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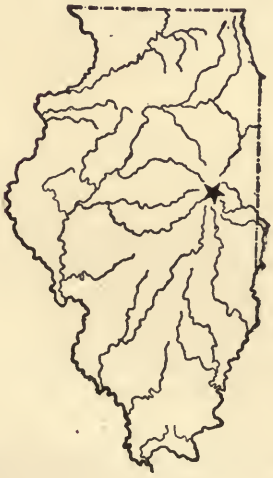
THE TESTING OF CORN FOR SEED.

By ALBERT N. HUME.



URBANA, ILLINOIS, NOVEMBER, 1904.

Summary of Bulletin No. 96.

1. It would be possible to make a test of the vitality of every ear of corn used for seed in Illinois. Page 401

2. The testing may be done with plates of sand or with a box and blotters, or with a box and folds of canton flannel. The *method* of doing the work *is not* so important as that it be done thoroughly. Page 403

3. One man can test enough seed corn for sixty-seven acres by the use of ten hours total time. Page 412

4. It is estimated that over $8,000,000, might have been saved to the corn growers of Illinois if all seed corn planted in 1904 had been properly tested. Page 415

5. It is reasonable to conclude that Illinois corn growers ought to be absolutely certain about the vitality of seed corn before it is planted. Page 416

THE TESTING OF CORN FOR SEED.

By ALBERT N. HUME, First Assistant in Crop Production.

We believe it would be possible for every ear of corn planted in Illinois to be tested for vitality. If an ear does not come to the desired standard, we may discard it, and plant only seed which will grow, and materially increase the stand of our corn crop the coming year. It may seem like a heavy task to germinate three or four kernels of corn from every ear in a bushel, and yet two or three evenings each week, for a few weeks, on the part of only one person, would test enough ears to plant his own crop at least. The kernels could be placed between folds of blotting-paper laid in a moist box, or moistened between two common dinner plates. It is not very difficult to keep track of the ear from which is taken each set of kernels. One kernel should be taken from the butt of the ear, at least one from the middle, and one from the tip. If all the kernels grow, the ear may reasonably be supposed to be good, otherwise it should be discarded.

Some such method as this has been employed (we are informed), by John R. Clisby, secretary of the Illinois Seed Corn Breeders' Association, for testing large quantities of seed corn. Doctor C. G. Hopkins of our University, suggested the idea to the writer. He employed it in testing every ear of seed corn which he planted on fifty acres of his own farm in southern Illinois. If these men can afford to test every ear of corn they use for seed, the same may be at least worth suggesting to farmers in general who are anxious to know what kind of corn they are going to plant.

When corn planting time arrives, the most serious question for corn growers is that of securing seed for their fields which will be certain to grow. Sometimes it is not only a difficult matter to buy corn for seed, but that which is purchased, even from the most trustworthy growers, is likely to be more or less deficient in vitality, especially under such conditions as prevailed last season. After the best seed growers have sold all their stock, they continue to receive orders which cannot be supplied. That a good deal of doubtful seed was planted last spring is shown by the following extracts from the Bloomington Weekly Pantagraph, of June 3, 1904:

"So far as this report shows, the proportion of replanted seed corn is not large, but it is large enough to attract attention and to emphasize the fact that early warnings about poor seed corn had foundation in fact.—Mr. Thomas Kuntz, living on the Thomas Janes farm near Stan-

ford, has to replant 200 acres of corn. It is reported that several others living in his neighborhood have so poor a stand that they have to replant."

"A 20-acre piece of corn on the Charles Bishop farm, 10 miles southeast of Bloomington, was being replanted, where needed, with a hoe."

"Mr. Albert Lantz, of Downs, has been replanting. Mrs. Esther Teter, of the same neighborhood, has been replanting corn."

"Mr. Oakley Stillman, of Waynesville, planted both 1903 and older corn, and the older corn came up a great deal better than last year's seed."

"Mr. Mark Gardner, of Towanda township, and Mr. James Gent, just across the line in Normal township, have been replanting corn. Mr. George Purcell, of the same neighborhood, thought he had about a half stand of corn, and was undecided whether he would replant."

"The Deer Creek correspondent writes: 'The seed corn seems to be of poor quality, as a great many farmers are planting again.'"

The low vitality of seed corn the past season was no doubt caused very largely by freezing weather while the corn was either still in the field or not sufficiently cured to withstand the low temperature. It is to be hoped that the fall of 1903 was an exceptional one in this respect, and that our recent experience may not be repeated. There is no way to guard against such falling temperatures, however. Moreover, if a season comes when our seed corn is frozen before it is put into storage, there is no way to correct the disastrous effects even with the most modern means of storage, unless we have some method of sorting out the ears which are unfit for seed. Therefore we say that the matter of selecting and testing seed is at present of foremost importance to every corn grower.

In suggesting the plan of testing each ear of seed corn, we do not mean to insist that every ear must be tested every season and in every place. We do insist, however, that this would be within easy range of possibility, as the following pages will show. Before time for planting, corn growers should test a sufficient amount of their stock of seed, ear by ear, so that they will know what they have on hand. It may or may not be necessary thus to test the entire stock, but that it would have been an extremely profitable procedure the past season for most farmers, can scarcely be doubted.

It is not sufficient to accept the warrant of the dealer from whom the seed is purchased, however trustworthy he may be. It is not possible for those who handle seed on the largest scale to give the closest attention to its quality. The following devices for testing are suggested as being obtainable for the general farmer.

METHODS OF TESTING.

There are several methods of testing corn, all of which depend upon the same principle, namely, that of supplying sufficient moisture and warmth to the kernels to cause them to sprout. The traditional ways of determining the quality of seeds, such as floating them in water, or heating them until they pop, or breaking them and noting the fracture, or cutting them and noting the appearance of the inside, cannot be called tests, although it must be granted that by practice some corn growers have become fairly expert in telling whether or not a given sample of corn will grow. Such methods are not only less accurate, but if carefully performed require as much or more time than need be taken to make a germination test.

One of the best and simplest ways of sprouting seed is to take a common dinner plate and fill it nearly full of sand. The sand should be as clean and white as possible. Such sand will be less likely to mould than that which has much organic matter in it. This makes it much more desirable for use in testing, for moulds interfere with the germination of the corn. After the sand is placed on the plate, it should be moistened. This can best be done with a small sprinkler, but if one is not at hand, the water may be poured carefully out of any small vessel or sprinkled with the hand. After sprinkling the water on the sand, it is well to mix the sand with the fingers until it is all equally moist. Do not saturate the sand with water. Special caution is necessary in this respect, for if the sand is too wet, the corn will fail to germinate for lack of air. Numerous failures have been reported in testing corn on plates of sand, the most of which probably resulted from having the sand too wet.

Having the sand properly placed and moistened, the kernels to be tested should be pressed into the sand, small end down, in order as they are taken from the ear. While taking the kernels from the ear, hold it in the left hand and remove with a pocket-knife or a pair of small, strong tweezers, a kernel two inches from the butt of the ear. A little practice will make it easy to remove a kernel with the knife and hold it between the thumb and the knife blade until it is put in place in the sand. Then turn the ear one-fourth around and take another kernel in the same manner, say two inches nearer the tip; then turn the ear the same distance again and take another kernel two inches nearer the tip. For the fourth kernel, turn the ear again one-fourth around and take the kernel about two inches from the tip. Four kernels is a large enough number to take from one ear for practical work. If they are properly taken, they represent both ends and all sides of the ear, so far as vitality is concerned. The four kernels from each ear must be placed in a separate group, and it is best that the group be marked or numbered to corre-

spond with the number of the ear from whence the kernels were taken. (Plate 1, Fig. 1.) For this plan, it is necessary that the ears be placed in regular order, as the kernels are removed from them. A good device for arranging the ears in regular order is shown in Plate 2. The frame from which the photograph was taken is in use at the Agricultural Experiment Station.

It does not take a mechanic of very great skill to make the frame. It will be noted from Plate 2 that the ends of the ears when they are put into place, rest upon small iron rods, and that the ears are kept from rolling sidewise by two small wires on each side. It would be possible to make the divisions for the separate ears out of lumber, but the wires are lighter in weight and cheaper. Moreover, they do not prevent the circulation of air between the ears of corn, which in some cases is an advantage, and they do not furnish a harbor for mice and rats.

THE GERMINATING ROOM.

After the kernels of corn are all placed as described above, they should be covered by turning a second plate over them to prevent too rapid evaporation of the moisture from the sand. (Plate 1, Fig. 2.) They may then be left in a warm temperature to sprout. As fast as the kernels are well germinated, they should be removed from the sand, and a careful record taken of the number which have sprouted. It has been proved by experiment that the best temperature for germinating corn is 77 degrees F. This is only a little higher than the temperature of an ordinary living-room. More harm will result from a considerable decrease of temperature than from a slight increase.

On the average farm it is not necessary to construct a special room for germinating. Usually the plates of corn will germinate well if put beside a stove, taking care that they do not get too hot. The plates must be inspected each day after they are put into the germinating room, and if the sand is becoming dry, add a little water. The amount to be put on must be determined by practice, for it will vary with the kind of sand used and with the humidity of the room. If one is fortunate enough to have furnace heat in the cellar, he will probably have a place near the furnace where the heat will be about right for germinating corn. Such heat was utilized by Dr. C. G. Hopkins, of the University of Illinois, in testing the corn for his own farm in southern Illinois, with entirely satisfactory results.

Plate 4 shows a sort of incubator which served as a germinating chamber at the seed house of Mr. John R. Clisby. The heat was furnished from below by a gasoline stove. A tank of water was set on the gasoline stove and the rising steam distributed the heat and prevented

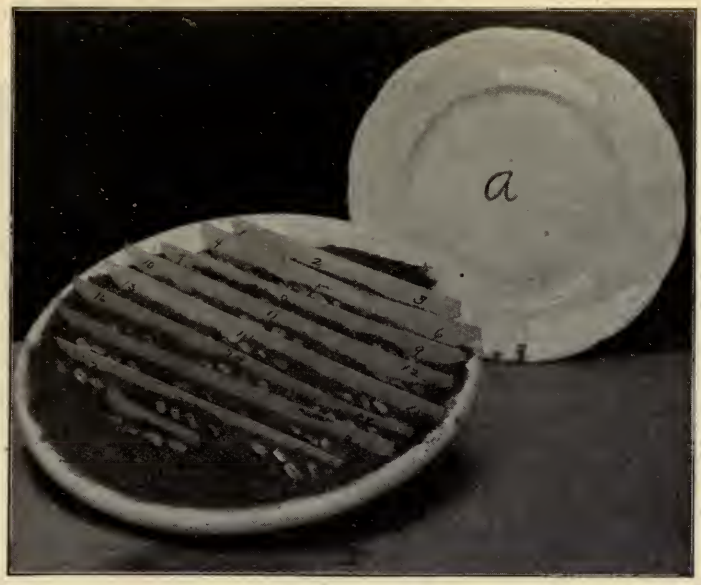


FIG. 1.

FIG. 2.

PLATE 1. FIG. 1 SHOWS GROUPS OF KERNELS FROM SINGLE EARS, READY TO BE PUT INTO THE GERMINATING ROOM.

FIG. 2. THE SAME KERNELS, GERMINATED, READY TO COUNT.

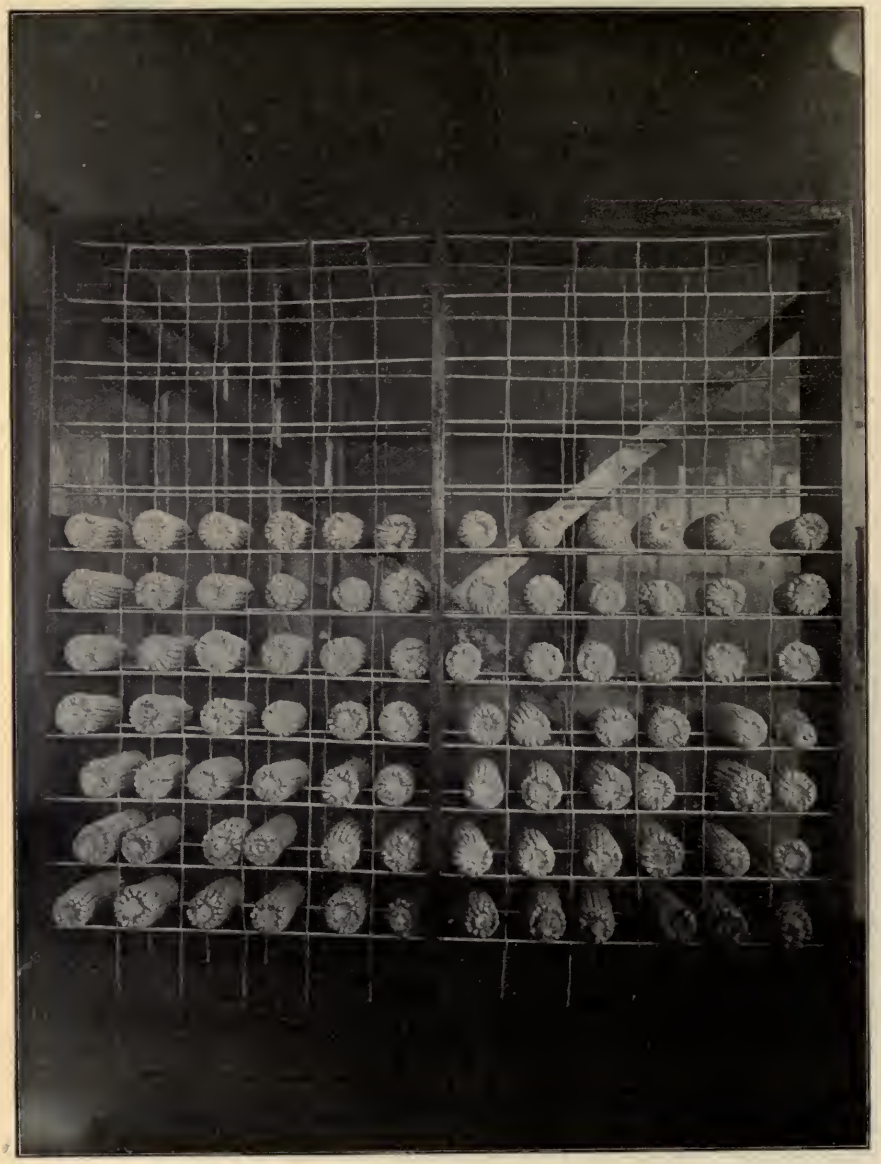


PLATE 2. SHOWS THE DEVICE FOR ARRANGING EARS IN REGULAR ORDER AFTER HAVING KERNELS REMOVED.

PLATE 3. THE GERMINATING ROOM NOW IN USE AT THE EXPERIMENT STATION.

the too rapid drying of the corn kernels. The arrangement was not entirely satisfactory, inasmuch as the steam warped the lumber of which the frame was made. An ordinary incubator, such as is used for hatching eggs, would doubtless answer the purpose of a germinating chamber.*

TESTING WITH PLATES AND SAND.

The method of using the plates of sand for germinating corn is very practicable in that any one can use it without purchasing any new material. Dinner plates are at hand on any farm, and sand may usually be had from the roadway or river bottom. But where there is much testing to do the method is inconvenient, and in some cases unprofitable, from the fact that it takes too much time. Time is lost in filling the plates with sand and in gauging the proper amount of moisture, when it must be renewed from time to time. The actual time used in testing several lots of corn by this method is shown in Table 2.

TESTING WITH BOX AND CLOTH.

One of the quickest and most convenient devices for making germination tests is that commonly known as the Geneva Tester, so called because it was first used by Professor Goff at the Geneva Station in New York. (Plate 5.) This apparatus consists of a water-tight box across which are extended folds of canton flannel. These folds are suspended from wires, as shown in Plate 5, and can be removed to dry when not in use. The box must be filled to the depth of about an inch with water, so that the folds of canton flannel will hang down enough to touch the water, and thus be moistened by capillarity. The box should be about 12 by 24 inches and 4 or 5 inches deep. It may be made of wood, galvanized iron, tin, or copper, and the wires can be cut from ordinary smooth galvanized fence wire. When kernels of corn are to be tested in this germinating apparatus, they are removed from the ears as described above, placed between the folds, in regular order (Plate 5) and the folds closed together. If it is thought best, the groups of kernels from the separate ears may be numbered with slips of paper, as shown in Plate 5. This numbering will not be absolutely necessary if proper care is used to have the groups of kernels correspond to the ears of corn from whence they came. After the kernels are put in place, the

*The germinating room in use at the Experiment Station is shown in Plate 3. Around the lower part of the wall are coils of steam pipes by which the room may be kept as nearly as possible at the desired temperature. Shelves are arranged around the three sides of the room, upon which are set the plates of corn for germination.

The improved standard germinating chamber, used by the Department of Agriculture, is described in Circular No. 34, and Circular No. 34 (revised) of the Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.

FIG. 1.

FIG. 2.

PLATE 5. FIG. 1 SHOWS GROUPS OF KERNELS FROM SINGLE EARS, READY TO BE PLACED IN THE GERMINATING ROOM.

FIG. 2. SHOWS THE SAME KERNELS, SPROUTED.

PLATE 4. AN INCUBATOR USED FOR GERMINATING CORN. A GASOLINE STOVE PROVIDES SOURCE OF HEAT.

PLATE 6. SHOWING THE WOODEN BOX, BLOTTING PAPERS, WIRE GAUZE, AND GROUP OF KERNELS ALREADY SPROUTED.

folds are drawn together at the top, the lid closed upon the box, and the apparatus left until the kernels germinate. When put into this box, the kernels will not usually suffer for moisture during the length of time of one test. This is one of the advantages of the Geneva Tester over the plate of sand where the moisture may need renewing each day, or even oftener. The folds are easily opened when it is necessary to inspect the kernels to count the number which have germinated. Some care is necessary in lifting the tester, that the groups of kernels be not jarred from their places.

TESTING WITH BOX AND BLOTTERS.

Another plan is to use a small box, with layers of moistened blotting-paper inside. (Plate 6.) This device consists first of a small box, say a foot long, six inches wide, and five inches deep. The bottom of the box should be made water-tight; if necessary, the cracks may be stopped with white lead or strips of cloth or asbestos. The kernels of corn are kept moist by putting water into the box to a depth of one-half inch more or less. Something must be laid in the box to hold the first blotter up out of the water. Small sticks laid crosswise of the box will answer this purpose.

The blotting papers should be moistened as they are placed in the box. When the first blotter is laid in, either small sticks or wire cloth are put down on top of it to mark the spaces for the separate groups of kernels. These spaces must correspond to the spaces in the frame where the ears of corn are placed (Plate 2). After one layer of blotting-paper is covered with the kernels, another similar layer may be put down on top of the first, and so on until the box is filled, or until the desired amount of corn has been put in.

Like the plate and sand method and the wooden box Geneva Tester, this device is easy to use on the ordinary farm because it does not necessitate the buying of any expensive apparatus or material. The box shown in Plate 6 was made to order, but it would be possible to substitute any ordinary box which is reasonably close at the joints. If small sticks are substituted for the wire gauze, it will only be necessary to purchase the pieces of blotting-paper, which can be secured at a merely nominal cost of almost any printer or stationer. Of course the wooden box will sometimes warp and begin to leak, making it somewhat difficult to keep the blotters from becoming too dry. Where it is desired to use a tester for any large amount of work, it is usually best to have the box made of copper.

We have gone into the matter of explaining the devices for testing seed corn at some length from the practical standpoint, in the hope that the greatest number of corn growers will arrange to test seed by one of the methods. The method of doing the work is not of such paramount importance as that it be done, and done thoroughly.

In advocating the testing, when necessary, of every ear of corn intended for seed, we have been met with the objection that "it takes too much time." We have therefore made some careful computations along this line. In Table 1 we have recorded the time in minutes used in testing each of nine one-bushel lots of corn. Column 1 gives the number of the lot, column 2, the number of the ears in the measured bushel, and column 3, the total time used in testing four kernels from each ear, in the Geneva Tester, with which we have been able so far to do our quickest work in testing.

TABLE 1.

Number of lot.	Number of ears in bushel tested.	Total time used in testing.
1	100	45 minutes.
2	98	44 minutes.
3	75	34 minutes.
4	116	56 minutes.
5	80	48 minutes.
6	77	38 minutes.
7	95	42 minutes.
8	96	46 minutes.
9	126	48 minutes.

Total time for 9 bushels, 401 minutes.
Average time for 1 bushel, 45 minutes.

From the above table, it will be seen that the total time used in testing 9 bushels of corn of various sized ears was 401 minutes. It takes longer to test a bushel of small ears than a bushel of large ones, but the average time per bushel is 45 minutes. At this rate, counting only 5 acres to one bushel of seed, one man, in 10 hours' total time, can test every ear of seed corn required to plant 67 acres. Of course the work must be done before planting time. It is suggested that winter evenings might profitably be employed in this way, but if the work is not done in the evenings, let it be done by daylight as part of the regular work. At all events, do not permit it to be overlooked, especially when we have such seed corn as much of that planted in 1904.

It has already been suggested that it takes more time to test corn in plates of sand than in the Geneva apparatus. Table 2 is offered to show the time used in testing by this method.

TABLE 2.

Number of lot.	Number of ears tested in measured bushel.	Time required for testing in sand.
29	100	80 minutes.
30	98	85 minutes.
31	75	63 minutes.
32	88	75 minutes.
33	92	72 minutes.

Total time required to test 5 bushels, 375 minutes.
Average time required to test 1 bushel, 75 minutes.

As seen by the above, the average time for testing in sand is 75 minutes per bushel as against 45 minutes per bushel with the Geneva Tester. It is apparent that any one who has any amount of testing to do, can well afford to make a Geneva Tester or have one made, rather than use sand.

It is sometimes urged that one who has had sufficient practice can select seed corn which will grow, simply by inspecting it, and that testing is unnecessary.

There are many persons who can tell, with some accuracy, by simple examination, whether or not corn will grow, but we do not believe that inspection can be so accurate as testing. Moreover, the time used in carefully inspecting each ear in a given lot of corn is usually as great or greater than the time used in testing the same ears. The time required depends much upon the care with which the work is done. If four kernels are taken from each ear of corn and each kernel examined carefully and the germ inspected, it will require more time than it will to test the kernels in the Geneva apparatus. The average time used at the Station for inspecting thirteen bushels of seed corn with reasonable care, was 31 minutes per bushel. With two lots, when four kernels were removed from each ear and carefully examined, the average time required was 44 minutes per bushel. The average time for testing these same two lots in the Geneva Tester was 32 minutes per bushel. Even when the time element is taken into consideration, the evidence is all in favor of carefully tested seed for the corn grower, as opposed to that selected mechanically.

The following table shows the results which were actually attained with 37 different lots of seed corn.

Eighteen of these lots of corn came to the Experiment Station from progressive farmers, and nineteen came from the most trustworthy corn specialists to be found. In the table given, column 1 indicates simply the number of the lot of corn tested. Column 2 gives the number of ears in that particular lot, and column 3 indicates the percent of the corn, taken just as it came to the Station, which germinated. This test was simply a composite one. Three kernels were taken from each ear, one

from the butt, one from the middle, and one from the tip. After three kernels were thus taken from every ear in the entire lot, they were mixed together, and 100 of them were selected at random. These 100 kernels were germinated and the resulting percent was put into column 3. After this composite test was made, every ear in each lot was tested, by taking four kernels from an ear and germinating them in sand. In case any one of the four kernels did not grow, the ear from which it came was discarded as unfit for seed. The number of ears thus discarded is recorded in column 4. The remainder were reserved as being good for seed. Then, in order to determine whether such testing really accomplishes the desired object, composite tests were made of the "good corn," which was reserved for seed, and of the "poor corn," which was discarded. The percents for the various lots as derived from these tests are recorded in columns 5 and 6.

TABLE 3.

No. of test.	Number of ears tested.	Composite test of all ears.	Number of ears discarded.	Percent of germination after testing	
				Good corn.	Poor corn.
1	41	91.0	11	98.9	82.0
2	439	82.5	144	97.0	68.0
3	81	87.0	12	99.0	72.2
4	371	84.0	95	95.0	55.0
5	34	78.0	18	97.9	72.2
6	330	95.0	51	98.0	80.0
7	433	94.0	38	100.0	72.0
8	414	83.0	124	95.0	63.0
9	552	77.0	299	86.0	67.0
10	389	97.0	31	100.0	85.5
11	88	96.0	14	97.0	80.9
12	80	82.0	18	94.0	70.8
13	298	93.0	44	98.0	71.0
14	89	93.0	10	97.0	66.6
15	60	84.0	22	96.0	77.0
16	18	88.8	5	89.7	66.6
17	43	83.0	20	90.0	40.0
18	451	96.0	33	99.0	68.0
19	332	93.0	88	98.0	81.0
20	456	62.0	295	93.0	30.0
21	278	74.0	164	86.0	36.0
22	109	87.0	21	97.0	71.4
23	45	83.0	17	97.6	75.0
24	40	51.0	28	97.2	52.3
25	73	89.0	20	95.0	48.0
26	144	92.0	36	95.0	81.0
27	100	93.0	25	97.0	69.8
28	98	91.0	18	95.0	68.9
29	75	94.0	17	95.0	76.0
30	88	87.0	26	96.0	66.6
31	92	93.0	13	93.0	77.0
32	116	90.0	39	93.0	70.0
33	80	86.0	34	83.0	75.0
34	77	68.0	41	74.0	42.0
35	95	74.0	54	90.0	57.0
36	96	64.0	63	80.0	51.0
37	126	97.0	20	96.0	60.3
Averages,		85.19		94.00	66.11

It will be observed that the percent of germination of the "good corn" in column 5, is higher in every instance than the percent of germination of the "poor corn," in column 6; also that there are only two instances—that of test number 33, composed of 80 ears, and that of test number 37, composed of 126 ears—in which the percent of germination for the good corn is not as high or higher than that of the composite sample from which it came. This evidence therefore practically all goes to indicate that the plan is effective. In other words, having given a number of ears of seed corn, *it is possible to determine with accuracy which of those ears have the highest average percent of germinable kernels.*

The average of all the tests of "good corn" in column 5 is 94.00 percent. The average of the composite tests of the lots of corn from whence those good ears were taken, is 85.19 percent. The original lots were made up of seed corn, which was carefully selected by ordinary methods before it came to the Agricultural Experiment Station. The difference between 94.00 and 85.19 is 8.81 percent, in favor of the "good corn," which is clearly attributable to the fact that every ear was tested and only the "good ones" reserved. That this difference is correct is further attested by noticing the average percent of the "poor" lots of corn in column 6, which is 66.11. Evidently from this, no mistake was made in the kind of ears discarded.

It is fair to assume, according to the above figures, that the seed corn planted in Illinois during the spring of 1904, might have been at least 8.81 percent better than it was. Although it does not follow absolutely, it is not far from correct to reason that the crop is 8.81 percent lighter than it might have been, had the best seed attainable been used. This is a conservative estimate considering that the original lots of corn above were probably better than the average seed corn planted in Illinois in 1904.

Granting, then, that 8.81 percent of the seed planted failed to grow and that there were 1,000,000 bushels of corn used for seed in Illinois, the amount of corn planted which did not grow was 88,100 bushels. Valuing it at $2.00 per bushel, it represented a dead loss of $176,200. This amount alone would pay for testing practically every ear of corn planted in Illinois, counting labor at $1.50 a day. The great loss, however, consists in the shortage of the crop due to this poor seed. The valuation of the corn crop in Illinois, as given in the year book of the Department of Agriculture for the year 1903, was $95,000,000. Counting the proportionate loss therefore, which might have been prevented by proper testing of seed corn, we have $8,369,500. The data herein presented certainly justifies the conclusion that such a sum could have been saved by Illinois corn growers the past year by properly testing seed.

To bring the matter as closely home as possible to the individual farmer, suppose that he raises 80 acres of corn, and that his normal yield is 60 bushels per acre, giving a total of 4,800 bushels. His average loss this year was 8.81 percent of that amount, or 422.88 bushels. Valuing this at 40 cents a bushel, we have a loss of $169.15 due to the use of untested seed. This amount would pay the necessary wages for testing every ear of seed corn which would be used on 7,555 acres of land, counting the wages at $1.50 a day. These figures ought to appeal not so much to our seed dealers as to farmers and corn growers. They are the people directly interested.

Having determined the data above, it is not unreasonable to assert that every corn grower ought to know beyond any peradventure, just what kind of seed corn he pours into his planter boxes at planting time. We do not mean to urge anything unreasonable, and we are not doing so. If we were to test say 1,000 ears of seed corn from a seed house and found them to grow perfectly, we would be ready to admit that the next 1,000 ears were reasonably safe for seed, providing they were the same kind of ears, kept under the same conditions as the first 1,000 had been; but we would not take too much for granted.

The object toward which we are all striving, is that agriculture be made an exact science. The testing of each ear of seed corn, whenever necessary, will certainly be a considerable stride in that direction.