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Corn Improvement for Missouri.

By Geo. M. Tucker,
Instructor in Soils and Crops.

In tests at the Station it is not unusual to have one variety or type of corn yield practically twice as much as another, even though they are grown side by side, on the same kind of soil and receive the same treatment. It is evident that the reasons for this difference in yield can not be attributed to environment, but must be found in the inherent qualities which the seed possessed when it was planted. Seed of a variety which has been grown for a number of years on rich soil with abundant moisture, has acquired the habit of using large quantities of plant food and of developing large stalks and ears out of this food.

If seed of this corn is planted on thin soil, it will exhaust the food supply in its efforts to build a large plant foundation for the large ear, which it is in the habit of forming, and the result is a crop giving a large yield of fodder and little grain.

The reverse is also true, and the seed from a variety that has been grown on thin land and has acquired the habit of making small plants that bear good grain, because the available plant food is in limited quantities in such soils, when planted on rich soils

reaches the limit of its capacity to grow long before it has exhausted the soil, and the result will be a smaller yield than the soil is really able to produce, provided a variety with inherent tendencies to larger growth had been used.

So a farmer by observing the quality of his soil, average weather conditions and methods of cultivation may be able to increase his yield by selecting and using a variety of corn that has the inherent qualities that adapt it to the conditions of that particular location.

POSSIBILITIES.

The acreage of corn in Missouri for 1902 was 7,645,600. An increase of one bushel per acre in 1903 would mean 7,645,600 bushels more corn than in 1902, and this means an increased valuation for 1903 of over $2,000,000.

The State revenue by direct taxation in 1902 was about $2,632,000, so one bushel of corn per acre (30 cents per bushel) will almost pay the direct tax of the whole State. What will two bushels of corn more per acre do? It will pay the price of pure bred seed and more than pay the direct tax. It will do it in this way.

One bushel of pure bred corn purchased of a reliable seed grower will cost say $2. Since this is high grade seed, less will be needed per acre, for it will germinate better, and what is of still more importance there will be fewer barren stalks. Three kernels per hill will be enough and a bushel will plant ten acres. This will make the seed cost 20 cents per acre, and two bushels of corn will be worth 60 cents, giving a profit of 40 cents per acre over the cost of seed. This 40

cents per acre means $3,058,240 for the State, which will more than pay the direct tax. There will be over $400,000 that would then be left to the farmers of the State, after paying taxes and seed.

Now if three, four, or five bushels more could be raised, $2,293,680, $4,587,360 or $6,881,040 respectively would be clear profit to the farmers of the State.

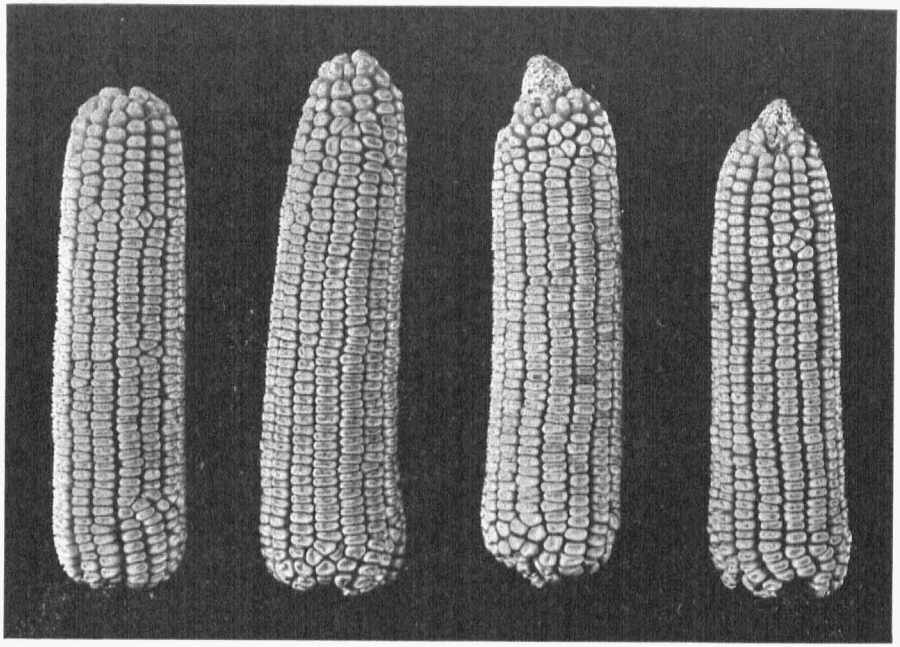
It may seem doubtful whether two bushels more could be produced this year than last. The average yield for the State last year was 39 bushels per acre. That means (if the hills are 3 feet 8 inches apart) 16 ears to 15 hills, allowing 100 ears to make a bushel.

Now the chief reason (the failure of many seeds to germinate is also an important one) that there are so few ears per hill is because a great many of the stalks are barren. This is largely a result of careless selection of seed, for if the ears of the growing corn are fertilized by the pollen of the barren stalks of the field, then the corn which is taken from those ears and used for seed has a great tendency to produce barren stalks. If we could get five ears to every 4 hills, we would be getting 42 bushels per acre, which is an increase of three bushels.

With selected seed corn we may expect to do better than that, because great care has been taken in preventing fertilization from barren stalks. We may plant three kernels to a hill of pedigreed corn and expect at least 4 ears for every 3 hills, taking into account missing hills if care is exercised in planting, and no farmer can afford to be careless in planting his corn.

In Figure 1 are shown ears that are well tipped out (a) with corn, and ears that show the naked cob at

the tip (b). Each ear in (a) has 1 1-2 oz. more corn on it than each ear in (b). That means that without increasing the number of ears, but only by increasing the quantity of developed kernels 1 1-2 oz., an increase



a b

Fig. 1

in yield equal to 6 bushels per acre may be realized. This is chiefly the result of careful and thorough cultivation which induces vigorous, thrifty plants that develop perfect flowers which secures complete fertilization of the flowers on the young cob.

It is clear that by planting proper seed and giving good cultivation, the yield of corn may be increased materially and that the expense connected with it is small.

Improved seed may be obtained by directly buying it of seed growers (and this is generally the most satisfactory way to begin if the corn that is now being grown on the farm is of only ordinary grade) or the farmer may by careful selection from his own field improve the qualities of the seed that he raises from year to year.

In either case, after the first year the farmer should select his seed from his own crop, unless some special and peculiar calamity has happened to his crop which would make the seed entirely undesirable.

Seed well selected from a crop on the farm will have the advantage of similar environment year after year: the soil, climate and method of treatment will be about the same, and then the farmer has the opportunity to adapt the type and quality to his special needs and uses, and the educational value of carefully watching his corn and the pleasure of seeing the improvements from year to year can not be estimated. Each farmer will thus become his own seed grower and in order to be successful in this he must have a standard of good corn in his mind.

First a type must be established. There are certain characteristics which are found in all good corn and which seem to be essential in order to get a large yield and good quality. These characteristics are in the appearance which the corn plant, ear and kernel

present to the eye. That is, the height, symmetry, vigor, of the plant. The length, diameter, number of rows, etc., of the ear, and the shape of the kernel.

The first thing that may be in mind is the yield of corn, and the grower must have a clear idea of the type of plant that will give a large yield. He would work on similar methods that a stock breeder would. A breeder of dairy cows has in mind the style of cow that experience has shown to be the best for dairy products, and his mental picture would be very different from that of a man who would breed beef cattle.

So with the corn grower. If the cornfield is made up of ill formed plants, twisted, crooked, spindling, dwarfed, abnormally large, abnormal leaf development, little tendency to produce ears, tendency to leaf-growth, and other objectionable points that a corn grower learns in his experience, he can not expect to get a large yield of grain, for the seed from such a field will be subject to a similar abnormal growth and poor development.

The quality and quantity of grain is dependent upon the *plant* that bears it, and the plant which has fertilized it.

Such plants should be strong and vigorous, of thrifty healthy appearance; with an erect, symmetrical and well developed stalk, tapering regularly from the base to the tassel; with well developed leaves, uniformly set on the stalk; a perfectly developed tassel, and no appearance of dwarfed or stunted ears at the various nodes, but with one well developed ear, and this borne at a medium height above the ground.

The height of the plant will vary to meet the conditions. On good fertile soil it may be from 10 to 14

feet; varying from 7 to 10 feet on a thin soil; and from 14 to 16 feet or even more on a very strong productive soil.

It is not advisable to select seed from large abnormal plants, nor to select the abnormally large ears to plant. The result will be to develop a tendency to produce plants that the soil will not be strong enough to bring to maturity, and the grain will suffer in consequence. This would be particularly true in a dry season or when any adverse circumstances overtook the plant.

In a field or breeding plot there are always abnormally small and abnormally large plants, but the actual adaption of the crop and soil is measured by the average, and not by the extremes. The best yields will be secured when there is uniformity in the size of the plants.

A large yield depends:

First, upon the perfection of the stand.
Second, upon the number of ears per acre.
Third, upon the type of the ear.
Fourth, upon the type of kernel.

A PERFECT STAND.

Uniformity in size of kernel:—Regularity is of great importance in securing a perfect stand. The corn plants will have an opportunity to develop good uniform ears when there are always the same number of stalks in a hill and to secure this the kernels must be of uniform size so that the planter will drop the same number of kernels in each hill. Then regulate the planter and drop the desired number of kernels,

and when this is once done, regularity in the number of kernels will be secured throughout the field.

With an ununiform lot of kernels, the number that the planter drops can not be regular, dropping sometimes more when small kernels come to the opening and then again fewer as large kernels present themselves.

With uniform size kernels there will be uniformity in strength and vigor of the plants, which will result in a uniform size not only of the plants but of the ears as well, which is a very important factor in getting a large yield. Hence the importance of shelling off the butts and tips of the ears and using only the centers as these kernels are more uniform in size.

Per cent of Germination:—If the seed has a high per cent of germination, a more perfect stand will be secured.

It is therefore important to test the vitality of the seed that is to be used, for many factors may have come in since the gathering of the corn the year before (or it may not have been mature when gathered) to influence the vitality.

Therefore the seed should always be tested, taking 200 kernels and placing them between wet cloths in a covered box where they should be kept moist. Germination should be completed by the fifth day. If the per cent of germination is found to be small, more kernels must be dropped by the planter than as if it were high.

Barren Stalks:—When everything has been done to secure a perfect stand, there may yet be a relatively small number of ears in the field on account of the

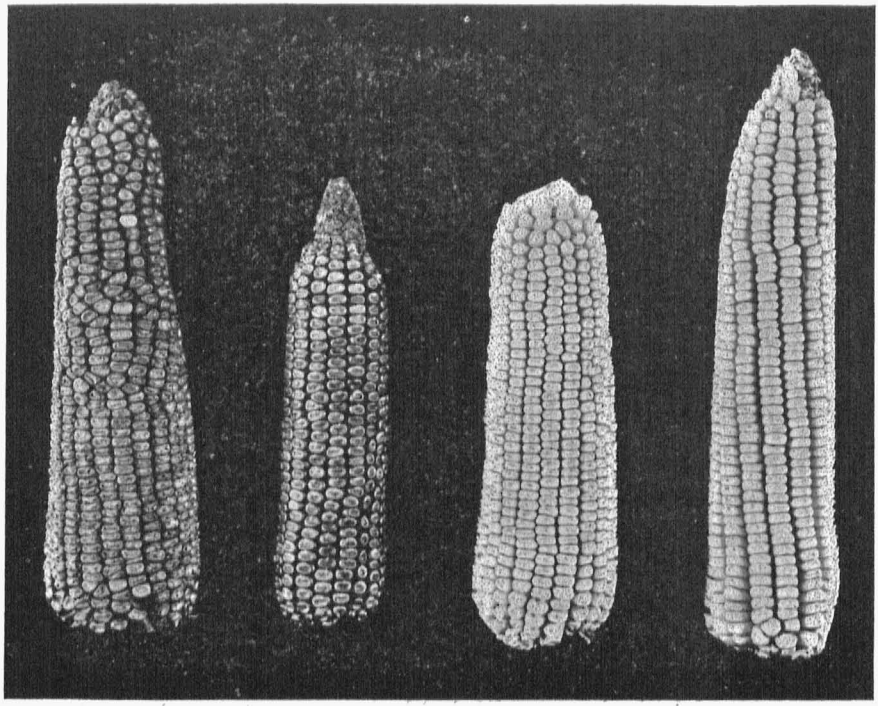


Fig. 2. Showing Lack of Uniformity in Selection.

barren stalks. Many stalks that come from the best selected kernels may not bear ears. Therefore, it is necessary in order to get a large number of ears that every kernel planted shall produce an ear bearing stalk. For this reason, detasseling the barren stalks

each year must not be neglected in the breeding field. For seed from an ear that has been fertilized by pollen from a barren stalk will tend to increase the per cent of barren stalks in the field.

TYPE OF EAR.

With the greatest care in planting to get a perfect stand and to have a large number of ears per acre, there may even then be a failure to get a large yield because of a lack of well proportioned, suitable sized, well filled and uniformly shaped ears.

Length and Circumference:—Every soil has a limit to its productive power and the vegetation upon the soil represents the amount of available plant food that season. In the case of this corn crop it is desirable that as much as possible of that soil food go to make kernels. The leaves, stalks and cob must all conform to produce the greatest quantity of kernels for the amount of available plant food in the field.

The shape of the cob must be such that the greatest number of kernels may be packed around it, and not only that, but the shape must allow of the largest and most uniform size of kernels.

A cylindrical ear or one varying only slightly from a cylindrical shape, will hold the largest number of kernels of uniform size. For a tapering ear means that the kernels must be either smaller at the smaller end or that there are a fewer number of rows, and either of these qualities will contribute to reduce the quantity of grain. While the cylindrical shape offers the best form for packing on kernels, there is also a most favorable relation of length to circumference of this cylinder.

For if the cob is very small in circumference, the number of rows around it will be few and a small quantity of grain will result. Also, this layer of kernels around the cob will be shallow and the weight of cob will be great in proportion to the weight of grain. This means

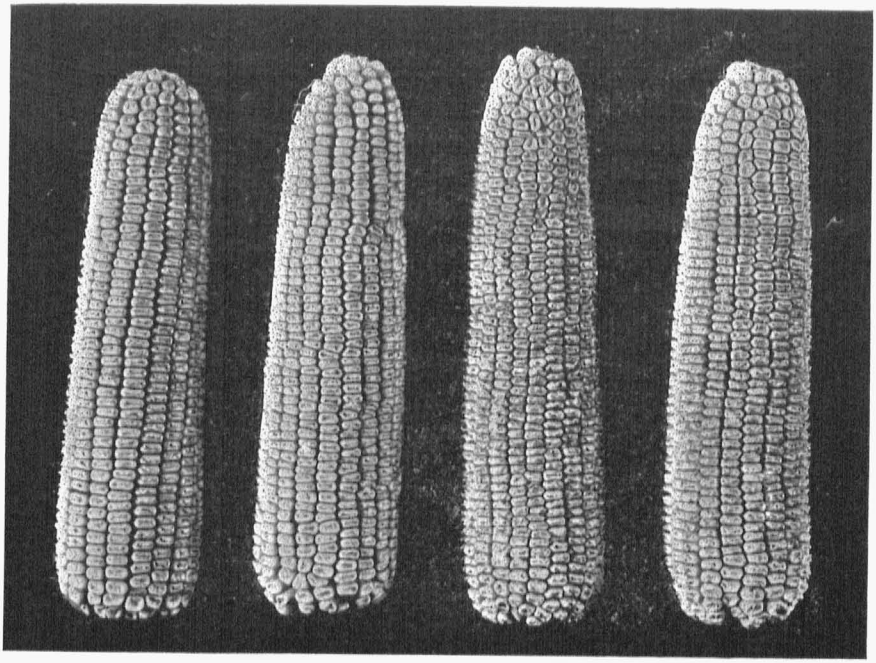


Fig. 3. Showing Improvement in Uniformity by Selection.

that much of the plant food has gone into making cob which might have been used to make kernels.

The best proportion of length to circumference is 4 to 3, which in practice give an ear of about 10 inches long and 7.5 inches in circumference for ordinary soils, while for thin soils an ear 8 1-2 to 9 inches will give

better yields. For if a large variety or type is grown on a thin soil, a very large per cent of the ears will not get food enough to mature well, and this will materially reduce the yield and greatly impair the quality of the kernels.

Butts and Tips:—The more nearly the ends of the cobs are filled out with kernels, just to that extent will the per cent of grain be increased on the ear. But too much stress should not be placed on the filling out of the tip in selecting the seed ears, for while the tendency to fill out is transmitted, yet the season and cultivation has much to do with this quality. Since fertilization of the ear begins at the butt, weather conditions, a hot dry wind, a storm, or drouth may injure the vitality of the flowers, before the tip of the ear becomes fertilized.

Spaces between the rows:—As much as possible of the cylindrically shaped ear should be solid corn. The rows should be packed close together and the kernels in the rows should be firmly pressed together making a rigid compact ear having very narrow spaces between the rows.

With these good characteristics the per cent of grain to cob will be the greatest possible, and will range from 86 to 90 per cent by weight. This means that the corn will shell from 62 to 63 lbs. per bushel instead of 56 lbs. as is customary. It is well to always make this determination before planting, by weighing the ear, then shelling the corn and weighing it.

TYPE OF KERNEL.

Uniformity of kernel:—Not only is the advantage of uniformity of size of kernel seen in order to get a perfect stand, but also it is a factor in getting a large

per cent of grain on the ear. If the kernels are more shallow at either end of the ear, then the per cent of corn is reduced in proportion.

Shape of Kernel:—The shape of the kernels should be such as to make a deep, compact layer of corn around the cob, and since this layer forms a hollow cylinder, the inside circumference of which is less than the outside circumference, the kernels which are in reality only sections of this layer, will have to be wider at the outer end than at the inner end where they are attached to the

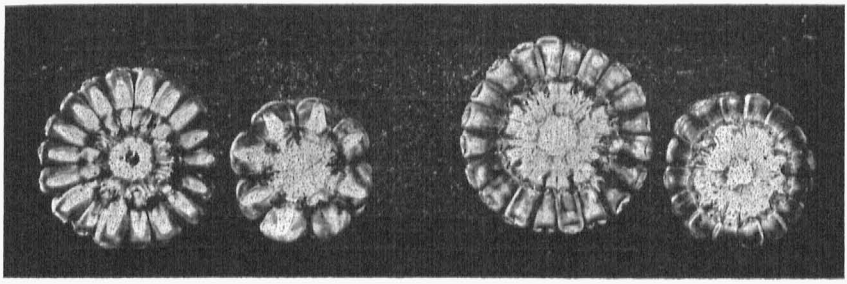


Fig. 4. a b a b

cob. This gives them a wedge shape (see Fig. 4 a, a,) with straight edges so as to leave no spaces between the rows or between the kernels, but make the whole grain layer compact and well filled out at the outer surface.

The wedge should be deep to give a thick layer of grain around the cob. The increase in depth takes place in the outer end of the kernel, and if the edges of the sides of the wedge tend to run out straight and give a flat rather than a rounded outer end to the kernel, the kernel will receive, by continual selection, a tendency to deepen.

Below are given standards of perfection for some of the established varieties:—

STANDARDS OF PERFECTION.*

	Name of Variety.						
	Reid's Yellow Dent.	Golden Eagle	Riley's Favorite	Leaming.	Boone County White.	Silver Mine	White Superior
Ear— Shape	slowly tapering	slowly tapering	slowly tapering	tapering	cylindrical	cylindrical	slowly tapering
Length	10 in.	9 in.	9 in.	10 in.	10 in.	9 in.	10 in.
Circumference	7 in.	7 in.	7 in.	7 in.	7.5 in.	7 in.	7 in.
Kernel— Condition	firm upright	loose upright	firm upright	firm upright	firm upright	firm upright	firm upright
Color	light yellow	deep yellow	deep yellow	deep yellow	pearl white	cream white	starch white
Indentation	medium smooth	very rough	rough	rough	rough	very rough	medium rough
Shape	long wedge	broad wedge	medium wedge	medium wedge	medium wedge	broad wedge	very broad wedge
Rows— Number	18-24	16-20	16-20	16-24	16-22	16-20	18-20
Space	narrow	medium	medium	medium	medium	narrow	medium
Arrangement	pairs	distinct	pairs	pairs	pairs	pairs	pairs
Butt— Filling out	deeply rounded compressed	moderately rounded compressed	moderately rounded compressed	moderately rounded compressed exp'nd'd	moderately rounded compressed	moderately rounded	shallow rounded depress'd
Tip— Filling out	regular rows of kernels	regular rows of kernels	regular rows of kernels	irregular rows of kernels	regular rows of kernels	regular rows of kernels	regular rows of kernels
Shank— Size	small	small	small	medium	medium	small	medium
Cob— Size	medium	small	small	medium	medium	small	medium
Color	deep red	deep red	deep red	deep red	white	white	white
Per cent Corn	88	90	90	88	86	90	88

* From the First Annual Report, Illinois Corn Growers Association.

From these standards one may be able to choose a variety or type for his use that is well adapted for his soil.

The most satisfactory method for home improvement, where it is possible to be carried out, is to plant selected corn in some part of the farm on good soil and at least one-fourth of a mile from other corn. Careful attention can be given to this small area, the undesirable

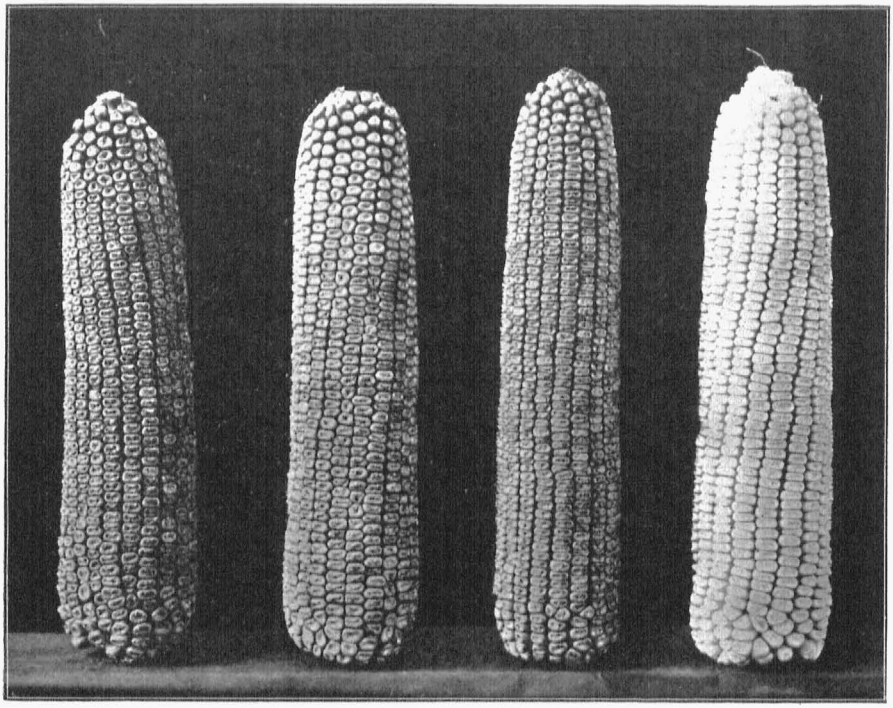


Fig. 5. 1 Leaming. 2 Reid's Yellow Dent. 3 Riley's Favorite. 4 Boone County White

stalks can be detasseled, good cultivation given, and in the fall the seed can be selected that will be of much higher value than that in the general cornfield which is too large to handle with great care.

Detasseling of undesirable plants is done to prevent pollen from fertilizing ears which may be growing on desirable plants. If pollen from such undesirable plants fertilizes an ear, the seed from that ear will inherit the tendency to reproduce the undesirable qualities of the pollenating plant.

Detasseling is done by pulling out the tassel just as soon as it appears in the roll of the last leaf and before it begins to open. Care must be taken to get the whole of the tassel.

The whole principle of selection may be summed up in a few words:

First. Begin with the whole field or breeding plot, from which select the best plants, according to performance.

Second. From these best plants select by the eye and by measurements the best ears.

Third. From these best ears select the best kernels.

Fourth. From these best kernels select the few very best for the breeding plot and plant the whole field with the remainder.

Scientific experimentalists and reliable seed corn growers have approached this stage in corn breeding and it seems very advisable for Missouri's corn growers to purchase seed corn which has been brought to this improved stage, and use it instead of the many inferior varieties that are now largely grown.

If seed corn can not be purchased for planting this season, we would recommend that ears uniform in shape and size (Fig. 3) with deep wedge-shaped kernels (Fig. 4 a, a) narrow spaces between the rows, well filled

butts and tips, small shank, be selected from the corn crib. Crib selection is the only selection which can now be made. The proper time to select is in the field when not only the ear but the whole plant can be taken into account, and selections made upon the performance of the whole plant in the field.

Do not select non-uniform ears, as shown in Figure 3. We must begin this season to improve our corn crop. The effect of corn breeding may be readily seen in Illinois where during the last ten years the farmers of the state have given the matter increased attention. To show this effect we notice the average yield per acre of corn in the ten years between 1890 and 1900 was 22.8 per cent greater than it was during the ten years between the 1880 and 1890. In Indiana where increased attention has recently been given to corn breeding, there is an average increase in yield per acre in the last decade over the preceding one of 12.8 per cent per acre. In Missouri for the same time the increased yield per acre has been less than one per cent (0.8 per cent).

The average value of corn per acre for the whole country during the last decade has decreased. But the value per acre in Illinois has decreased only 1.6 per cent, while the decrease in value of an acre in Missouri, where practically no attention has been given to corn breeding, has been 9.3 per cent.

The difference between the rates of gain in yield per acre and the rates of decrease in value per acre, both prominently in favor of the states that are giving increased attention to corn breeding, brings home to us the importance of a more careful seed selection and cultivation of our corn.

We would impress upon each farmer of the State who raised an acre of corn, to use only carefully selected seed. We seriously urge him to begin this season. Purchase seed always on the ear—it will pay. If it is impossible to purchase, select from the best you have, but begin improvement this season.

Professor C. G. Hopkins of the Illinois Agricultural College recommends the following method of planting in the breeding plot: "40 selected ears are planted in 40 separate parallel rows, one ear to a row. Consequently the breeding plot should be 40 rows wide and long enough to plant three-fourths of an ear to a row. It is well to shell the remainder of the corn from the 40 ears, mix it together and use it to plant a border several rows wide entirely around the breeding plot, to protect it especially from foreign pollen.

The very best ears of seed corn are planted in the center rows of the breeding plot, the remainder of the ears being planted in approximate uniform gradation to either side, and in final selection preference is given to the rows near the center of the plot."

Missouri Corn Growers Association.

The students of the Missouri Agricultural College, have had under consideration for some time a means by which the advantages that seem certain to grow out of a more widespread understanding of the principles of corn growing and corn breeding could best be grasped and used by Missouri farmers.

This thought has resulted in the formation of a preliminary Corn Growers Association, the objects and purposes of which are briefly as follows:

To improve the yield of corn per acre.

To study improved methods of handling and feeding of the crop.

To introduce the standard varieties of corn and to maintain and improve them.

To aid members in obtaining information as to best methods of improved corn culture.

To adopt a score card.

One definite purpose of the Association will be to promote and establish an Annual Corn School and Exhibit of a few days, to be held next winter at the Agricultural College in connection with the State Board of Agriculture and the annual meeting of the State Industrial Association.

It is very much desired by the present members of the Corn Growers Association that every corn grower of the State become acquainted with this movement for corn improvement in Missouri, and that he will become a member of the Association and attend the Corn School. It is also hoped that they will correspond freely with the Secretary of the Association, Geo. M. Tucker, Columbia, Missouri, and express their views in regard to the movement.