Fifteenth biennial report of the Kansas State Board of Agriculture, 1905-1906

Section 3, Pages 61 - 90

This biennial report from the Kansas State Board of Agriculture includes information on the selection, cultivation, and harvesting of Indian corn, ideas for improving the conditions of farm life, and information on commercial fertilizers. There are various kinds of statistics for each county that include population, acreages, livestock, and assessed valuation of property. There are also a number of tables listing statistics for all counties. The proceedings and activities of the Kansas State Board of Agriculture are included beginning on page 977. Please see the table of contents on image 8 to determine appropriate page numbers. Page numbering starts over after page 1264. This section contains compiled statistics from the 1905 Kansas decennial census but individuals are not listed. A general index starts on page 61 of the Decennial Census section at the back of the volume.

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While it is a good plan to have a stove in the seed-house for use in damp weather, fire drying of seed-corn should not generally be practiced. It is always more or less risky on account of the danger of overheating while the corn is still moist. Natural drying, if there is time for it, is always safest.

BUYING SEED-CORN.

Seed-corn should always be purchased in the ear. For this there are at least three important reasons. First, the purchaser can see exactly what he is getting, and the corn is likely to be of much better quality. Dealers always select the better ears to supply the customers who demand ear corn. Second, the vitality can be more thoroughly tested and the poor ears can be detected and discarded. Third, the seed can be better prepared for the planter by more thoroughly discarding the ununiform kernels. Ear corn usually sells for double the price of shelled corn, and there is good reason for it. Only a small proportion of the ears in a wagon-load of corn are good-looking enough to sell for seed in the ear. The ten best ears in a bushel of corn, as it comes from the field, are worth more than all the rest for seed purposes. The farmer who has purchased his first lot of seed-corn in the ear is apt to be dissatisfied with its appearance. He is apt to expect show ears. He should remember, however, that there are but few show ears in a wagon-load of corn and they are worth very much more than he has paid for what he got.

As a rule it is not wise to import seed-corn from a distance, because it may not be adapted to the conditions where it is to be used. If a farmer can get good seed from his own crop, or from a neighbor, it will usually give better results than imported seed. When it *is* necessary to import seed, or a different variety is desired, it should be secured from a place in the same latitude. When one goes south for seed-corn he is apt to get something that will not mature in his locality, and if he goes north he is likely to get something that is earlier than necessary and too small. The greatest mistakes are made in trying to produce varieties which are too late-maturing for the locality. It is a deplorable fact that immense quantities of corn are either severely damaged or totally spoiled every year on account of immaturity. With the hope of securing larger yields farmers are too apt to use varieties or strains of corn that cannot thoroughly ripen under their conditions. Such corn is worth less for feeding; grain dealers must pay lower prices for it on account of the risks of spoiling, and all around the farmer is the loser. As a rule, every degree north or south of a given point means eight or ten days difference in the time of ripening. Going east or west makes much less difference. Seed-corn brought from a distance will usually take two or three years to accustom itself to the new conditions before it will give the best results, no matter how good the seed may be. On this account only small quantities should be imported.

If seed-corn must be purchased, the price should be least considered. The quality and purity of breeding are the important factors to be taken into account, as there may easily be a difference of several bushels per acre in its yielding power. The seed that will yield five bushels more per acre is easily worth ten dollars more per bushel. Many experiments have proven that the quality of the seed may make a very much greater difference than this.

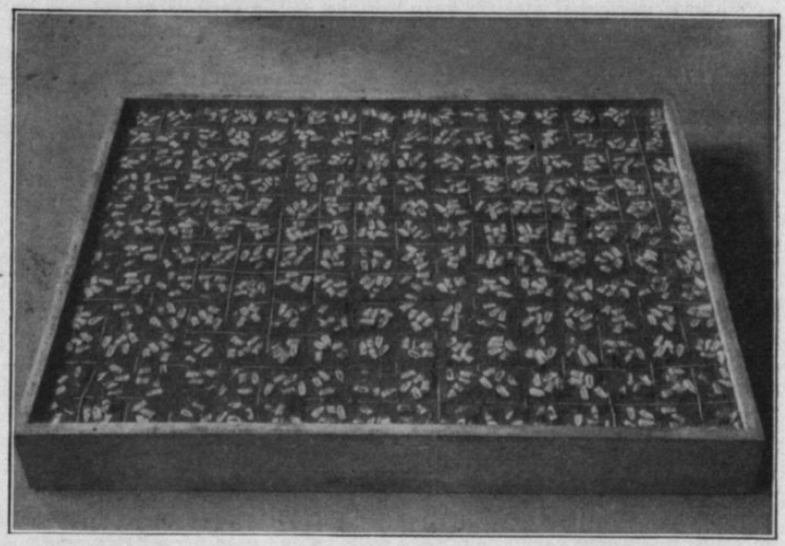


FIG. 2.

Much of the seed-corn sold by so-called seed-corn dealers is nothing more than crib corn. This state of affairs can be remedied only by the purchasers insisting on being supplied with corn on the ear, and accepting it only after they have satisfied themselves as to its quality and germinating power. All honest dealers will guarantee their corn. There are a number of good dealers in the state who breed their own corn, and these men deserve to get a good price for what they offer for seed.

THE FINAL SELECTION OF SEED EARS.

In spare time during the winter, or at least several weeks before planting-time, the farmer should go over his seed-corn carefully and cull out the poor ears. The best of the best should be laid aside for the best field. A good way to proceed is to first select the single ear that most nearly represents the type wanted, as to shape of ear and character of kernel, and then, with this ear in one hand, the others should be compared with it, one at a time, until a sufficient number has been selected. To facilitate this work a table of some kind should be provided—a single board will do—upon which the ears may be laid a row at a time. Plenty of time should be given to this operation. A lover of good corn will find the work very interesting and the profitableness of it cannot be overestimated. After this careful selection the ears are ready to be tested for vitality.

TESTING THE VITALITY OF SEED-CORN.

No farmer can afford to neglect the simple vitality test. Many a field has to be planted a second time on account of imperfect germination, and very often a poor stand is allowed to remain or is patched up by replanting odd hills by hand, which is often labor thrown away, except for

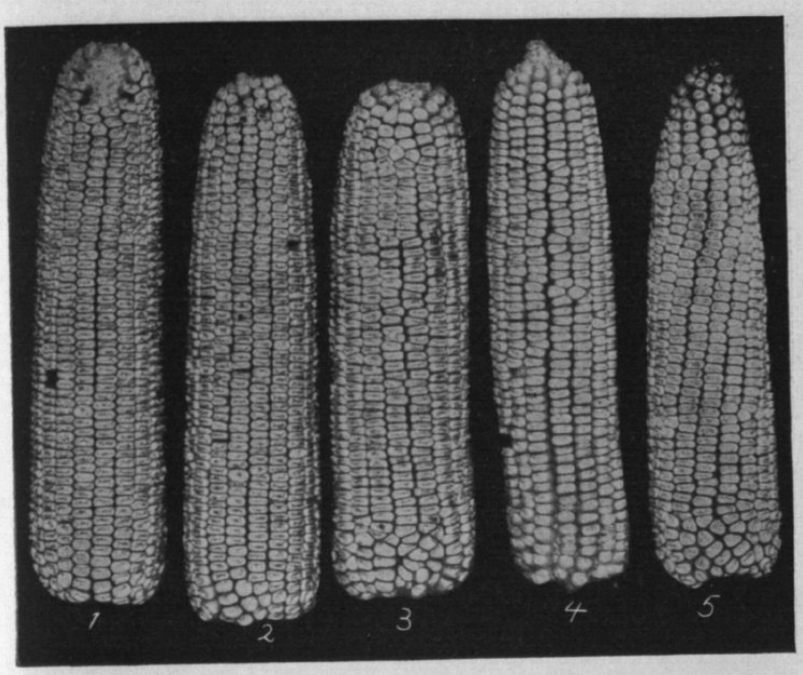


FIG. 3. Good and poor shapes of ears.

the fodder, because replanted hills seldom produce perfect ears, there being insufficient pollen to properly fertilize them.

No one can pick out all the ears of imperfect vitality by a mechanical examination. Most farmers have learned this from the experience of the last two years. It is easy to pick out the ears that are visibly injured, but there are many cases of destroyed or weakened vitality that cannot be seen, even by the most expert examiner. Every weak germ means a weak plant and a small yield. Nearly every corn-field will show many hills with one or more weak plants. These are nearly always directly due to weak germs.

Germination tests should always be made several weeks before the seed is required for planting, so that in case it is not good there may be sufficient time to get a new supply. On the other hand, the testing should not be done until after the corn is thoroughly dry and out of all further danger of injury from overheating, molding, fermenting, or freezing. The month of March is a good time for this work.

There are many simple methods of making the germination test, but in all cases each ear should be tested by itself. Experiments have shown that as a rule the testing of a few kernels picked at random from different parts of the ear will safely determine whether or not the ear should be used for seed. About five kernels should be taken from each ear and kept separate, and the ear from which they came must be marked or placed in such a way that it can be readily located after the

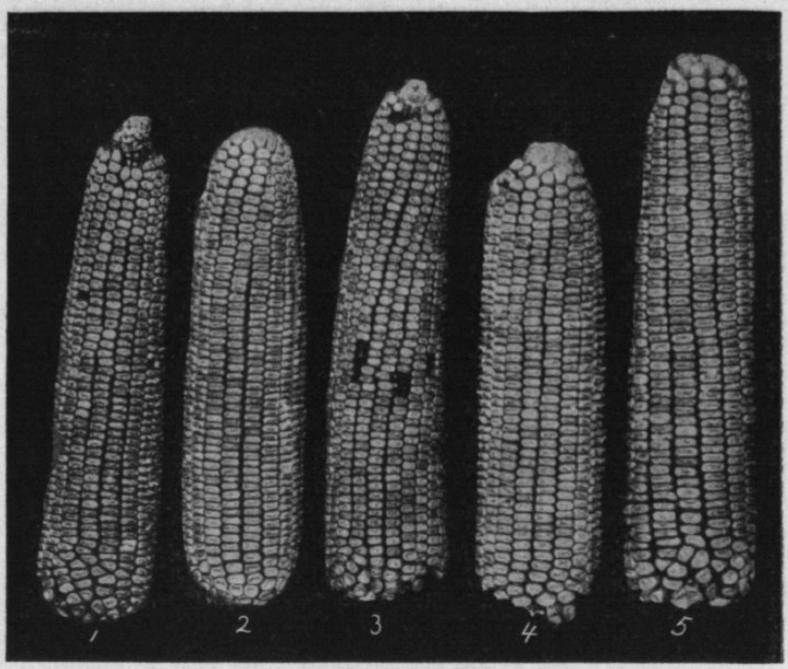


FIG. 4. Different-sized kernels.

test is made. In selecting the kernels for the test, take one from near the butt, three from various parts of the middle portion, and one from near the tip. Look for elevated or swollen spots on the ear from which to take the kernels. If there are any weak germs, they are likely to be found on the swollen spots, because there the cob was probably more or less spongy and retained moisture after the rest of the ear was dry and out of danger of being injured.

The requisites for germination are moisture, warmth, and air. Any chamber or vessel in which these can be provided will answer the purpose. The exact method employed will be largely a matter of convenience. An ordinary dinner-plate with a double fold of moistened muslin between which the kernels can be laid, covered with another plate to prevent too rapid drying, makes a very good germinating chamber. A shallow box into which several lots of kernels may be laid between folds of moistened paper and covered with a lid will do. A shallow box containing moist earth, sand or sawdust in which the kernels may be planted may also be handy. In any case the tester should be put in a warm place, but not too near the stove. The temperature of the ordinary living-room is about right, provided that it does not become colder than fifty-five degrees during the night.

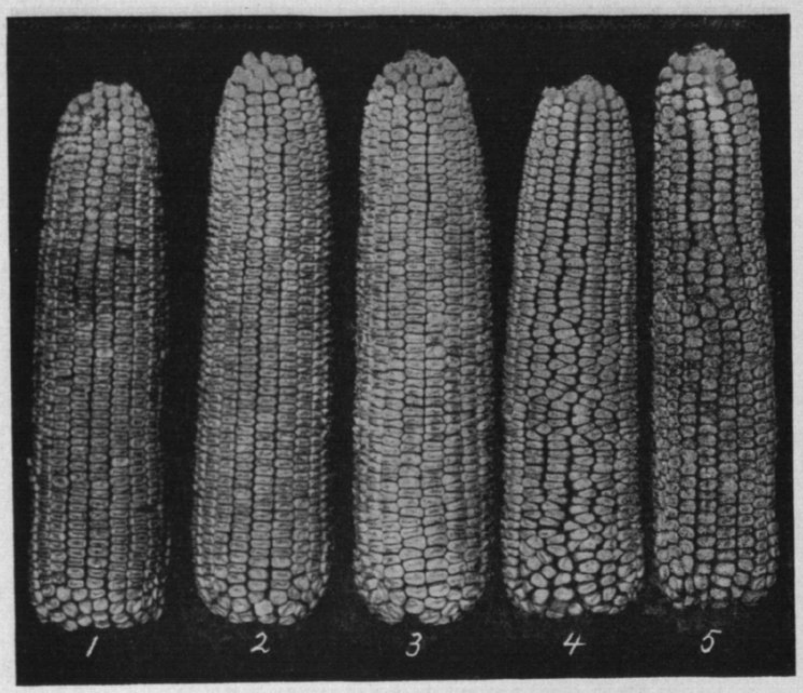


FIG. 5. Uniform and ununiform kernels.

A GOOD SEED-CORN TESTER.

A convenient tester, and one which we would strongly recommend every farmer to use, is shown in fig. 2 (p. 52), and may be made as follows: Take ordinary inch lumber and make a shallow tray of convenient size, say about two by three feet, and two and a half inches deep. Then bore small holes through the sides and ends about two inches above the bottom and about an inch and three-fourths apart. Through these holes string light galvanized or copper wire in both directions. Then fill the tray up to the wires with sand, earth, or fine sawdust. Sand is preferred, because it is clean and easily kept in good condition. Each square marked off on the surface by the cross-wires is intended for the kernels from a single ear of corn. Instead of weaving in the cross-wires as indicated, a piece of large-meshed, wire chicken fence may be fastened in. If this be preferred, the tray should be made two inches deep, then the piece of chicken fence fastened on top, and a half inch strip nailed on top of that, so as to raise the edges of the tray half an inch above the wire netting, as in the other case. After the tray has been filled up to the wire with sand or other material as directed above and thoroughly moistened, the tester is ready for use. If much corn is to be tested, several of these testers should be provided. They are easily made, and with good care will last many years. For the average farmer one will be sufficient, as about three bushels of seed ears can be tested at one time.

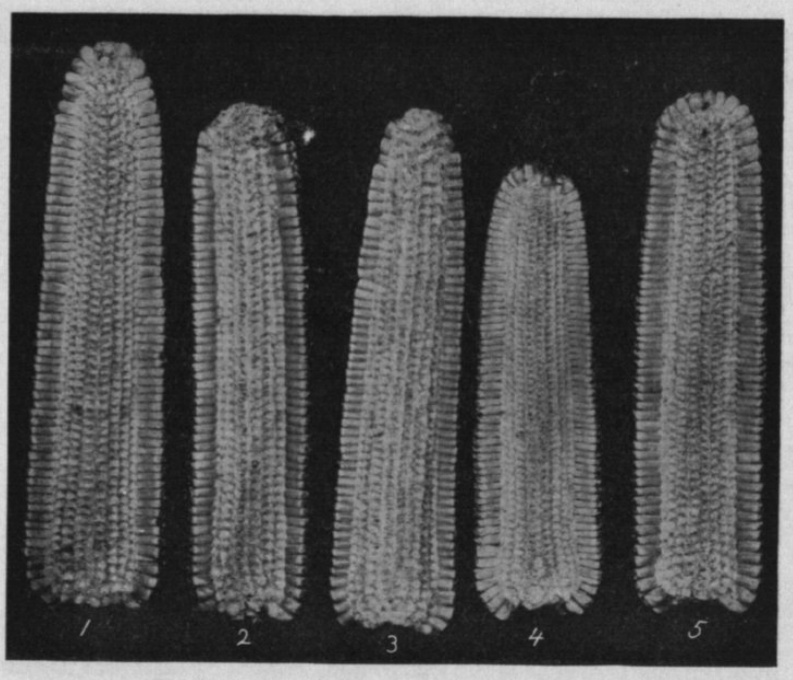


FIG. 6. Good and bad spacing of kernels at the cob.

When making tests, some convenient system of arranging the ears on a floor, table, shelf or rack must be employed, so that the ear corresponding to a certain square in the tester may be readily located. Begin filling the tester by placing five kernels from the first ear, selected as directed above, in the first square at the upper left-hand corner and fill each row of squares in regular order.

After the kernels have been placed, the material in the tester must be kept thoroughly moist. Some kind of cover must be used to keep the surface from drying, and if this is properly done the kernels need not be buried out of sight. Some kind of a glass plate or frame makes the most satisfactory cover. This should rest loosely on the edges of the tester, so as to admit some air. With such a cover, the soil need be moistened only once for each test, as the evaporated moisture will condense on the under surface of the glass and drop down again. When moistening is necessary after the kernels have been placed, a towel or other cloth should be spread on the surface and the water poured gently on top. If this is not done, the water poured on will move many of the kernels out of place.

The tester should be placed in a room ranging around 70 deg. F. in temperature, as stated above. All kernels which do not send out vigorous root and stem sprouts within *five days*, under these conditions, should be considered as too weak to germinate properly under ordinary field conditions. If the germination of any lot of kernels is unsatis-

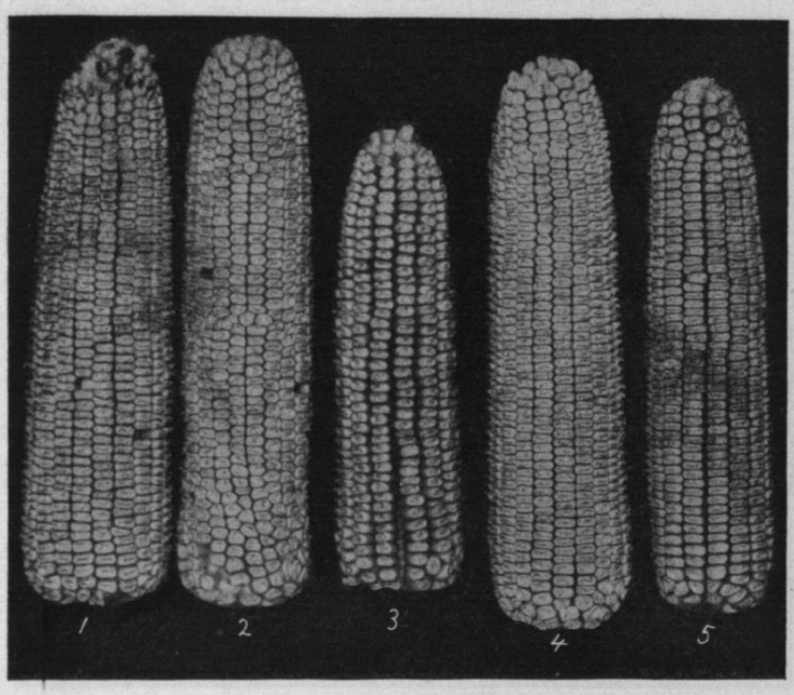


FIG. 7. Furrows between rows.

factory, the ear from which they came should be discarded. About ninety-five per cent. of the kernels should germinate strongly within the five days.

The seed-corn tester should be as important a part of the corn grower's outfit as the planter or cultivator, and its use should never be neglected. A handy person can easily make an individual ear test of five or six bushels in a day, and the labor involved will be paid for many times over in the better stand of plants and the consequently larger crop secured.

PREPARATION FOR PLANTING.

After the seed ears have been properly selected and their vitality tested as above described, they are ready to be shelled and the grain prepared for planting. The small and irregular kernels at the tips of the ears and the larger irregular ones at the butts must be shelled off and discarded. Irregular kernels in the body of the ear should also be discarded as completely as possible, so that only those kernels which are of uniform size and shape may go to the planter. This is very important, because it is impossible for a planter to drop uniformly the required number of grains per hill if they are not of the same size and shape. A uniform stand of plants can be secured only when the seed is uniform. Many a poor stand of corn is due solely to ununiform seed. It would surprise most farmers to learn how imperfect the stand is in their best

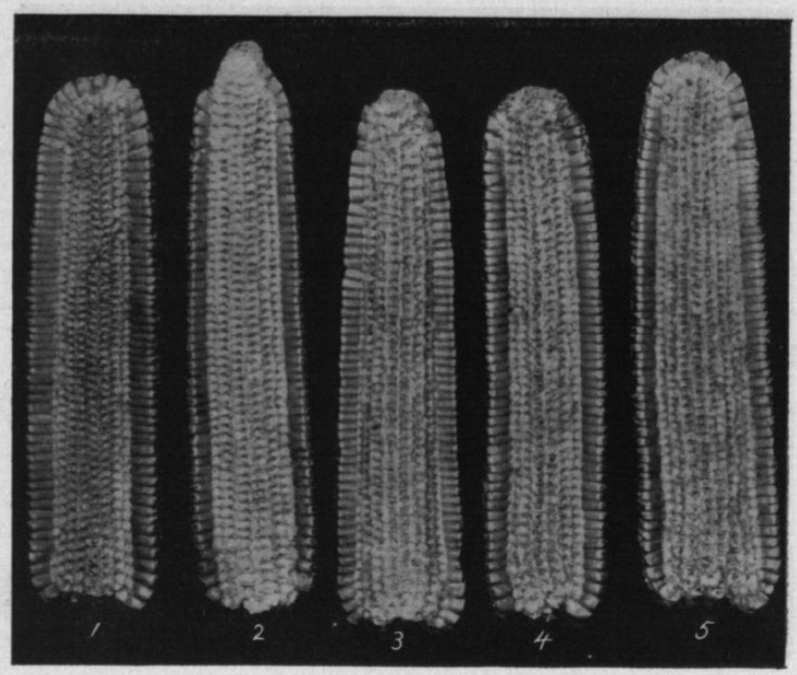


FIG. 8. Deep and shallow kernels.

fields. One has to count the missing hills on an acre and those that have less than the required number of plants to learn the truth.

It is a good plan to use a set of screens of two sizes through which to pass the shelled corn, discarding that which is retained on the larger and that which passes through the smaller. The grain should then be spread out thinly and carefully examined for broken, moldy or otherwise damaged kernels, which must be picked out by hand. When seed of ununiform size must be used it should be graded, by means of sieves, into large, medium and small sizes, and a suitable planter plate used for each size.

There are now on the market a number of simple machines for grading seed-corn which are very useful where large quantities of seed are to be prepared, but for the farmer who has only a few bushels of seed to prepare the eyes and the hands are the best graders.

When one considers how easily a difference in the yield of several bushels per acre may be caused by the character of the stand, he will readily see the wisdom of spending a little extra time in preparing the seed. A couple of hours spent in picking the ununiform, rotten and broken kernels out of a bushel of seed may earn several bushels of corn. The observing farmer will soon learn that he may easily earn dollars for hours spent in preparing his seed-corn.

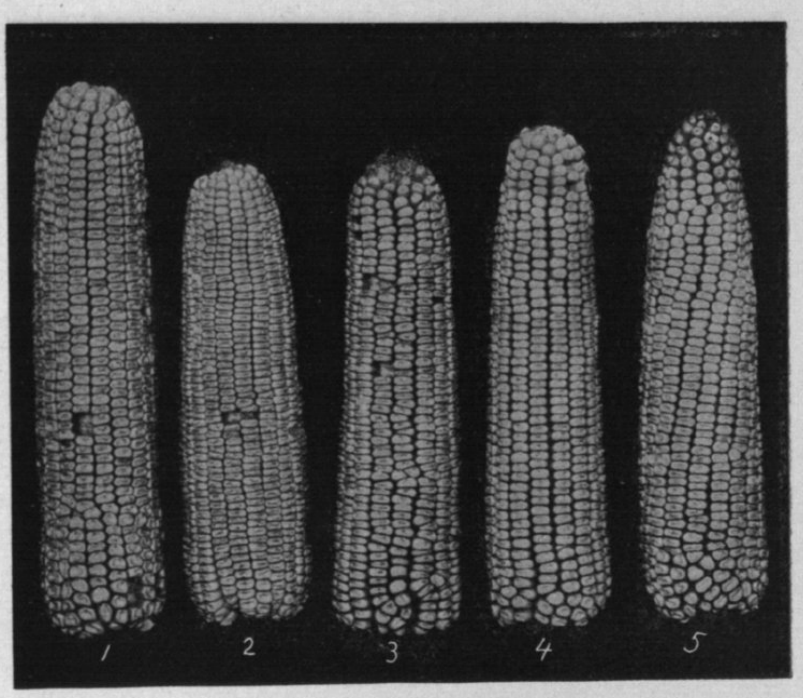


FIG. 9. Five poor ears.

TESTING THE PLANTER.

After the seed-corn has been perfectly prepared there is still one more important thing to be done, and that is to test the planter and make sure that it will drop the required number of kernels at least 95 times out of 100. The planter should be set up on a clean floor or on some boards and operated by hand, using plates with different-sized openings until the pair is found that will drop the desired number of kernels every time, if possible. Most up-to-date planters are supplied with a sufficient number of plates of different sizes, so that it is only necessary to select the right set for the corn to be planted. If the plates do not quite do the work as required, they must be filed or drilled until they will. Generally a very little of such adjusting is all that will be necessary to give a perfect stand of the desired number of plants per hill. A poorly adjusted planter may easily offset the advantages to be derived from well-selected seed, and therefore this simple testing and adjusting should never be neglected.

EFFECT OF GRADING THE SEED ON UNIFORMITY OF DROPPING.

The most up-to-date corn-planter cannot do good work unless the corn kernels it is to handle are approximately of the same size and shape. If all sizes and shapes are mixed, the number dropped at any one time will vary according to the proportions of kernels that are either larger or

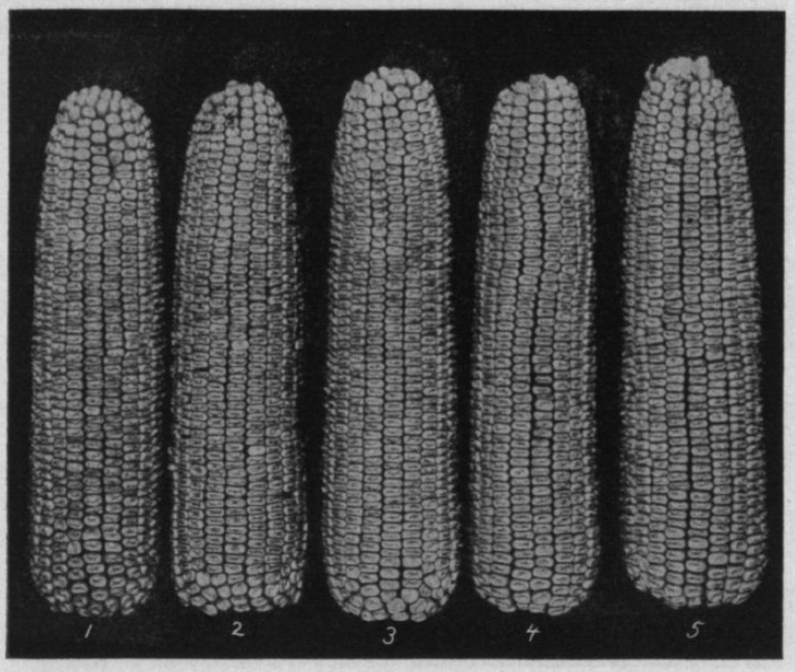


FIG. 10. Five good ears.

smaller than the size for which the plate used is intended. The table below shows the results of dropping tests made with graded and ungraded corn. In each case it was desired to drop three kernels per hill, and several plates were tried. The figures given show the best results that could be secured with the corn used.

RECORDS MADE IN 100 DROPS.

No. of kernels dropped.	Middle kernels only.	Whole ear.	Deep and shallow kernels mixed.	Deep kernels only.	Shallow kernels only.
1	.....	1 time	.....	.....	2 times
2	8 times	6 "	5 times	4 times	2 "
3	92 "	66 "	75 "	92 "	95 "
4	.....	25 "	18 "	4 "	1 "
5	.....	1 "	2 "	.....	.....
6	.....	1 "	.....	.....	.....

It will be seen that, when the large, irregular kernels from the butt of the ear and the small ones from the tip were mixed with the more uniform kernels from the middle of the ear, it was impossible to get anything like a satisfactory stand, and the same was true when deep and shallow kernels were mixed; but when the butt and tip kernels were discarded and the deep and shallow ones separated an almost perfect drop-

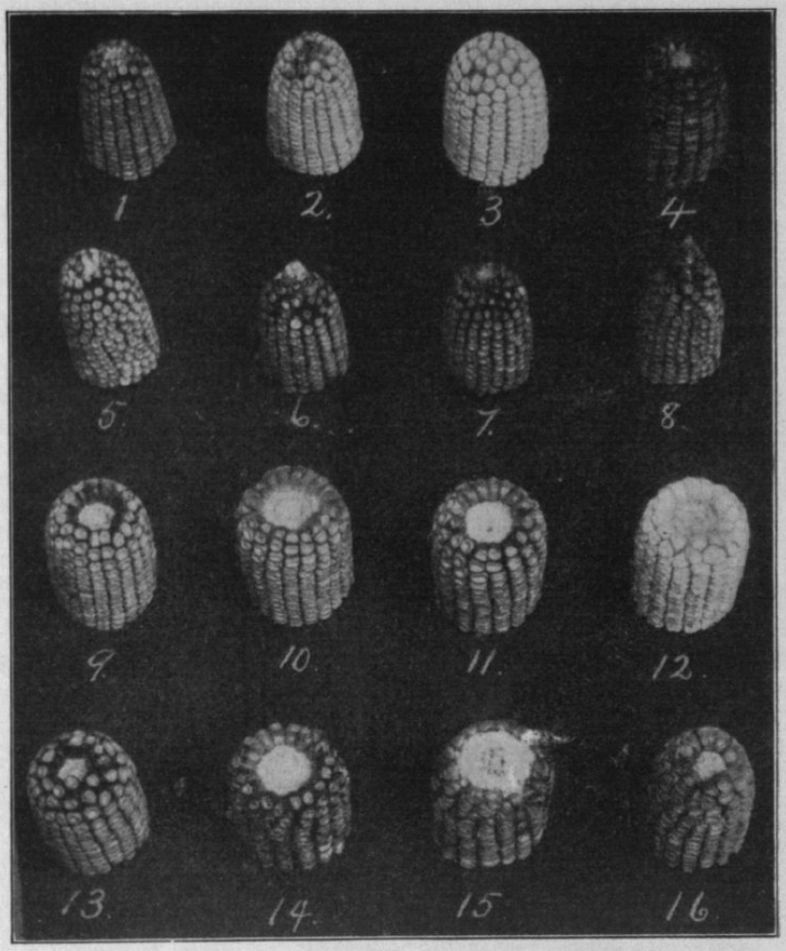


FIG. 11.

ping was secured in both cases. These planter tests very strongly emphasize the advantage of properly grading all seed-corn and selecting the right plates to drop it.

PLANTING AND CULTIVATION.

As a rule, corn should be planted in hills, or check-rowed, if only for the reason that it may be better tended by cultivating both ways. No definite rule can be laid down as to the thickness of planting. The best distance between rows and the number of stalks per hill, or the distance between stalks in drills, will vary with the size of the variety and the character of the soil and climate. Under average conditions, with an average-sized variety, about 10,000 stalks per acre will usually give the best results. The richer the soil the thicker may be the planting, and the

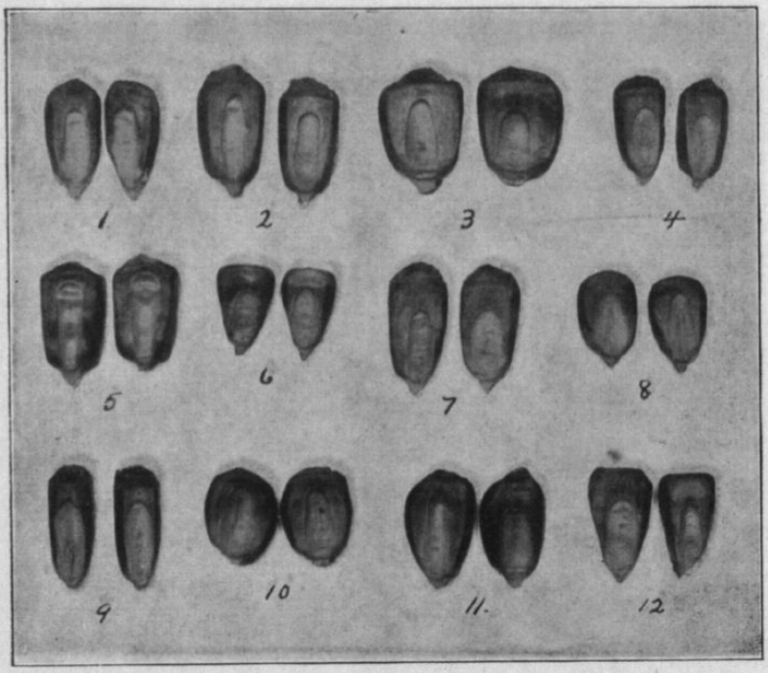


FIG. 12. Various types of kernels.

larger the variety the thinner it should be. The best thickness must be determined by each farmer for himself.

The ground should be deeply and finely prepared before planting. No amount of cultivation after planting can make up for a poorly prepared seed-bed. Cultivation should be thorough from the beginning of growth until the tassels appear, and frequent enough to keep a clean, fine, loose mulch of earth, two or three inches in depth, on the surface throughout the season. Before the corn is large enough for the ordinary cultivator, a light harrow or weeder, which will break any crust that may have formed and kill small weeds, should be used. The first and second times over with the regular cultivator should generally be deep, but subsequent cultivations must be shallow, so as not to disturb the roots. It should never be necessary to use a large-shoveled cultivator. The small shovel stirs the ground more completely and leaves it more level, causing less evaporation of moisture. After the corn is too high for the two-horse cultivator a one-horse implement should be used. The corn-field should never be laid by before the tassels appear.

TYPES OF EARS AND KERNELS.

The following photographs of ears and kernels were prepared with a view to serving as aids in the selection of good seed-corn. They illustrate desirable and undesirable types of ears and kernels, not in a glaring way,

but in such a way that, with a little study, good and poor seed-corn may be recognized.

A perfect ear of corn should be full and strong in the middle portion, indicating a strong constitution. It should retain its size to near the tip, giving a large proportion of corn to cob. The kernels should also retain a uniform size and depth to near the tip, and the rows should be straight. The tip should taper but slightly and then round off in a neat oval.

Ears 1 and 2 (fig. 3) represent ideal forms. They are well proportioned and strongly developed.

Ear 3 is too heavy and blunt at the tip, indicating coarseness. It is also somewhat depressed or weak near the butt.

Ear 4 is decidedly weak and imperfect at the butt, denoting a weak constitution.

Ear 5 is too tapering and the tip is too pointed, showing weakness. The kernels towards the tip are shallow, rounded, and ununiform with the rest of the ear. The proportion of corn to cob is relatively small. Ears 3, 4 and 5 are all undesirable for seed.

Figure 4 shows wide variations in size and type of kernels. They are so different in size and shape that if shelled together for seed no planter could possibly drop the same number of kernels per hill. Ears 2 and 4 would go together very well, but otherwise no two would do for the same lot of seed. The kernels on ear 5 are much too large for any dent variety, while those on ear 3 are rather small, besides being more or less ununiform.

The kernels in a good seed ear should be uniform in size and shape throughout the ear, and all ears to be used together should have similar kernels.

Ears 1 and 2 (fig. 5) have fine types of kernels, of very uniform size and shape.

Ear 3 has a good form, but is not a good seed ear. A close examination will show that the kernels are, many of them, weak and of ununiform shape, varying much in thickness.

The kernels of ear 4 are much too irregular in shape.

Ear 5 has several broken rows. The kernels are too thick and also otherwise ununiform.

The kernels in the rows, as well as the rows of kernels, should fit closely together at the cob, showing a full, strong development. Wide spaces are often found and are due to shrunken or pointed tips. The tip end of the kernel should be strong and full, giving room for a large, deep germ. Since the germ is largest at the tip of the kernel and contains a large per cent. of protein and nearly all the oil, a strong tip is essential to a high feeding value.

Ears 1 and 4 (fig. 6) show wide spaces between the kernels at the cob, ear 4 being particularly bad. The tips of the kernels are very much shrunken, of poor vitality and low feeding value. Such space is very objectionable. Both ears look good from the outside.

Ears 2 and 3 are fairly perfect, the kernels fitting closely together from tip to crown.

Ear 5 is also fair, but shows quite a number of small spaces at the cob.

The edges of a well-shaped kernel should be almost straight, and the rows of kernels should fit together fairly closely. The furrows should be merely wide enough to admit air to facilitate drying. The spacing at the crowns may be too close, especially in large ears, making them dry too slowly and liable to mold.

The furrows on ear 3 (fig. 7) are far too wide, indicating a small proportion of corn to cob. The furrows on ear 5 are also too wide.

The rows on ear 2 are rather close together, and in places the kernels have pinched each other out of the cob.

Ears 1 and 4 are very nicely spaced.

The kernels should be deep throughout the length of the ear, as shown in ear 1 (fig. 8). It is, however, possible to have too small a cob, which would indicate a weakened constitution and small yielding power.

The kernels on ears 2 and 5 are too shallow, showing too small a proportion of corn to cob.

The kernels on ear 3 are too shallow near the tip, while ear 4 is fairly good and ear 1 is excellent.

All of the ears in figure 9 are undesirable for seed purposes.

Ear 1 is weak in development a short distance above the butt and the kernels are too thick and irregular in shape, besides being rather smooth and shallow.

Ear 2 is very objectionable on account of its weak, chaffy, shrunken kernels.

Ear 3 is fairly strong in type but its kernels are too irregular.

Ear 4 has kernels that are too much rounded on the edges, rather smooth and much too shallow, showing a small proportion of corn to cob.

Ear 5 is much too tapering and pointed, besides having a large proportion of ununiform kernels.

Figure 10 shows five ears that are almost ideal in type and uniformity. They need no apology.

GOOD AND POOR TIPS AND BUTTS.

In selecting seed ears the characters of the tips and butts should always be considered. The character of the butt is especially important as an indicator of good breeding. Nos. 9, 10, 11 and 12 (fig. 11) are all good butts. No. 9 is particularly uniform, but the kernels are a little too thick. In No. 10 the kernels are most regular. No. 12 is well rounded and deep, but shows some irregular kernels, which is its only objectionable feature. Nos. 13, 14, 15 and 16 are all poor butts. No. 13 is too pinched and has too small a shank. No. 14 is too open. No. 15 is flat and shallow and the shank is much too large and coarse. No. 16 is too compressed and pointed, besides being quite shallow and having too small a shank.

The tip of the ear should be well filled with deep, regular-sized kernels. Uniformity with the rest of the ear in size, shape and depth of kernel is more important than complete covering of the tip. Nos. 1, 2, 3 and 4 (fig. 11) are all good tips, No. 4 being particularly fine although not completely capped over. Nos. 5, 6, 7 and 8 are all poor tips. The kernels on No. 5 are shallow and very irregular, while No. 8 is much too pointed.

Pair 2 (fig. 12) are excellent kernels, and 4 and 5 are also good.

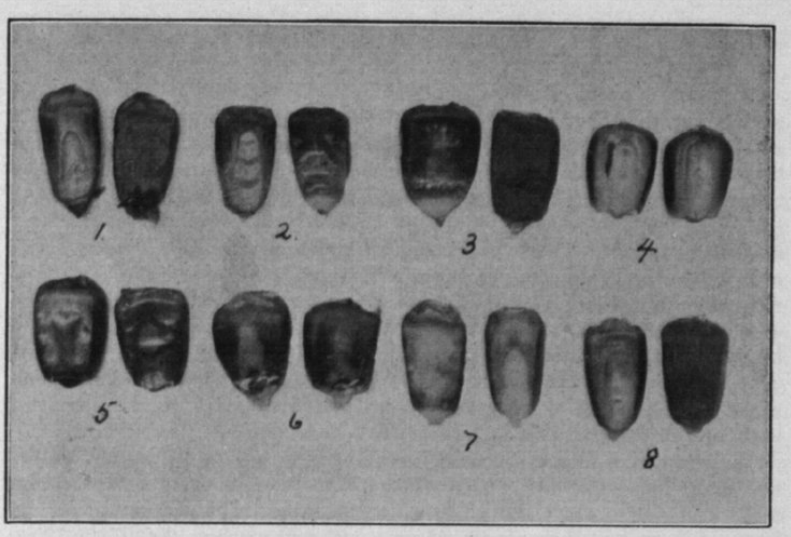


FIG. 13. Immature and damaged kernels.

Pair 1 are rather pointed and rounded on the edges. Pairs 6 and 12 are much too pointed and weak at the tips. Pair 3 are much too large. Pairs 8, 10 and 11 are too short and rounded, pair 10 being particularly poor in shape. Pair 7 are thin and chaffy, and pair 9 are too narrow.

A good kernel must be full and strong at the tip, giving room for a large germ, which is essential to strong vitality and high feeding value. The edges should be nearly straight, but they must converge towards the tip sufficiently to allow the rows to fit closely together. In other words, the kernel should represent the thick end of a wedge in shape. A good kernel must also be of uniform thickness from crown to tip. The right-hand kernel of pair 2 is almost ideal in size and shape for a medium-sized dent variety, measuring a strong five-sixteenths of an inch in width, five-eighths of an inch in length, and nearly one-sixth of an inch in thickness.

A mature kernel should have a clean tip, a uniform color on back and front, a smooth, full germ, and a fresh, glossy appearance.

Pair 1 (fig. 13) have chaff and bits of cob adhering to the tips. No. 2 are blistered on back and front. If the skin over the germ is blistered it indicates that the germ has started to grow. The left-hand kernel in pair 3 has light-colored spots on the back, an indication of immaturity. The right-hand kernel shows a well-matured back, of uniform color. Pair 4 show broken tips, the tips having remained in the cob, exposing the germs, which would be more liable to decay in cold, wet ground. Pair 5 are badly blistered and off color on back and front. Pair 6 are cracked and decayed near the tips. Pair 7 have a light, dull color and are generally chaffy. Pair 8 are well-matured, strong kernels.

CORN BREEDING FOR PRACTICAL FARMERS.

The improvement of corn by breeding along definite lines is no longer a work for the scientist or professional seed-corn grower alone. That it can be done easily, and by every farmer on his own farm, has been proven beyond a doubt. Simple and effective methods have been worked out and thoroughly tried. These any farmer can follow, and, by the use of a little judgment in selecting his seed, he can, in a short time make very marked progress towards producing what he wants. The greatest success will, of course, come to those who have a taste for the work and who are prepared to give it the necessary care and attention. If properly attended to, the time given to the work will be many times repaid by the larger and better crops produced. Selecting seed from the products of individual ears is the only rapid way of improving corn along any line. A study of the yields from individual ears recorded in this bulletin will show what may be expected.

Corn breeding is easy because the plant is large and all its characters are easily distinguished, and variations are consequently easily recognized. It is also easy because types or characteristics are not so rigidly fixed as in many other plants. Variations are marked enough and frequent enough to permit of easy selection of individuals with desirable characteristics. It is also easy because of the large number of kernels produced by an individual and the consequent rapidity with which a desirable strain can be multiplied. Corn breeding is difficult because of the natural cross-fertilization and the consequent difficulty of isolating the breeding plat and keeping the breed pure. The dangers of close fertilization and self-fertilization are also difficulties which must be constantly guarded against.

BREEDING FOR LARGE YIELDS AND UNIFORM QUALITY.

The most simple way for the farmer to breed better seed-corn is by selecting a bunch of the very best ears obtainable and planting them in a place by themselves, or on one side or in one corner of his corn-field, and selecting his seed from this portion of the field, and again planting the best of it by itself year after year.

A still better way, but one requiring a little more work, is to plant the very best ears one to a row, determining the yield of each and selecting seed from the highest-yielding rows. The best ears from the highest-yielding rows are then selected for planting the breeding plat the following year, and so on. By this method the low-yielding ears can be weeded out and seed selected from the best only. To prevent the ill effects of inbreeding, the rows from which seed is to be selected should be detasseled before pollen is produced. To get the best results from this method, a comparatively large number of seed ears must be used each year and seed for the next year's plat selected from at least several of the best rows.

For the man who wants the best and can give a breeding plat a few days' extra time, the method we have adopted in the experiment station work will be thoroughly practical and highly profitable. The method is as follows: Eighty to 100 good seed ears of the desired type and variety

are selected and carefully tested, to make sure that all will grow well. If a good type is not at hand, it will be wise to purchase a few bushels of good ears rather than spend valuable time in trying to breed up a poor variety. It is like laying a foundation for a good herd of animals; the best obtainable should be secured as foundation stock. A clear idea of the type desired must be had in mind when selecting the ears. A study of the illustrations in the preceding portion of this bulletin will be found useful in making this selection. All the ears selected should be as nearly alike in every respect as possible. The best forty out of the eighty or more ears are then selected for planting in individual rows. The others are shelled together and may be called "bulk seed."

A uniform piece of ground about 220 feet long by 300 feet wide is then selected for the breeding plat. This may be located in a place by itself, away from all other corn-fields, or it may be one corner of a regular corn-field planted with the same variety. If the latter location be chosen, it should be the southwest corner of the field, as the prevailing winds at tasseling-time usually come from the south or west, and the breeding plat should be protected as much as possible from the pollen of the corn in the main part of the field. Owing to the fact that corn is wind-pollinated it is difficult to prevent cross-fertilization from other corn, which can seldom be altogether avoided. As an additional safeguard against ill effects, all that portion of the corn-field lying next to the breeding plat should be planted with specially selected seed. Pollen will blow half a mile on a windy day. In locating the breeding plat, the position of neighbors' corn-fields must, therefore, also be considered. The danger of mixing can often be avoided by a week or ten days earlier or later planting.

After the breeding plat is located the planting is commenced at one side by planting two rows through, sixty hills long, with bulk seed. After turning to come back, the box on the side of row 4 is emptied and corn from the first of the individual ears put into it. Rows 3 and 4 are then planted. After turning both boxes are emptied and bulk seed put into the one which is to plant row 5, and seed from the second individual ear put into the box which is to plant row 6. After rows 5 and 6 are planted both boxes are again emptied, and the bulk seed put into the one which is to plant row 7 and seed from the third individual ear into the one which is to plant row 8. This process is repeated until row 82 is planted, and then three more rows are planted with bulk seed. This gives a plat of eighty-five rows, the even-numbered ones, beginning with 4 and ending with 82, containing the forty individual ears, and three border rows on each side and all the odd-numbered rows between containing bulk seed.

At tasseling-time all of the tassels in the individual-ear rows are removed as soon as they appear. This insures the fertilization of these rows by pollen from the bulk-seed rows on either side and prevents inbreeding. The weak and barren stalks in the bulk-seed rows are also detasseled, so as to make sure that only good, ear-bearing stalks take part in fertilization. In the work of detasseling it is necessary to go over the plat several days in succession, as all the tassels do not appear at the same time, and care must be taken to remove them before they shed pollen. The tassels should be carefully pulled out, and without

otherwise injuring the stalks. If the corn is so tall that the tassels are not easily reached, it is a good plan to carry a light packing box or something else upon which to stand while pulling the tassels.

At husking-time both ends of the rows are trimmed so as to leave fifty hills in each. The individual-ear rows are then gone over and about ten of the best ears from the best stalks in each husked and kept separate by careful labeling, as from these lots the seed for the next year's plat is to be selected. All of the individual-ear rows are then husked separately and the total product of each determined by weighing. After this is done, the first-picked ten-ear lots which came from the sixteen best rows, as determined by yield and quality, are put away separately until the next spring, when they are tested and the best five from each of the best eight rows selected for planting the forty individual-ear rows of that year's breeding plat. In the same way the best five ears from each of the second best eight rows are selected, and these are shelled together to plant the bulk-seed rows.

The remaining good ears from all of the sixteen best rows are then mixed and the seed used to plant a multiplying plat to provide well-bred seed for the whole of the main crop the following year. This multiplying plat may be a small field by itself, or it may be a portion of a larger field.

After the first year, in order to prevent inbreeding as much as possible, care should be taken to select each of the two groups of eight rows from which seed is to be saved for the next year's breeding plat in such a way as to have represented as large a number as possible of the rows which furnished seed the year before.

In the breeding work of the station a description of each of the forty individual ears is made before planting and filed away for future reference. Record blanks for this purpose will be furnished to any one desiring them. Care is also taken to get a uniform stand by planting all the rows with three or four kernels per hill and later thinning to a uniform stand of either two or three stalks per hill, according to the condition of the soil. At harvest-time records are also made of the exact stand, number of suckers, barren stalks, etc., and these are taken into account in selecting ears for the next year's work. The yield of each bulk-seed row is also determined separately. This gives us a uniform basis upon which to compare the yields of the individual-ear rows. The yield of each individual-ear row is compared with the average yield of the two flanking tassel rows. The proportion of ears true to type is also determined in each individual-ear row, and the results used, together with the other data, in determining the best rows from which to select seed for the next year's breeding plat.

The beginner in corn breeding need not be deterred by the labor involved. It will be found to be the best-paying work on the farm. Even though all the details of the system outlined above cannot be carried out, every farmer who produces his own seed-corn should use the individual-ear and row method.

BREEDING FOR HIGHER FEEDING VALUE.

In breeding for higher feeding value the same general methods as in breeding for yield and uniformity are followed, with the addition of

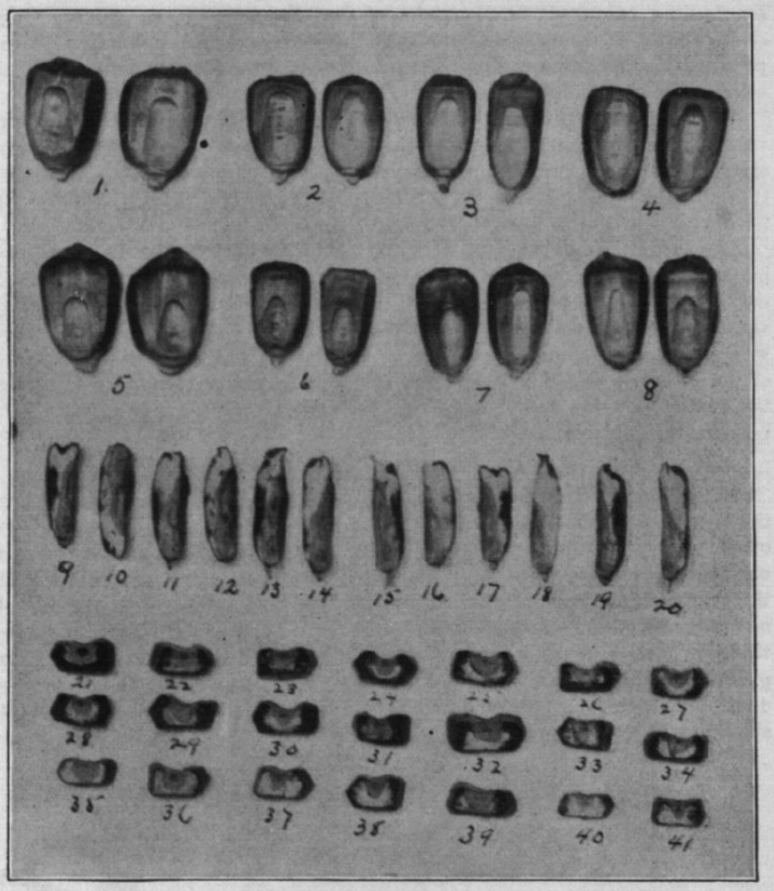


FIG. 14. Showing differences in proportions of germ, hard, horny matter and white, floury matter in kernels from different ears of corn.

selecting the ears that are rich in the important food constituents, namely, protein and oil.

In selecting ears for this purpose, due attention must be given, first of all, to yielding power and uniformity. These qualities must never be lost sight of; otherwise, while improving the feeding value per pound of corn, the variety may be injured in other respects.

The feeding value of a grain of corn depends upon the amount of protein (flesh-producing material) and fat it contains. The germ is rich in protein and contains nearly all the oil in the kernel. The hard, horny matter contains most of the protein, while the white, floury portion contains relatively little of either protein or fat. Bearing this in mind, the relative feeding value of two ears of corn can be roughly determined by an examination of the kernels. The larger the germ and the greater the proportion of hard, horny matter to white, floury matter the higher

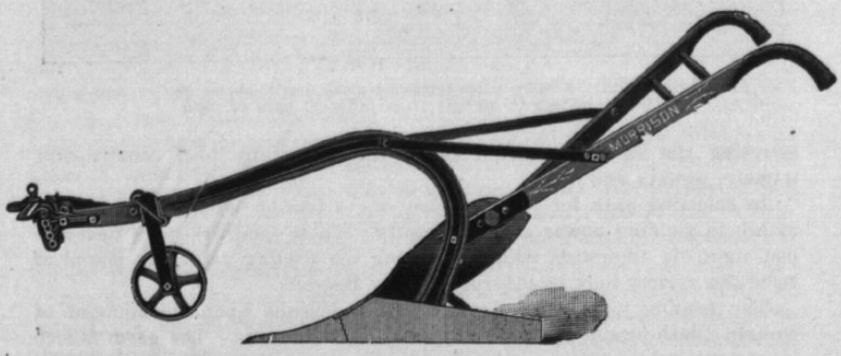
the feeding value. It has been found that the ears of any variety vary considerably in composition, but that the kernels on each ear are of approximately the same composition. It is therefore comparatively easy to select the ears of highest feeding value.

Figure 14 shows, in the upper row, kernels from ears of high feeding value. Observe the large germs. The second row shows kernels from ears of the same varieties which are low in feeding value. The longitudinal and cross-sections of kernels show very clearly how widely the proportions of germ, hard, horny and white, floury portions may vary.

The larger the number of ears from which selection can be made the better. Select for their general qualities several times the number of ears you intend to use and then go over them carefully for their feeding value. Examine several kernels from each ear, by cutting them crosswise through the middle, as shown in figure 14. The relative proportions of germ, horny and floury portions can thus be easily seen. By selecting the richer ears for seed, year after year, the feeding value of corn can be considerably increased.

CARE OF THE BREEDING PLAT.

Sound sense should be exercised in selecting, preparing and caring for the breeding plat. Many beginners in corn breeding make the mistake of selecting a specially rich piece of ground for the purpose, or they pile on an unreasonable amount of manure or fertilizer, with the result that the whole thing is a great disappointment—the stalks grow beyond all bounds; they don't produce good ears; the corn doesn't ripen, or something of the kind goes wrong—it has been killed by kindness. The ground should be simply in good average condition, so that the corn may develop naturally. The seed-bed should be well prepared and the plat should receive good care throughout the season, but no pampering.



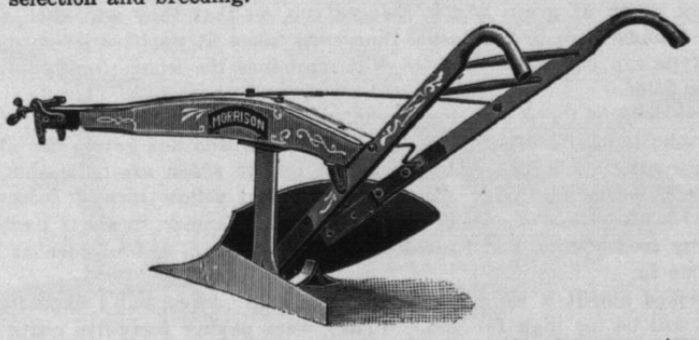
Morrison Manufacturing Company's steel-beam, sloping-landside stubble-plow.

IMPROVEMENT BY SELECTION.

By WALDO F. BROWN, Butler county, Ohio.

Many years ago I wrote on this subject something like the following: "There is no method by which the corn crop can be improved so easily and so cheaply as by the proper selection and breeding of seed." At that time there had been little or nothing done along this line. The farmer usually did not even select his corn in the fall, but went to his crib in the spring and took such as he happened to find. He was cured of this blunder, however, when a late, wet fall and an early winter destroyed the germ of his corn, and he was obliged to plant over the fields, which generally resulted in a crop of inferior quality and a largely reduced yield.

I did not expect to see the advance along this line and this idea worked out as it has been during the last few years. There are now corn-breeders' associations in most of our best corn states, our agricultural colleges are teaching the methods of selection and improvement of corn, and the farmer now, instead of having to begin at the foundation and spend several years in the work, can get the benefit of the labor of his predecessors by buying even a small quantity of improved seed and growing it isolated, so that it will not mix with the other corn, and the first year raise as good corn as he would have obtained by several years of selection and breeding.



Morrison Manufacturing Company's wood-beam stubble-plow—rear view.

This work has been done not only by our college professors and students, but also in some of our common schools, and by individual farmers. As it is a work of time to fix any type of a new plant, it is a great advantage to be able to avail yourself of the painstaking experiments of those who have gone before.

Some thirty-five years ago (but I think I have told this before) I found a single ear of red sweet corn, and, as it was a curiosity, I planted it, and found that it took seven years to establish the type which I desired. I am still experimenting with the same corn, and am now breeding for ears containing ten and twelve rows instead of the eight rows so common on the small, early varieties of corn.

I know a gentleman in my county who began selecting and improving corn almost fifty years ago. I visited his corn-fields something like ten years ago, and decided that he had made a success of his experiments, for I never saw a more uniform type of corn or one that I thought would outyield this corn, which he had been laboring so long to establish. I am glad to notice that he carried off an excellent premium at the Louisiana Purchase Exposition, at St. Louis.

It is not only along the line of a larger yield of corn that these experiments have been carried on, although they have accomplished this and have added probably twenty or twenty-five per cent. to the yield, but also they have been enabled to breed the more valuable feeding elements into the corn—the fat and protein. This, before I had thought much about the matter, seemed to me almost an impossibility, and it would have been, probably, without scientific men in the laboratory, who could, by chemical analysis, select the ears which contained a high proportion of both fat and protein. I have not the exact figures before me, but my impression is that a given weight of corn with this high ratio will be worth several cents a bushel more than that taken from a field where there has been no attempt at improvement.

The exhibit of selected seed-corn at our fairs and institutes, and especially at the experiment stations, shows that almost any desired form of ear can be established by the patient experimenter. Ears containing eighteen to more than twenty rows each; ears the points of which are covered with corn, so that there is scarcely room to put another grain in; ears which are uniform in shape, not tapering to a point, and which have a depth of grain and a reduced cob, so that they will shell out some pounds more to the bushel than corn taken at haphazard—corn of this type can be produced which will reproduce the same when planted in our fields.

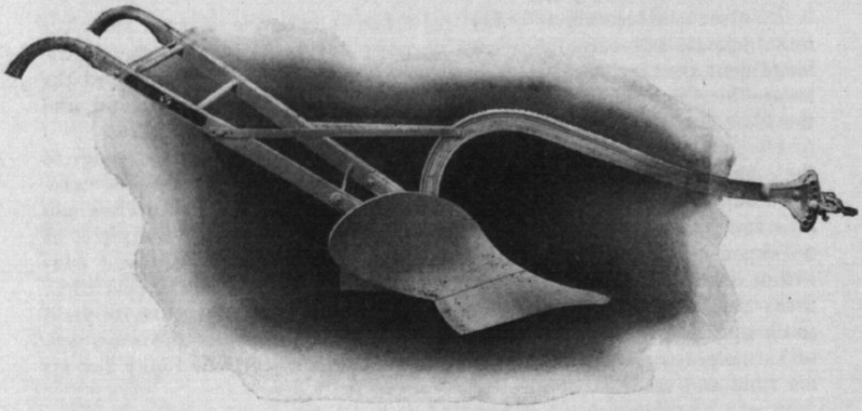
Occasionally there is a man, who, perhaps, has never heard of the corn schools or the experiments at the stations, who has gotten the idea of improving his corn, and has produced results which are noticeable to the most casual observer. Needing some good yellow corn, I recently visited a man I had known to be a very careful farmer, to see if I could get any seed of him, and I never saw as handsome a crib of corn as he took me to.

I asked him if it were for sale, and he said: "Yes, but I expect my price will be too high for you." (They were paying forty-five cents at the station, two miles away.) "What do you want for it?" I said. "Fifty-five cents," was the reply. I closed with him at that price for two wagon-loads, and felt that even if I were going to feed every ear of it to stock it was as well worth the extra ten cents per bushel as the ordinary run of corn was worth forty-five cents per bushel.

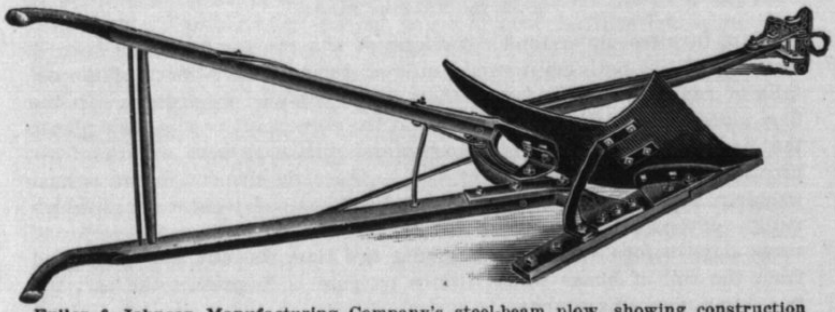
My advice to all would be, that they get enough to plant at least an acre or two of corn from some one of these painstaking experimenters; that they take selected ears of the product of the corn, and weigh them, note the difference between them and other ears, settle on the type that they would like, and then select enough from this experimental plat to plant their entire crop for the ensuing year.

It is well to locate this where it will not be fertilized by pollen from

other corn. One company, in making contracts with those who grow seed-corn for it, stipulates that it shall not be planted within ten rods of any other corn. I think it would be better to multiply this by four, and have it forty rods away. If, however, you must plant it contiguous to a field of ordinary corn, place it on the west side; as the prevailing winds are mostly from the west and north, and the pollen will rarely blow in the opposite direction.



Fuller & Johnson Manufacturing Company's steel-beam walking plow. Price in Kansas, (about) $14 to $16.



Fuller & Johnson Manufacturing Company's steel-beam plow, showing construction of bottom.

From some experiments of which I have been cognizant, I believe a late variety of corn, too late to mature in the latitude where one lives, can be bred for earliness, so that in a few years it will become adapted to the climate, and will mature thoroughly.

The method of doing this is to gather the corn when it is in the roasting-ear stage and hang it up in an airy place (a hot attic is perhaps best) and cure it thoroughly before cold weather. The grains may shrink until they look almost as light as some of the varieties of sweet corn, but they will grow with even greater vigor than if allowed to ripen on the stalk, and a few years of this selection will establish the habit of

early ripening, so that it can be grown to maturity where it formerly did not ripen.

The handsomest corn I have seen this year is a sample from Kansas—a large white corn, with beautiful large grains and a very strong habit of growth; also, the habit of producing twin ears on quite a per cent. of the stalks. I shall plant in an isolated plat an acre of this, sixty rods from any corn that will mature at the same time, and select from it the best seed the coming year.

It is very interesting to study the different varieties of corn, from the most delicate pop-corn, with ears perhaps but three inches long, to the large dent corn, which I have seen with thirty rows to the ear, and the long, flint, eight-row varieties which are grown in New England and the North. One could make a very interesting collection of these.

I would advise the farmers interested in improving corn to write to their experiment stations for bulletins along this line, and make a careful study of them. Certainly, if we can add, as I firmly believe we can in a few years of careful selection, ten bushels per acre to the yield, at no expense except painstaking care in the selection of seed and educating ourselves up to the point that we can know what is the best corn, there is no way in which we can improve our crop and increase its yield so cheaply. And usually the farmer who will do this can sell seed-corn to his neighbors at an advanced price that will more than repay for all his time and labor.

HOW THE CORN PLANT REPRODUCES.

From the *Nebraska Farmer.*

Most farmers understand something of the process by which corn is reproduced, but perhaps it would interest some to know more of the details of reproduction, so far as they are understood at present. In the first place, it should be understood that the corn plant is a perfect plant; that is, each plant possesses stamens and pistils, or both organs of reproduction. The stamens correspond to the male element in the animal kingdom, and the pistils correspond to the female element, or that which really reproduces. The miniature tassels usually appear from two to seven days before the silk. At about the time the silk has protruded from the roll of husks whose future purpose is to protect the ear, the tassel has reached maturity.

Each tassel is made up of many sections, and on these sections are filaments, bearing tiny sacs which contain innumerable grains of pollen. When the tassel has reached the stage of maturity referred to above, these pollen sacs, called anthers, open, and the pollen is free to drop out. The Iowa Experiment Station made a count of the number of pollen grains in an anther, and thus ascertained the number of grains on a tassel, which was found to be between forty-nine and fifty millions. The mission of these pollen grains is to cooperate with the silks in producing the individual grains of corn. Each silk leads to an embryo grain of corn. As stated above, the silks are the pistils.

On the protruding end of the silk is a little roughened surface called the stigma. This catches the pollen grain as it falls, and by some mys-

terious means, understood only by the Creator, the union of the life principles of the germ of the pollen and the germ of the silk is brought about, and we say the ear is fertilized; that is, the many miniature grains are brought to life. From this time on the grain receives its nutriment from the stalk through the cob, and the tassels and silks have no longer a mission to perform; hence they soon die and wither away.

Each grain of corn is fertilized through its own individual silk. If one silk fails to receive any pollen as it falls, the grain which that silk should have fertilized will be missing from the ear. An average-sized ear has approximately 1000 silks. When we consider that every tassel sheds nearly fifty million pollen grains, it would seem almost impossible that any silk should fail to catch a part of this. There are, however, many causes for poor pollenization, some of which are within the control of man, and others which nature alone can control. As the silks could not be expected to catch all the pollen, much of it would naturally fall to the ground, where it would repose until it returned to the dust from which it came. Much of the pollen falls on the leaves, where it can do no good, and also much of it is carried away by the wind. These are necessary losses, dictated by the whims of nature, but another important factor influencing the fertilization is the uniformity in the time of tasseling and silking. The tassels and silks should appear at practically the same time, not only on the individual stalk, but through the whole field.

When a stalk sends out its silks before the main portion of the field is in tassel, that bunch of silks is apt to receive scarcely any pollen, and by the time the main season for pollenization is at hand these silks will have withered, and will no longer be able to utilize the pollen which falls upon them. Another more serious cause of poor fertilization is the late appearance of the silks; that is, a portion of the stalks fail to put out their silks in time to catch the pollen as it falls from the tassels. Of course, in this case the silks are not fertilized, and here one of the strange vagaries of nature is evidenced. When these late-appearing silks fail to be fertilized they do not wither and die, as would naturally be expected, but continue to grow longer and longer, seemingly striving hopelessly to reach the pollen, upon the possession of which depends their future usefulness. Sometimes these silks, in their efforts to reach the pollen, will grow eighteen or more inches past the point where they protrude from the husks.

Bees are very useful agents in transferring pollen from one stalk to another, thus lessening the per cent. of inbreeding in the field. By proper selection of seed the lack of uniformity in time of tasseling and silking can be largely overcome. If selection is made early in the fall, care should be taken to select ears that are of the same degree of ripeness, showing that they had been fertilized at practically the same time. The uniformity in time of ripening and also in the height and general characteristics of these stalks is an almost absolutely reliable indication of uniformity in time of tasseling and silking. This is quite an important factor influencing the yield of corn, as any one will be compelled to admit after careful examination of a field of corn. The lesson to be learned from this is, that corn should be selected not only

with due regard to the individual excellence of the ears, but care should be taken to select ears from stalks which have desirable characteristics, and are uniform in time of tasseling, height of stalk, size of ear, and those other minor features, all of which make for general uniformity throughout the field.

SUGGESTIONS TO CORN GROWERS.

From Circular No. 19, by M. F. MILLER, M. S., Agronomist Missouri Experiment Station.

The three important essentials to high yields of corn in any locality are good seed, good soil, and good tillage. By neglecting to give proper attention to any one of these the yield may be greatly decreased; by careful attention to all three the yield may be increased to a maximum. Probably the essential that is deserving of most special attention at this time is that of the seed. Proper attention to the selection and care of seed-corn would increase the average Missouri corn yield not less than twenty per cent. at a conservative estimate, and many careful men can increase the yields on their individual farms much more than this. It is with the idea of calling especial attention to this important detail in corn growing that this circular is issued.

It has been found by investigation that the average stand of corn is usually not above seventy per cent. This means that where a man is growing one hundred acres of corn he is harvesting a crop which could be grown on seventy acres. The cost of plowing, planting and cultivating is the same whether we have a stand of seventy per cent. or of ninety-five per cent., so that any increase in the yield of corn resulting from a good stand will be almost pure profit. The difficulty of getting perfect stands lies almost entirely in the improper attention to selection and care of seed ears, and a careful attention to this one particular offers large opportunity for increasing the yield of corn.

Seed Should Be Evenly Distributed.—An essential step in securing a perfect stand of corn is to get an even distribution by the planter. The average corn-planter will drop quite accurately, providing the kernels that are put through it are of uniform shape and size. Reference to figure 1 will show three ears of corn from the same field which differ largely in the general character of the kernels. The ear on the left bears broad, rounded kernels, the one on the right deep, pointed ones, while the middle ear shows a shape and size differing from either of the others.

A planter may be adjusted to plant kernels from either of these ears quite uniformly, when they are planted separately, but not when the three are shelled together. It has been found, for instance, that after shelling the butts and tips, if the kernels from a single ear are placed in a planter box and the plate properly adjusted, a good planter will drop, say, three kernels in a hill ninety to ninety-five times in a hundred; but when corn from ears of such widely differing kernels is mixed, no adjustment of the plates will allow the planter to drop over seventy-five to eighty hills of the required number of kernels. The importance of

selecting seed ears which have as nearly as possible the same shape and size of kernels is thus emphasized. Whatever type of ear one prefers, therefore, let that type alone be selected for planting, and let the plates of the planter be arranged to drop accurately the number of kernels desired.

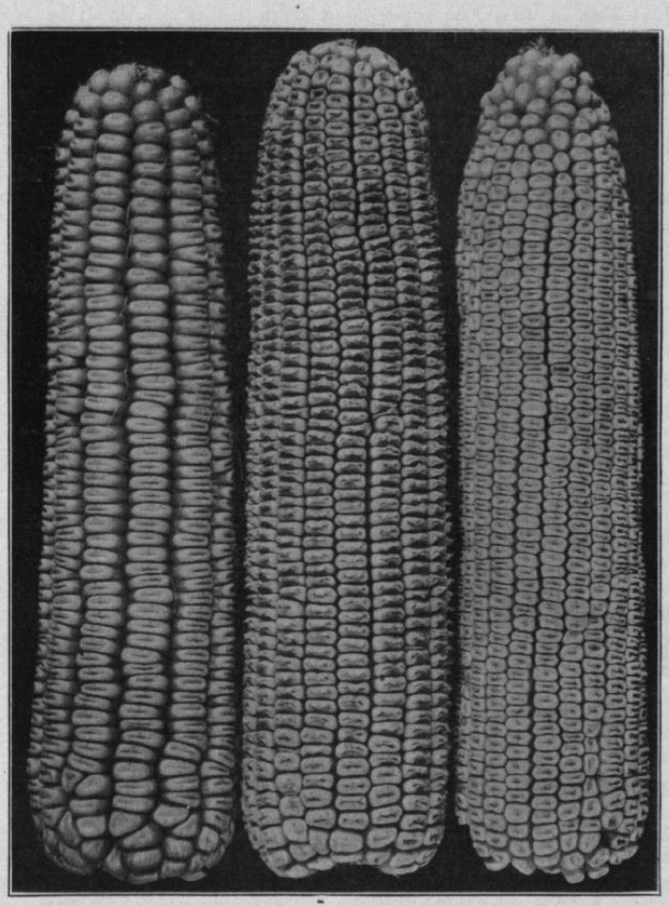
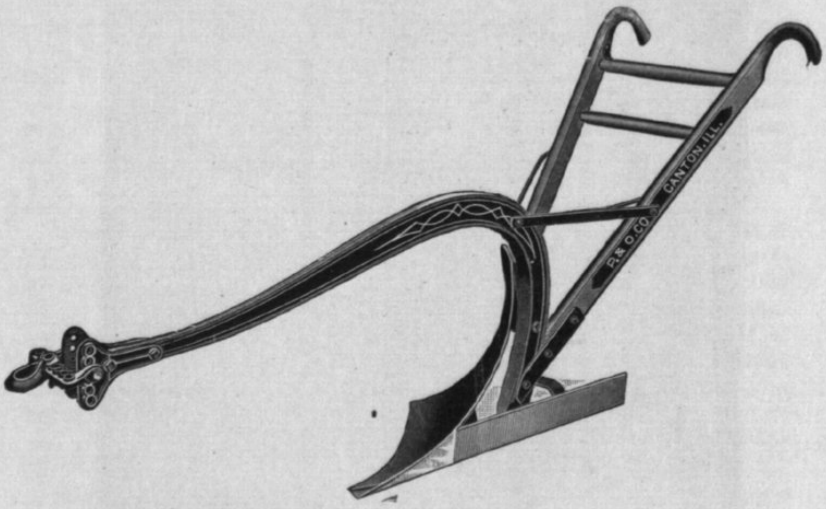


FIG. 1. Ears showing variation in the shape and size of kernel.

A second means of controlling the uniformity of distribution is found in the custom of removing the butt and tip kernels of the seed ears. It has been determined experimentally that when all the kernels of an ear are shelled together a good planter will not drop over seventy to seventy-five per cent. with the proper number per hill, but when the irregular kernels from butt and tip are removed, the same planter will drop as high as ninety to ninety-five per cent. with the desired number. It is, therefore, always necessary that butts and tips be removed from ears before shelling.

Plant Corn of Strong Vitality.—The failure to plant corn of strong germinating qualities is undoubtedly responsible for the greater number of poor stands of corn. The matter of getting a uniform distribution of seed is but secondary to the more important factor, that of planting only corn which is known to be of strong vitality. Germination tests which have just been made at the experiment station with a number of samples of corn from farmers' cribs around Columbia show an average germination of but 63½ per cent. This means that there will be a great deal of corn in the state this spring of weak vitality, and, unless proper precautions are taken to test such corn before planting, very poor stands will certainly result. If only corn of strong vitality were planted, with due consideration to securing a uniform distribution of seed, the stand on average seasons should not run much under ninety-five per cent. Such a stand means a long step in the direction of a profitable corn crop.

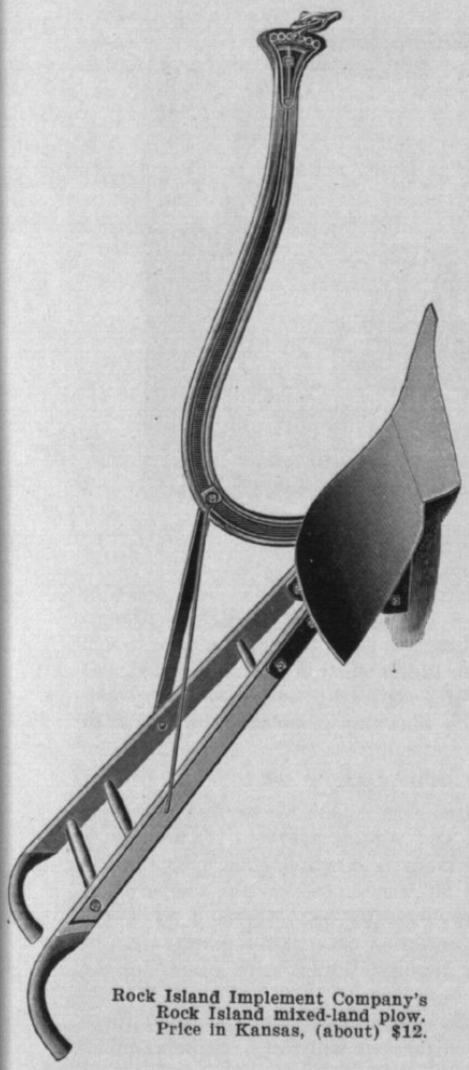


Parlin & Orendorff Plow Company's steel-beam, low-landside stubble-plow. Price in Kansas, (about) $14.

Test the Vitality in a Germinating Box.—It is perfectly practicable for the average farmer to test for germination every ear of corn he plants, and where corn has not been carefully preserved this should always be done. It has been found that if an ear is lacking in vitality the character is shared to a great extent by the majority of the kernels on that ear; consequently, if a half-dozen kernels are selected from different parts of the ear and tested, a very good idea of the strength of germination of that particular ear may be obtained. The method of doing this is as follows: Lay out the ears selected on a long board or on the crib floor, marking a number opposite each. Prepare a box two or three inches deep and two or three feet square (fig. 2), nailing the bottom on tightly, in order that it will not warp when it becomes wet. Place in the bottom of the box a half to three-quarters of an inch of sand and

moisten thoroughly. Cut a piece of white cloth to fit the box and mark it off with a pencil into squares two to two and one-half inches in size, numbering them from 1 up, laying the cloth on the sand.

Now remove two kernels about two inches from the butt of ear 1, turn it one-third around and take two more from near the middle, again turn it one-third around and remove two more from near the tip, placing the half-dozen kernels in square 1. In like manner take the same number of kernels from ear 2 and place in square 2, and so on until the squares are filled. Cover the corn with another piece of moist cloth, which is somewhat larger than the box, filling in on top of this with three-quarters of an inch of moist sand. A piece of oilcloth or some wet paper thrown over the top helps to keep the germinator from drying out. Set in a warm place, say near the kitchen stove, where the temperature will stand from seventy to ninety degrees, and allow it to remain about a week, moistening the sand occasionally, if necessary, and noting the progress of germination from time to time. At the end of this time the kernels of good vitality will have sprouted strongly and one can tell by looking at the different squares which ears are to be discarded for seed. For instance, if ear 10 shows a tendency to weak germination, or if one or more of the kernels failed to sprout at all, such an ear should be thrown out. It will be found in ordinary crib corn that a large per cent. of the ears will have to be discarded entirely. The ordinary practice of planting such ears is responsible for most of our poor corn stands.



Rock Island Implement Company's Rock Island mixed-land plow. Price in Kansas, (about) $12.

The time necessary to do this testing is very trifling compared to the money return which it will bring. By such a test, if one is depending upon the crib corn for seed, a most conservative estimate is that the stand may be increased five per cent., which should mean two bushels more corn per acre where the average yield is forty bushels. The actual time necessary to test sufficient corn to plant fifty acres in this way is not over

two days, and a little figuring will show at once the income which such work will bring. The germinatng box costs practically nothing, and, if one wishes, several may be run at once. Probably the most convenient size is one two feet square, which will test about one bushel of corn. Another method of arranging this germinator is to use, instead of the sand, layers of wet paper, or sometimes bran is used, but the sand is probably the most satisfactory.

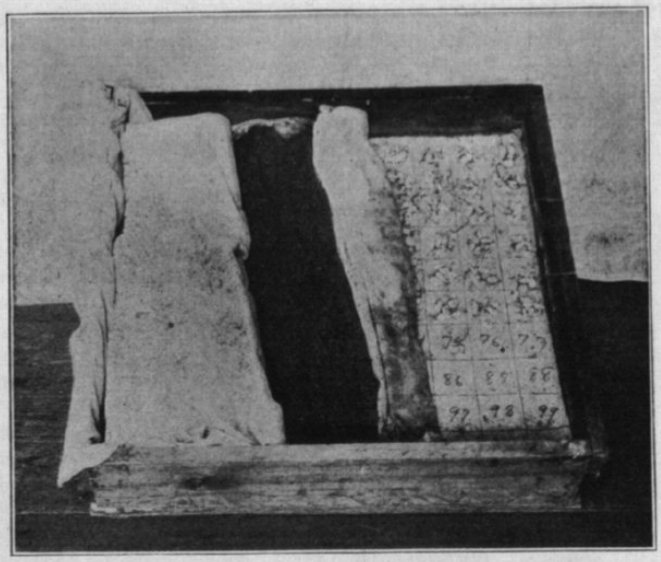


FIG. 2. Germinating box. The cloth on which the sand is placed is rolled back to show the squares holding the corn.

It should be said that, where very careful attention has been given to drying out and preserving the seed-corn, it should test as high as ninety-five per cent. of the kernels germinating strongly. In such a case it will probably not be necessary to test each individual ear that is planted, but rather to test, say, ten kernels from fifty representative ears. Some test, however, should always be made before planting, to be sure that the corn is of strong vitality.

IMPORTANCE OF THE PROPER CARE OF SEED.

The low vitality of much of our seed-corn is due to the fact that it is improperly cared for during the fall and winter months. If the corn is not thoroughly dry by the time hard-freezing weather comes, its vitality is sure to be injured. It makes little difference how low the temperature may fall if the corn is perfectly dry, but any hard freezing when the corn is damp will weaken its vitality, and even prevent the germination of many kernels entirely. It is usually thought that if corn comes up the vitality has not been injured; but experiments have shown that corn stored in the crib will not only produce less vigorous stalks than those from corn that has been properly cared for, but will fail to make as much