

THE DEVELOPMENT AND IMPROVEMENT
OF CORN FOR THE PRACTICAL FARMER OF
K A N S A S

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There are few agricultural plants that offer such advantages for improvement by breeding as the corn plant. The characteristics of the individual plant are of sufficient size to distinguish them readily; as, for example, the height of ear on the stalk, the length of the shank, the size and shape of the ear, etc.

It is the purpose of this article to deal principally with the breeding of the Dent varieties, and to assist the practical farmer in the increasing of his crop, improving his land and the bettering of the community and the state in which he lives.

--Origin and History--

Indian corn or Maize, botanically known as *Zea May L.*, is distinctly an American plant. The plant was unknown to the Old World until it was introduced from America. The tribes of Indians before the discovery of America raised this crop to quite an extent. Their methods of cultivation were crude, but they have no doubt improved the corn more than it has been improved since by the white man. Among the pioneer breeders we may place J. S. Leaming, James Reid, and James Riley.

There are five important classes of corn grown in the United States. 1. The Dent corn:--This is a large growing type with large ears and the kernels have a dented crown. The various colors of varieties are yellow, white, red, calico and blue. 2. The Sweet Corn:--This is a small growing type with hard kernels and wrinkled crowns. 3. The Flint corn is a small type with hard and flinty kernels rounded at the crown. 4. The Pop corn: Is a small to a medium sized variety. It differs from other varieties in that it "pops" when heated. 5. The Pod corn: This corn is very leafy, has small ears and each kernel is enclosed in a separate husk

As I have mentioned before we shall only consider the Dent type, as it is the most important to the farmers of Kansas. Special emphasis will also be placed upon the breeding plot.

The principal Dent varieties of corn grown in Kansas that have proved themselves superior are McAuley, Silver Mine, Boone and County White, Roseland, of the white varieties, and Hildreth, Reid's Yellow Dent, Kansas Sunflower, Legal Tender, and Hogue Yellow Dent of the yellow varieties.

Any corn breeder upon starting to breed corn must realize the importance of having a well-bred seed corn; but there is no corn grown that we can say is pure. It takes years to establish a pure bred type, yet there is corn that has been raised to a high proficiency. How can we still improve it? It will be through selection and proper care that we shall attain our standard of perfection.

Any farmer who has not a well-bred type of corn should purchase some seed of a breeder. There are several important reasons why seed corn should be purchased in the ear. First, the purchaser can see exactly what he is getting, and the corn will be of a better quality; second, the vitality can be thoroughly tested and the poorest ears discarded; third, seed can be better prepared for the planter by removing the ununiform kernels; fourth, shelled seed corn will lose its vitality more readily.

In buying corn it is not advisable to secure it from a long distance, as it will take several years for the seed to become climatized.

In the study of the characteristics of a good seed ear one must make a study of the individual plant itself, as individuality is the basis of plant breeding. We may see "nice" ears, but

they are not always "good" breeders. But most "good" breeders are "nice" ears, and will generally produce a high yield. It is, therefore, necessary to know the past history of that ear. Again, do not always take into consideration that a nice appearing ear, according to the score card, will be the best breeder or give the highest yield, for this is not always true, because a good looker is no guarantee that it can grow good looking ears or will make a high yield. A well formed ear and well developed kernels, as required by the score card, tends to associate with a large yield and a good quality of grain. You will find as a rule that the highest yielding rows will produce ears that will score the highest.

There is perhaps no one thing that will do so much to increase the yield of the corn crop on every farm as the testing of the vitality of each ear to be used for seed. No farmer can afford to neglect the simple vitality test. The importance of discarding the ears that are poor in vitality is essential when we realize that one good ear will plant from one-tenth to one-eighth of an acre. Many a field has been replanted on account of poor germination. No one can pick out by a mechanical examination all the ears that are deficient in vitality. It is easy enough to pick out ears whose vitality is totally injured, but a large number of ears have poor vitality or weak germs. As a rule weak germs mean a weak plant and a small yield.

It is best to test the germination of your seed several weeks before planting and if your seed is low in vitality you will have sufficient time to secure seed from some one else. The middle of February is a good time to test the seed. Do

not test your seed until it is thoroughly dry and free from further injury, such as molding, over-heating or freezing.

The simplest and best method of testing the germination of each ear is by the use of a germination box. There are many simple germinators that can be used. The most convenient box is one two feet wide and three feet long, and two and one-half inches deep. Small holes are bored about two inches from the bottom on all sides and two inches apart. Through these holes wires are stretched cross-wise, forming squares large enough to hold from eight to ten kernels. Fill the box with sand or sawdust and dampen. Each square marked off by the cross wires will contain the kernels of a single ear. The rows of the tester should be labeled by numbering on one side a, b, c, d, e, etc. and on the adjoining side 1, 2, 3, 4, 5, etc. We are then able to tell the exact location of the kernels of any ear.

From what part of the ear shall I take the kernels in making a germination test? Ten kernels should be removed with a dull pocket knife or similar instrument, choosing three kernels near the butt, four kernels near the middle and three kernels from the tip, removing only one kernel from a place.

The kernels of ear No. 1 are placed in square No. A1; ear No. 2 in A2, etc. Label each ear corresponding to the number of the square in the tester. Keep a record of the time of germination and the kernels which fail to grow. The strength of the vitality of each ear is in this way determined.

After the seed ears have been properly selected and their vitality tested, they are ready to be shelled and the grain prepared for the planter. The kernels of the tips and butts and

irregular and mixed kernels are removed, leaving the uniform kernels for seed. It is impossible for the planter to drop uniformly the required number of grains per hill if the kernels are not uniform in size. Another important thing is the testing of the planter. Run the planter over a smooth surface and note if a certain number of kernels will drop with regularity and at regular distance apart. Other plates should be tried until one is found to work accurately. X

A factor which is very important in the growing of a corn crop is a well prepared seed-bed. It is essential that the soil be packed firm. A loose mulch should cover the surface. The ground should be plowed in the fall rather than in the spring as the freezing and thawing will tend to pulverize the soil. It also has its disadvantages, as some of the plant food is leached out. The best time to prepare seed-beds is during the month of January or the first part of February. In plowing the ground one should have a disk attachment on the plow. The ground should be harrowed immediately afterwards. A cut-a-way disk should then be used to pack the lower part of the soil. We cannot lay too much emphasis on the preparation of the seed-bed.

--The Breeding Plot--

It is evident in order to breed corn for increased production we must breed corn for uniformity in size and shape of kernels for two reasons: (1) uniform kernels will plant more evenly, (2) that ears ~~are~~ ^{may be} produced like the parent one. The method used by most corn breeders is ^{to have} a plot of ground of three to five acres on which to grow the seed. It is the object of this breeding plot to allow only good individuals to cross. Your choicest ears

should be selected for this purpose. The plat should either be isolated from all other fields or else planted in the middle of a large field of the same variety of corn.

Corn breeding should appeal to every farmer just as does the breeding of animals. Before we can make very great gains, we must get down to the bottom of the trouble, and that is the breeding of seed corn. We must know whether the ears we plant have been grown from a high yielding strain of corn or from a low one. We must know whether their powers of transmission are weak or strong. We must remember that corn, as well as animals, transmits the breeding characteristics to its offspring or "like begets like." By planting high-yielding ears together year after year we will steadily increase the quality and quantity of the corn.

Below is a design showing the location of the breeding plat and the multiplying plats. No. 5 is the breeding plat and the rest are the multiplying plats. Below this design is a design showing in detail the method used in each plat.

Multiplying and Breeding Plots

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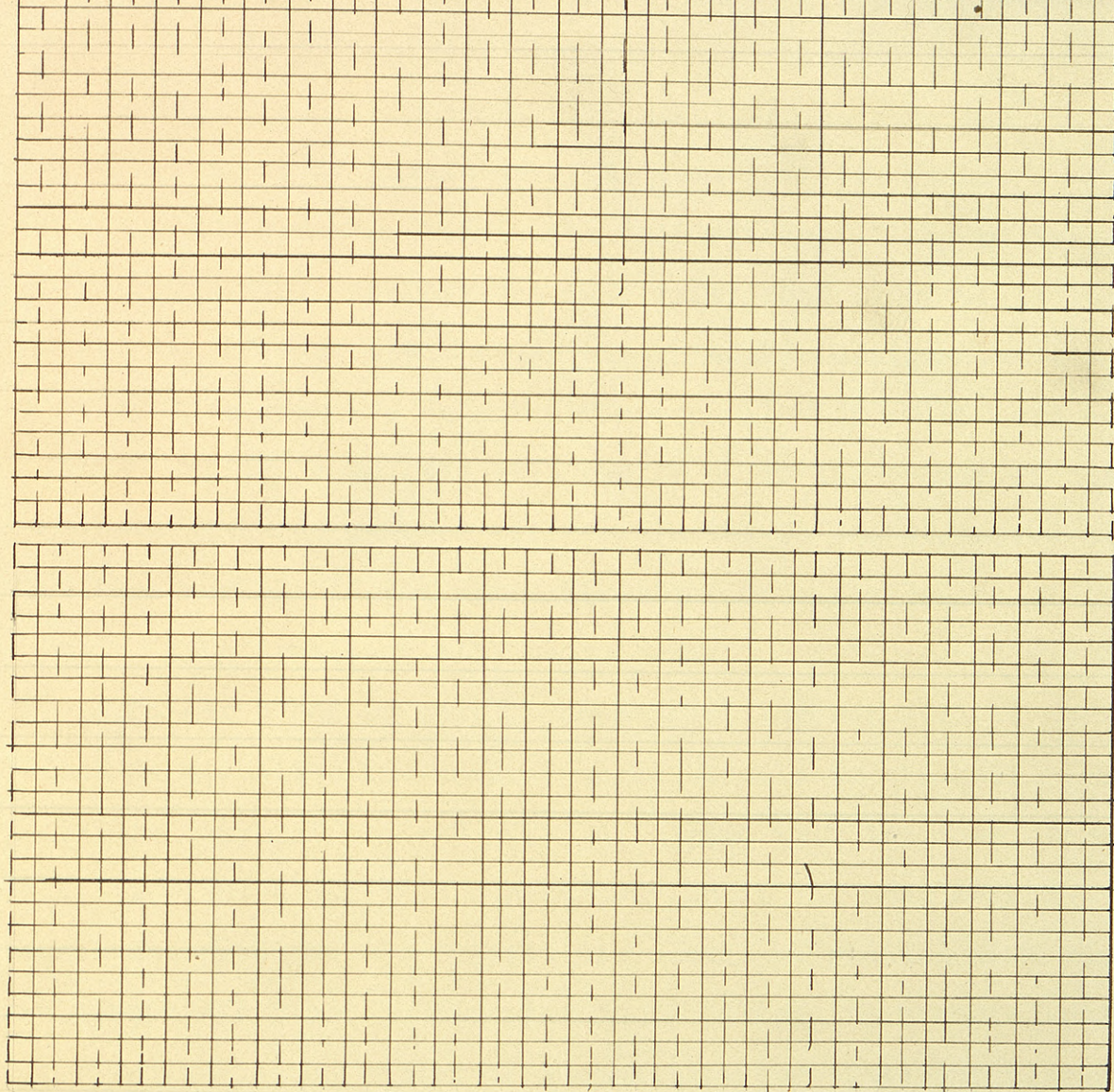
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9

Detail of Plat

9

48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100



..... Detasseled

——— Undetasseled

It is best to have the plats isolated, as the pollen from only desirable stalks will fertilize the silks of the seed ears. If one cannot secure this it will be better to have the plats on a uniform piece of ground near the center of the field.

The "ear row" method is the only successful way of breeding corn. The plats are divided into fifty rows fifty hills long and at the end of each row a stake with a number designating the row. Twenty-five ears are selected for each plat of which each ear is to plant two rows, the best ear to be in the center of the plat. The rows with odd numbers will be planted in one direction and the even numbers in the other direction from the center of the plat. The first ear will be numbered 1 and 2, second ear 3 and 4, third ear 5 and 6, etc. One-half of the ear will be sufficient to plant the two rows of three kernels to the hill. The remaining half of the ear will be labeled with the rows of the plat it planted and then stored away until the next season. The ears that produced the highest yield will be planted next year in a separate plat. This plat to be called the breeding plat, is situated in the center of the multiplying plats, as plat No. 5. One-half of each row is detasseled every other row and on the opposite side in the same way, so that one-half of each row will be cross-fertilized by the adjoining row. We are then able to secure seed from every row that is cross-fertilized.

After each plat has been planted with its respective ears, take a part of the seed that remained shelled of each ear and put it in the germination box. After the seed has sprouted from seven to ten days, the plants are transplanted in the respective row wherever there is a missing plant. Each row will be uniform

in stand and all the plants will have an equal start.

The plats should receive the proper cultivation throughout the growing season. We should go through the plat every other day when the corn is starting to tassel and removed the tassels by pulling instead of cutting. Half of the row is to be detasseled and the barren and weak stalks from the remaining half of the row detasseled. All smut should be removed. A careful data of everything done should be made in your record book.

The time to gather seed corn is after it is fully matured and before frost. The best ears of the standing stalks should be husked first, then the poor ears. Weigh each lot separately and label. The best ears from the undetasseled part of the row husked separate from the poorer ears, each being weighed separately and labeled. The sum of their weights are taken and compared with the weights of the other rows. The weights of the two rows planted from the same ear are added together, and the exact yield of each ear recorded on the books. The ears of the highest producing rows are saved for next season's multiplying plats. Care should be taken that the ears of the detasseled and undetasseled rows are not mixed. The corn from the lowest yielding rows may be discarded and also the corresponding seed ears. The breeding plat which is located in the center of the multiplying plats will consist of the remaining half of the ears that produced the highest yields.

Before selecting the ears for the next year's multiplying plats it is best to eliminate the seed from the rows which (1) germinated poorly, (2) lack vigor and strength of growth, (3) suckered abnormally, (4) produced ears too high on the stalk,

(5) fell low in the per cent of standing stalks at harvest time. It is probable that all of these deficiencies except the first came through heredity from the mother ear, since the hereditary characteristics are transmissible through the influence of the sire. We may take two ears of the same variety looking as nearly alike as possible and plant each ear separately and the yield of the one may vary fifty per cent greater than the other.

There are three things required in corn breeding; (1) Breeding plat (2) multiplying plats, (3) commercial field. The first and second may be together. After these three have been supplied with the best seed, the balance of the good ears can be sold as pedigreed corn. The main bulk of the pedigreed corn coming from the commercial field.

The breeding of corn is devoted for several reasons; (1) to increase the yield, (2) to improve the physical characteristics of the ear, (3) to increase or decrease the protein, oil, or carbohydrates, (4) to raise or lower the ear on the stalk. The first is the most essential to the Kansas farmer, as utility is what every breeder is seeking.

A chart of each plat should be kept showing the yield of each row. The method I have presented below is a very simple one that can be placed in the record book.

Yield Design

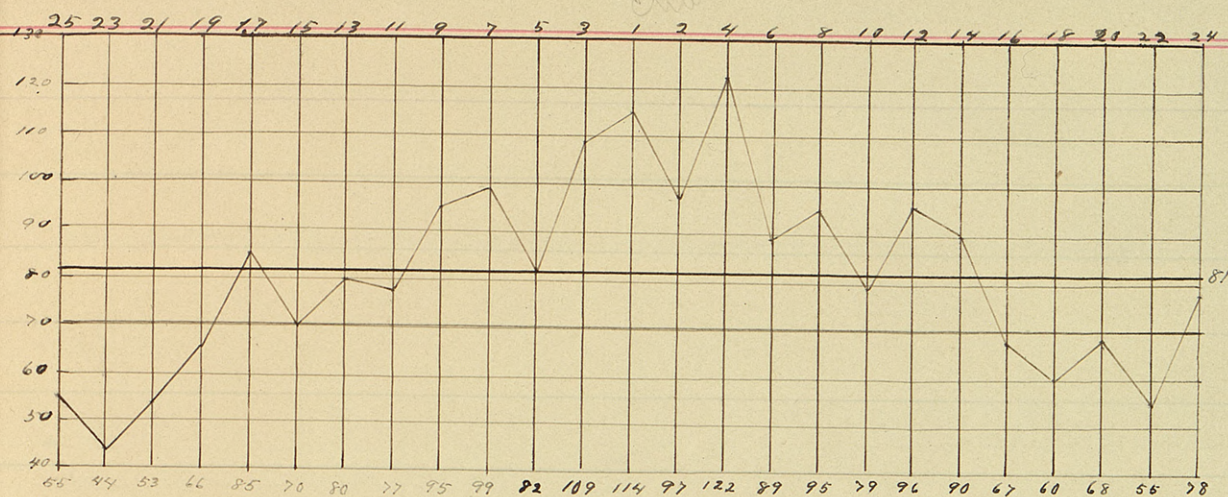


Chart 1

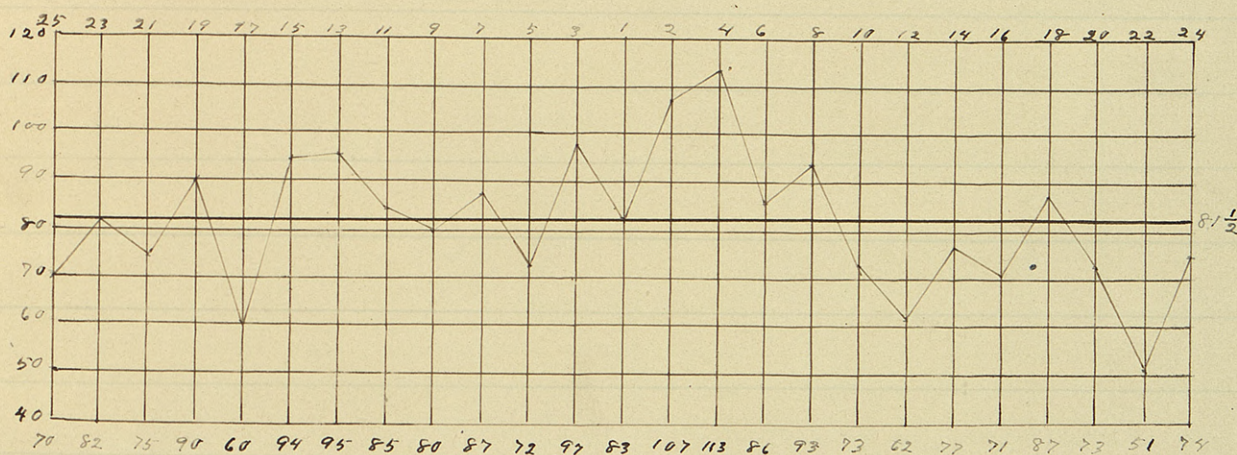


Chart 2

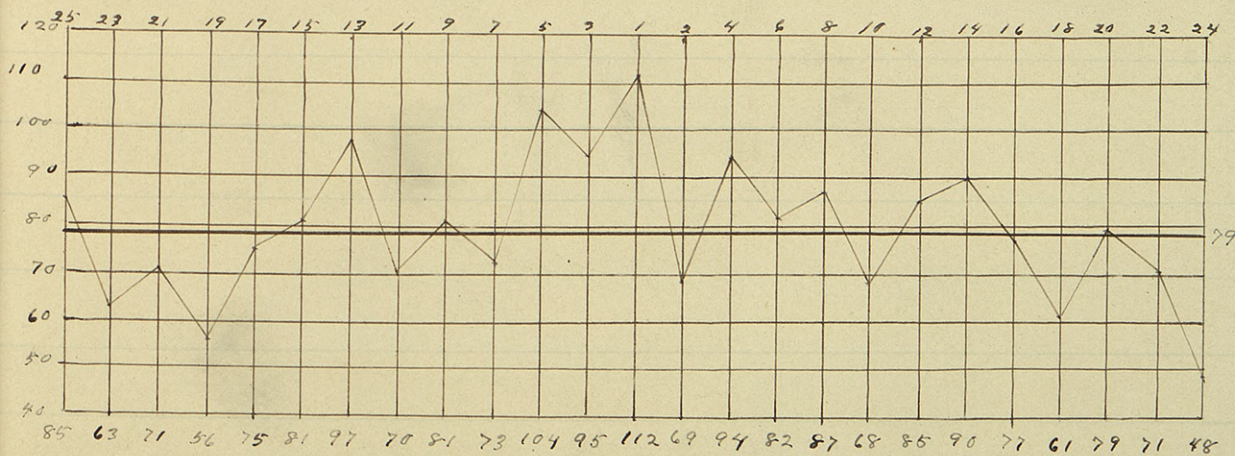


Chart 3

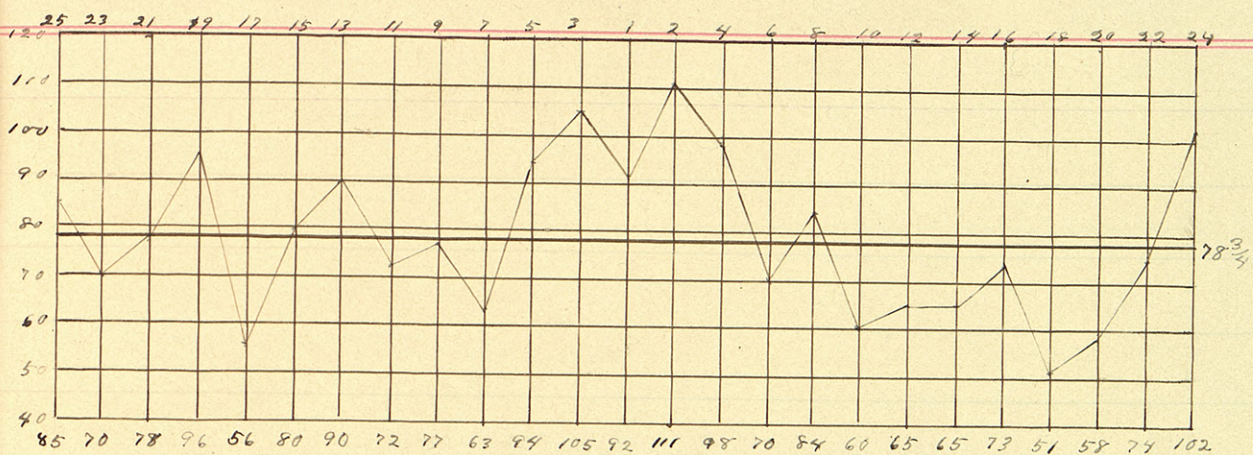


Chart 4

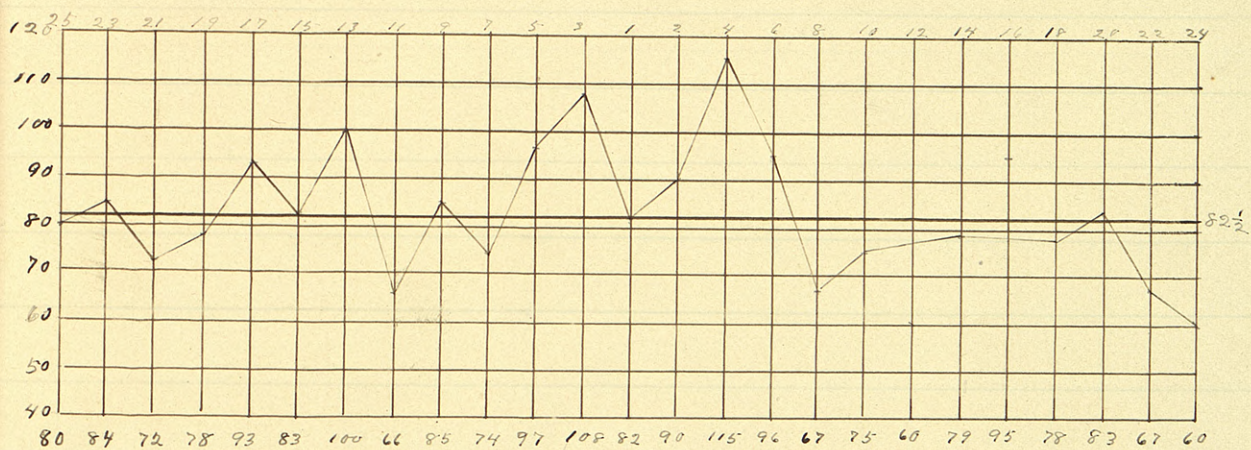


Chart 5

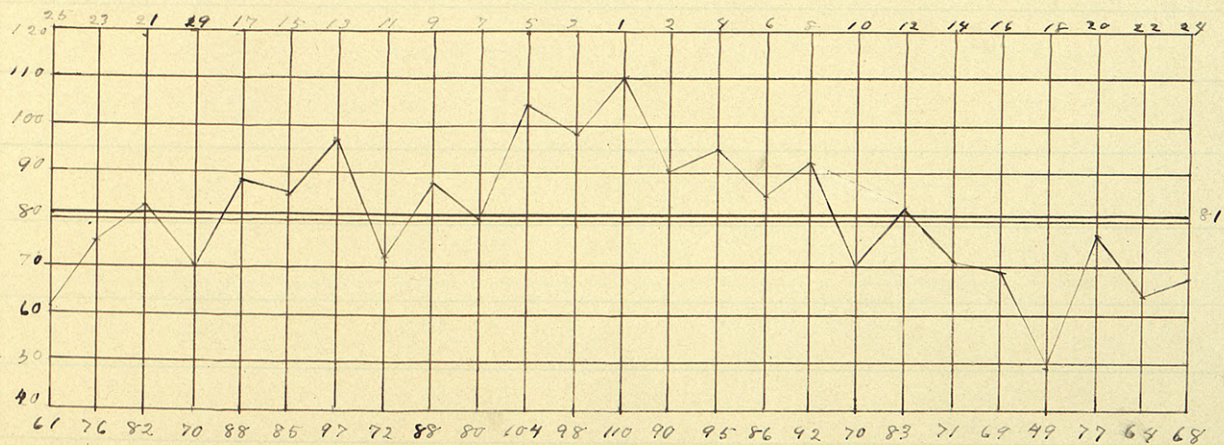


Chart 6

Chart 7

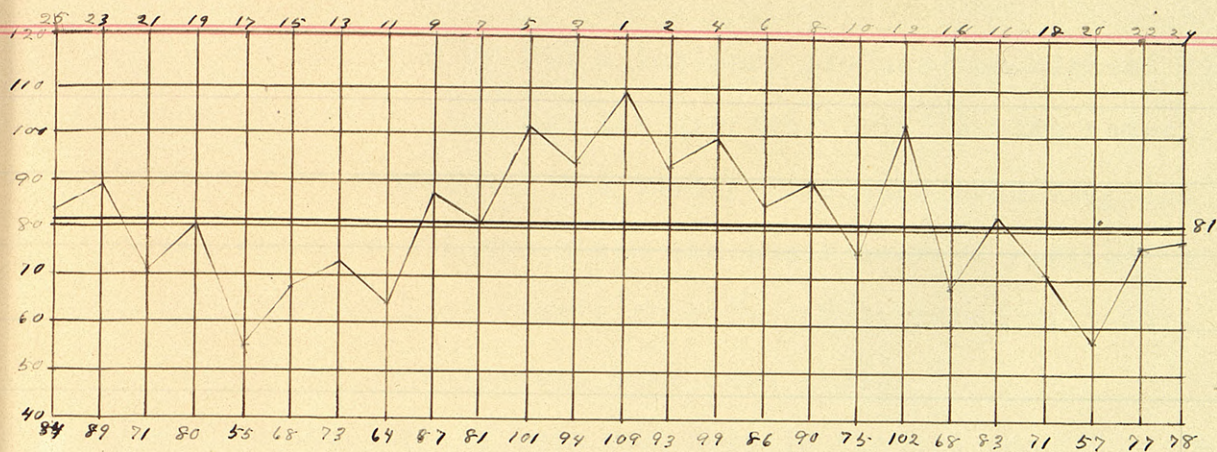


Chart 8

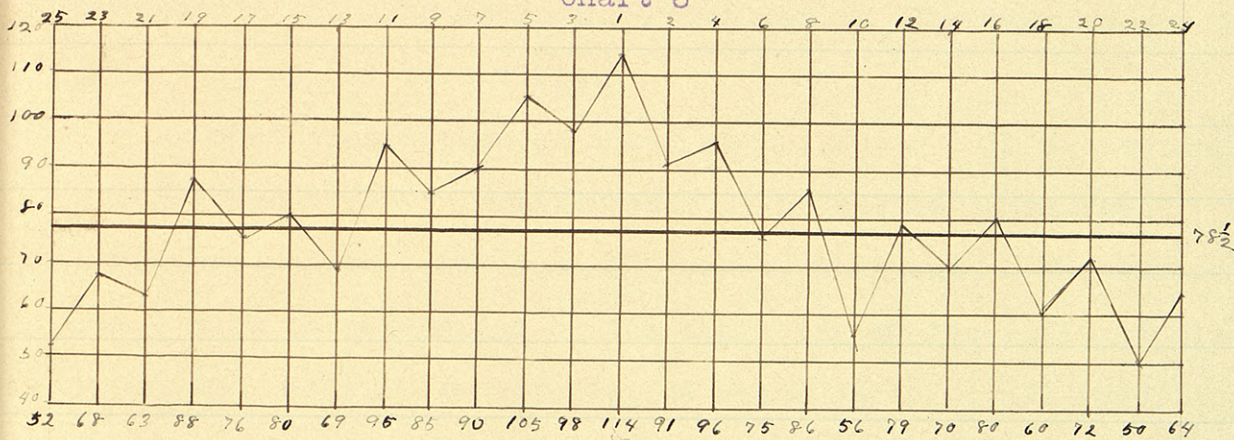


Chart 9

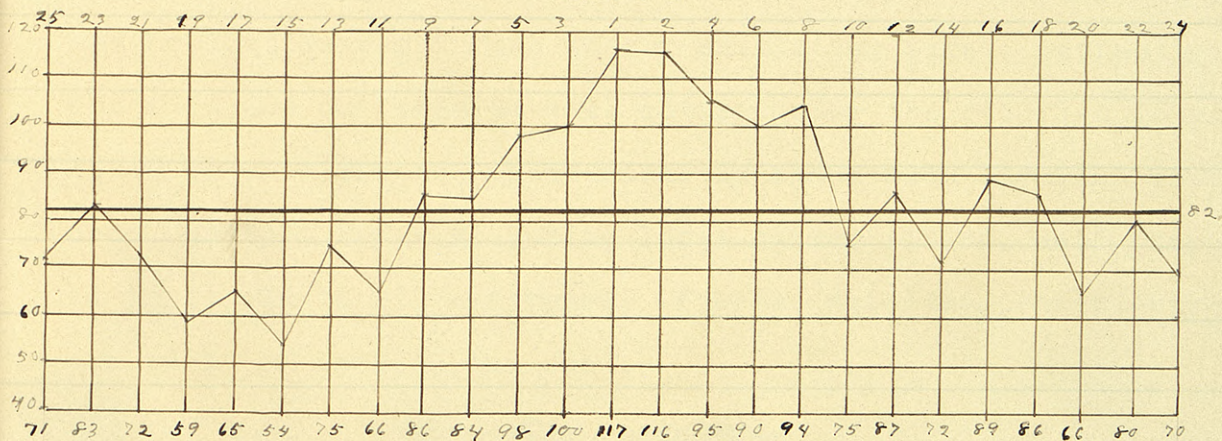
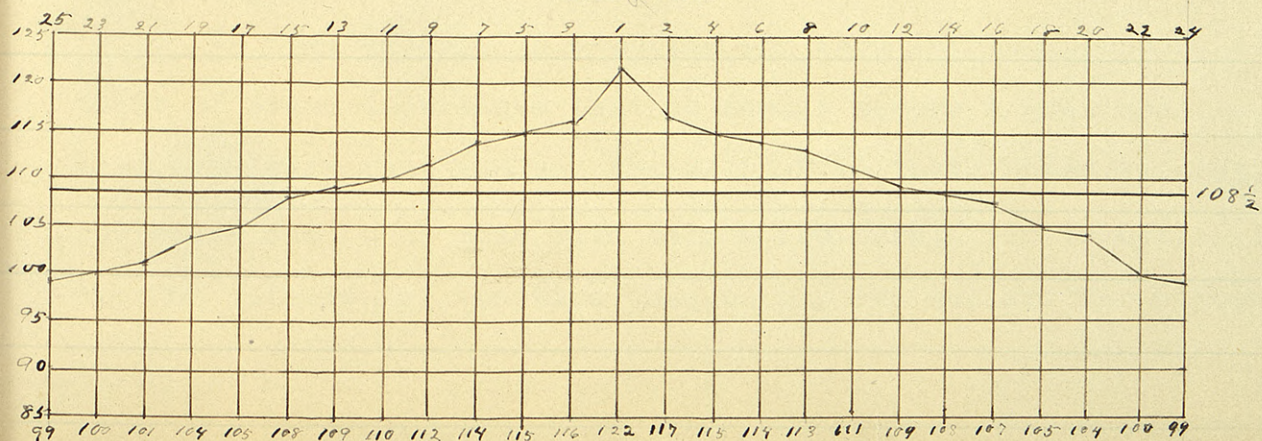


Chart 10



One can readily see which ears produce the highest yield in each plat. A line for the average yield is also noted. Chart No. 10 represents the twenty-five ears producing the highest yield in all the plats and their average yield. A similar chart of last year's crop can be compared with this chart as to see so see if any improvements have been made.

The ancestry of each ear that is planted should be recorded in the Record Book. Corn can in time receive a pedigree just as any live stock.

What constitutes an ideal ear of corn? This question must be answered by every corn-breeder if he wishes to succeed. He must have an ideal in mind and work to that end. The ear of his ideal must be determined by the character of the soil and climate. There are certain characteristics which apply to all conditions. An ideal ear must have the characteristics of maturity, vitality and productiveness. Such an ear should be; first, perfectly sound and firm and as large as will mature under the condition in which it is grown; second, cylindrical in shape with straight rows of deep, uniform kernels, having large germs; third, well proportioned in length to circumference; fourth, not less than eighty-six per cent. of corn to the cob.

--The Beginner--

To the beginner in securing the seed for the breeding plat it is of prime importance that he should secure a good quality of seed from ears that can be traced back to their breeding qualities. The start should be made with only a few ears. It is better to pay Ten dollars for ten ears than to pay Two dollars for a bushel

of poorer seed. Each ear should be planted separately, and a complete record kept of each ear.

--Selection of Variety--

One variety succeeds in a certain locality while another variety does not. Some varieties mature earlier than others. The principal point to be observed in the selection of a variety is, therefore, its adaptability to the climate and environment of the locality in which it is to grow. It is always best to secure seed in the same locality if possible.

To make a success at corn breeding one must be a lover of corn, taking a delight in its growth and development and be quick to understand its needs. He must enjoy the labor of caring for it and must be willing to give that labor ^{at} the proper time. A data should be kept of all work done. The apparent ease with which many men succeed in corn-breeding is due in large measure to their intimate knowledge of their variety.

A large yield depends, (1) upon the uniformity of the stand, (2) upon the number and size of ears per acre, (3) upon the type of kernels, (4) upon the physical condition of the soil, (5) upon the amount of regularity of rainfall, (6) upon the length of season, (7) upon the amount of available plant food.

--Cultivation--

Returning to the general cultivation of the field, we must do the work in the most effective and economical way. The object of cultivation is (1) to kill weeds, (2) to conserve moisture, (3) to areate the soil, (4) to promote bacterial action. The most important factor is the conservation of moisture. The ground

should be stirred after every rain to keep it from baking and to keep the moisture from escaping. Capillarity is destroyed by this operation and instead of the moisture evaporating it is retained in the soil for the use of the plants. Cultivation should be continued even though the weeds are absent. This is the vital function of tillage, that we keep the soil in good tilt, which condition facilitates the growth of plants.

It is a good policy to cultivate deep as long as the roots are not injured. But, as the corn becomes matured, we cannot cultivate deep as the feeding roots of the plant will be injured. The depth of root growth depends upon the character of the soil. The more roots a plant has the greater will be its power to nourish itself.

We cannot lay down any exact rules for cultivating corn, but a farmer must judge from the crop and soil condition, and may vary the manner of cultivation to suit the conditions desired. We may say that it usually pays well to have a well prepared seed bed and give the land a cultivation after every rain.

--Rotation of Crops--

The ground which is planted in a succession of years with the same kind of crop decreases in certain plant food elements, but by the rotation of crops, especially leguminous crops, the ground will maintain its fertility and larger yields will be produced. Rotation tends to destroy insect pests.

--Number of Stalks per Acre--

Among the various factors of production of corn the distance in planting and number of stalks per hill should be considered, (1) as to the amount of moisture in the soil, (2) as to the amount of soluble plant food, (3) as to the amount of sunshine, (4) as to the number of tillers, or "suckers."

The average distance between the hills is three and one-half feet. There should be three stalks planted to the hill, or about 10,620 stalks per acre. If each stalk produced an ear of corn, and it takes eighty-five ears to the bushel, we would produce one hundred twenty-five bushels of corn to an acre. Kansas today plants about seven million acres, and the yield is only one hundred sixty-eight million bushels, or twenty-four bushels to the acre. Why do we not produce more per acre? It is because the vitality is poor, and a large per cent. of the stalks are barren.

There are four factors which go to produce corn, (1) soil, (2) season, (3) seed, (4) farmer. If any one of these factors be divided by two it will nearly divide the maximum yield by two.

To be a successful corn breeder we must not despise the small things. Get what advice you can from agricultural professors, then put a great deal of hard work and careful attention to the raising of the crop and keep a record of everything.

Tillers, or "suckers," have been of great value to the farmers of the past and are to this day. But we are virtually trying to decrease the number by planting such seed that does not produce tillers, as it has been found by the experiment stations where the stand is thin that the stalk has a tendency to produce more tillers. Good breeding will do more toward increasing the yield than tillers or suckers.

The Time and Place to Select Seed.

The best time to select seed corn is in the field after it has been matured and while the characteristics of the parent stalk can be observed. This can be done by going through the field and selecting ears of good size and quality from strong and vigorous, leafy stalks. We must remember that leafy plants have the power to manufacture more food. The stalk should stand up well, and bear its ear at a medium height. The ears should have a medium shank.

In selecting ears select those ears which have a strong constitution and well developed kernels of regular size. The kernels should be deep and rectangular, with medium dent crowns, and the ear well filled out at the butt and tip. The seed ears should be a little rougher than the average crop, as smooth kernels tend to be shallow, thereby lowering the per cent of corn to the cob. Seed corn should always be matured before gathering.

Seed which is selected from the crib is always objectionable for several reasons; (1) the vitality is more or less injured, (2) one cannot tell the character of the stalk which produced the ear, (3) seed from the crib produces smaller yields.

The quantity of seed selected should always be several times more than will be needed. A more critical selection can be made later. It will pay one to save the best seed for his own planting and sell the rest to his neighbors. One can readily secure a fair price for good seed corn.

--Storing--

The best plan for storing or saving seed is a good seed house built for that purpose which can be heated, ventilated, and fumigated successfully, but taking everything into consideration, for the practical farmer probably there is no better place than the attic of the house, close to the chimney, or a cellar where there is a furnace; unless one is fortunate enough to have a

vacant room in the house in which corn can be stored to a great advantage. Racks or drawers with wire netting bottoms to allow free circulation of the air can be built around the walls of the room. A little stove could be placed in the room and the temperature kept at about 70°.F. to insure rapid drying. Hang the corn by a cord or place in drawers of convenient size with wire netting bottoms. The room should be well ventilated. If corn cannot receive sufficient ventilation it may become moldy, and the vitality of the seed be injured.

A few places where seed corn should not be stored: (1) In barrels or boxes, (2) in piles, (3) in the crib with other corn, (4) in the horse or cow stable where the ammonia or moisture from the stable will come in contact with the ears, (5) where the temperature varies continually, (6) where rats and mice can get to the seed.

The advantage of having a special place such as a vacant room in a house for storing seed is (1) that the circulation of the air can be easily regulated, (2) protected from rodents, (3) that artificial heat can be applied (but do not have too intense heat), (4) that the temperature will not vary continually, (5) that it may be possible to fumigate and destroy insects.

Storing the Ears from the Breeding and Multiplying Plats.--

The seed corn coming from the breeding and multiplying plats should be kept separate from the seed of the commercial field. The ears, as they are placed in the storing room, should be labeled with the number of the plat, number of the

row, and the yield of the row per acre. The corn should be stored at once after it is picked into dry, ventilated places. We should always store seed corn in the ear.

During the winter the corn should be selected and the poorer ears discarded or sold as second or third grade seed. In making the selection for the multiplying plats, select ears coming from the highest yielding rows. The balance of the high yielding rows can be used in the commercial field. The seed coming from the commercial ^{field} can be graded into three grades and sold to customers.

In selling seed corn always satisfy your customers. The seed should be sold in the ear. A pedigree should be sent to every purchaser, describing the ancestry and the yield per acre. All mail orders should be promptly filled and the corn shipped in crates.

If the above methods are pursued by the practical farmer it will result in virtually increasing the value and yield of Kansas corn.