12-5-1905

Experiments with Corn.

T. L. Lyon
University of Nebraska-Lincoln

BULLETIN No. 91.

THE UNIVERSITY OF NEBRASKA

BULLETIN

OF THE

AGRICULTURAL EXPERIMENT STATION

OF

NEBRASKA.

VOLUME XVIII, ARTICLE II.

EXPERIMENTS WITH CORN.

BY T. L. LYON.

DISTRIBUTED DECEMBER 5, 1905.

VARIETY TEST OF CORN ON STATION FARM.

LINCOLN, NEBRASKA
U. S. A.

AGRICULTURAL EXPERIMENT STATION

OF

NEBRASKA

THE GOVERNING BOARD

(THE REGENTS OF THE UNIVERSITY)

JOHN L. TEETERS, *President*, Lincoln
EDSON P. RICH, Omaha
ELISHA C. CALKINS, Kearney
CARL J. ERNST, Omaha
CHAS. S. ALLEN, Lincoln
WM. G. WHITMORE, Valley

THE STATION OFFICERS

E. A. BURNETT, B. Sc., *Director*
T. L. LYON, Ph. D., *Associate Director and Agriculturist*
J. S. DALES, M. Ph., *Financial Secretary*
WM. W. MARSHALL, *Executive Clerk*

THE WORKING STAFF

H. R. Smith, B. Sc., *Animal Husbandman*
A. T. Peters, D. V. M., *Animal Pathologist*
Frederick D. Heald, Ph. D., *Botanist*
S. Avery, Ph. D., *Chemist*
A. L. Haecker, B. Sc. A., *Dairy Husbandman*
Lawrence Bruner, B. Sc., *Entomologist*
Erwin H. Barbour, Ph. D., *Geologist*
G. R. Chatburn, A. M., *Highway Engineer*
R. A. Emerson, B. Sc., *Horticulturist*
O. V. P. Stout, C. E , *Irrigation and Drainage Engineer*
G. D. Swezey, M. A., *Meteorologist*
J. H. Gain, M. D. C., *Associate Animal Pathologist*
W. P. Snyder, M. S , *Superintendent Experimental Substation, North Platte*
Alvin Keyser, B. Sc., *Assistant Chemist*
S. W. Perin, *Farm Foreman*

EXPERIMENTS WITH CORN.

BY T. L. LYON.

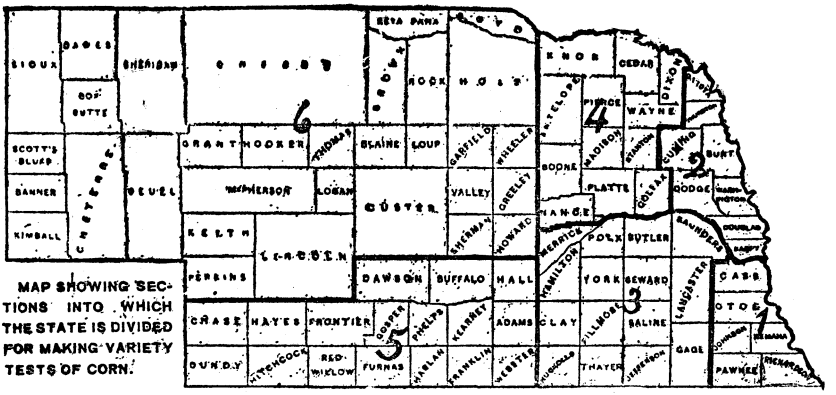
This bulletin is a preliminary report on experiments which have been under way at this Station during the past three years. Many of the experiments have not been carried on long enough to be subjected to all varieties of Nebraska seasons, but the results in some cases are of such general interest that they should be published at this time. No argument need be presented to prove the great value of any new information on the habits and nature of the corn plant which will enable the vast army of corn growers to handle the crop in a more successful manner.

COOPERATIVE TESTS OF VARIETIES.

Owing to the widely different climatic and soil conditions that prevail in this state, and in order to secure tests under ordinary farming conditions, the cooperation of farmers in various parts of the state was secured in experiments to determine the value of different leading varieties of corn under Nebraska conditions. The cooperating farmer was furnished with enough seed of each variety to be tested to plant one fourth acre. For the purpose of the experiment the state was divided into six sections with reference to climatic differences, and the experimenters in each section were given the same varieties to test. The heavy lines in the accompanying map indicate the boundaries of the divisions, which are designated by the numbers on the map.

By way of illustration, the results of the 1904 tests are given in the following table.[1] Fourteen different varieties

[1] Reports of cooperative tests in 1902 and 1903 have been published in Bulletin 83



MAP SHOWING SECTIONS INTO WHICH THE STATE IS DIVIDED FOR MAKING VARIETY TESTS OF CORN.

of corn in all were tested. These varieties, together with the locality in which the seed was grown and with the results of germination tests of each variety, are shown in the following table:

TABLE I.—*Varieties tested in 1904.*

* Variety.	Source of Seed.	Germination.
		Per cent.
Reid's Yellow Dent	Lancaster Co., Nebr	87.5
Hogue's Yellow Dent	Saline Co., Nebr	87.
Nebraska White Prize	Washington Co., Nebr	97.
Mammoth White Pearl	Washington Co., Nebr	97.5
Mammoth Golden Yellow	Washington Co., Nebr	98.5
Golden Row	Washington Co., Nebr	97.5
Legal Tender	Washington Co., Nebr	92.5
Silver Mine	Washington Co., Nebr	86.
Golden Cap	Washington Co., Nebr	85.
Leaming	Illinois	96.
Calico	Merrick Co., Nebr	96.
Leaming	Buffalo Co., Nebr	98.5
Boone County White	Illinois	95.
Silver Mine	Saline Co., Nebr	100.
Calico	Lincoln Co., Nebr	99.
Pride of the North	Merrick Co., Nebr	100.
Flint	Vermont	96.

The yield per acre of each variety by each farmer making the tests is given in the following tables, each section being treated by itself:

* Where corn of the same variety was obtained from different sources, the western grown seed was tested in the section in which raised and in other sections equally far or farther west.

TABLE II.—*Cooperative tests in 1904.*

SECTION 1. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent.	Reid's Yellow Dent.	Leaming.	Legal Tender.	Silver Mine.	Mam'oth Golden Yellow.	Mam'oth White Pearl.	Nebr. White Prize.	Golden Row.	Golden Cap.
C. F. Chase, Pawnee City	32.29	30.57	30.57	28.29	37.71	31.43	33.14	35.14	34.85	28.29
J. B. Cleghorn, Manley	35.	40.	30.	25.	30.	35.	40.	30.	35.	25.
H. R. Coles, Pawnee City	16.	35.	15.	30.	37.	25.	34.	15.	18.	17.
Joseph G. Heim, Dawson	65.	68.57	60.	61.43	67.14	62.14	62.14	62.86	63.57	61.43
Chas. Howe, Howe	40.	45.	39.5	60.	35.	39.	46.	30.	29.5	30.
E. G. Jury, Tecumseh	50.	48.	48.	58.	52.	47.	45.	65.	52.	49.
F. B. Liphardt, Graf	41.57	41.57	37.86	35.	47.	40.	44.57	41.57	47.	45.57
Ben Maiben, Palmyra	45.67	43.	45.67	36.	41.50	40.	41.	43.	41.	36.
H. P. Sturm, Nehawka	37.33	33.78	36.	27.43	39.62	42.67	46.93	44.44	35.56	34.
Dean L. Young, Palmyra	36.	34.	32.	26.	34.	28.	28.	28.	34.	28.

TABLE III.—*Cooperative tests in 1904.*

SECTION 2. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent.	Reid's Yellow Dent.	Leaming.	Legal Tender.	Silver Mine.	Mam'oth Golden Yellow.	Mam'oth White Pearl.	Nebr. White Prize.	Golden Row.	Golden Cap.
A. M. Bottorff, Gretna	51.8	52.3	57.4	52.	48.9	45.4	48.	47.8	49.4	43.2
O. H. Brockman, West Point	85.5	81.6	78.73	74.5	83.	96.	85.	78.5	78.5	77.73
J. M. Brown, Scribner	69.	68.	60.5	63.	56.5	65.	49.	58.	66.5	57.5
M. Dabelstein, Waterloo	69.14	60.57	61.14	73.14	62.86	71.43	61.71	61.14	62.28	60.57
Wm. Eiche, Sta. B, Omaha	45.	40.	42.	38.	55.	50.	52.	50.	39.	37.
A. O. Ford, Oakland	63.14	66.	55.6	55.3	51.9	56.6	60.	62.3	56.6	46.9
Charles Grau, Bennington	42.	48.	45.	50.	50.	48.	55.	52.	46.	40.
A. S. Grigereit, Fremont	62.	55.	60.	58.	61.	64.	70.	67.	56.	47.
Joseph Hall, Tekamah	73.	73.	63.	70.	72.	81.	81.	64.	72.	72.
W. H. Hoegemeyer, Hooper	51.	56.14	57.	53.57	56.6	49.97	52.03	55.46	52.28	49.28
Geo. W. Monnich, Hooper	70.4	74.96	69.04	63.28	62.04	59.68	58.88	60.72	62.72	52.24
J. G. Mulloy, Fremont	65.7	63.9	73.9	62.8	75.	70.7	70.1	72.5	68.5	66.4
John Oberst, Tekamah	48.	50.	45.	45.	50.	52.	54.	50.	40.	38.
F. F. Petersen, Herman	68.53	68.53	72.47	60.38	64.19	69.74	65.14	63.37	62.14	60.38
C. Y. Thompson, West Point	47.5	55.	55.	55.	60.	50.	50.	55.	50.	40.
Andrew Young, Jr., Craig	70.	72.	73.	65.	76.	70.	85.	80.	75.	68.
John P. Young, Oakland	77.5	78.12	75.25	75.5	90.	79.	79.5	68.5	74.	74.25

TABLE IV.—*Cooperative tests in 1904.*

SECTION 3. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent.	Reid's Yellow Dent.	Nebr. White Prize.	Golden Row.	Golden Cap.	Silver Mine.	Legal Tender.	Leaming.	Calico.	Boone County White.
Ed. P. Brown, Lincoln	48.	37.	70.	64.	72.	60.	61.	60.	39.	48.
E. P. Dill, Belvidere	34.66	30.33	31.	29.33	30.33	29.	31.33	27.	32.32	23.
J. F. Egger, Hickman	52.57	62.14	54.	56.14	56.86	57.14	59.78	59.14	59.57	53.57
J. E. Fenton, Ashland	16.24	13.24	14.13	16.1	16.27	14.27	14.56	16.59	16.3	11.96
A. A. Galt, Edgar	34.67	36.5	36.5	35.75	33.33	35.75	33.33	31.5	37.75	28.75
J. D. Hasik, Abie	55.	52.	48.	40.5	47.	45.	50.	49.	56.5	54.
J. H. Huyck, Liberty	39.	47.	42.	45.	42.5	48.	46.5	47.5	40.	46.
J. A. Jacobson, Marquette	46.	41.	36.	44.	44.	44.	43.5	43.	48.	33.
S. T. Johnson, Edholm	47.	40.	45.	52.	45.	50.	42.	46.	52.	36.
L. R. Lambert, Diller	26.93	24.	26.67	25.33	24.53	29.33	25.6	22.4	27.47	21.33
John C. Lloyd, Utica	62.57	60.	61.71	61.71	60.86	61.71	60.86	55.71	70.03	47.14
Charles Murray, Friend	42.5	41.36	35.36	41.07	41.07	42.5	37.09	42.14	41.79	35.36
A. J. Olson, Wahoo	56.	58.	50.	55.	50.	50.	50.	55.	48.	50.
D. E. Ritchey, Rising City	55.	52.	56.	56.	52.	54.	53.	51.	53.	52.
Chas. N. Schmale, Emerald	40.05	36.3	45.	45.05	40.9	47.25	43.06	40.05	44.	44.3
A. M. Tremain, Malcolm	30.	30.	34.	28.	28.	28.	30.	32.	28.	40.
Raleigh Wilder, Central City	37.5	40.	65.	32.5	40.	40.	37.	40.	37.5	40.
R. M. Wolcott, Palmer	38.	36.	39.	40.	40.	35.	36.	37.	39.	38.

TABLE V.—*Cooperative tests in 1904.*

SECTION 4. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent.	Reid's Yellow Dent.	Nebr. White Prize.	Golden Row.	Golden Cap.	Silver Mine.	Legal Tender.	Leaming.	Calico.	Mam'oth White Pearl.
L. G. Bollen, Laurel	41.	40.	42.	50.	45.	42.	45.	50.	55.	50.
Geo. F. Coupland, Elgin	59.	57.	60.	50.	55.	55.	50.	50.	52.	40.
W. G. Cramer, Boone	28.3	23.6	26.6	28.3	17.9	32.3	28.	25.3	36.	23.3
N. E. Davis, Howell	25.	42.	39.	42.	42.	42.	45.	42.	36.	42.
D. M. Decamp, Clearwater	58.01	53.09	54.09	46.04	59.01	59.01	59.07	50.04	57.02	48.06
W. F. Dodds, Columbus	19.7	18.7	20.6	17.5	17.1	17.4	14.3	19.4	21.3	16.
J. E. Donaldson, Albion	49.5	46.5	48.	51.	49.5	45.	48.	48.	51.	52.5
H. J. Herron, Ewing	.....	40.7	45.42	51.64	48.48	46.	48.17	45.6	50.	42.85
L. M. Heesacker, Humphrey	48.	46.	44.	42.	45.	42.	45.	43.	44.	38.
F. J. Houtz, Albion	47.	45.	47.5	47.5	41.5	52.5	47.5	45.	48.75	55.
Charles Jonas, Schuyler	54.	48.	48.86	53.	52.57	49.14	46.	46.	49.43	42.28
Herman Mullenhoff, Leigh	45.36	45.36	47.21	48.69	53.93	48.	49.24	39.	36.57	39.
J. A. Niles, Fullerton	47.9	38.7	44.3	48.8	32.2	45.7	37.5	41.6	44.6	39.
Fred Porter, Orchard	14.	12.25	12.75	18.	10.5	18.	15.	12.	14.25	10.5
P. N. Seim, Plainview	63.44	57.24	65.6	62.28	61.72	61.12	64.	62.56	64.	58.56

TABLE VI.—*Cooperative tests in 1904.*

SECTION 5. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent.	Golden Cap.	Reid's Yellow Dent.	Silver Mine.	Pride of the North.	Calico.	Leaming.	Flint.
S. C. Bassett, Gibbon	35.	32.	38.	40.	30.	38.	45.	12.
A. C. Bischel, Kearney	58.	60.	63.	68.	60.	50.	50.	15.
Max Buschow, Blue Hill	45.8	44.15	49.84	39.5	51.5	42.2	38.21	.....
No name	27.1	25.6	23.7	28.9	33.9	34.4	36.	12.
Robt. T. Erickson, Funk	54.28	51.28	47.43	57.86	67.86	68.86	71.71	12.
I. D. Evans, Kenesaw	25.	20.	25.	25.	18.	25.	25.	.....
L. M. Higgins, Freedom	36.	25.	28.	.....	18.	32.	25.	.....
H. J. McLaughlin, Doniphan	37.	41.	42.5	40.	35.5	40.5	51.5	.....
John Pierce, Gibbon	38.	36.	.....	40.	36.	38.	36.	.....
G. A. Prime, Arapahoe	60.	56.5	58.	57.5	42.	58.	56.	28.
C. F. Sjogren, Axtell	48.	42.	42.	48.	46.	54.	45.	15.
W. F. Fallert, Holbrook	25.	22.	23.	25.	20.	18.	20.	.....

TABLE VII.—*Cooperative tests in 1904.*

SECTION 6. YIELD IN BUSHELS PER ACRE.

Names of Experimenters.	Hogue's Yellow Dent	Golden Cap.	Reid's Yellow Dent.	Silver Mine.	Pride of the North.	Calico.	Leaming.	Flint.
W. J. Armstrong, Ord	37.38	39.38	36.91	47.99	42.63	50.45	42.63	19.68
H. B. Glover, Comstock	40.66	39.86	34.	41.27	46.46	52.93	47.	.....
C. H. Kuhn, Farwell	45.43	39.86	37.2	44.4	38.	40.6	39.86	.....
H. D. Lute, Paxton	25.	28.	22.	24.	32.	22.	36.	8.
L. H. Perkins, Valentine	29.5	26.4	18.	23.	34.	34.	34.6	14.67

From the results of the three years' cooperative tests the following conclusions may be drawn:

For Section 1, Reid's Yellow Dent and Hogue's Yellow Dent proved to be the best varieties of yellow corn, and Nebraska White Prize and Silver Mine the best varieties of white corn.

In Section 2, Golden Cap, Hogue's Yellow Dent, and Mammoth Golden Yellow were the varieties of yellow corn giving the best results, and Silver Mine the best white corn.

In Section 3, Hogue's Yellow Dent and Golden Row were the best yielding varieties of yellow corn, Silver Mine and Mammoth White Pearl the best varieties of white corn, and Calico proved to be a very productive variety.

In Section 4, some of the varieties giving the largest yields mature so late that they are not reliable if the seed be brought from some distance. Of the yellow varieties, Golden Row is the most productive and there were no reports that it did not mature in 1904, although there were such reports in other years. Golden Cap is an early maturing variety, but did not yield as well as Golden Row. Of the white varieties, Nebraska White Prize and Silver Mine gave the best yields, but the former did not always ripen fully in the northern part of the section. Calico gave good results.

In Section 5, Hogue's Yellow Dent, although yielding best, failed to ripen in a number of trials, and is doubtless too late maturing for most of that region. Leaming makes the best showing of any of the yellow varieties. Pride of the North is earlier than Leaming and gave satisfaction in some trials where Leaming failed to ripen. Silver Mine yielded well, but in some trials failed to mature. Calico yielded well and ripened in nearly every test. All things considered, Calico is probably the best variety for the section.

In Section 6, the results were much the same as they were in Section 5. Calico and Pride of the North are the best varieties.

VARIETY TESTS ON THE EXPERIMENT STATION FARM.

New varieties are tested at the Station farm before being sent out to cooperators.

A number of new varieties are thus taken on each year, while others are dropped. Also corn of the same variety but grown in different localities is tested to note the effects of adaptation in hopes of finding the best region for seed-corn growing.

The following table is a summary of those varieties which have been grown two or three years:

TABLE VIII.—*Variety tests on the Experiment Station Farm.*

VARIETIES GROWN THREE YEARS.

Variety.	Source of seed.	Yield in bushels per acre.			
		1902.	1903.	1904.	Av.
Hogue's Yellow Dent....	Saline Co., Nebr.....	75.4	75.1	80.6	77.0
Reid's Yellow Dent.....	Illinois	68.9	72.2	82.8	74.6
Legal Tender.....	Washington Co., Nebr..	65.0	68.1	78.5	70.5
Golden Cap	Dodge Co., Nebr.....	65.7	66.7	77.2	69.9
Golden Row	Washington Co., Nebr..	63.6	69.1	74.0	68.9
Nebraska White Prize ...	" " " ..	62.7	59.9	82.1	68.2
Early Yellow Rose	Iowa	65.4	62.1	76.9	68.1
Snowflake White.....	"	58.9	68.7	72.8	66.8
Mammoth White Pearl ..	Washington Co., Nebr..	54.3	61.8	83.1	66.4
Mammoth Golden Yellow	" " " ..	54.3	65.7	78.7	66.2
Leaming.....	Illinois	59.6	61.6	76.6	65.9
Boone County White.....	"	58.2	59.8	68.9	62.3
Riley's Favorite.....	Indiana	53.2	51.0	80.4	61.5
Silver Mine	Illinois	50.0	58.1	65.1	57.7

VARIETIES GROWN TWO YEARS.

Iowa Gold Mine	Buffalo Co., Nebr.....	.....	61.5	84.9	73.23
Calico	Washington Co., Nebr..	60.0	59.8	.....	59.9
Early Cattle King.....	" " " ..	56.8	59.8	.....	59.9
Early Cattle King	" " " ..	56.8	62.5	.....	59.6
Iowa Gold Mine.....	" " " ..	57.9	60.9	.....	59.4

It may be said that the five varieties yielding the most heavily in these tests are the same as in the tests of the two previous years; and in nearly the same relative standing. The average yield of the varieties for the three years represents the relative productiveness of these varieties in years

of liberal rainfall, all three of these seasons having been of that kind.

RELATION OF SIZE OF EAR TO YIELD.

It is frequently assumed that large ears and a large yield of corn go together. In order to get at the relation between the average size of ear and the yield per acre of the varieties tested at the Station farm, one hundred ears of each variety, taken as they came in the row, were weighed and measured. The interesting fact developed that the heaviest yielding varieties instead of being of the large eared kind are on the contrary of medium size. The average weight per ear of the five highest yielding varieties was .705 pound, which was considerably below the average weight per ear of all the varieties. The five varieties having the heaviest ears ranked only a little above the average in yield, and in some cases large eared varieties were rather low in yield. Corn growers should look rather at the performance record in the field of a variety of corn than at the size of the ear or any fancy point.

The fact should not be overlooked in this connection that the most desirable size of ear must vary to some extent according to locality and season, and must depend moreover on soil, climate, and elevation. This is brought out in the cooperative tests, in which each year the weight of ten ears of each variety has been reported by each experimenter. These reports indicated the number of ears to the bushel on the average in each section to be as follows:

Section number.	Ears per bushel.
1	93
2	84
3	98
4	92
5	111
6	132

This table shows some marked differences in the size of ear in different sections, and while we are not justified in concluding that these ratios should always exist, yet the data unquestionably prove that the best type of corn for western and central Nebraska should be a smaller eared type than for the eastern portion of the state.

THICKNESS OF PLANTING CORN.

In 1903 and again in 1904, experiments were made at the Station to determine the effect of different rates of planting corn upon the yield of grain, size of ear, quality of the grain, number of barren stalks and suckers, and upon the yield of stover. To get the exact number of plants desired per hill, in making the experiment the plantings were made by hand and three extra kernels were planted in the hill. When the corn was about six inches high, it was thinned down to the desired number of plants per hill. In 1903 the plantings were made to vary from one to four kernels per hill, but in 1904 the maximum was increased to five grains per hill. The hills were placed forty-four inches apart each way. The general results in their various phases may be noted from the following table showing the average results for two years:

TABLE IX.

No. stalks per hill.	Yield per acre.	Av. weight of ears.	Good ears.	No. of ears per 100 plants.	No. of suckers per 100 plants.
	Bushels.	*Ounces.*	*Per cent.*		
1	55	10.7	64	174	198
2	68	10.5	68	119	76
3	78	9.2	55	98	25
4	78	8.	42	82	8

THE YIELD OF GRAIN.

To the Nebraska corn grower the all-important question is how to increase his yield. This point is therefore the one of chief importance in connection with a study of the rate

of planting. Of plantings made in 1903, the best yield came from the planting of four plants to the hill, while in 1904, three plants to the hill produced the most grain. The average for the two years for the plats containing three stalks to the hill and for the plats containing four are seen to be exactly the same, owing to the fact that the first year, being wet and a good corn season, favored the heavier planting, and 1904, being drier, favored the lighter. Experiments at the Illinois Station carried on over a period of years point to similar conclusions, that four stalks to the hill give better results in good years and three stalks in poor years. Experiments in Missouri show that poorer soil demands lighter planting than good soil, hence the conclusion that the rate of planting that gives the best yield will vary according to soil and season.

In Nebraska, the rate of planting should be heaviest in the east, not less than three kernels per hill. The rate should gradually decrease as it proceeds westward, two grains per hill probably being sufficient for the best average results on the western edge of the corn belt.

AS TO SIZE AND QUALITY OF EARS.

A study of the results from the different rates of plantings made in these two years shows a regular decrease in the size of ears as the rate of planting increases. The average ear from the planting containing one stalk per hill weighed 10.6 ounces, while the average ear of the five stalks per hill plantings was only 6.6 ounces per ear. These results were similar in both years.

As to quality, the results showed the highest per cent of good ears to have been obtained with two plants to the hill. It might have been expected that one plant per hill would produce the highest proportion of good ears, but this was not the case because with one plant per hill a large number of tillers produced ears, most of which were small. Two plants per hill produced the highest yield of good ears

per acre, although they yielded less grain per acre than any planting except one stalk per hill. This would seem to indicate that where size of ear is a consideration, a rather thin planting is best, while for maximum yield the rate should be greater.

THE YIELD OF STOVER.

Observations on the yield of stover were made only in 1904. In this case the quantity increased regularly with the rate of planting. One stalk per hill gave 4,392 pounds per acre, and this increased to 6,975 pounds per acre with five stalks to the hill. The proportion of grain to stover was greatest with three stalks per hill, which was the rate that produced the greatest total yield in that year. It would be expected that the highest proportion of corn to stover would occur with the thinnest planting, but this is not true because of the larger number of barren tillers on the thinner planting. A larger number of barren plants occur in the thicker plantings, and this also results in a smaller proportion of corn to stover. The Illinois Station reports results similar to these, the thickest plantings making the most stover, while the highest yield of corn and lowest percentage of fodder were obtained from stalks planted twelve inches apart in the row.

BARREN STALKS.

A study of the results noted from the difference in rates of planting discovers that the per cent of barren stalks is directly affected by the rate of planting. Thus in 1904 six per cent of the stalks planted at the rate of one to the hill were barren, while the rate reached as high as twenty-seven per cent in the corn planted at the rate of five stalks per hill. Crowding is thus seen to result in a degree of barrenness higher than would otherwise be natural.

TILLERS, OR "SUCKERS."

In order to understand the significance of the observations that have been made on the development and value or lack of value of tillers in corn, it will be necessary to remember the botanical and histological facts that have been developed in this connection. Botanically, a tiller is simply a lateral branch arising from one of the lower nodes or joints of the corn plant. The early progenitor of corn was undoubtedly a much branched plant with many ears. The number of branches and ears has been reduced to the point which we now observe, no doubt through the fact that men naturally chose through periods of years the larger ears for seed, and these grew on the plants having the least number of ears and

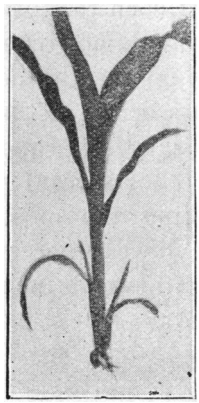


Fig. 1. From photograph of a plant 10 inches high, showing two tillers just starting.

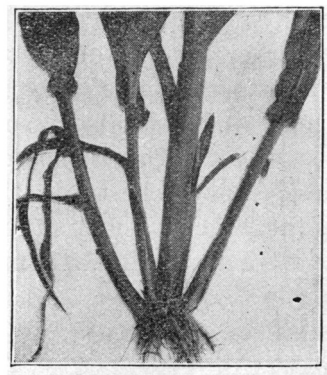


Fig. 2. Plant about 20 inches high, showing four tillers.

stalks. By this form of artificial selection the number has been gradually reduced. Under certain conditions these branches still appear, when they are called tillers, or "suckers."

The development of the tiller varies considerably, according to the variety of corn, as sweet corns, dent varieties, or flint corns. To take the dent corns as an example, on a good variety of this corn soon after the young plant is up, em-

bryonic branches or buds can be detected by careful examination, usually one to every node. If conditions are favorable, one or more of the lower buds begin to develop into tillers when the corn is eight to ten inches high.

With common dent corn about two of these buds are all that develop, though under very favorable conditions as many as five or six of the lower buds may make tillers. In figure 2 are three well-developed tillers. Usually all tillers that are going to appear have made their start by the time the plant is twenty inches high.

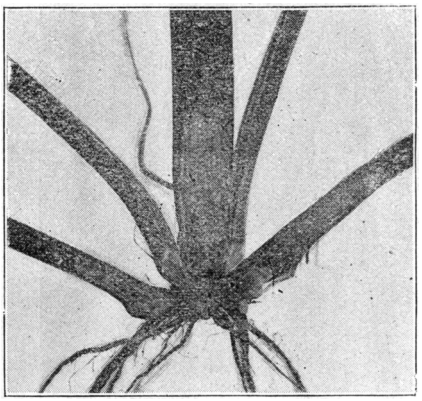


Fig. 3. From photograph showing how the young tillers are separated from the main plant The two lower ones are developing their own roots.

The young tillers are at first attached to the main plant and draw their subsistence from it (hence the name sucker), but they soon develop their own roots and finally become virtually independent plants. Sometimes entire separation takes place through the pushing away of the tiller by the rapid growth of both itself and the main plant. Figure 3 illustrates the different degrees of separation, in this case the lower tiller being almost completely separated. Figure 4 shows a more advanced stage.

CONDITIONS AFFECTING THE PRODUCTION OF TILLERS.

A number of conditions may be mentioned which favor the production of tillers. In making the tests of rates of planting at the Station, observations were made of the number of suckers produced by the different plantings. The results of these observations as shown in the averages for two years are as follows:

Fig 4. From photograph of a thrifty sweet-corn plant, having six tillers. The two lower tillers had practically separated from the main plant, and were established on their own roots, while the next two had also started a set of roots.

Table X.

For every 100 plants, 4 in a hill, 8 tillers developed.
For every 100 plants, 3 in a hill, 25 tillers developed.
For every 100 plants, 2 in a hill, 76 tillers developed.
For every 100 plants, 1 in a hill, 198 tillers developed.

Under the conditions in which this experiment was conducted, it would seem that about three stalks per hill was a full stand, since only one tiller developed to every four stalks, but where only one or two stalks per hill were left, enough tillers developed to make up the difference. The number of tillers will also vary from year to year, just as the number of plants which constitute a maximum stand will vary from year to year, depending on soil, moisture, climatic conditions, etc. For example, the season of 1903 was very favorable, and experiments showed that about four plants per hill gave the maximum yield, while in 1904, a drier season, three stalks per hill gave best yield. The following table also shows that in 1903 the tendency of the tillers was to increase the stand to four stalks per hill and in 1904 to about three.

TABLE XI.—*Number of tillers and plants per hill.*

No. of plants per hill.	1903.	1904.
1	3.5	2.5
2	4.2	2.9
3	4.1	3.4
4	4.4	4.2
Av. stalks and tillers in hills of 1, 2, and 3 plants.	3.93	2.93

Fertility of the soil is another influence in determining the production of tillers. To test this, plantings were made on adjacent plats, one of which had been in grass for several

Fig. 5. Plat No. 16. Corn on old ground, seed from same mother ear as that on plat 12. Very few tillers developed on this plat. Compare with plat 12, on new ground, where a large number of tillers developed.

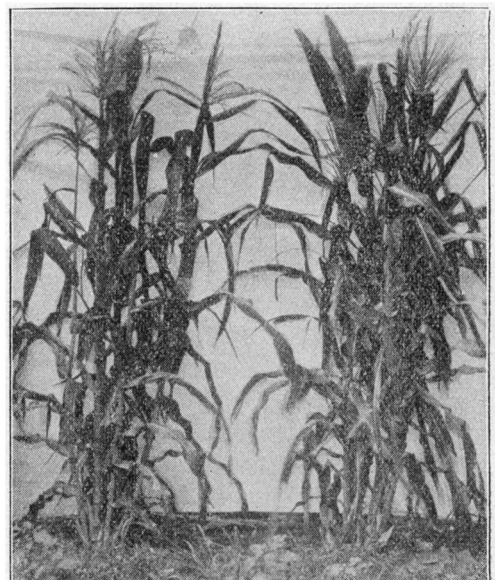


Fig. 6. Plat 12. Corn on new ground. Compare with plat 16 (fig. 5).

years, the sod having been manured. The other had been cropped in grain. At the highest development of tillers the enriched plat was found to have produced 134 tillers per hundred stalks. The other, under identical conditions except as to soil, had produced but 61 tillers per hundred.

Another such test was made in 1903 when seed grown from the same mother ear was planted on plats differing as in the other case. The result was the same as before as will be seen from a comparison of figures 5 and 6 showing photographs of two hills in each of the two plats:

TILLERING ON LISTED AND SURFACE-PLANTED CORN.

In a general way, listed corn has fewer tillers than surface-planted. This is mostly due to the slower start it gets in the early part of the season. Most of the tillers start during the first six weeks of growth. Listed corn usually has much less favorable conditions for growth during the first six weeks than surface-planted, and therefore develops fewer tillers. Also in cultivating they are more or less covered up in the listed corn. In careful counts made for two years on listed and surface-planted corn, where both were put on fall plowing, and the listed had almost as good a start as the surface-planted, there was very little difference in the percentage of tillers.

INHERITED TENDENCY TO TILLER.

Inherited tendencies also are found to play a part in the production of tillers. This has been observed in the difference in the number of tillers that are produced under similar conditions by seed from different ears. Figure 7 illustrates this point.

It seems probable, in fact, that the tendency to tiller is inherent in all corn and that it is possessed in greater or less degree by different ears and different varieties. But the development of this tendency depends largely upon local

Fig. 7. Plats 28 a d 29, Field J. The two plats were planted from different ears of corn. Note the difference in amount of tillering.

conditions such as the influences which have been mentioned above. A corn with a tendency to tiller may be grown under conditions that prevent the formation of tillers, whereas had it been planted under more favorable circumstances it would have produced tillers.

We have found in practice that if the tillers are removed when the plants are 20 to 25 inches high no more will

develop, and any cause that affects tillering must therefore act before that stage of growth is reached.

ECONOMIC VALUE OF TILLERS.

Fig. 3. From a photograph showing a plant of dent corn, w th two tillers, each bearing an ear.

Very few experimental data are yet at hand on which to base an idea of the value of tillers. They have a value in that they thicken up a deficient stand of corn and when well developed produce ears.

In the experiments on the rate of planting it was found that for each 100 plants at the rate of one per hill there were produced 174 ears of corn. As only about two per cent of the plants produced more than one ear, it is evident that a large number of tillers produced ears.

The same conclusion has been reached in another way. For the past two years we have carefully removed the tillers from every other row in a portion of the corn-field. The yield of these rows, as compared with those on which the tillers were left, was as follows:

TABLE XII.—*Yield of grain per acre.*

Year.	Tillers removed.	Tillers left on.
	Bushels.	*Bushels.*
1903	68	88
1904	60	74
Average ..	64	81

Removing the tillers in these instances caused an average loss of 17 bushels per acre in the yield. The fact that both the years of the experiment were years of plentiful rainfall, when rather thick stands gave the best yields, may help to account for the better yield of the rows in which the tillers were not removed.

When tillers develop, it may be taken as a sign that the stand is too thin. Our observation is that quite as many tillers start on corn planted thick as on corn planted thin, but in the thick planting they make only a feeble growth and usually die and dry up later in the season. Obviously it is better to have the ears produced by a stalk grown from a seed than by a sucker, and it is therefore desirable that the stand be of the proper thickness at the start.

While the exact economic value of tillers has not yet been established, there is at least no question that they serve a purpose whenever the stand is thinner than the soil or season will support. In regions of sufficient rainfall, it would not seem advisable to remove the tillers in the hope of improving the yield.

INCREASING YIELDS OF CORN BY SELECTION OF PLANTS.

In the past, most of the efforts to improve corn have been in the direction of improving the type of ear, and much good has been accomplished in this way. But type alone is not a sure guide to the yielding power of a variety. We may take two ears of the most approved type, looking as nearly alike as possible, plant them in separate plats, and the yield of one may be twenty-five per cent more than the yield of the other. The difference in productiveness can not be learned by examining the ears, but only by planting each ear separately and measuring its yield. During three years past we have practiced the "individual ear" method of seed selection, each ear being planted in a row by itself and the yield taken. To show the variation in the yield from different ears on the same soil, and under similar treatment, there is given below

as an example the yield of ten adjacent rows, each planted with a different ear:

TABLE XIII.—*Yields from different seed ears.*

Row No.	16	17	18	19	20	21	22	23	24	25
Yield per acre in bushels.....	68.7	73.9	44.3	35.6	81.6	48.2	55.2	56.8	80.0	76.8

In these ten rows the yield varied from 35.6 to 81.6 bushels, a difference of 46 bushels per acre.

The general plan followed in this method of corn breeding is to select about 100 good ears of corn and plant each in a row by itself. Marked differences will often be noticed between the rows from the time they come through the ground until harvest time. One row may be two feet taller than the row next to it, while there may be a week's difference in the time of tasseling and ten days' difference in the time of maturity. At husking time each row is harvested separately, and all the corn is discarded but that from about 20 of the best yielding rows. This corn from each row is kept in a separate lot and carefully looked over. Any lot that is in any way undesirable is discarded. When the rows that are to be saved have finally been selected, five or ten of the best ears are chosen from each to be planted after the same system again the next year. Many of these ears coming from the high yielding rows fail to inherit high yielding qualities, but by constantly selecting out high yielding rows from year to year the tendency becomes more fixed.

Even one year's work may produce good results, as our experiments have shown. In 1903, 82 rows were planted with different ears. The yield varied from 70 to 108 bushels per acre. From these, 17 rows were selected, all of which had yielded more than 90 bushels per acre. Six ears were taken from each of these and planted in 1904. The season of 1904 was not as good a corn year as 1903, and the soil was not as good as that used in 1903, but an average yield of

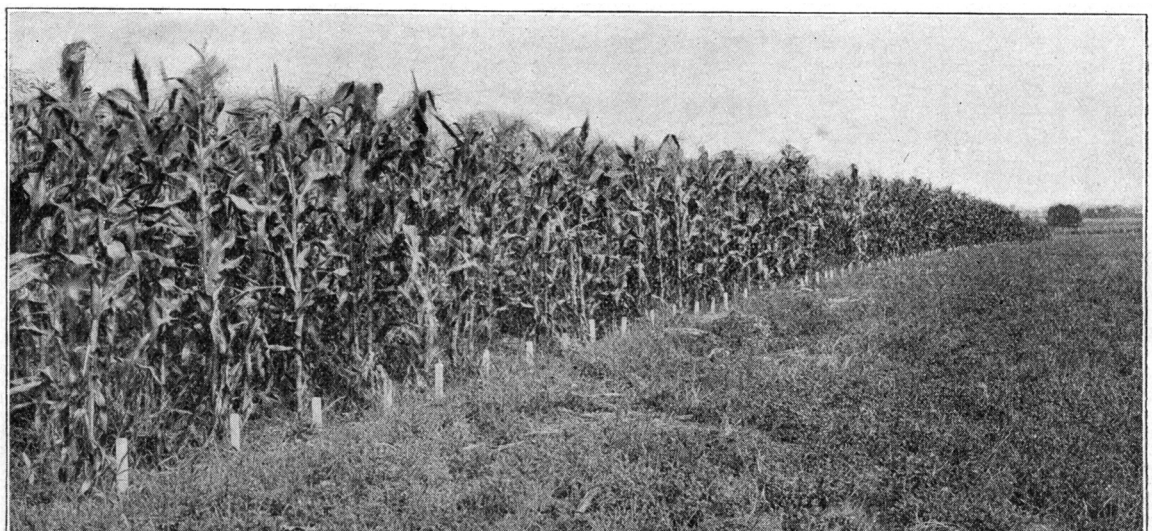


Fig. 9. Field of corn in which each row is planted with a different ear. Selection is being made for high yield.

68.6 bushels was obtained, while the yield of corn of the same variety in the same field, the seed for which had been selected in the ordinary way, yielded only 62 bushels per acre, or a difference of 6.6 bushels as the result of one year's work. It is hoped that by following this method of selection for several years the average yield may be greatly increased.

SELECTING CORN FOR HIGH OIL CONTENT.

By the same method of selection as that followed else where, we are attempting to increase the oil and protein content of corn. The oil content of different ears of corn may vary from three to six per cent. It is easy to pick out these ears that are high in oil by chemical analysis, but there is no way to tell which ears will transmit this high oil quality except to plant each ear separately and analyze its crop. The same is true of high protein ears.

Just how desirable it is to increase the oil and protein content of corn is still a question, but at any rate it is important to know how much can be accomplished in this line. We have not succeeded in gaining any marked increase in the protein or starch content of corn during the short time our experiments have been conducted, but there has been a considerable increase in oil. Following is a summary of three years' results:

TABLE XIV.—*Results of selecting corn for high oil content.*

1902.			1903.			1904.			1905.
Oil content of original ears.	Oil in crop.	Gain or loss.	Oil in ears select'd for planting.	Oil in crop.	Gain or loss.	Oil in ears select'd for planting.	Oil in crop.	Gain or loss.	Oil in ears select'd for planting.
Per cent.	*Per cent*	*Per cent.*	*P. r cent*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent*	*Per ct.*
5.80	4.69	—1.11	5.04	5.14	+.10	5.52	5.68	+.16	6.503

It will be noted that in the season of 1902 the oil content of the crop fell 1.11 per cent below the oil in the ears planted,

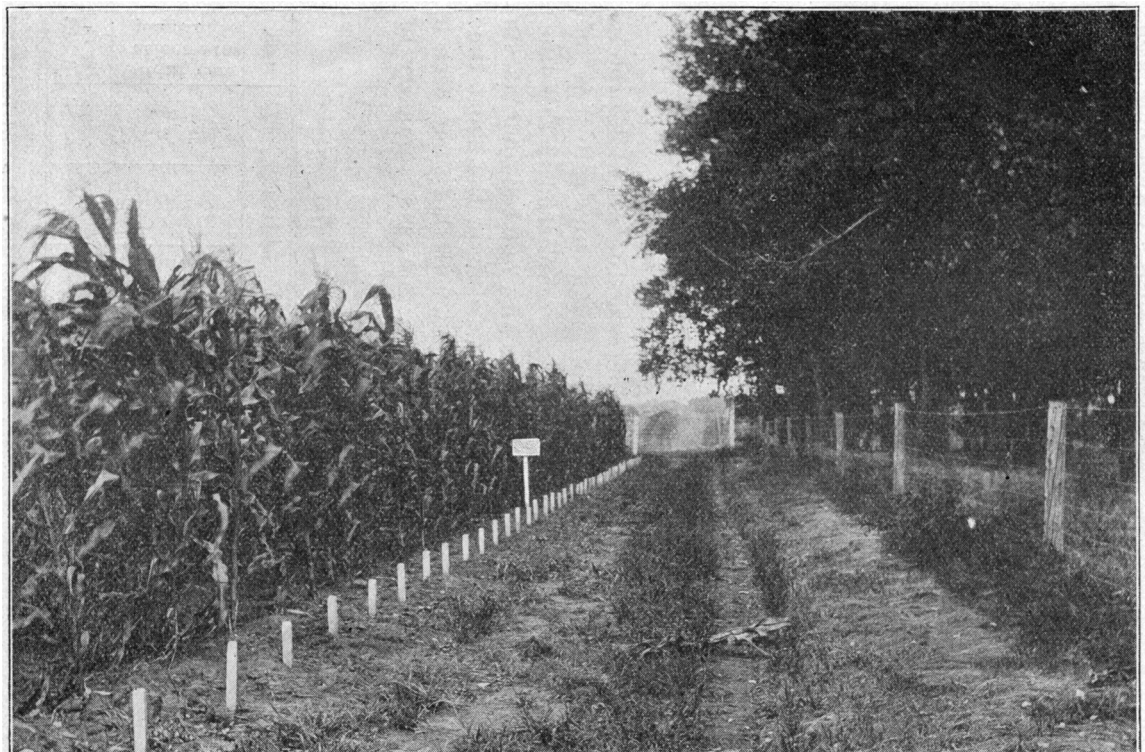


Fig. 10. **Breeding plat of "High Oil" corn. Each row is planted with corn from a differ. nt ear.**

while a rather remarkable fact is observed in that the oil content of the crop in the seasons of 1903 and 1904 exceeded the oil content of the seed planted. It would seem from this that seasonal changes affect the oil content independently of natural variation and heredity.

ADAPTATION OF CORN TO A NEW LOCALITY.

When corn grown in one section of the country for a number of years is moved to another section where soil and climate are different, the plant always undergoes more or less change during the first two or three years before it becomes "adapted" to its new conditions.

The definite effect of climate in modifying the corn plant is shown in the following experiment: Seed of two varieties of corn, Snowflake White and Iowa Gold Mine, was obtained from Iowa and grown in Nebraska for two years. In the third year seed was taken from this, and seed was also obtained from the same original source in Iowa. These were all planted in adjacent plats at the Experiment Station. A marked difference was shown throughout the experiment between the different plats. In the Snowflake White variety the stalk from the seed that had grown in central Nebraska for two years had decreased almost a foot in height, the ear was 8.8 inches lower down and the ear shank almost two inches shorter, while the plants from Nebraska seed had an average of 1.2 fewer leaves.

The weight of both stalk and ear was found to be heavier in the corn grown from the seed just from Iowa, but the proportion of ear to stalk was higher in the acclimated corn. The Nebraska corn averaged almost 200 square inches less leaf area, which was to be expected of plants grown in a drier climate. The yield of grain was in favor of the home-grown seed.

Similar conclusions were indicated from the variety tests described in the first part of this bulletin. Of the 22 varieties that were tested by the cooperating farmers in various

parts of the state, 13 were Nebraska grown, 4 from Illinois, 2 from Iowa, 1 from Indiana, and 2 from Minnesota. In these experiments the significant fact was revealed that not one of the nine varieties the seed of which was grown outside the state ever took first or even second place in the

Fig. 11. Iowa Gold Mine grown at the Nebraska Experiment Station in 1903, showing the effects of adaptation. The bunch on the left was grown from seed directly from Iowa, while that on the right was from seed which had been grown in Nebraska two years.

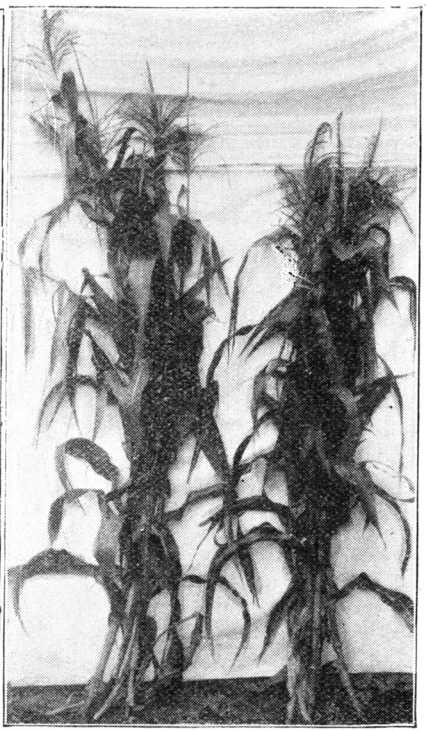


Fig. 12. Snowflake White, grown at the Nebraska Experiment Station in 1903, showing the effects of adaptation. The taller bunch was grown from seed directly from Iowa, while the shorter was grown from seed which had been grown in Nebraska two years.

average results for the state. These results do not indicate that the varieties from the other states are poorer seed than our own. Their low yield is due to the fact that they are not at first adapted or acclimatized to Nebraska conditions.

The lesson to be learned from this is that to get the best results in corn growing, the seed must be home-grown, and grown not only in the same state but in the same locality. The results of the variety tests indicate that seed grown in eastern Nebraska will not do as well in western Nebraska as local varieties, and *vice versa*. There should be careful growers of seed in every county of the state.

A CROSS-BRED VARIETY.

One of the easiest ways to develop a new type of corn is by crossing two well-established varieties. Crossing induces variations, and it is sometimes possible to combine in the hybrid the good qualities of the two varieties.

The best type of corn for Nebraska has probably not yet been developed. In the search for improvement we have crossed two leading varieties and will now attempt to develop in several sections of the state, new strains of corn from this product, in the hope of getting a variety that shall be superior to either and which shall be adapted to the different regions in which it is being grown.

KEEPING SEED-CORN.

The importance of having good, vigorous seed-corn is generally recognized, but the importance of saving the seed under proper conditions is not so well understood. Seed-corn suffers great damage by being frozen while it still contains considerable moisture—as it usually does when first taken from the field. Ordinarily to prevent damage to the germ by freezing it is necessary to gather the seed-corn early and dry it on racks or hang it up in some dry, well-ventilated place.

In a test to determine the value of drying seed-corn carefully before freezing, the corn from one field was divided into two lots, part being put in an ordinary crib and part in a dry seed room. In a field test the next spring, that from the seed room germinated 90 per cent and that from the crib

70 per cent. Furthermore, of the 70 per cent that did come up of the cribbed seed, many of the plants were weak, showing that they had been injured though not killed.

In some years the loss to corn growers of the state through seed-corn which has been injured by freezing is very great.

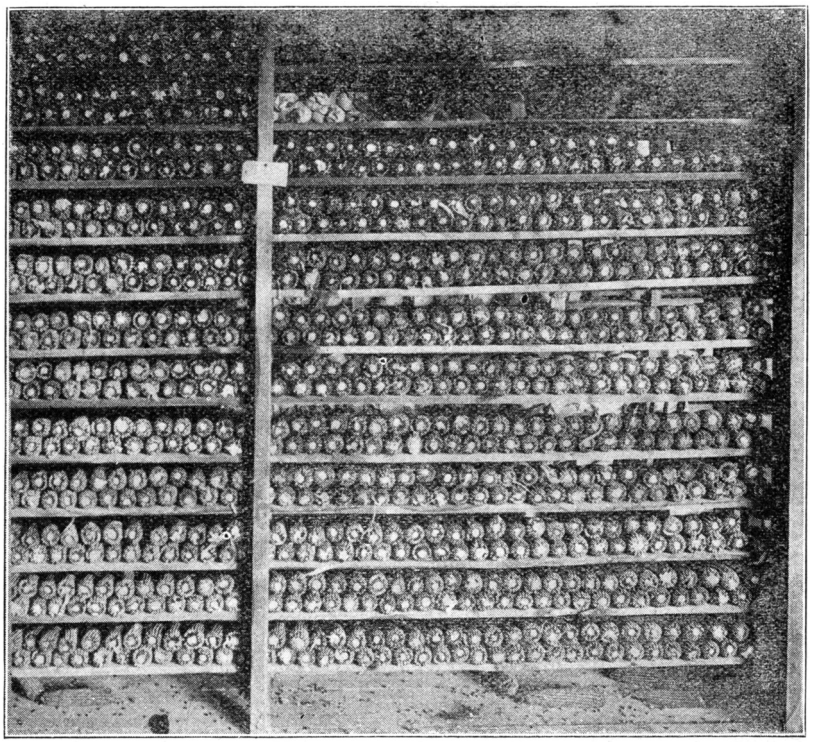


Fig. 13. Rack for drying seed-corn at the Nebraska Experiment Station.

Every farmer should husk his seed-corn early in the fall but after it has completely ripened, and see that it is thoroughly dry before freezing weather. A fairly good drying rack can be made by fastening 2 x 4 scantling above the floor in an ordinary crib. Lay narrow boards on these with wide cracks between them. The seed-corn should be placed on this about one or two feet deep. Make several racks, one above the other. A much better drying rack is shown in figure 13.

DEPTH OF PLANTING.

An experiment to note the effect of depth of planting on germination and root development was carried out in 1904. Corn was planted at depths of one, two, three, and four inches. That planted at a depth of one and two inches came up readily, and gave a good stand, while only a small per cent of those planted three inches deep came and a still less number planted four inches deep. It was quite cold and wet after planting, which doubtless caused a larger per cent of the deep planted corn to rot.

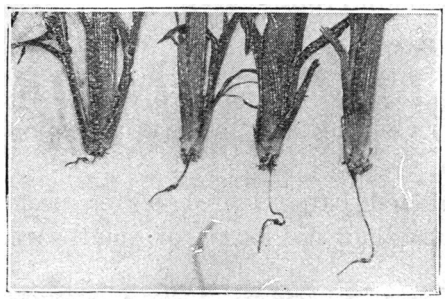


Fig. 14. Photograph of corn planted at different depths. The grains were planted one to four inches deep from left to right. Notice that the root systems all developed at same depth.

It is generally thought that deep planting will cause the roots to develop deeper, but this is not the case. Figure 14 is from a photograph of four plants, the seed of which was planted at depths of one, two, three, and four inches. It will be seen from this that, no matter what the depth of planting, the main root system which develops at the base of the plant branches out at about $\frac{3}{4}$ inch below the surface. This is the normal depth under average conditions, but planting should be deeper to secure moisture for the seed.

There is no object in planting corn at a greater depth than enough to insure good germination; in fact, it is a positive detriment to plant deeper than this. Listing permits the roots to be deeply covered with soil, although the seed when dropped is not too deep.

THE SEED FIELD.

Every farmer should attempt to keep up a seed-corn plat, even for his own use, as it will require careful attention to keep up his stock of corn. He will always be able to select a little very choice seed-corn and this should be planted together on a small field, sufficiently far from other corn to prevent mixing. This field should not be too small, as there is then danger of too close fertilization. It should contain at least two acres. The best of the seed from this plat should be saved to plant the seed-plat for the next year, while the rest is used as seed for the main crop.

SUMMARY.

No one variety of corn is equally well adapted to all parts of the state. For varieties yielding best in certain sections see page 10 of this bulletin.

Varieties with medium-sized ears yielded better under average Nebraska conditions than did large- or small-eared varieties.

Corn raised in the central and western part of the state produced smaller ears than did the same varieties raised in the eastern part.

On good soil with liberal moisture supply, three stalks per hill (44 x 44 inches apart) gave the largest yield of grain, although the ears were smaller than where the planting was thinner. Experiments indicate that towards the western edge of the corn belt two stalks per hill are better than a larger number.

The proportion of barren stalks in corn is directly affected by the rate of planting, increasing with the number of stalks per acre.

Suckers are more abundant in a thin than in a thick stand of corn, and more abundant on very rich soil than on that which is less productive. The tendency towards tillering is more strongly inherent in some plants than in others, and this tendency is hereditary.

Tillers serve a useful purpose in producing ears when the stand of corn is thinner than the soil and moisture can easily support. In regions of sufficient rainfall it would not seem advisable to remove the tillers in the hope of improving the yield.

Seed-corn should be grown as near as possible to the locality in which it is to be planted. There should be careful growers of seed in every county of the state.

Seed-corn placed in a dry seed room in the fall gave twenty per cent better stand in the field than seed-corn from the same field that was left in the crib over winter.

ACKNOWLEDGMENTS.

The writer wishes to express his indebtedness to Mr. E. G. Montgomery for the assistance he has rendered in the execution of the experiments here reported, and for helpful suggestions in the interpretation of results.

The necessary analyses of corn were obtained through the courtesy of the Department of Chemistry, under the direction of Professor Samuel Avery.