	41.6	34.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Silvermine	43.4	43.4	39.4	35.9	32.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hogue Yellow Dent	.....	.....	.....	38.7	35.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	.....	.....	41.7	32.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	.....	48.1	36.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Farmers' Interest	.....	.....	59.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	.....	.....	.....	41.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

in wet seasons, as well as in very dry seasons, crops suffer as a result of the unfavorable moisture conditions.

The soils on the rolling lands in the eastern part of the level prairie region are quite variable and range from dark brown to gray silt loams or loams with reddish brown to yellowish gray clay loam or sandy clay subsoils. In general, the soils are shallow and contain a relatively small amount of organic matter. A small quantity of sand and fine gravel is present in both soil and subsoil, and on some of the steeper slopes where the soil is thin, limestone rock outcrops at the surface. The surface features of the region in general are those of a vast smooth plain with a gentle slope to the southeast. Along its eastern edge, bordering the Mississippi River, the surface is rolling to moderate hilly. Along the river bluffs the soil material is mostly loess, and is on the average more productive than the soil of the remainder of the region.

Eighty-five cooperative tests were conducted in this region, through a period of 10 years. They are summarized in Table 11.

The differences in the productivity between the six standard varieties are slight, the leaders being Commercial White, Reid Yellow Dent, and Boone County White. Considering relative shrinkage, Leaming should be added to this group. Johnson County White gave about the same results as Boone County White in the years in which it was tested. Silvermine was distinctly inferior to the other varieties in the years it was included.

Two outlying experiment fields were located in this region, one at Lewistown, the other at Shelbina. The yields of varieties tested at Lewistown during a five-year period are reported in Table 12.

The leading varieties at this point were Commercial White, Leaming, and Reid Yellow Dent. St. Charles White and Boone County White also

TABLE 12.—YIELDS OF CORN VARIETIES AT LEWISTOWN, LEWIS COUNTY.

Level Prairies of Northeastern Missouri.

VARIETY	1910	1911	1912	1913	1914	Average Yields			
						5 Yrs. 10-14	4 Yrs. 10-12 and 14	4 Yrs. 10-11 13-14	3 Yrs. 11-13
Boone County White	57.8	52.5	30.8	15.2	18.6	35.0	39.9	36.0	32.8
Commercial White	71.2	62.8	36.2	21.5	18.8	42.1	47.3	43.6	40.2
St. Charles White	62.3	56.4	25.4	14.8	17.3	35.2	40.4	37.7	32.2
Leaming	67.2	47.9	34.6	14.5	20.6	37.0	42.6	37.6	32.3
Reid Yellow Dent	64.8	50.1	34.1	8.7	21.6	35.9	42.7	36.3	31.0
St. Charles Yellow	60.5	51.4	30.0	5.4	17.2	32.9	39.8	33.6	28.9
Johnson County White	57.2	48.3	27.1	15.4	16.2	32.8	37.2	34.3	30.3
Silvermine	49.3	46.3	23.2	20.2	20.6	31.9	34.9	34.1	29.9
Hogue Yellow Dent	50.8	45.2	.....	14.1	20.0	.....	.....	32.5	.....
Cartner	62.9	49.4	26.4	.....	19.0	.....	39.4	.....	.....
Hildreth Yellow Dent	.....	53.4	27.5	3.9	.....	.....	.....	.....	28.3
Calico	.....	.....	.....	16.0	22.9	.....	.....	.....	.....
Golden Yellow Dent	.....	.....	.....	10.9	16.2	.....	.....	.....	.....
Tucker Special	.....	42.5	.....	13.0	.....	.....	.....	.....	.....
Bloody Butcher	.....	.....	.....	.....	15.7	.....	.....	.....	.....
Smoot Ninety Day	.....	.....	.....	.....	18.2	.....	.....	.....	.....
Funk Ninety Day	.....	.....	.....	.....	19.1	.....	.....	.....	.....

yielded fairly well. St. Charles Yellow, Johnson County White, Silvermine, Hogue Yellow Dent, Cartner, and Hildreth Yellow Dent made inferior yields.

The yields obtained in the variety test at Shelbina through a four-year period are reported in Table 13. The difference in yield between the leading varieties in this test are slight and have little significance.

The variety test at Columbia was located at the souhwestern edge of the level prairies region, and gives some indication of the adaptation of varieties to the southern part of this region. In this test the leading varieties were Commercial White, St. Charles White, and Boone County White.

TABLE 13.—YIELDS OF CORN VARIETIES AT SHELBINA, SHELBY COUNTY.

Level Prairies of Northeastern Missouri.

VARIETY	1912	1913	1914	1916	Average Yields			
					4 Yrs. 12-16	3 Yrs. 12-14	3 Yrs. 13-16	2 Yrs. 14-16
Boone County White	34.6	3.8	22.6	13.0	18.5	20.3	13.1	17.8
Commercial White	34.1	3.5	23.0	15.4	19.0	20.2	14.0	19.2
St. Charles White	32.1	4.8	24.0	16.1	19.3	20.3	15.0	20.1
Leaming	37.5	3.9	27.4	13.9	20.7	22.9	15.1	20.7
Reid Yellow Dent	33.9	4.0	24.4	13.5	19.0	20.8	14.0	19.0
St. Charles Yellow	31.0	1.9	27.6	15.8	19.1	20.2	15.1	21.7
Johnson County White	28.5	3.7	23.5	8.7	16.1	18.6	12.0	16.1
Silvermine	23.9	6.7	29.0	.....	.....	19.9	.....	.....
Hogue Yellow Dent	.....	6.6	31.6	14.7	.....	.....	17.6	23.2
Cartner	25.0	4.3	21.3	18.2	17.2	16.9	14.6	19.8
Hildreth Yellow Dent	27.5	1.6	.....	.....	.....	.....	.....	.....
Calico	42.8	5.6	26.8	12.7	22.0	25.1	15.0	19.8
Golden Yellow Dent	.....	3.3	26.2	.....	.....	.....	.....	.....
Tucker Special	.....	2.3	.....	.....	.....	.....	.....	.....
Bloody Butcher	.....	.....	20.4	14.7	.....	.....	.....	17.6
Smoot Ninety Day	.....	.....	20.7	8.8	.....	.....	.....	14.8
Funk Ninety Day	.....	.....	27.2	11.8	.....	.....	.....	19.5
Eureka	.....	.....	.....	14.2	.....	.....	.....	.....

The leading variety for the level prairies region was Commercial White. In the northern part of the region Leaming and Reid Yellow Dent yielded almost or quite as much dry shelled corn as Commercial White, and may be preferable because of their earlier maturity and better keeping quality. In the southern part of the region, however, these varieties were outyielded not only by Commercial White, but also by St. Charles White and Boone County White. These five varieties outyielded all others tried in this region.

GRAY PRAIRIES OF SOUTHWESTERN MISSOURI

The soils of the gray prairie region are of two general types—flat prairies and rolling prairies. The rolling land is confined mostly to the eastern edge of the region. It is mainly a dark brown to a grayish brown fine sandy loam with a brown friable sandy clay subsoil, highly mottled red and yellow. The amount of sand in both soil and subsoil varies with the

TABLE 14.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Gray Prairies of Southwestern Missouri (Upland Soils Only)

VARIETY	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	Average Yields					
											10 yrs. 05-14	8 yrs. 05 08-14	7 yrs. 07 09-14	3 yrs. 07-09	3 yrs. 06-08	2 yr 07-08
Boone County White	47.6	22.5	42.6	39.2	24.1	26.4	17.9	28.8	4.7	20.3	27.4	26.1	23.5	35.3	34.8	40.9
Commercial White	.....	.....	42.3	.....	28.6	35.3	16.2	33.0	8.9	23.8	.....	.....	26.9	.....	.....	.....
St. Charles White	50.0	24.9	34.3	38.8	27.3	26.8	19.0	25.4	6.3	22.8	27.6	27.0	23.1	33.5	32.7	36.5
Leaming	45.4	21.2	38.3	34.5	28.5	26.4	15.4	25.7	6.8	21.6	26.4	25.5	23.2	33.8	31.3	36.4
Reid Yellow Dent	45.4	.....	.....	33.4	22.9	26.5	17.0	25.7	6.2	22.2	.....	24.8	.....	.....	.....	.....
St. Charles Yellow	54.5	17.4	35.9	32.8	23.8	26.0	13.7	30.6	6.3	18.9	26.0	25.8	22.2	30.8	28.7	34.3
Johnson County White	.....	.....	40.1	37.6	22.3	.....	.....	.....	.....	.....	.....	.....	.....	33.3	.....	38.8
Silvermine	.....	.....	36.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hogue Yellow Dent	.....	.....	40.0	33.1	21.2	.....	.....	.....	.....	.....	.....	.....	.....	31.4	.....	36.5
Cartner	45.4	.....	37.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	.....	47.2	38.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42.9
Legal Tender	.....	21.6	38.5	34.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.4	36.2

topography and is greatest on the droughty rolling areas, which are frequently underlaid by sandstone rock. The flat prairie soils are gray to black sandy loams six to twelve inches deep, underlaid by a gray to dark drab stiff clay loam, mottled yellow, brown, and gray. Between the soil and subsoil is a gray ashy layer containing iron concretions. The lower subsoil is distinctly lighter in color and more friable than the upper portion. In general this gray prairie soil is very similar in physical characteristics to the level prairies of northeastern Missouri. In Bates, Henry, and Cooper Counties it is somewhat more productive than in the counties in the south and in its agricultural importance approaches the black prairie soils.

In this region 39 cooperative tests extending through a period of 10 years, were conducted. They are summarized in Table 14.

In cooperative tests in the gray prairie region the highest yielding variety was Commercial White, though its advantage in yield over St. Charles White and Boone County White was not great. In these tests there was little difference in yield between the six standard varieties.

The tests at the experiment fields at Carthage (Table 16) and at Columbia (Table 5) have some application to this region, as they were located almost on its borders, the former on the south and the latter on the north. In both of these tests the leading variety was Commercial White. Apparently Commercial White is the best adapted variety for the gray prairie region, with St. Charles White and Boone County White ranking next in value.

THE OZARK BORDER

The Ozark border soils form an almost unbroken belt around the main part of the Ozark region. They extend in a semi-circle from the southern part of Cape Girardeau County along the Mississippi and Missouri Rivers to the southwestern corner of the State. The Ozark border, as a whole, has considerable variation in soils, but in its agricultural importance and development it is rather uniform.

The soils of the Ozark border in the southwestern part of the State are almost uniformly gravelly loams, although the occasional level areas are generally stone-free. They vary in color from gray to brown, with reddish-brown subsoils. In texture they are silty, with silty clay subsoils. The content of chert gravel varies from 10 to 50 per cent, the higher percentage prevailing on the rolling areas. As a rule, it is not present in sufficient quantity to make cultivation impossible, but in some cases it is rather difficult In general, the red soils are not as gravelly and are more productive than the gray soils.

The soils of the Ozark border along the Missouri River are mainly yellow and gray silt loams with yellowish-gray, compact, silty clay subsoils. Along the Mississippi River are extensive areas of red limestone soils. They are stone free, contain a fair supply of organic matter and lime, and represent the most productive land in this region. The rough, hilly land bordering the larger streams is stony and much of it is of little agricultural value. In general, the more productive land lies nearest the Missouri and

TABLE 15.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Ozark Border (Upland Soils Only)

VARIETY	1906	1907	1908	1909	1910	1911	1912	1913	1914	Average Yields			
										9 yrs. 06-14	8 yrs. 07-14	7 yrs. 07 & 09-14	3 yrs. 07-09
Boone County White	37.8	33.5	76.6	42.3	46.6	41.8	38.1	25.5	29.6	41.3	41.8	36.8	50.8
Commercial White	.....	32.6	.....	40.1	52.5	45.6	42.2	26.2	31.0	.....	.....	38.6	.....
St. Charles White	.....	28.8	69.5	42.2	48.4	39.5	34.3	24.7	28.9	.....	39.5	35.3	46.8
Leaming	.....	34.7	73.9	39.6	41.1	37.5	35.3	24.0	27.6	.....	39.2	34.3	49.4
Reid Yellow Dent	34.6	33.4	70.1	43.3	44.2	39.0	33.9	25.2	30.9	39.4	40.0	35.7	48.9
St. Charles Yellow	.....	38.2	73.5	42.2	44.3	38.9	35.4	25.7	31.6	.....	41.2	36.6	51.3
Johnson County White	.....	32.4	75.0	42.1	.....	.....	.....	.....	.....	.....	.....	.....	49.8
Silvermine	.....	.....	.....	38.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hogue Yellow Dent	.....	30.4	.....	44.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	.....	31.0	72.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	34.7	72.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	35.1	.....	74.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Farmers' Interest	.....	36.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Mississippi Rivers. Away from the rivers the surface becomes more hilly and the soils are more stony and less productive.

In this region 66 cooperative tests were made during the nine year period from 1906 to 1914 inclusive. They are summarized in Table 15.

The best yielding variety in the cooperative tests in the Ozark border region was Commercial White, although its advantage in yield over the other standard varieties was hardly more than sufficient to offset its greater shrinkage. There has been little difference in yield between the other standard varieties, the leaders being Boone County White and St. Charles Yellow.

Two outlying experiment fields were located in the Ozark border region, one at Carthage in the southwestern part of the State, and the

TABLE 16.—YIELDS OF CORN VARIETIES AT CARTHAGE, JASPER COUNTY.

Ozark Border

VARIETY	1909	1910	1911	1912	1913	Average Yields		
						5 Yrs. 09-13	4 Yrs. 09 & 11-13	3 Yrs. 11-13
Boone County White	32.9	40.2	49.1	35.3	15.7	34.6	33.3	33.4
Commercial White	41.1	43.4	54.2	33.4	19.6	38.3	37.1	35.7
St. Charles White	30.5	41.3	42.5	22.7	15.5	30.5	27.8	26.9
Leaming	35.3	35.7	45.7	32.5	17.1	33.3	32.7	31.8
Reid Yellow Dent	36.0	42.5	42.6	36.6	17.3	35.0	33.1	32.2
St. Charles Yellow	31.5	38.8	39.6	30.0	17.6	31.5	29.7	29.1
Johnson County White	30.9	41.7	44.3	27.3	14.8	31.8	29.3	28.8
Silvermine	27.1	33.5	26.6	30.9	17.9	27.2	25.6	25.1
Hogue Yellow Dent	34.9	36.4	40.6	32.4	18.1	32.5	31.5	30.4
Cartner	31.5	39.2	39.4	30.5	19.1	31.9	30.1	29.7
Hildreth Yellow Dent	22.6	.....	47.0	19.9	7.3	.....	24.2	24.7
Tucker Special	.....	.....	41.8	25.3	17.4	.....	.....	28.2
Calico	.....	.....	.....	.....	17.0	.....	.....	.....
Golden Yellow Dent	.....	.....	.....	.....	16.4	.....	.....	.....
Champion White Pearl	34.3	.....	.....	.....	.....	.....	.....	.....
Hoffmeister White	.....	.....	.....	30.3	.....	.....	.....	.....

other at Cape Girardeau in the southeasern part. Both of these stations were located near the edge of the Ozark border region and the results obtained apply almost as well to the neighboring regions as to the Ozark border region. Thus the test at Carthage may be applied to the gray prairie region as well as to the Ozark border region, while the tests at Cape Girardeau apply to the southern part of the Ozark border region and the northern part of the southeastern Missouri region. The results of the variety tests at Carthage are shown in Table 16.

Of the 10 varieties tested through the five years at Carthage, Commercial White, Reid Yellow Dent, and Boone County White gave the highest yields. Under the conditions at Carthage and in the neighboring territory, Commercial White is apparently the best yielding variety of corn, although many farmers will prefer to grow Reid Yellow Dent or Boone County White because of their higher shelling percentage and earlier maturity. St.

Charles White, which is rather widely grown in this part of the State has given only fair yields in this experiment.

The result of the varieties tested at Cape Girardeau are shown in Table 17.

In this test Commercial White has been the outstanding leader. No other variety has approached it in yield. Moreover, the shrinkage of Commercial White at Cape Girardeau has not been appreciably higher than that of other varieties.

Both Cape Girardeau and Carthage are in the southern part of the Ozark border region. A considerable portion of this region is in central Missouri, along the Missouri River in the the eastern half of the State. The

TABLE 17.—YIELDS OF CORN VARIETIES AT CAPE GIRARDEAU, CAPE GIRARDEAU COUNTY.

Ozark Border

VARIETY	1916	1917	1918	1919	Average Yields			
					4 Yrs. 16-19	3 Yrs. 16-17 19	2 Yrs. 17-19	2 Yrs. 16-17
Boone County White	67.3	70.9	50.5	33.4	55.5	57.2	52.2	69.1
Commercial White	62.2	83.9	73.0	69.0	72.0	71.7	76.5	73.1
St. Charles White	57.6	77.7	31.5	55.4	55.6	63.6	66.6	67.7
Leaming	65.2	68.3	52.0	42.0	56.9	58.5	55.2	66.8
Reid Yellow Dent	63.2	65.9	.....	42.5	.....	57.2	54.2	64.6
St. Charles Yellow	48.9	64.7	.....	.....	.....	.....	.....	56.8
Johnson County White	69.7	.....	.....	.....	.....	.....	.....	.....
Silvermine	.....	63.6	.....	26.0	.....	.....	44.8	.....
Hogue Yellow Dent	58.9	.....	.....	.....	.....	.....	.....	.....
Cartner	65.8	.....	.....	.....	.....	.....	.....	.....
Calico	55.5	.....	.....	.....	.....	.....	.....	.....
Bloody Butcher	45.9	.....	.....	.....	.....	.....	.....	.....
Eureka	59.3	.....	.....	.....	.....	.....	.....	.....
Cape County	60.8	86.8	63.0	.....	.....	.....	.....	.....
Funk Ninety Day	52.1	.....	.....	.....	.....	.....	.....	.....
Smoot Ninety Day	46.7	.....	.....	.....	.....	.....	.....	.....

variety test at Columbia (Table 5) applies more nearly to the conditions in this part of the region than do the tests at any other station. In this test, it will be remembered, Commercial White was the leader, followed by St. Charles White and Boone County White.

The leading variety in all tests in the Ozark border region was Commercial White. Boone County White also gave very good results in all tests in this region, though in the southeastern portion of the region the yield of Commercial White had been far more than that of any other variety. St. Charles White is well adapted to the northern part of the region along the Missouri River.

THE OZARK CENTER

The soils of the Ozark region, with a few minor exceptions, are all derived from cherty limestones, and are, therefore, mostly gravelly and stony loams. They are usually gray in color and are low in organic matter

and lime. The lack of organic matter gives rise to undue compactness in the surface soil and renders its tillage difficult unless the mechanical handling of the soil is undertaken when the moisture content is neither too great nor too small.

Throughout the Ozark region are found rather extensive areas of relatively smooth and stone-free soil. These areas occupy the highest parts and represent the plateaus and broad inter-stream divides. The soil is a dark gray silt loam or moderately gravelly loam, underlaid by yellowish-gray, stiff, clay subsoil. Although it is fairly easily cultivated, it is generally considered not as productive as the gravelly land.

Probably more than 50 per cent of the soils of the Ozark region are stony loams. The most extensive areas of rough, stony land are found in the eastern part of the region—in Reynolds and all the surrounding counties. Areas of similar character occur along the White River and to a lesser extent along the Gasconade and Osage Rivers and their main tributaries. In these rough and stony areas the narrow bottoms along the streams form the only important agricultural land.

On most of the moderately rolling areas the soil is a gray or brown gravelly loam with gravelly subsoil. Land of this character although somewhat difficult to handle, is of fair productivity.

In this region 20 cooperative tests were reported, covering a period of eight years. The results are summarized in Table 18.

The highest yielding variety in the Ozark region was Commercial White, followed by St. Charles Yellow and Boone County White. The differences in yield between these three varieties were slight. St. Charles White, Reid Yellow Dent, and Leaming gave about equal yields, slightly less than the three varieties mentioned above. Johnson County White, during the three seasons in which it was tested, yielded about as well as Boone County White. It seems probable that some of the earlier maturing varieties, such as the so-called Ninety-Day varieties, will give better results in this region than any of the standard Missouri varieties, as they will probably be less affected by drought. These varieties have been tested in the region for two years and have given substantially better yields than the standard Missouri varieties. In this region of Missouri, however, it is probable that the grain sorghums, Kafir and Milo, will give better results than any variety of corn.

THE LOWLANDS OF SOUTHEASTERN MISSOURI

With the exception of a few narrow upland ridges, the soils of the southeast lowlands are alluvial in origin. They represent, therefore, a mixture of material derived from various sources, which has formed soils of great diversity in physical properties and in productivity. In texture they vary from sands to heavy clays, and in color from light gray to deep black.

In general the soils bordering the Mississippi River, including Mississippi and Scott counties and the eastern half of New Madrid and Pemiscot counties, are dark brown loams and fine sandy loams, with yellowish gray fine sandy loam subsoils. Except in the most sandy areas, these soils contain a high percentage of organic matter and are very productive.

TABLE 18.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Ozark Center (Upland)

VARIETY	1906	1907	1908	1909	1910	1911	1912	1913	Average Yields				
									8 yrs. 06-13	7 yrs. 06-08 10-13	6 yrs. 08-13	5 yrs. 08, 10-13	3 yrs. 06, 08 09
Boone County White	30.1	30.9	33.0	28.8	50.9	28.1	22.5	8.8	29.1	29.2	28.7	28.7	30.6
Commercial White	.....	.....	32.3	30.6	58.9	31.0	25.9	8.6	.....	.....	31.2	31.3	.....
St. Charles White	.....	.....	30.4	28.2	51.0	27.6	21.2	7.6	.....	.....	27.7	27.6	.....
Johnson County White	32.6	.....	27.9	30.1	.....	.....	.....	.....	.....	.....	.....	.....	30.2
Silvermine	.....	.....	20.6	25.8	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reids Yellow Dent	21.8	28.5	28.7	27.7	51.8	24.9	15.8	10.2	26.2	26.0	26.5	26.3	26.1
Leaming	27.7	31.8	27.2	.....	37.9	23.2	18.3	11.3	.....	25.3	.....	23.6	.....
St. Charles Yellow	25.6	32.7	31.1	39.0	52.5	23.6	21.5	11.0	29.6	28.3	29.8	27.9	31.9
Hogue Yellow Dent	.....	.....	31.0	27.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	.....	32.6	27.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	29.1	26.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	.....	.....	26.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

They are well drained and represent the most highly improved portion of the lowland region.

The soils in the central part of the lowland region are mainly clay loams or sandy clays with black, heavy clay subsoils. They form a continuous belt extending from the southern part of Cape Girardeau county to the southern part of Pemiscot and Dunklin counties. Large areas of these very productive soils have not yet been brought under cultivation and are covered with a dense growth of timber. Drainage is necessary before crops can be successfully grown.

In the western part of the lowland region, the soils are prevailingly gray loams with compact subsoils. The content of organic matter and lime is low and the soils are, therefore, of only moderate productivity. Both surface and under drainage are inadequate.

Nine cooperative tests were conducted in the lowlands of southeast Missouri. They are reported in Table 19.

Although the number of cooperative tests is small it is clear from the data given in Table 19, that the later maturing varieties, St. Charles White,

TABLE 19.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Lowlands of Southeastern Missouri

VARIETY	1908	1910	1911	1912	1913	1915	Average Yield 6 Years 1908-15
Boone County White	74.8	47.5	63.9	46.5	40.4	31.4	50.9
Commercial White	85.8	37.4	66.1	41.8	31.7	29.1	48.6
St. Charles White	70.7	49.8	81.3	40.2	42.9	27.0	52.0
Reid Yellow Dent	54.2	32.9	36.4	43.3	43.5	28.8	39.8
Leaming	68.8	29.9	46.7	43.3	40.4	30.1	43.2
St. Charles Yellow	74.4	43.2	49.1	43.6	43.5	29.3	47.2

Boone County White, and Commercial White are better adapted than others to the lowlands of southeastern Missouri. St. Charles Yellow, which is a late maturing variety, has been the best yielding variety of yellow corn, but has not given as high a yield as any of the three varieties of white corn tested.

Corn varieties have also been tested at the outlying experiment field at Kennett, in southeastern Missouri, during the last six years. The results of this test are shown in Table 20.

The leading varieties of corn at Kennett have been Commercial White and St. Charles Yellow, though the differences in productivity between the six standard corn varieties have been slight. Biggs Seven-ear, a variety of prolific corn from the South, has yielded slightly more than any other variety during the four years it has been included in the tests. It is possible that the late prolific varieties grown in the southern states may give better results than even the late standard varieties of Missouri, but their numerous small ears are objectionable on account of the greater labor required to harvest them. Several such varieties will be tested at Kennett in comparison with the better adapted Missouri varieties, particularly to determine their relative value for silage production.

TABLE 20.—YIELDS OF CORN VARIETIES AT KENNETT, DUNKLIN COUNTY.

Lowlands of Southeastern Missouri.

VARIETY	1915	1916	1917	1918	1919	1920	Average Yields				
							6 yrs. 15-20	5 yrs. 15-18 & 20	4 yrs. 15-17 & 20	4 yrs. 17-19 & 20	3 yrs. 15-17
Boone County White	31.4	13.4	29.4	14.9	20.0	19.8	21.7	21.8	23.3	21.0	24.7
Commercial White	29.1	16.9	31.1	14.2	23.3	22.0	22.8	22.7	24.8	22.7	25.7
St. Charles White	27.0	16.4	29.6	11.9	21.9	20.2	21.2	21.0	23.3	20.9	24.3
Johnson County White	28.3	16.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Silvermine	26.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reid Yellow Dent	28.7	13.2	31.6	12.1	23.3	20.1	21.5	21.1	23.4	21.8	24.5
Leaming	30.2	18.4	28.5	.....	.....	.....	.....	.....	.....	.....	25.7
St. Charles Yellow	29.3	18.5	31.8	10.9	.....	23.1	.....	22.7	25.7	.....	26.5
Hogue Yellow Dent	32.3	18.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	27.3	16.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Smoot Ninety Day	27.4	14.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bloody Butcher	39.5	17.4	.....	.....	21.2	.....	.....	.....	.....	.....	.....
Golden Yellow Dent	29.4	19.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Calico	27.2	18.6	.....	.....	.....	.....	.....	.....	.....	.....	.....
Biggs Seven-Ear	.....	.....	37.9	13.9	21.0	22.0	.....	.....	.....	23.7	.....
Sanders Improved	.....	.....	26.1	16.0	.....	.....	.....	.....	.....	.....	.....

VARIETY TESTS ON THE BOTTOM LANDS OF NORTHERN AND SOUTHERN MISSOURI

Most of the cooperative corn variety tests have been located on upland soil, in order to place them on the average corn soil of the community. Each year, however, a few experiments have been placed on bottom lands in the various sections of the State. Since there is not a sufficient number to summarize the results of these experiments by the same soil types as those made on uplands, and since there is no apparent reason for making such a grouping of these data, they have been divided into two groups, one for northern Missouri and one for southern Missouri. All tests made on the bottom lands within the black prairies, rolling prairies, and level prairies regions have been placed in the first group, and all tests made on bottom lands within the gray prairies, Ozark border, and Ozark center regions have been placed in the second.

The data for corn variety tests on the bottom lands of northern Missouri are shown in Table 21.

In these tests the later-maturing varieties, Commercial White and Boone County White, have given better results than the earlier maturing varieties, Reid Yellow Dent and Leaming. Commercial White is the leading variety. and both Boone County White and St. Charles White apparently will give better results than Reid Yellow Dent and Leaming. As the moisture content of Commercial White corn has been high in this section of the State, Boone County White is to be preferred.

The yields of corn varieties on the bottom lands of southern Missouri are shown in Table 22.

On the bottomlands of southern Missouri all three standard varieties of white corn have outyielded the standard varieties of yellow corn by a considerable margin. The highest yielding variety, considering shrinkage, has been Boone County White, as on the bottom lands of northern Missouri. The yields of Commercial White and St. Charles White have also been very good.

VARIETIES OF CORN FOR SILAGE

Although special varieties of corn for silage are often recommended, it is a common custom to use the same variety for both silage and grain. The total of the digestible nutrients in a pound of ear corn is estimated as about 60 per cent greater than in a pound of stover (stems, husks and leaves) when the corn plant as a whole is ensilaged. Consequently the variety which yields the most grain will make the richest silage, pound for pound, although its total acre yield of silage may fall below that of other varieties which yield a greater bulk of plant matter with less grain. If now the variety which makes a high yield of grain compares favorably in total yield of plant matter with varieties which yield less grain, it may fairly be considered superior in the production of silage on the basis of feeding value per acre.

All so-called special silage varieties are tall, heavy plants which pro-

TABLE 21.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Bottomlands of Northern Missouri.

VARIETY	1905	1906	1907	1908	1909	1910	1911	1913	1914	Average Yield				
										9 yr. 05-11 13, 14	7 yr. 05, 06 08, 10 11, 13 14	7 yr. 06, 08 11, 13 14	6 yr. 07, 08 10, 11 13, 14	3 yr. 06, 08 09
Boone County White	33.4	66.2	70.0	37.5	22.6	62.2	52.4	11.6	42.8	44.3	43.7	42.2	46.1	42.1
Commercial White	.....	.....	80.3	35.2	.....	58.7	56.7	11.7	49.4	.....	.....	.....	48.7	.....
St. Charles White	.....	54.9	.....	29.3	23.5	63.1	52.9	12.3	55.8	.....	.....	41.7	.....	35.9
Johnson County White	.....	.....	.....	36.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Silvermine	.....	60.6	.....	28.2	24.3	.....	.....	.....	.....	.....	.....	.....	.....	37.7
Reid Yellow Dent	32.7	58.8	.....	36.0	.....	56.1	53.8	11.8	44.4	.....	41.9	.....	.....	.....
Leaming	28.8	62.2	.....	36.4	.....	53.8	49.5	12.8	46.3	.....	41.4	.....	.....	.....
St. Charles Yellow	.....	.....	62.8	37.7	.....	49.5	47.6	13.0	45.7	.....	.....	.....	42.7	.....
Hogue Yellow Dent	.....	.....	57.9	34.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	.....	.....	.....	36.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	.....	74.7	34.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	.....	.....	65.5	35.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 22.—YIELDS OF CORN VARIETIES IN CO-OPERATIVE TESTS.

Bottomlands of Southern Missouri.

VARIETY	1905	1906	1907	1908	1909	1910	1911	1912	1913	Average Yield				
										9 yr. 05-13	8 yr. 05-08 10-13	8 yr. 05 07-13	7 yr. 05 08-13	6 yr. 08-13
Boone County White	65.9	54.9	59.3	48.8	36.0	69.5	41.1	57.7	28.1	51.3	53.2	50.8	49.6	46.9
Commercial White	.....	.....	.....	49.8	32.2	73.3	41.4	63.4	27.9	.....	.....	.....	.....	48.0
St. Charles White	56.4	.....	50.7	44.6	32.3	73.8	40.4	59.9	25.5	.....	.....	47.9	47.6	46.1
Johnson County White	.....	.....	54.7	47.2	34.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Silvermine	.....	.....	.....	40.5	27.6	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reid Yellow Dent	61.2	43.4	52.3	48.1	29.9	61.3	33.0	58.1	26.3	46.0	48.0	46.3	45.4	42.8
Leaming	57.9	56.0	54.7	45.5	.....	52.6	35.0	58.1	28.5	.....	48.5	.....	.....	.....
St. Charles Yellow	46.4	.....	.....	43.3	32.2	65.1	34.6	58.0	27.8	.....	.....	.....	43.9	43.5
Hogue Yellow Dent	.....	.....	51.6	41.1	26.4	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cartner	59.0	.....	53.0	44.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hildreth Yellow Dent	.....	.....	58.8	48.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Farmers' Interest	.....	59.7	58.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Legal Tender	.....	54.3	51.7	43.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

duce low yields of grain, but high yields of total plant matter. Eureka, or Eureka Ensilage, is probably the best known of these varieties. Also the prolific varieties of the South, because of their tall leafy growth, are sometimes recommended for use in silage production outside of their adapted region. In the seasons of 1917 and 1918 two well known prolific varieties, Cocke Prolific and Biggs Seven-Ear, together with Eureka, were compared in silage production with Commercial White, a standard Missouri variety which during the period 1905 to 1915 made the highest average yield of grain in variety tests at Columbia. Table 23 shows the acre yields of the varieties in tons of silage containing 75 per cent of moisture.

The data show that in each of two extremely different seasons—one remarkably good for corn, the other remarkably poor—Commercial White has compared very favorably with the special silage varieties, in acre yield of total plant matter. As the average of two years Commercial White ranked second and was outyielded by Eureka, the leader, by less than half a ton per acre.

Because of a serious shortage of labor during the critical years of 1917 and 1918, no separate yields of grain were actually measured for these varieties. But by careful observation, it was determined that Commercial White yielded far more grain than Eureka, the special silage variety, and somewhat more grain than either of the two prolific varieties.

A comparison of Commercial White with the two prolific varieties and the special silage variety may now be summarized.

1. As a silage variety Commercial White was far superior to the special silage corn, Eureka, when the production of grain as well as total plant matter is considered.

2. Commercial White was probably slightly superior to Cocke Prolific, the better of the two prolific varieties, in combined value of grain and other plant parts. At least it can safely be said that the prolific variety was not a better silage producer than Commercial White. This comparison would leave the advantage with Commercial White, for unless a prolific variety will heavily outyield a standard variety it is undesirable, on account of its late maturity and the difficulty of preventing it from mixing with other varieties.

A COMPARISON OF STANDARD VARIETIES FOR SILAGE

It is important to compare also the standard varieties with one another for their value in silage production. Accordingly Table 24 gives the following data:

(1) in column 7 the average acre-yields of 10 well known standard varieties, in ear corn and stover (stems, husks and leaves) during a six year period at Columbia.

(2) in column 8 the silage equivalents computed from the yields of ear corn and stover assumed to contain 20 per cent moisture.

(3) in column 9 the yields in pounds of ear corn for each 1000 pounds of stover produced.

TABLE 23.—YIELDS OF CORN VARIETIES AT COLUMBIA IN GRAIN AND STOVER

VARIETY		Yields Per Acre.								Pounds Stover Per 1000 Pounds Ear Corn	Relative Value for Silage
		1908	1910	1911	1912	1914	1915	Average	Tons of Silage Containing 75% Moisture		
Commercial White	Grain (bu.)	46.1	82.3	38.5	116.4	29.3	27.4	56.7	14.07	1216	1.000
	Stover (lb.)	4151	4549	4512	6564	5294	3886	4826			
St. Charles White	Grain (bu.)	53.8	65.8	41.3	83.3	36.4	27.4	51.3	11.91	1074	.860
	Stover (lb.)	3181	3148	4251	5178	4130	3246	3856			
St. Charles Yellow	Grain (bu.)	40.1	62.1	37.7	76.6	31.6	32.8	46.8	11.36	1167	.811
	Stover (lb.)	4373	3795	4354	3644	3492	3288	3824			
Cartner	Grain (bu.)	33.3	62.8	43.9	81.3	30.6	30.6	47.1	11.20	1123	.804
	Stover (lb.)	3402	3040	4531	4752	3606	2874	3701			
Boone County White	Grain (bu.)	42.7	66.0	36.4	78.6	28.9	35.3	48.0	10.85	1019	.789
	Stover (lb.)	3684	3277	3208	3474	3834	3068	3424			
Johnson County White	Grain (bu.)	42.8	55.5	41.3	73.2	32.8	32.1	46.3	9.91	911	.730
	Stover (lb.)	4101	2199	2469	3008	3925	2022	2954			
Reid Yellow Dent	Grain (bu.)	36.5	78.4	43.6	66.5	29.7	31.6	47.7	9.35	749	.705
	Stover (lb.)	2875	2005	2273	2805	3104	1948	2502			
Leaming	Grain (bu.)	36.9	61.6	37.0	65.1	33.3	33.2	44.5	9.57	919	.704
	Stover (lb.)	2890	2458	3135	2842	3172	2678	2863			
Hogue Yellow Dent	Grain (bu.)	41.1	63.9	37.1	70.9	34.3	33.6	46.8	9.17	749	.692
	Stover (lb.)	3015	1703	2348	3303	2442	1924	2456			
Silvermine	Grain (bu.)	34.9	56.5	28.0	72.1	22.3	29.4	40.5	8.08	780	.606
	Stover (lb.)	2629	1466	1690	3425	2190	1870	2212			

ERROR CORRECTION

On page 36, "Table 23" should read "Table 24." Table properly numbered 23 is supplied herewith.

TABLE 23.—SILAGE YIELDS OF CORN VARIETIES AT COLUMBIA.
(In Tons of Silage Containing 75 percent of Moisture)

Variety	Yield per Acre		
	1917	1918	Average
Eureka Ensilage	16.03	6.27	11.15
Cocke Prolific	15.25	6.13	10.69
Biggs Seven-ear	12.56	5.53	9.05
Commercial White	15.24	6.44	10.84

(4) in column 10 the relative value of the varieties for silage, assuming a pound of ear corn to contain 60 per cent more of total digestible nutrients than a pound of stover.

Among the standard varieties Commercial White was the outstanding leader in the production of silage, because of its high yield of both grain and stover. The varieties ranking next are St. Charles White, St. Charles Yellow, and Cartner, with little difference between them. The third group—Boone County White, Reid Yellow Dent, Leaming, Johnson County White, White, Silvermine and Hogue Yellow Dent—do not rank as silage varieties.

In general the varieties rank in silage production according to the length of their growing periods. Commercial White, in first place, is the latest of the lot to mature; the second group, although made up of late varieties, is not so late as Commercial White; and the third group is in general medium early in maturity. The variety which grows through the long est period has a natural advantage over others in the development of plant matter, including grain.

THE STANDARD MISSOURI VARIETIES

Six varieties, Boone County White, Commercial White, St. Charles White, Reid Yellow Dent, Leaming, and St. Charles Yellow, were the outstanding leaders in the tests reported in this bulletin. Some of the six led in each section of the State and in most cases all of the six have outyielded all other varieties. The sectional adaptation of each of these varieties in Missouri is briefly stated in the following paragraphs.

Boone County White: A medium late maturing variety of white corn very extensively grown in Missouri, especially in the river bottoms and on the better uplands. In these tests it was the best yielding variety on bottom lands in all parts of the State and one of the leaders on uplands throughout central and southern Missouri. The variety Johnson County White is so similar to Boone County White in general features and adaptation that for practical purposes the two varieties may be considered as one.

Commercial White: A late maturing variety of white corn grown fairly extensively in southwestern Missouri, where it was originated. In these tests it was the highest yielding variety throughout central and southern Missouri and gave good yields on bottom lands all over the State. This variety does not mature well in the average season in northern and central Missouri and consequently yields grain of high moisture content and poor keeping quality. The danger of producing soft corn and the difficulty of securing seed of good germination are increased by growing a variety so late in maturity. In the southern third of the State, where the growing season is longer, the variety will mature fairly well and is free from most of the disadvantages named. In this section it will out-yield the other varieties by a considerable margin. It is to be recommended as a variety for grain in the southern third of Missouri, and as a variety for silage in any part of the State, but particularly the southern part.

St. Charles White: A medium late maturing variety of white corn extensively grown in southern Missouri. In the tests St. Charles White was

found to be one of the leading varieties for grain in central and southeastern Missouri and a good yielder on bottom lands all over the State. This variety is an exceptionally good silage variety, producing a heavy yield of silage of good quality without extremely late maturity.

Reid Yellow Dent: A medium early maturing variety of yellow corn widely grown in Missouri, particularly in the northern part of the State. In these tests it was found an especially good yielder on the upland soils in the northern third of the State, particularly in the western portion. In southern Missouri and in the bottom lands of northern Missouri it will not yield as well as Boone County White or Commercial White.

Leaming: A medium early maturing variety of yellow corn, similar in adaptation to Reid Yellow Dent. This variety is not widely grown in Missouri and adapted seed is therefore hard to obtain. It has no marked advantage over Reid Yellow Dent and as improved and adapted seed of the latter is available in abundance, Leaming is not to be recommended.

St. Charles Yellow: A late maturing variety of yellow corn which in general gave good yields in the tests, but did not lead in any section. In northern and central Missouri it does not mature well in the average season and has the same disadvantages as Commercial White without its high yield. In southeastern Missouri St. Charles Yellow has given good yields but offers no advantages over St. Charles White and Commercial White.

CORN IMPROVEMENT

Although certain varieties of corn are clearly superior in yield and quality to others, under Missouri conditions, it is undoubtedly true that a wide variation may occur between strains of the same variety. Few economic plants are more variable than corn. By continual selection toward a definite type the character of a strain of corn may be modified to an astonishing degree. When corn is moved to a new locality it gradually changes and adapts itself to the new conditions. Therefore the limits of corn varieties are necessarily vague. It cannot truly be said, in the strictest sense, that any one variety of corn is better adapted than all others to a given region, for the difference in yield and other characters between the strains of the same variety is sometimes greater than the difference between fairly typical strains of different varieties. For example, at the Iowa Experiment Station a number of strains of Reid Yellow Dent varied widely in a yield test, though all were of good type and were furnished by growers of Reid Yellow Dent for seed in Iowa. Thus in 1919 the highest yielding strain yielded 76.8 bushels per acre, while another strain grown on the same field under the same conditions yielded only 51 bushels per acre. In other words, improved strains of Reid Yellow Dent have varied in yield fully as much as one would expect different varieties to vary. If ordinary, unimproved strains had been included in the test probably the variation would have been even greater. Therefore, it may not always be wise to give up an adapted and improved strain of a good variety because another variety has yielded more in a variety test. In the variety tests reported in this bulletin the best strains of each variety available were used, but except in cases of large differences in average yields be-

tween varieties, it is not recommended that strains which have been selected toward a desirable type and have proved satisfactory be abandoned for varieties yielding better in the tests.

The difference in ability to yield between strains of the same variety is caused by differences in the natural conditions under which they have been grown and in the selection or other means which have been used in their improvement. In buying seed corn it should be remembered that the strain is almost as important as the variety, and further, that the value of the strain for any one place depends upon two things, how nearly the natural conditions under which it has been recently grown approach those under which it is to be grown, and how well it has been improved by selection or other means. Seed corn imported from a region where the growing season is long will be late in maturity, while seed corn from a region where the growing season is short will be early. Seed corn from as far as 100 miles south is to be avoided, and seed corn from 100 miles north, though not so undesirable, is not recommended.

The principal methods which have been advocated for increasing the yielding ability of corn are (1) continuous selection in the field, (2) pedigree selection, (3) crossing varieties, and (4) crossing inbred strains. There has been much investigation of the value of these methods which is here briefly reviewed.

Continuous Selection. Continuous field selection is the method by which most of the varieties of corn now in existence have been developed. The well marked features of such varieties as Leaming, Reid Yellow Dent, and Boone County White, in which selection has been carried on for many years, prove the power of selection in changing the type of both the ear and the plant. This has been shown most strikingly in a number of experiments in which selection has been made in opposite directions in the same strain of corn. For example, at the Illinois Station, a high-protein strain containing about 15 per cent of protein, a low-protein strain containing about 6 per cent of protein, a high oil strain containing about 9 per cent of oil, and a low-oil strain containing about 2 per cent of oil have all been produced by continuous selection from one original strain containing about 11 per cent of protein and about 5 per cent of oil. By the same process the height of the ear and the angle at which it is borne have also been greatly changed. At the Indiana Station the tendency to bear suckers was found to be readily changed by selection. At the Ohio Station features of the ear have been modified materially in selection experiments. Apparently it is possible to mold the type of corn almost at will, if selection toward any desired type is continued long enough.

But selection to increase the yield has not given such marked results. Selection for yield is a much more difficult matter than selection for any single visible feature, because yield is determined by so many factors, and these factors vary widely in their importance in different seasons. If one or a few visible features were known to be always connected with yield it would be a simple matter to increase yield by selection. It was assumed for many years that certain features of the ear were connected with high yielding ability and these features were emphasized on the score card and in corn shows. But very thorough investigation has failed to

reveal a consistent connection between yield and any feature commonly considered desirable in show corn. Thus, tapering ears have been found to yield as well as cylindrical ears; ears with bare tips have yielded as much as ears with well covered tips, and so on. Plant features as well as ear features have been investigated, and thus far no visible feature of the ear or of the plant has been found which may serve as a reliable index to yield. Some experiments have indicated that selection for large ears may increase the yield, though this has not been definitely proved.

But field selection of seed corn is undoubtedly a profitable practice, even if no increase in yield can be made. By selecting seed corn in the field before the first killing frost it is possible to obtain sound seed ears from healthy plants of desirable form. Moreover, if selection is made for yielding ability itself, that is, if seed is selected only from plants which have yielded well without any advantage in growing conditions, it is likely that the yield of the strain can be increased. Increases in yield obtained by this sort of selection have been reported in some experiments, although it is true that carefully conducted experiments in which well adapted and improved varieties have been used in the corn belt region have generally failed to show an increase. It is easily possible by this method to develop an earlier maturing type, to reduce the prevalence of disease, and to change the type of both plant and ear.

Pedigree Selection. The difficulty of recognizing the plants of highest yielding ability from their appearance alone led to the development of pedigree selection. Several methods of pedigree selection have been recommended, but the essentials of all of them are similar.

A large number of desirable ears are selected and their yield under the same conditions is determined in an "ear-row" test, in which seed from each ear is planted in a separate row. The ear-rows usually show rather distinct differences in plant features, maturity, disease resistance, and yield. The ear-row test may be run either one or two seasons from the same ears. Part of the seed from each of the original ears is retained and the remnants of the ears found best in yield and other features in the ear-row test are mixed together and planted as foundation stock for an improved strain.

Pedigree selection has been very strongly recommended and in some parts of the country this method is used rather extensively by farmers. It is relatively an easy matter to make rapid progress in obtaining earliness of maturity or desirable plant features by this method. Some considerable increases in yield by pedigree selection have also been reported, but in most cases these have been obtained in varieties which had not previously been highly improved or in sections where the varieties grown were not perfectly adapted. None of the experiment stations in the corn belt states, except the Ohio Station, have reported pronounced increases obtained by pedigree selection. At the Nebraska Station over 15 years of very careful pedigree selection work with Hogue Yellow Dent failed to produce a strain at all superior in yield to the strain carried on from the start by ordinary continuous selection. Although attractive in theory, pedigree selection in corn has been, on the whole, disappointing in practice. Perhaps this is caused by narrow breeding resulting from choosing a small

number of ears to serve as foundation stock. Perhaps it is impossible to find the ears naturally best in yielding power in only one or two years' tests. Perhaps the seeds planted in the ear-row do not represent fairly the qualities of the seeds in the remnant retained, because of fertilization by different pollen. At any rate, it seems that little more improvement is to be expected from pedigree selection in well adapted strains of corn than can be obtained by ordinary continuous selection in the field. Certainly under farm conditions it is not only expensive to carry on careful car-row tests, but it is extremely difficult to obtain reliable results from them. Under ordinary conditions, then, the method of pedigree selection is not recommended for use on the farm.

Crossing Varieties. When two varieties are crossed, the hybrid is usually more vigorous in growth and higher in yield than the average of the parents. The hybrid vigor gained is greater in some crosses than in others and seems greatest when the parent varieties have been closely bred for a long time and when they are not closely related. The most successful crosses reported have been those between flint corn and dent corn varieties. But in all cases the hybrid vigor is greatest in the first generation following the cross and rapidly decreases thereafter.

A varietal cross has no practical value unless the hybrid out-yields the higher yielding parent and can be relied on to do so in the average of a series of seasons. Moreover, the gain must be great enough to pay the expense involved in making the cross every year. This expense is not very great as hybrid seed can easily be produced by planting in alternate rows the varieties to be crossed and detasselling plants of one variety. The seed borne on detasselled plants will then be hybrid seed, and the seed borne on plants not detasselled will be pure seed of one of the parent varieties. Pure seed of the other parent variety must be produced in a field far enough from other corn fields to prevent foreign pollen from reaching it.

First generation hybrids of varietal crosses which are said to be of practical value have been produced by the Connecticut and Minnesota experiment stations. At the Connecticut Station, of 50 varietal crosses made, 88 percent yielded more than the average of the parents and 66 percent yielded more than the higher yielding parent. The average yield of the crosses was about 9 per cent more than that of their parents. Some crosses exceeded their parents by more than 10 bushels per acre. At the Minnesota Station several crosses have produced increases in yield over the better yielding parents, and one cross of two well adapted varieties has produced 7 bushels more than the better yielding parent in the average of a four-year test.

In the corn belt states, however, varietal crosses have not given such striking results. Some crosses giving higher yields than either parent have been produced, but most crosses between well adapted varieties have been found to give yields lower than those of the higher yielding parents. Up to the present time no varietal cross has been found in any of the corn belt states which can be relied upon to produce a higher average yield in a series of seasons than the best commercial varieties now obtainable. It may be that the varieties in use in the corn belt have been improved to

such a point that it is more difficult to produce superior strains there than in regions where corn has not been grown so extensively. Possibly, also, the fact that the best corn belt varieties are more closely related than are the best varieties in northern States where both flint and dent corn is grown increases the difficulty of producing profitable varietal crosses. However, varietal crosses superior to the best varieties now being grown in the corn belt may yet be found, after more combinations have been tried.

Some experiments indicate that there is an increase in yield from crossing not only in the crop grown from the hybrid seed, but also in the crop of the season in which the cross is made. If this is true, a mixture of varieties might give a larger yield than any of the varieties making up the mixture, grown alone. In the two experiments which have been reported on this point, mixtures have yielded slightly better than any of the included varieties. But it has not been shown that such an increase will take place in all varietal mixtures or that in the same mixture the increase will be made in different seasons. The effects of crossing some of the standard Missouri varieties, both on the yield of the current crop and of the cross produced from hybrid seed, are being investigated in experiments now in progress at the Missouri Experiment Station. For the present, however, no varietal crosses or mixtures are known to be desirable in this State.

Crossing Inbred Strains. Corn is naturally cross-fertilized, and continual self-fertilization, or inbreeding, rapidly reduces its vigor. When the progeny of an ear of corn is continually self-fertilized a very rapid decrease in plant vigor takes place in the first few generations, shown by a decrease in the height of the plant, the size of the ear, and the yield. After about six to eight generations the inbred strains usually reach a level of vigor which is held thereafter. The number of generations necessary to bring the strains to this constant level varies. The rate of decrease in vigor is also very different in different strains, some dying out completely within a few generations, some rapidly reaching a constant state of more or less reduced vigor, and some reaching this condition more slowly. By the time the inbred strain has reached a fairly constant state of vigor, it has become remarkably uniform in type. Thus after several generations of inbreding of an ordinary commercial variety several strains are obtained, all less vigorous than the original variety and differing widely in their appearance, vigor and yield, but each almost perfectly uniform within itself.

For example, at the Connecticut Station four plants of Leaming yellow dent corn were self-pollinated in 1905 and the strains then produced have been inbred in each succeeding season. The yields in these four strains steadily decreased as inbreeding progressed, and in the tenth generation the yields of the four strains were 32.8, 32.7, 19.2 and 31.8 bushels per acre respectively, while the original Leaming corn grown on the same field and under the same conditions yielded 74.7 bushels.

When two of these apparently worthless inbred strains are crossed very surprising results are obtained. The vigor lost by constant inbreeding is suddenly regained and the yield is in many cases enormously increased. Seventeen crosses of the four inbred strains of Leaming corn mentioned above are reported by the Connecticut Station. The average yields of the parent strains used in these crosses were 27.8 and 27.2 bushels per acre,

while the average yield obtained in the same season and under like conditions from the hybrid seed was 78.4 bushels. Some of the crosses of inbred strains have outyielded the original Leaming parent by more than 20 bushels per acre. Moreover, the crosses have the uniformity of the inbred strains. Practically every plant bears a sizeable ear, and the monstrosities common in the ordinary corn field never occur.

Not all crosses between inbred strains are highly productive. Some strains apparently "nick" much better than others. There seems to be a fairly general but by no means invariable relation between the yield of the strains crossed and of the hybrids obtained. Crosses between very closely related strains are nearly always less productive than crosses between strains not closely related. The gain made in the first generation hybrid is not maintained, so it is necessary to produce crossed seed every year or two. As most inbred strains are low in vigor and bear stunted ears and grains of poor size and quality, the hybrid seed is usually inferior, to the great disadvantage of the first generation crop. This disadvantage may be overcome, however, by double crossing; that is, the crossing of two vigorous strains, themselves produced by the crossing of inbred strains.

It seems quite likely that in the future the most marked improvement of corn will be gained by the production, selection, and crossing of inbred strains. This method offers possibilities which could not be approached by older methods. The inbreeding and crossing could all be done by breeders, who would sell the hybrid seed of crosses found by experience to be well suited to the conditions of limited regions. Such seed would be worth a much higher price than any seed corn now on the market. Its value would decrease very considerably in a few seasons and it would probably be advisable for farmers to purchase new seed every season. The discoverer of a valuable cross would retain the inbred strains and sell the hybrid seed from them each year, thus gaining a financial reward comparable to that of successful animal breeders. Such opportunities for profit in corn breeding would provide a stimulus which could not fail to result in the production of valuable improvements.

These results, however, are not immediately obtainable. Much experimental work must be done in investigating the methods outlined above and in devising means for their practical use. This work is now being done at several experiment stations. For the present it is extremely unlikely that valuable results will be attained in this line of breeding by any one not thoroughly familiar with the fundamental facts of inheritance in corn. At the present time the method is of interest not because it offers the prospect of immediate profit, but because of its promise of future value.

HEALTH AND VIABILITY OF SEED

In addition to inherent ability to produce high yielding plants, good seed must have the power to germinate and produce thrifty seedlings and must be free from seed-borne disease. The use of seed with a low power of germination and of seed infected with highly injurious diseases causes enormous loss to corn growers every year. It is probable that a far greater gain in yield per acre over the country as a whole can be made by im-

proving the quality of seed simply in germinating power and health, than can be made by breeding directly for high yields.

Germinating Power of Seed. The production of seed of high germinating power is almost wholly a matter of reducing the moisture content to a low point before the seed is subjected to extreme temperatures, either high or low. The relation between moisture content and freezing injury is strikingly shown by recent experiments at the Nebraska Station. Samples of seed containing different percentages of moisture were subjected to a temperature of 28-32° Fahrenheit for 24 hours. The germination of corn containing less than 25 per cent of moisture was not at all injured by this treatment, while corn

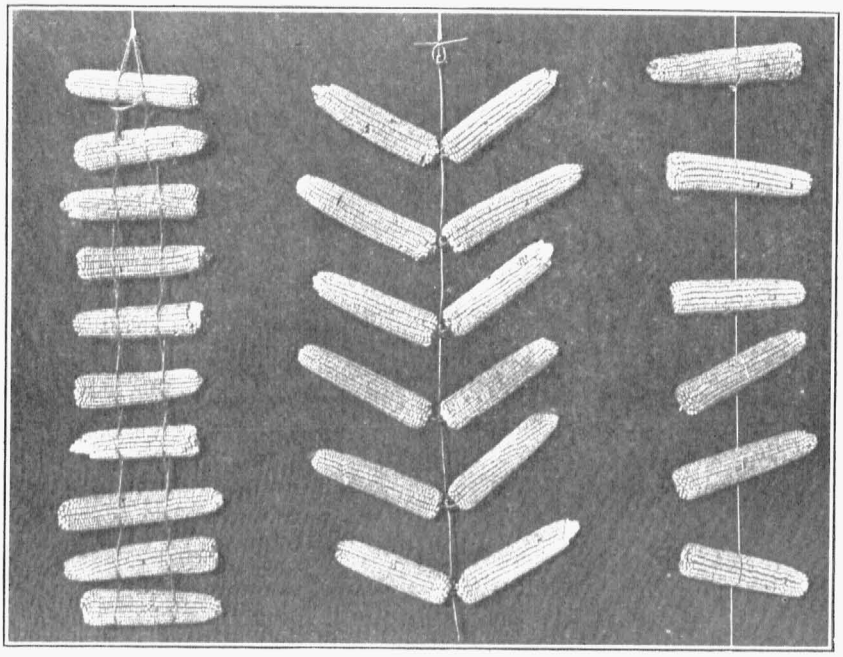

Fig. 3. Three good methods of drying seed corn. The hanger in the center is cut from electrically welded wire fencing.

containing 35-45 per cent moisture germinated only 80 per cent, and corn containing 45-55 per cent moisture germinated only 33 per cent after the treatment. The corn containing 25 per cent moisture, which was not injured in germination by a temperature of 28-32°, germinated only 88 per cent when exposed to a temperature of 12-16°; and only 27 per cent when exposed to a temperature of 4-8° for 24 hours. Air-dry corn contains only about 10-14 per cent of moisture. Corn as dry as this was found to withstand the temperature of liquid air, 190 degrees below zero. Contrary to the general impression, the first killing frost is not the main cause of freezing injury of seed corn. The greatest damage is apparently done by continued freezing temperatures in the late fall. Seed selected immediately after the first killing frost, and properly stored, so as to dry out rapidly,

will germinate well. For several reasons seed corn should be selected before the first killing frost, but when this is not done, seed selected immediately after the frost can be used with satisfactory results.

The average date of the first killing frost in Missouri is about October 10th in the northern section, October 15 in the central section and in the Ozark region, and October 20 in the southeastern section. These dates are variable and may differ by as much as two or three weeks in different seasons. The variety of corn grown should be one which will mature under normal conditions in ordinary seasons, but not necessarily in the shortest season, for the later maturing varieties generally outyield the earlier maturing varieties. The number of days required for maturity varies with seasonal conditions and with the date of planting, although it is influenced greatly by the variety. It is probably best to grow neither the latest and heaviest yielding variety nor the earliest variety available, but to grow one which is early enough to escape freezing injury in all but the exceptionally short seasons, and to depend upon early seed selection and a reserve supply of seed for such seasons. With most varieties it is possible to obtain by selection a strain fully a week earlier in maturity without sacrificing yielding ability. Such selection should be made early in the fall before the first killing frost, when the variation in maturity is most apparent.

The safest way to obtain sound seed corn of high germinating power is to select it in the field from the standing stalks before or immediately after the first killing frost. Such selection also gives an opportunity for improvement of the corn. Although this practice is undoubtedly a profitable one, it involves extra labor which some are unwilling or unable to give. Seed of high germination may in most seasons be obtained while husking for early feed or even at the time of general husking. Whether early field selection is practiced regularly or not, seed corn should always be gathered in the field in early fall in seasons when corn in general is late in maturity and seems in danger of being caught by frost.

The germinating power of the seed is influenced fully as much by the method of storage as by the method of selection. It is essential that seed ears be stored in such a way that they may dry out rapidly. The germination test should not be regarded as a substitute for proper selection and storage. Ears of perfect germination can usually be selected from the crib, but ears which have been properly stored may outyield them even if the germination of both samples is perfect. For example, in a test reported by the United States Department of Agriculture, 400 ears were divided into two equal lots, one of which was well cared for and the other placed in a barn as corn ordinarily is cribbed. The well preserved seed produced yields 12 per cent higher on poor soil and 27 per cent higher on fertile soil than that poorly preserved, although both lots of seed germinated equally well. Methods of storage are discussed on page 48.

Seed-Borne Diseases. Several important diseases of corn, particularly those causing root, stalk, and ear rots, appear to be carried over from one generation to the next largely by the seed. These diseases are extremely important and it has been estimated that they cause a loss of 10 per cent in the yield of corn in the United States. The losses they cause result

from the death of infected plants in the seeding stage, from the stunting of other plants, from delayed maturity, and from the rotting of roots, stalks, ears and shanks. They are very generally distributed and seem to be present in every corn growing section of Missouri.

It is found in ear-row tests that plants from some ears are much less affected by disease than those from other ears, a fact which indicates that these diseases can be controlled in large measure through the use of seed free from disease. Much can be done to control disease in corn by careful selection of seed in the field. This selection should be made before

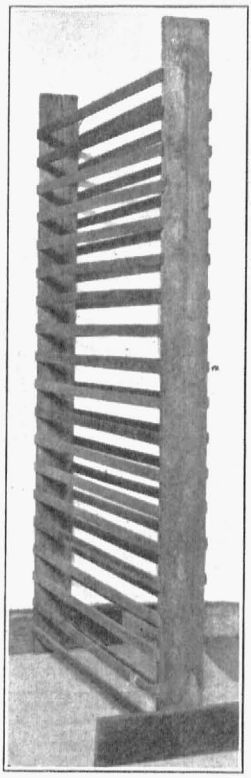

FIG. 4. A seed corn rack, made from 1x6 lumber and plastering lath.

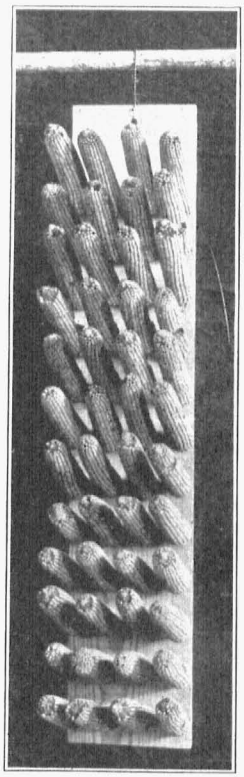

FIG. 5. Another satisfactory method of drying seed corn.

the first killing frost, so that ears which have matured normally can be distinguished from those that have ripened prematurely on account of disease. Only mature ears borne on sound shanks and on stalks which still bear green leaves should be selected. It has been found that kernels with rough indentation are more frequently diseased than kernels of smooth type. Dull and discolored kernels, particularly those with discolored germs, are often diseased.

Apparently there is a great deal of difference between plants in resistance to disease. It will probably be possible during the next few years

to develop resistant strains by selection or by the crossing of inbred strains. At present, however, no available varieties or strains are known to be resistant, and the best procedure for the corn grower to follow is to improve his own adapted corn in disease resistance by field selection and by the method of germination testing described on page 49.

Testing for Germination. The germination test is a valuable aid in detecting dead or diseased seed. The germinating power of seed ears gathered before the first killing frost and properly stored may be relied upon ordinarily without testing, unless the ears were extremely immature when gathered. When the germinating power of such seed ears is doubtful, a bulk germination test may be run by taking six kernels from each of 100 ears selected at random and determining their germination in the usual way. If the germination of these kernels is found to be less than 90 per cent, individual ear tests should be run to detect the ears low in germinative power. A special germination test for the detection of diseased ears as well as ears of low germination has been devised by the United States Department of Agriculture. It will probably pay to use this test even when the germinating power of the ears tested is known to be satisfactory. In an experiment reported by the United States Department of Agriculture, a group of apparently healthy ears were separated by such a germination test into diseased and disease-free lots. The average acre yield from disease-free ears was 15 bushels more than that from the diseased ears. The special germination test is hardly more expensive than the older methods. It is described on page 49.

CORN IMPROVEMENT BY THE FARMER

It is possible for farmers to make very substantial and profitable improvement in corn by simple, inexpensive methods. The increase in yield which may be obtained by such methods cannot be stated, though it is safe to say that there are few strains of corn now being grown by Missouri farmers which could not be improved to some extent in natural yielding power by continuous selection of the right sort under farm conditions. The features of the plants could be changed in the desired way, the time required for maturity shortened if necessary, the proportion of weak and diseased stalks reduced, the keeping quality of the grain improved and good germinable seed obtained in every season, by proper selection and storage of seed. Actual corn breeding is not usually profitable under ordinary farm conditions, when the variety is already a good yielder. This is true not only because of the extra expense involved, but because it is decidedly doubtful under farm conditions that better results can be obtained by such methods than by ordinary selection.

The first step in corn improvement is to obtain seed of an adapted and productive strain of a good variety, for foundation stock. If the corn already being grown on the farm is not considered suitable, an improved strain should be obtained, from some nearby source if possible. If it is necessary to obtain seed from a distance, it is better to go east or west than north, and better to go north than south. The most important element in adaptation is time of maturity, and corn which has been grown

for some years where seasons are longer will be found too late for best results.

Seed corn should be selected in the field when most of the ears have matured and, if possible, before the first killing frost. If the first killing frost occurs before most of the ears have matured, the seed corn should be gathered the following morning. About 30 to 40 ears should be selected for each acre to be planted, so that ears found diseased or otherwise undesirable may be eliminated and so that an extra supply may be on hand for possible replanting and for reserve stock for the following year in case of an early freeze or a crop failure.

The all-important points in the selection of seed corn are yield, good maturity and soundness. These should not be sacrificed for any other features of the ear or plant. Ears should be selected only from plants producing well and growing in a full stand with no apparent advantage in growing conditions. In selecting for yield, large ears are desirable, but the ear which is large and heavy because of late maturity should be avoided. Freedom from disease is indicated in several ways. The stalks and leaves of undiseased plants usually hold some of their color for some time after the ears have ripened. Broken ear shanks and leaning and broken stalks are indications of disease, and plants showing these defects should be avoided even though they bear ears of seemingly good quality. Relatively short, sturdy stalks bearing the ear at a convenient height and at a declining angle are desirable. Ears not covered to the tip by the husks should be avoided as they are more likely to be injured by insects and disease. Apparently it does not pay to study the features of the ear too closely in selecting for seed. None of the fancy points used in scoring seed corn have been shown to be associated with yield. Apparently, ears having a relatively shallow indentation are less susceptible to disease than ears of deeper indentation.

The seed ears selected should invariably be stored on the day they are gathered. This is very important, for their germinating power may be greatly reduced if they are left in the sack or piled on the ground even for a day or two. The most important requirements of storage are dryness and ventilation. The storage place should also be fairly warm, but if artificial heat is used, the seed must be given plenty of ventilation to carry off excess moisture, or injury may result. The great necessity in storing seed corn is to dry it out thoroughly before it freezes or heats. Seed ears should never be left for any considerable length of time in direct sunlight, however. Some good methods of storing seed are shown in Figures 3, 4 and 5. When the ears have dried out thoroughly, which will usually take from four to six weeks, they can be stored in crates, which should be lined with one-fourth inch wire screen for protection from rats and mice.

In the late winter or early spring the ears should be individually tested for germinating power and freedom from disease. If the corn has been properly selected and stored, there is little danger that it will fail to germinate well, but the various rot diseases, which can be recognized in the right sort of germination test, are so injurious that it will pay to test all seed ears, so that those affected by such diseases may be thrown out.

A special rag-doll germination test, for the detection of dead and diseased ears, is performed as follows:

Lay a strip of butchers' wrapping paper, 12 inches wide and 60 inches long, on a clean surface, and on top of this lay a moistened strip of bleached or unbleached muslin, 12 inches wide and 54 inches long, so that about three inches of paper extends beyond each end of the cloth. Now place eight representative kernels from each ear in a row on the muslin, germs down and tips pointing in the same direction, towards one side of the muslin. Roll the paper and the cloth into a doll just tightly enough to hold the kernels in place, using the extra three inches of paper at one end for a core, and fasten at each end with a rubber band or string. Place the doll in the germinator box so that the tips of the kernels point downward, and

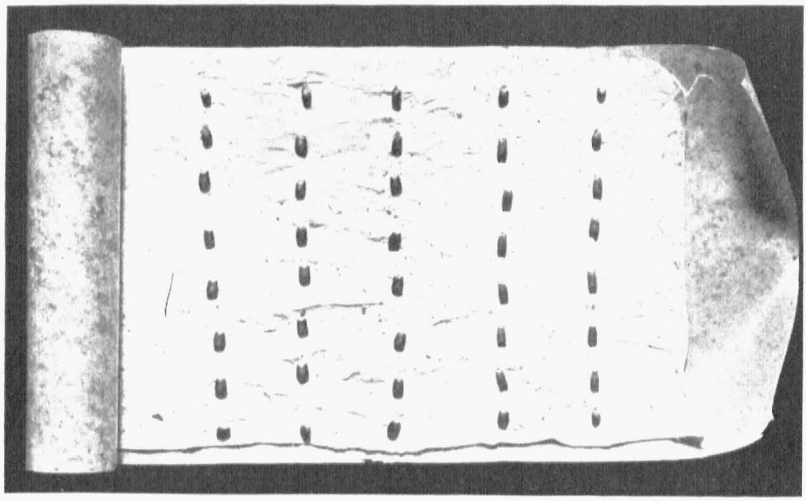

Fig. 6. A rag-doll germinator for the detection of both dead and diseased kernels.

on the upper end attach a tag indicating the numbers of the ears tested No guiding lines or ear numbers inside the doll are necessary if the ears are numbered in the order in which their kernels are placed in the doll. The muslin should be put in boiling water for a few minutes before it is used in another test.

The germinator box consists of an outer and an inner box with sawdust between, as illustrated in Figure 7. A convenient size for the inner box is 12x24x18 inches inside. Wire cross rods three inches apart are placed in the upper part of the box to hold the dolls apart. The outer box should be large enough to allow at least two inches of space for a tight sawdust filling around the sides of the inner box. The sawdust should be kept moist, and holes should be made in the sides of the inner box to allow damp air to enter the germination chamber. A three-inch layer of sawdust in the bottom of the inner box provides a base for the dolls to rest upon. The top of the box is covered with wet gunny sacks

while the test is in progress. The dolls should be sprinkled thoroughly twice a day with lukewarm water, but they need not be soaked in water at any time. After seven days the doll is taken out of the box and unrolled. The percentage of germination of each ear is determined in the usual way and the seedlings are then examined for molding or rotting of the roots. The seedlings which have rotted stems or roots, or which come from rotted kernels, indicate ears infected with disease. These ears, as well as ears which do not give good germination, should be discarded.*

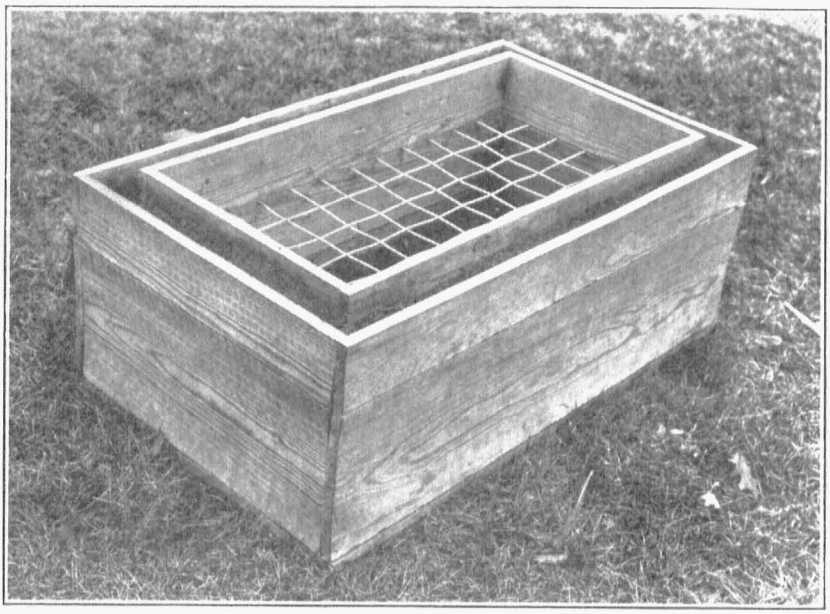

FIG. 7. Germinator box for rag doll disease germinators.

SUMMARY

1. Variety tests of corn extending through a period of 16 years, from 1905 through 1920, are reported. Nearly 500 cooperative tests on farms well distributed over the State, and tests of several years duration on the experiment station field at Columbia and on each of eight outlying experiment fields are included.

2. The best varieties for upland soils in northern Missouri were the medium early maturing varieties, Reid Yellow Dent and Leaming. Their advantage in yield over the later maturing varieties, such as Boone County White, St. Charles White, and Commercial White, was greatest in northwestern Missouri and least in northeastern Missouri.

3. The best varieties on upland soils in central Missouri were Boone

*A germinator of the table type for the detection of diseased ears has also been devised. This is described in Farmers Bulletin 1176, in which practical methods for the control of the root, stalk, and ear rot diseases are fully discussed. This bulletin may be obtained free from the Division of Publications, United States Department of Agriculture, Washington, D. C.

County White, St. Charles White, and Commercial White. Although Commercial White has given the highest yields in this part of the State, Boone County White and St. Charles White are to be preferred because of their earlier maturity and the better keeping quality of their stored grain.

4. The best variety for upland soils in southern Missouri was Commercial White. In the lowlands of southeastern Missouri St. Charles White was found best adapted.

5. The best variety for bottom lands both in northern and southern Missouri was Boone County White.

6. Commercial White was the best variety for silage at Columbia, the only point at which a direct test for silage was made. Other good varieties were St. Charles White, St. Charles Yellow, and Cartner.

7. On account of the wide variation between strains of the same variety, it is not recommended that adapted and improved strains which have proved satisfactory be abandoned for another variety which has been reported as giving higher yields.

8. The practical value of various methods of corn improvement is discussed and methods of corn improvement for the farm are briefly stated. Continuous selection of seed corn in the field is recommended as the most practical method of corn improvement on the farm.

9. Germination testing for the detection of disease is recommended even when the germinating ability of the seed is unquestioned.