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Corn Breeding in Alabama

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INTRODUCTION.

During the past decade a very large amount of attention has been given to corn breeding, particularly in the corn belt, by the various Experiment Stations and the United States Department of Agriculture. The practical value of such work has been so apparent that several private corn growers have undertaken the work and have made important contributions to our knowledge of the subject. The net result is that we now have a rather extensive literature that is freely available to all who are interested in this line of investigation. Several factors contributed to show the necessity of undertaking this line of work in Alabama, among the most important of which we mention:—(A) the low average yield per acre of corn, (B) the high market price of corn, and (C) the increasing need of a larger corn yield as feed for the rapidly increasing number of live stock being grown in the State. Besides it seemed important to undertake this line of work here to show exactly what could be done in developing a type of corn better suited to our needs in this latitude and one giving higher yields than the sorts in common cultivation. We therefore arranged to undertake this work, and in 1905 planted the first breeding plot. All of our corn-breeding work has been done on the "Hurstview" farm near Montgomery, and to Mr. Jesse M. Jones much credit is due for his very intelligent interest in the work and for numerous valuable suggestions made from time to time. My personal thanks are due to the Funk Brothers, Bloomington, Illinois, Professor P. G. Holden, of the Iowa Agricultural College, and Dr. Cyril G. Hopkins, of the University of Illinois, for numerous kindnesses and suggestions while visiting their institutions.

I am also under great obligations to various seedsmen and corn growers for seed furnished for the first year's work.

In this Bulletin we have given a summary of the most important practical results secured, but have purposely postponed for subsequent treatment some of the theoreti-

cal questions that have come to light during the work. The writer has not had a very large amount of time in the past to devote to this line of work, but it is to be hoped that the very satisfactory results secured will cause several progressive farmers to undertake similar work on their own farms. During the present season the author proposes to continue and intensify this line of work along certain important lines.

VARIETY OF CORN EMPLOYED.

The original ears employed in the first breeding plot were secured from the Mississippi Experiment Station and were of the sort called Mosby's Prolific. This is a corn of medium sized ear having white kernels on a white cob and with the stalk characteristics of the other prolific varieties. The mere name of the variety is of much less importance than its characteristics which have been found to be very well suited to the soil and climatic conditions of central Alabama where this work has been done. And yet the corn we have today differs in several marked particulars from the ears with which we started.

The following table shows the variation as to number of rows per ear for those ears planted each year in the breeding plots, in percentages.

Rows per ear	12	14	16	18	20
1905	1.66	43.33	50.00	3.33	1.66
1906	10.20	55.09	31.62	3.06	0.00
1907	9.18	52.03	28.56	8.16	2.04

It should be understood that no attention was given to the number of rows per ear in selecting the ears for the breeding plots.

The small cob generally found in the prolific sorts like Mosby has an advantage that in the South is of greater value than is ordinarily considered. A large cob is generally very sappy at harvest time, and thus such ears dry out more slowly than small ones, and the kernels are more easily injured by unfavorable temperature conditions and are more subject to rotting.

OBJECTS OF CORN BREEDING.

All plant-breeding has for its object principally an economic one, i. e., the improvement of the plant with reference to some character considered important to man. This character may be one of yield, chemical composition or some mere question of beauty as in the case of decorative plants and flowers. In all cases the methods are much the same. The prime object in corn-breeding is the increase of yield and the development of sorts best adapted to the soils on which they are to be grown and to the climatic conditions there prevailing. In the Illinois work one of the main objects has been to develop strains of corn rich in one or more of the chemical compounds found in the kernel. As a result they have developed a "high-protein" corn and a "high-oil" corn and also a "high-combination" corn, i. e., one high in both protein and oil. But for the Alabama farmer the main point at present is to increase the yield. The present average yield in Alabama, according to the last census, is about 13 bushels per acre. The purpose of corn-breeding is to largely increase this low yield. And our results show that this object can readily be accomplished.

We must keep in mind, however, the desirability of correlating the high-yielding tendency with some character of the ear or stalk so that we can predict from a mere physical examination the probable yielding tendency of the progeny of a given ear or stalk. There can hardly be any question that uniformity of stalk and ear is a quality that we should strive to secure. As an example and illustration of what is meant by uniformity or conformity to type in the ear see Plate 2. A study of the ears shown on plates 3 to 7 inclusive will show that we have materially increased the uniformity of the Mosby corn.

It will no doubt be found desirable to secure by breeding and selection sorts of corn adapted to the various soil types found in the State. These soil types not only imply soils of different chemical and physical nature, but in many cases involve distinct methods of cultivation. In other words the methods of cultivation adapted to the sandy soils

of the wire-grass region would scarcely be desirable for the black-belt or vice versa. We would be pleased to undertake co-operative work in corn breeding with several farmers in various parts of the State to test some of these questions and to demonstrate the highly satisfactory results secured by intelligent selection.

THE EAR-ROW METHOD.

The ear-row method of corn breeding, which we are using, depends upon the well known individuality of the ear, i. e., its ability to transmit to its progeny various characteristics that it in turn has received from its ancestors.

The method may be briefly described as follows: We select 98 ears to be planted in what we call a "breeding plot". The tip and butt kernels are removed from each of these ears and the balance of the corn from each ear is planted in a row to itself. In our work we have planted the corn by machine in checks three feet and eight inches apart in both directions. One should have 98 rows from as many different ears and should mark each row with its proper number. The rows should be 100 hills long and in each hill just two stalks should be allowed to grow. This will save much calculation when the results are being worked up for comparison of the different rows.

During the growing season this breeding-plot is to be carefully watched to note any peculiarities that may appear in any of the rows. Plate 1 shows one row in one of the breeding plots that started its growth much more slowly than the adjacent rows. And as a matter of fact, the harvest showed conclusively that the ear from which this row was planted must have been weak in some particular. The progeny of this row does not enter into our subsequent work, as the yield from it was so low it was at once eliminated. Care should be taken to note any barren stalks and to detassel them at once to prevent the pollen from such worthless stalks falling upon the silks of any of the other stalks and thus perhaps perpetuating this tendency towards barrenness. One should also be on the lookout

for the finest stalks as to strength and number of good ears on them, and such stalks should be marked so that they can be told when the corn is harvested.

Desirable stalks are marked during the summer with tags of the form shown below:

O

Row ..... Ear No. .....

Stalk

Height ....M.

Diameter..... ....Cm.

Leaves

No. ....

Length ....Cm.

Width .... Cm.

Ears

No. to Stalk.. ....

Height..... .. ..Cm.

Angle..... ....

Ear Stalk

Length..... .....Cm.

Diameter .... Cm.

At harvest time the ears selected for breeding purposes are marked in the following manner to show their origin and to connect them with the above data regarding the stalk on which they are produced. An ordinary gun wad has written on it the row and ear number, and this is attached to the butt of the ear by means of a strong pin known in the trade as "Bank Pins". These pins are driven into the butt of the ear, and in this manner the wad is rarely lost and can readily be seen when studying the ears in the laboratory. We of course gather a much larger number of ears in this manner than we subsequently use in the breeding plot, but for each ear we have all the data recorded on the tag referred to above.

BREEDING RECORDS.

It is absolutely necessary that detailed records be kept showing every character of each ear planted in the breeding plot. It is only by so doing that any definite progress can be made. For our work we are employing the following forms.

The form shown on page 9 is the one used in keeping our records of the characters of individual ears planted in the breeding plot. Our register number is so made as to indicate the crop-year in which the ear was produced, and the last two figures show the row number in which said ear is planted. For example, Register Number 642 shows that that ear was grown in 1906 and that it was planted in row 42 of 1907. We are attaching to each of these forms a photograph of the ear so that we believe we have a very satisfactory record of the ears we have employed.

The form shown on page 10 is the front page of our field record form. The form shown on page 11 is the back of this same sheet. This sheet is filled out for each row and gives us the exact performance record of each ear planted in the breeding plot.

Variety

Ear Reg. No.

Source

Field

Row No.

	First	All	Average
Plant Up			
Tassel Out			
Silks Out			
Ear Mature			

	Total	%
Plants with marketable ears		
Number of marketable ears		
Plants without marketable ears		
Number of unmarketable ears		
Barren stalks		
Leaning and fallen stalks		
Plants with suckers		
Number of suckers		
Smutted plants		

	1	2	3	4	5	Av.
Diam. of stem at 20 cm.						
Height in meters						
Height of lowest ear						
Height of highest ear						
Ear-angle of good ears						
Ear-angle of rotten ears						
No. of leaves						
Blade - length						
Blade - width						
Ear-stalk - length						
Ear-stalk - diameter						
Ears per stalk						

(Devised By E. Mead Wilcox 1907)

VARIETY

SOURCE

Register No.

Annual Ear No.

PLANT		EAR		COB		KERNELS		Chem. Analysis	
Row No.		Weight		Weight		% Corn to Ear		Protein	
Plant No.		Length		Tip Circ.		Breadth		Oil	
Height		Shape		Butt Circ.		Depth		Starch	
Height of Lowest Ear		Tip		Color		Shape		Ash	
Height of Highest Ear		Butt				Indentation		Moisture	
No. of Ears		Tip Circ.				Color			
Ear-Angle		Butt Circ.							
Ear-Stalk		No. of Rows							
		Kernels to Row							
		Sulci							

(DEVISED BY E. MEAD WILCOX, 1904.)

Planted

Harvested

	Number of Stalks	Total No. of Ears	No. of Ears per Stalk	Wt. of Ears per Stalk	Total No. of Ears	Total Wt. of Ears	No. of Mark. Ears	Wt. of Mark. Ears	Av. Wt. per Ear
Row									
Acre									

CULTURE METHODS		Notes
How Planted		
Distance between rows		
1st cultivation		
2nd cultivation		
3rd cultivation		
Thinned		
Replanted		
Barren stalks detasseled		
Rows detasseled		

POLLINATION AND DETASSELING.

It has been estimated that a single tassel may produce as many as 50,000,000 pollen grains each one of which is sufficient to fertilize one ovule and produce one kernel of corn. These pollen grains to do this must fall upon the end of a silk that is ready to be fertilized, and there the pollen grain grows and sends a fertilizing tube down into the ovule at the base of the silk. The silks that are connected with the kernels at the base of the ear are fertilized first, and then from there towards the tip of the ear the work goes on. For each silk and each kernel therefore a single pollen grain is required. These pollen grains are blown about by the wind and may travel for some distance before falling on a silk. Of course large numbers are produced to be certain that enough fall on the silks to fertilize each one.

Now we may recognize three types of pollination or fertilization as follows:

1. The ovules of an ear are fertilized by the pollen of the tassel on the same stalk. This is called inbreeding, or self-pollination.

2. The ovules of an ear are fertilized by the pollen from the tassel of a stalk that arose from kernels produced on one and the same ear. That is these stalks might be called sister stalks and this type is called close-breeding or close-pollination.

3. The ovules of an ear are fertilized by the pollen of the tassel of a stalk not closely related to the ear stalk. This type is called cross-pollination or cross-breeding.

Now in the field and in the ordinary breeding plot some inbreeding probably occurs, but in the breeding plot we may have continuous and injurious amounts of close-breeding and this must be prevented. This is to be prevented by detasseling and gathering the seed corn for the next year's breeding plot from the detasseled rows alone.

Our plan is shown by the following diagram in which stars show stalks not detasseled and D denotes detasseled

stalks. Of course the diagram does not show all the stalks in the plot, and shows only ten of the rows:

D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D

In other words, it is seen that we detassel alternate halves of adjacent rows. Our seed corn is then gathered only from the halves of each row that have been detasseled.

This work of removing the tassels can not be done at one time, but must be looked after at intervals of a week or more until the tassels cease appearing. Just before the tassel is exposed one can, by gently opening the leaves, take a firm grasp on the tassel and remove it by a steady pull, without injuring the stalk at all.

CULTIVATION OF THE BREEDING PLOT.

The important thing in corn culture is frequent and shal low cultivation. Our breeding plot receives 4 to 6 cultivations and one or more hoeings. Too good care cannot be taken of the breeding plot, for from it you are to secure your improved corn for future planting. At harvest time the plot should be free of weeds, at least this is the ideal condition towards which you should aim. For further information on this subject, and upon the question of fertilizers and other matters of this nature see the Bulletins of the Alabama and Georgia Experiment Stations on Corn Culture.

SOME RESULTS SECURED.

The increase in yield we have secured is well shown by the following table, which gives the percentage of the rows each year that have been above and the percentage of the

rows that were below the average yield for all the rows of that year:

	Average.	P.C. of rows above.	P.C. of rows below.
1905	30.79	41.6	58.4
1906	36.62	47.9	52.1
1907	36.85	50.0	50.0

A comparison of the average or mean yield for 1905 with that for 1907 shows that we have increased the yield in three years 19.6 per cent.

The following table gives the yields of the fourteen best rows of the crop of 1907, together with the yields of the rows during the two preceding years which have been the ancestors on the female side of each of the fourteen ears. The yields are given in bushels per acre as calculated from the actual yields of the rows. In each case the yield is calculated to a perfect stand:

1907	1906	1905
642	537	425
53.7	41.9	43.9
650	550	433
51.2	36.2	58.2
691	539	435
49.2	50.4	35.4
652	522	429
46.9	37.7	37.7
623	535	445
45.3	40.8	34.7
661	551	422
45.1	43.9	35.1
649	593	458
44.1	39.6	39.8
656	527	429
42.9	35.6	37.7
630	510	443
42.3	49.9	39.8

684	510	443
42.1	49.9	39.8
647	577	418
41.6	45.3	31.6
645	583	417
40.8	40.0	25.2
653	519	426
40.5	37.9	42.9
646	513	425
40.5	35.2	43.9

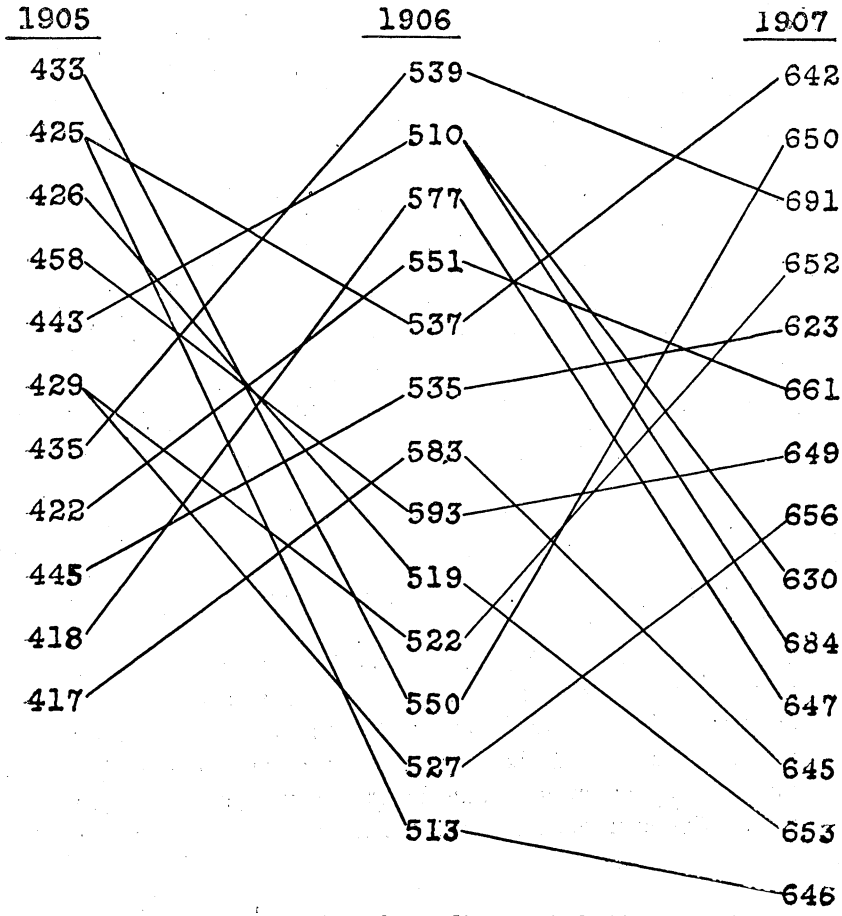


FIG. 1. Chart showing the pedigree of the fourteen best rows of the 1907 crop.

TESTS OF MOSBY CORN BY FARMERS.

The following yields are taken at random from a larger number of reports made by farmers in various parts of the State who have planted corn purchased from Mr. Jones. This corn was taken from the breeding plot of 1906:

J. G. Little, Greenville, 60 bushels.

Clark Adams, Greenville, 65 bushels.

Geo. A. Watson, Monroeville, 72.5 bushels.

W. M. Newton, Belleville, 97.75 bushels.

H. E. Hudson, Monroeville, 30 bushels.

HOW TO BEGIN CORN-BREEDING.

A farmer who desires to begin the systematic selection of corn should proceed as follows: During this season study carefully your field of corn and select enough of the best stalks to give you at least 200 ears. It does not matter about the name of the corn so much as it does about its being suited to your local conditions and to yourself. Where the land will stand it you had best select one of the prolific sorts, but under other conditions a 1-eared sort may be better. Allow the ears so selected to mature on the stalks, and under no circumstances "pull" the fodder from these stalks. When mature gather these ears and tag them in such a way that you will know the sort of a stalk each came from. These ears constitute your basis for further improvement, and should be well cared for during the winter.

PREVENTING INJURY BY WEEVILS AND MICE.

The corn for the breeding plot should be stored during the winter in some dry and cool place and in some barrel or box to which mice cannot enter, and tight enough to permit of fumigation against weevils. A good method to fumigate against weevils is to place the ears in a tight box or barrel and place an ordinary tea cup half full of carbon bisulphid on top of the corn and cover the whole with a blanket. After twenty-four hours every weevil will be dead. The corn should then be examined at intervals dur-

ing the winter to see that weevils or mice have not entered the barrel.

SELECTING THE EARS FOR THE BREEDING PLOT.

During the winter while you have time study these 200 ears by means of the score card, and from them select the 98 best ears for the breeding plot.

THE SCORE CARD AND CORN JUDGING.

The main value of the score card to the corn grower is that it causes him to give close attention to the various characters of the ear and teaches him the most desirable features to be looked for in the corn he is breeding. We are well aware that in the ordinary corn shows and in ordinary corn judging little or no attention is given to the relative yields of the ancestors of the various ears being compared. In other words the ears in the exhibit are compared to one another without any reference to the performance record of their parents which may well be expected to appear in the progeny of the ears. For example, it might be possible to gather two samples showing equal perfection as to the points mentioned on the score card, but one sample might have come from a field yielding 50 bushels to the acre and the other from a nearby field yielding but 10 bushels to the acre. But from his high yielding rows in the breeding plot the corn grower must be able to select the ears which are best from the standpoint of the score card.

It must be left to future work to develop a score card that is well adjusted to our Alabama types of corn and for the present we offer the score card employed by the author in order to call attention to this line of work:

1.	Uniformity.	
	A. Trueness to type	10
	B Uniformity of exhibit	5
2.	Shape of ear	5
3.	Color	10
4.	Market condition	10
5.	Tips	5

6.	Butts	10
7.	Kernel uniformity	5
8.	Kernel shape	5
9.	Length	10
10.	Space.	
	A. Space between rows	5
	B. Space between kernels at the cob	5
11.	Percentage of corn to cob	15
	Total	100

SUGGESTIONS AS TO USE OF SCORE CARD ON MOSBY CORN.

1. The deficiency and excess in length of the ears that do not conform to the standard for the variety shall be added together and a cut of one point made for each inch thus secured. For the Mosby corn the standard length shall be 8 inches.

2. The deficiency and excess in circumference of all the ears that do not conform to the standard for the variety shall be added together, and for every two inches thus secured a cut of one point shall be made. The standard circumference, taken at one-third the distance from butt to tip, in the Mosby corn shall be 6 inches.

3. The shape of the ear in the standard is such that the proportion between length and circumference is the same as 4 to 3. Cut each ear that is off, 1-2 point.

4. For kernels off in color, i. e., yellow in the case of Mosby corn, cut 1-4 point for each two kernels. That is for 6 yellow kernels, cut the ear 3-4 point.

5. For a red cob in Mosby corn cut each ear 2 points.

6. Vitality is indicated finally by the germination test, but this is out of the question for score card purposes. The ears should be well-matured, firm and sound. For each ear that is off cut 1-2 point.

9. The kernels should be of uniform shape and true to the type. For each ear that is off cut 1-2 point.

10. The kernels should be so shaped that their edges touch from tip to crown. Cut 1-2 point for each two kernels not so shaped.

11. The proportion of corn to ear should be from 85 to 90 per cent. in the case of the Mosby corn. For every per cent below this standard cut the exhibit 1-2 point.

TESTING THE VITALITY OF SEED CORN.

This should never be neglected for the breeding plot, and would prove of great value even in the general fields. When we remember that 15 to 20 ears should give plenty of corn to plant an acre, we see that the time and labor to test enough corn for even large fields is not very great. It will certainly pay in better stands of corn and larger yields. The method is simple and requires no expensive apparatus. A box should be made 12 by 18 inches inside and about 3 inches deep. Do not make this water tight. At the bottom of this place two thicknesses of canton flannel moistened with water. The upper side of this cloth should be marked off into squares 2 inches square with a lead pencil. These squares should be numbered from 1 to 54. Now from the ears numbered in the same manner remove six kernels as follows: Near the base of the ear remove two kernels on opposite sides of the ear. Near the tip select two kernels also on opposite sides of the ear and directly above those previously removed. Then from near the middle of the ear remove two kernels from opposite side of the ear but at right angles with the kernels already removed. These six kernels are to be placed with the germ up in the square having the same number as that on the ear. Proceed in this manner until all the ears have had samples taken for the test. Then cover the kernels with two thicknesses of canton flannel. Sprinkle with water and cover the box with a piece of glass. Ordinarily no more water will be needed. But if so it should be simply sprinkled over the upper piece of cloth. At the end of six days examine the

kernels by carefully removing the upper cloth. Ears whose kernels have not given a good strong sprout should be discarded. If any ears must be discarded select others to take their places and proceed to test their vitality.

SHELLING CORN FOR PLANTING.

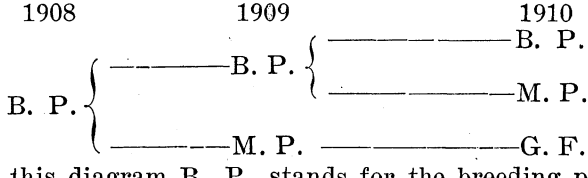
To secure the corn from the breeding ears for planting first discard the tip and butt kernels. Then remove all the balance of the corn with the exception of two adjacent rows which are to be left as a means of telling at any time the character of the ear and its kernels. This ear should be tagged with a number so that it may be told at any time. These samples should be stored where they will not be injured. The corn should be placed in a paper sack until wanted for planting, so that there is no danger of mixing it with the corn from other ears.

BREEDING PLOT.

This should be the best and most uniform piece of ground on your farm, and be isolated to prevent the pollination of any of the silks by foreign pollen. The other details as to planting and care of the breeding plots have already been described.

MULTIPLYING PLOT.

After selecting the breeding ears for the next year all the remaining good ears should be saved to be planted in the multiplying plot. Place this plot where no foreign pollen can reach it. The corn from this field is to be selected and planted the following year in the general field as follows:



In this diagram B. P. stands for the breeding plot, M. P. for the multiplying plot, and G. F. for the general field.

THE FUTURE OF CORN BREEDING IN ALABAMA.

There is no doubt that corn-breeding will in the near future occupy much more attention at the hands of Alabama farmers than at present. To the man who engages in it now with the determination to produce the best type of corn possible this field of work offers good returns on the time and money invested. Not only will the individual corn-breeder secure higher yields, but there is a fine chance to dispose of high-grade seed corn when it is backed by good honest work and detailed records as to pedigree. The time is coming when more and more people will demand seed corn on the ear and from fields that have given high yields. We should be glad to enter into correspondence with all persons interested in this line of work, and stand ready to offer the best suggestions we have on the subject.

LITERATURE OF CORN BREEDING.

The following list includes some of the more important publications of the Experiment Stations and United States Department of Agriculture that should be read by farmers who desire to undertake work along this line. Publications referring particularly to sweet corn are omitted:

Card, F. W.
1906. Corn Selection. Bull, R. Is. Exp. Stat. 116: 1-35. Fig. 1-9.

Davenport, E.
1906. Methods of testing variability in corn. Circ. Ill .Exp. Stat. 101:1-7.

Davenport, E., and Rietz, H. L.
1907. Type and variability of Indian corn. Bull. Ill. Exp. Stat. 119:1-29.

Crosthwait, G. A.
1907. Indian corn. Its production and improvement. Bull. Idaho Exp. Stat. 57:1-59. plate 1-11.

Duvel, J. W. T.
1906. The germination of seed corn. Farmers' Bulletin 253:1-16. fig. 1-4.

East, E. M.

1906. The improvement of corn in Connecticut. Bull. Conn. Exp. Stat. 152:1-21.

Hartley, C. P.

1903. Improvement of corn by seed selection. Yearbook U. S. Dept. Agr. 1902:539-552. plate 71-77.

1904. Corn Growing. Farmers' Bulletin 199:1-31. fig. 1-23.

1905. The production of good seed corn. Farmers' Bulletin 229:5-20. fig. 1-10.

Hayward, H., and Jackson, H. S.

1907. A study of Delaware seed corn with some suggestions for its improvement. Bull. Del. Exp. Stat. 77:1-16. fig. 1-10.

Holden, P. G.

1902. Storing and purchasing seed corn. Press Bull. Iowa Exp. Stat. 4pp.

1903. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 68.

1904. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 77.

1905. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 77.

Hopkins, C .G.

1898. The chemistry of the corn kernel. Bull. Ill. Exp. Stat. 53.

1899. Improvement in the chemical composition of the corn kernel. Bull. Ill. Exp. Stat. 55.

1902. Methods of corn breeding. Bull Ill. Exp. Stat. 82.

Hopkins, C. G., Smith, L. H., and East, E. M.

1903. The structure of the corn kernel and the composition of its different parts. Bull. Ill. Exp. Stat. 87.

1903. Corn experiments in Illinois. Circ. Ill. Exp. Stat. 66.

1905. Directions for the breeding of corn, including methods for the prevention of in-breeding. Bull. Ill. Exp. Stat. 100.

Hume, A. N.

1904. The testing of corn for seed. Bull. Ill. Exp. Stat. 96.

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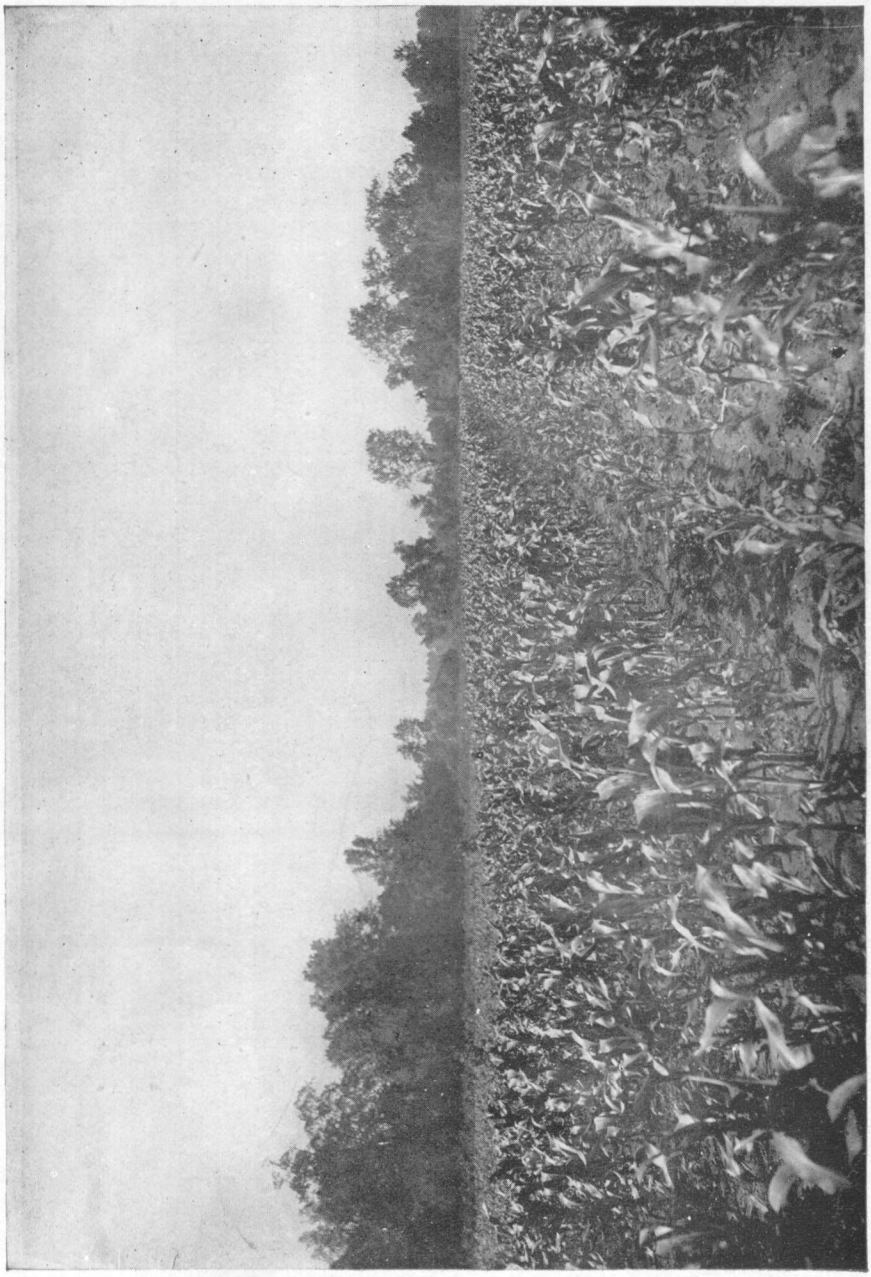
EXPLANATION OF PLATES.

Plate 1. Individuality of the ear as shown by differences in height of the stalk during the season. Note particularly the low row in the center of the field.

Plate 2. Funk's Yellow Dent corn grown by Funk Brothers of Bloomington, Illinois. Note the great uniformity of the ears.

Plates 3 to 7, inclusive. Showing the ears in the ancestry of the ten best ears grown in the breeding plot during 1907. The ears marked with numbers in five hundred were grown in 1905, those marked in six hundreds were grown in 1906, and those marked in seven hundreds were grown in 1907. Ear 702 was from row 42 of 1907, and this in turn from row 37 of 1906. Each horizontal series of three ears is similarly related.

PLATE I.



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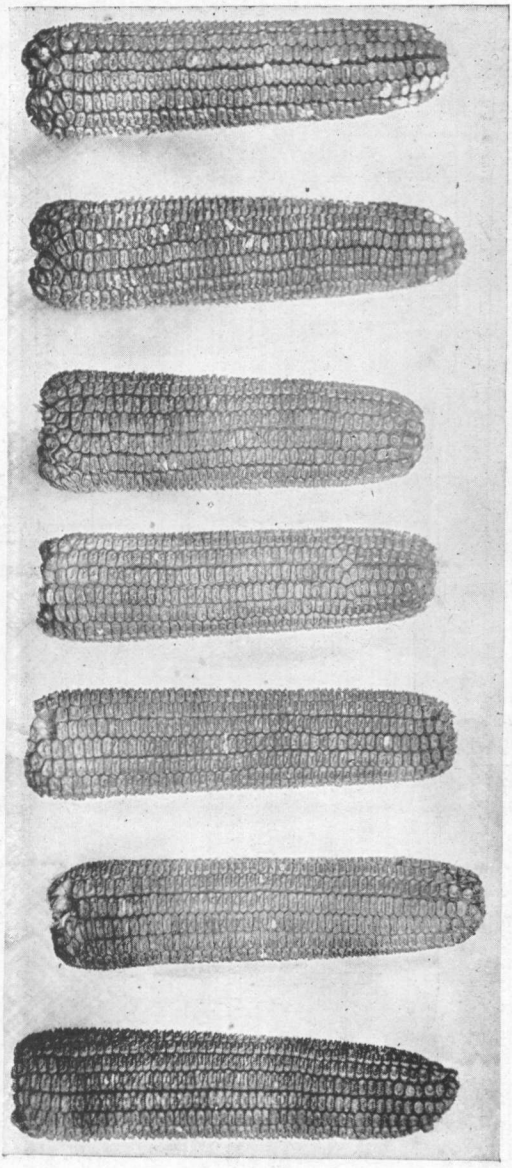

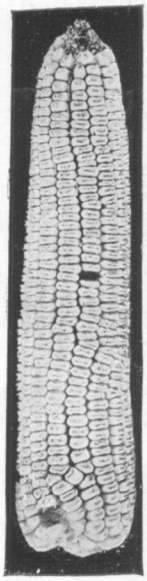

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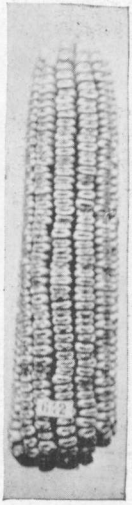

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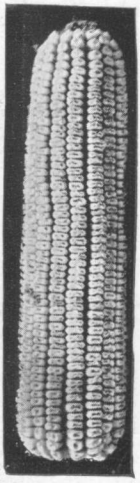

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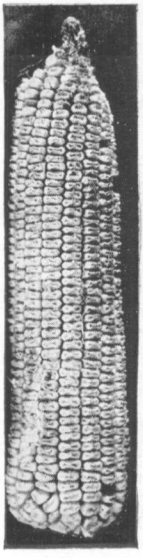

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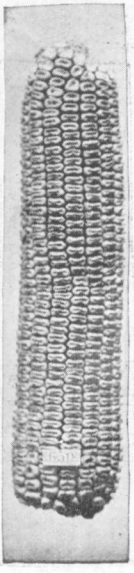

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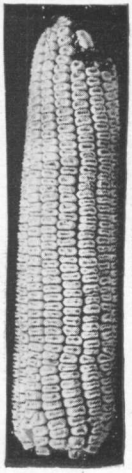

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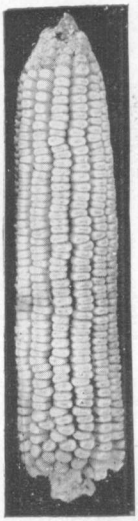

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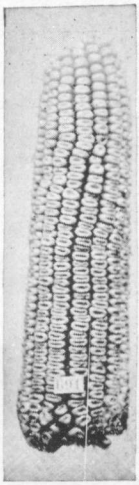

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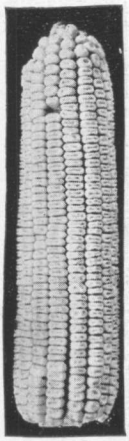

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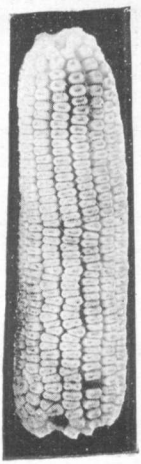

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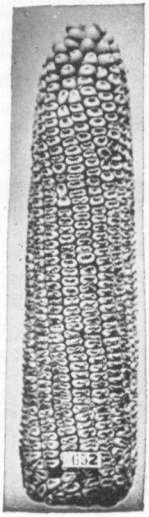

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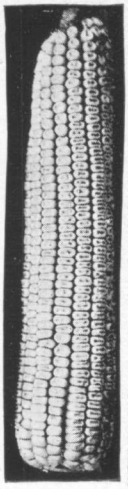

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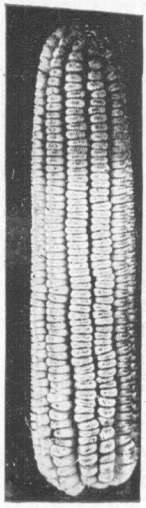

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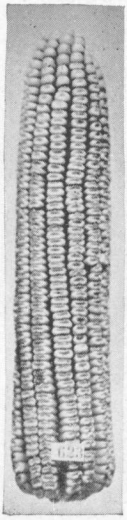

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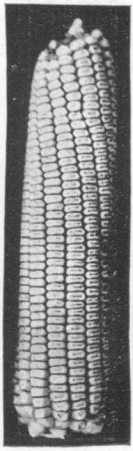

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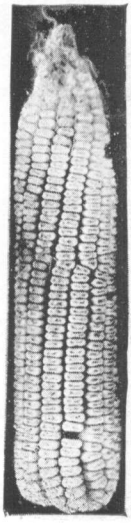

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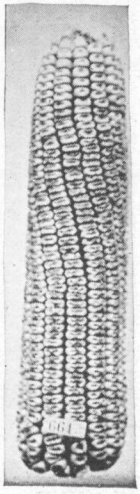

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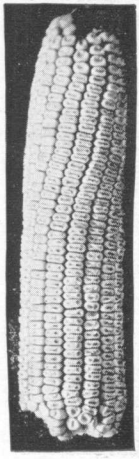

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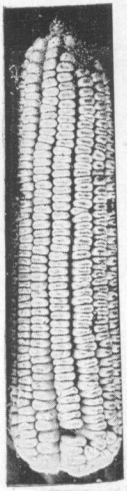

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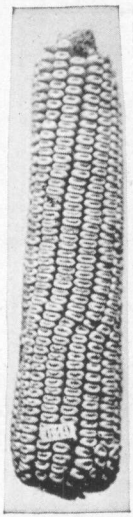

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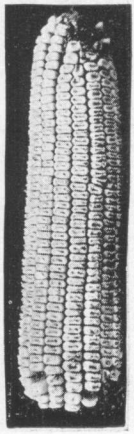

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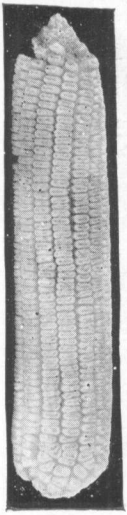

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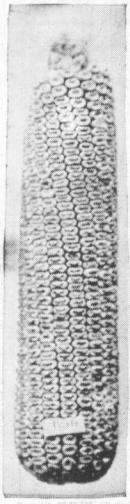

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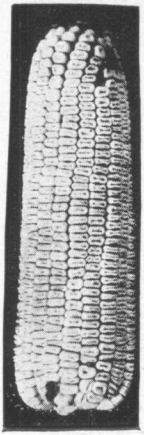

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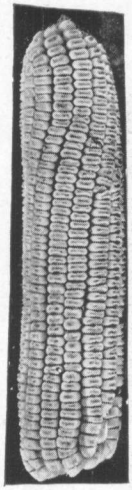

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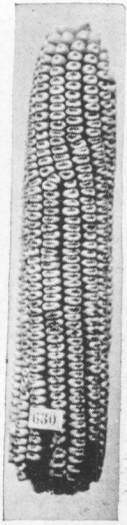

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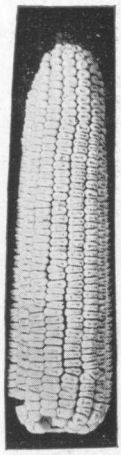

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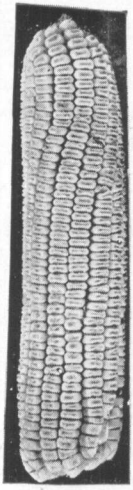

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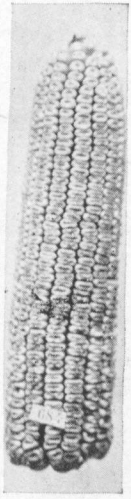

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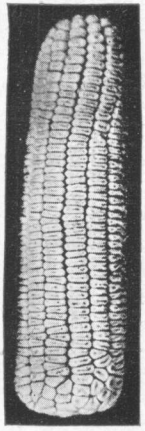

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