

IMPROVEMENT OF CORN BY SEED SELECTION.

# THE BULLETIN

OF THE

NORTH CAROLINA

STATE BOARD OF

# AGRICULTURE

Raleigh



SEPTEMBER, 1903.

THIS BULLETIN IS SENT FREE TO FARMERS ON APPLICATION.

# STATE BOARD OF AGRICULTURE

## OF

### NORTH CAROLINA.

---

S. L. PATTERSON, Commissioner, <i>ex officio</i> Chairman, Raleigh.	
J. M. FOREHAND -----	Rockyhock ----- First District.
J. B. STOKES -----	Windsor ----- Second District.
WM. DUNN -----	New Bern ----- Third District.
C. N. ALLEN -----	Auburn ----- Fourth District.
R. W. SCOTT -----	Melville ----- Fifth District.
A. T. McCALLUM -----	Red Springs ----- Sixth District.
J. P. McRAE -----	Laurinburg ----- Seventh District.
R. L. DOUGHTON -----	Laurel Springs ----- Eighth District.
W. A. GRAHAM -----	Machpelah ----- Ninth District.
A. CANNON -----	Horse Shoe ----- Tenth District.

---

#### OFFICERS:

S. L. PATTERSON, Commissioner.	TAIT BUTLER, Veterinarian.
T. K. BRUNER, Secretary.	FRANKLIN SHERMAN, JR., Entomologist.
B. W. KILGORE, State Chemist.	GERALD MCCARTHY, Bot. and Biologist.
H. H. BRIMLEY, Naturalist and Curator.	



# THE BULLETIN.

---

VOLUME 24.

NORTH CAROLINA STATE BOARD OF AGRICULTURE.

NUMBER 9.

---

Entered at the Raleigh Post-office as second class mail matter.

THE BULLETIN is published monthly by the State Board of Agriculture.

---

RALEIGH, SEPTEMBER 1903.

---

## IMPROVEMENT OF CORN BY SEED SELECTION.

BY C. B. WILLIAMS.

Over 47 per cent. of the cultivated land in North Carolina is devoted to corn. The average yield for the State is less than thirteen bushels of shelled corn per acre. Three years ago experiments were inaugurated by the Department of Agriculture looking toward the increase of this very low yield per acre by means of careful seed selection. The method that is being followed is to conduct on the large soil-type areas of the State comparative tests of the leading varieties grown in this and other States through a sufficient number of years to secure average weather conditions. From the variety or varieties demonstrated by this test to be the most prolific seed selection for further improvement is begun. The testing of varieties of all agricultural crops is of the most fundamental importance, as is evidenced by the difference in yield of different varieties grown side by side in the same field on the same type of soil with identical cultivation and fertilization, this difference being due to the inherent qualities of the seeds of the individual varieties which are transmitted from parent to progeny.

The work last year at the Edgecombe Test Farm brought out a very striking example of the difference in yield of two varieties of corn under identical soil, fertilization and cultivation conditions. *Cocke's Prolific* (from selected seed) yielded 35.2 bushels of shelled corn per acre, while another variety only produced 20.5 bushels—a difference in yield of 14.7 bushels, which at fifty cents per bushel gave a clear gain of \$7.35 in favor of the first variety.

It must be kept in mind that the underlying principles of plant and animal improvement are almost identical, and that similar methods to those which have been adopted in the improvement of the



FIG. 1.

various breeds of live stock must be followed by all those who wish to grow plants of increasing productiveness. It must also be remembered that as intelligent feeding and good care stand to animal breeding, so does proper fertilization and thorough cultivation of the soil stand to plant breeding or improvement; for if proper food and care are not furnished both plants and animals, improved breeding will not only be impossible, but retrogression inevitable. With the same thought and care, results are secured much quicker with plants than with animals, as a completed growth is obtained in one year with most plants, while with animals it requires several years to secure complete knowledge of what one has obtained by a certain cross.

#### METHODS OF IMPROVEMENT.

At present there are three methods in common practice for the improvement of corn by seed selection, viz.: (1) importation of improved seed; (2) field selection of the best home-grown seed; and (3) home field selection and growing of seed corn in an isolated field.

##### *Importation of Seed.*

Under no circumstances should farmers depend each year upon importation for seed corn, as corn brought from a distance (where soil and climate conditions are different) seldom yields satisfactory results until it has become thoroughly acclimated, which usually requires from two to three years. The force of this statement is amply illustrated in our experience at the Edgecombe Farm last year with *Leaming* corn, which was brought from Illinois for our comparative variety test. At the Illinois Experiment Station *Leaming* had proven to be one of the best varieties raised in that State, but when brought to North Carolina it gave the smallest yield of the thirteen varieties tested. It is likely then that this variety, when thoroughly acclimated, will increase materially in yield. This further emphasizes the need in all variety tests of as complete history as possible of the conditions under which the parent plants were grown, especially should the locations be known from whence all seed come, before one can properly interpret varietal results, for if not acclimated, suppressed yield may be expected.

The advantage in imported seed is that the farmer is enabled to begin improvement where some careful grower or skilled plant breeder has left off. It is here as with animals: if it is desired to breed milk cows, it is not best to go back to the "scrub" to begin to breed, selecting the desirable animals, but rather to begin with some of the best of the recognized milk breeds, like the Jerseys, Guernseys, etc., and with these continue improvement by breeding and selection.

In buying imported seed, care should be exercised that it comes from some careful grower or breeder, preferably a member of some seed-corn breeders association, for it is well known that many seedsmen buy the whole surplus of corn crops in the West, and without a particle of selection, shell and screen this corn and place it on the market as seed of a high grade, advertising it in extravagant superla-

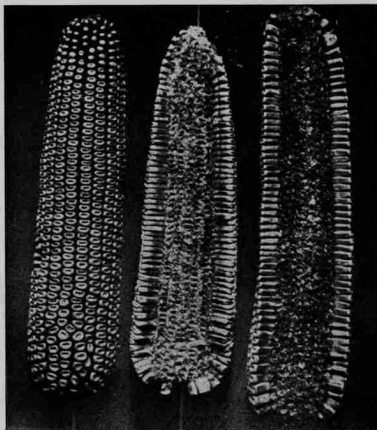


FIG. 2.

(From Iowa Agl. Expt. Station).

tives and charging for it many times the market price of ordinary corn. To avoid this deception, have the seed shipped to you on the cob, so that you can see exactly what you are getting and know what to expect from the seed when planted. When the ears come, if they are not satisfactory they can be returned to the shipper, or if only

a few ears are unsatisfactory they can easily be thrown out before shelling. It is best in shelling seed corn that each ear should be shelled separately before putting with others, so that ears with undesirable characteristics may most easily be discarded.

### *Simple Field Selection of Seed.*

By going into the field just before harvest time and making careful selections of seed corn from the best stalks bearing the best ears and hence best adapted to local conditions, it will be possible for the farmer to greatly increase his yields of corn at very little expense. The selection should not be turned over to the hired man, but should be given the best efforts of the farmer himself, as it is known that time thus expended will give better returns than any other work done on the farm. It must constantly be kept in mind that on every farm changes beneficial or detrimental are continually taking place, as it is an inherent tendency of all plants to vary more or less and retrograde or "revert" to a less productive state if selection of some kind is not continually kept up. By continually selecting and planting corn possessing certain desirable characteristics, it will gradually increase in yield and have these desirable qualities more permanently fixed from year to year.

In making the seed selection in the field, at least four times as much corn should be gathered as is desired for seed the following year, so that further and more careful selection can be made after the corn has been taken to the barn. In the final selection, the ears should be arranged conveniently on the barn floor or ground, and with an ear of the type desired in mind or hand, go over the lot and remove all undesirable ears. The seed thus selected should be transferred to a box or barrel and covered with wire gauze to keep out rats and mice, and placed in some dry place and allowed to remain until the following spring.

It is a common and almost universal practice in North Carolina to make seed corn selection, where it is made at all, from the crib in the spring just before planting time. This method yields better results than no selection at all, but is far inferior to the field selection method outlined above, which has taken into consideration the performance record of the parent plant.

### *Field Selection and Growth of Seed Corn in an Isolated Field.*

By carefully selecting a limited number of the very best obtainable seed ears from the field in the fall and planting them in a field separated from any other corn, something like five or six hundred yards, to prevent crossing by pollen carried by the wind, much better and



<sup>b</sup>  
FIG. 3.



quicker results are secured than where simple selection alone is practised, *i. e.*, if the breeding plat or field is properly cared for. This field should be tolerably fertile (equal at least to the lands on which the general crop is to be grown), for poverty of soil is very conclusive to reversion, thereby losing in one year's growth on a poor soil what has been gained by a number of years of rigid selection. The rows in the breeding plat should be of such length that they will require only about three-quarters of an ear per row, and in planting, each row should receive its individual ear, so that the performance record of each seed ear can be seen, and if not satisfactory the whole row can be rejected. After planting as many rows as is desired from the selected ears, a composite sample should then be made of the quantity of each ear left over, and a border of several rows planted entirely around the breeding plat to still further prevent the possibility of wind pollination from outside corn fields. The land on which this plat is to be located should be given deep and thorough preparation. The subsequent cultivations of the corn should be every ten to twelve days, with a cultivator with small hoes on, rather deep early in the season, but becoming shallower and with the larger hoes on as the season advances and the root system extends towards the middle of the row and nearer the surface. Especially is this important on upland soil, where conservation of all moisture plays such an important part in yield. When the corn in the breeding plat has attained to the tasseling stage, the tassels from all barren stalks should be carefully removed just as they are emerging from the roll of the last leaf. The tassel is the male part of the corn plant, while the silk is the female part. When a stalk is barren or bears only male organs, the tassel is generally above the average in size, strength and vigor, as all the vital forces of such a plant has been expended on this single organ of reproduction; hence, when an ovule or embryonic kernel, through the silk, is fertilized or pollinated by the yellow dust-like pollen from a barren stalk, it will, when planted, have a strong tendency, inherited through its male parent, to produce a barren stalk. The tassels should also be removed from all weak and stunted plants; for the same reason we would not use a "scrubby" stunted bull in a herd of cows if we cared anything for the future improvement of the stock. It has been demonstrated time and again by carefully conducted experiments that by selection from poor plants the yield of corn will not only be materially reduced, but will be of inferior quality. The writer has, during the past summer, visited quite a number of corn-fields in different parts of the State and has yet to find one that contained less than 10 per cent. of barren stalks, which means that from every ten acres in cultivation a loss of one acre's yield from non-productive stalks is sustained. In one field in which a count was made it was found that from 40 to 50 per cent. of the

stalks were barren, although this corn possessed a luxurious growth and had attained an average height of something like 10 to 12 feet. It must not be overlooked that the secret in successful corn raising consists in having each stalk bear at least one good-sized ear, as it costs just as much to cultivate non-productive stalks as prolific ones. The number of barren stalks in our fields should not, under average conditions of weather and cultivation, ever reach over 3 to 5 per cent.

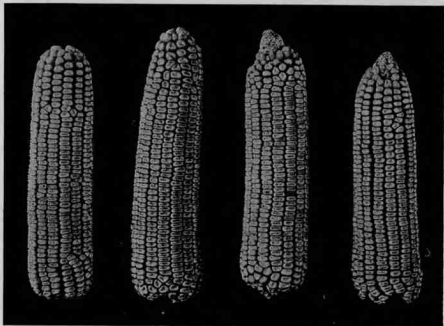


FIG. 4.

(From Mo. Agl. Expt. Station).

#### CHARACTERISTICS TO BE TAKEN INTO CONSIDERATION IN SEED SELECTION.

As total yield of shelled corn per acre is the principal consideration in the production of corn, the following characteristics correlated with large yield will be taken up somewhat in detail for considera-

##### *Number of Ears per Stalk.*

The stalk that bears two medium-sized ears will yield more corn per stalk, and hence more per acre, than the one that grows only one large ear. This is an important factor that is of necessity entirely left out of consideration when barn selection in the spring is resorted

to, as it will be perfectly natural to select there the largest specimens for seed, which will almost invariably have been grown upon stalks that bore but one ear; hence we have unconsciously, by the methods in common practice in North Carolina for seed selection, established generally one-eared varieties. In experiments conducted at the Edgcombe farm last year with seed from one-eared, two-eared (bottom and top) and four-eared stalks, the larger yields generally resulted from the selections from the stalks that bore the highest number of ears. To illustrate further, take for comparison two varieties of corn that were in our variety test of corn at this same farm last year. *Cocke's Prolific* is a two or more eared variety, while *Holt's Strawberry* is mainly a one-eared variety with a large stalk. The difference in shelled-corn yield of these two varieties under identical cultivation and fertilization on the same soil was 10.3 bushels in favor of *Cocke's Prolific*. The difference in yield between *Holt's Strawberry* and *Weekley's Improved*, another two or more eared variety, was 8.6 bushels in favor of *Weekley's Improved*.

### Stalks.

The kind of stalk from which to make selections is one possessing a tolerably large circumference at the base and gradually tapering towards the top, as this is the type that stands drought best and is not as apt to be blown down as a high, slender one. In selection, weight should be attached to good root and leaf development of the mother parent, as all nourishment and growth is entirely dependent upon the thoroughness with which these two organs do their work. Poor root or leaf development is always indicative of meager growth and small, poorly developed production. All selections should be made from perfectly healthy plants.

### Ears.

In selecting seed corn, care should be given to the following characteristics of the ear: Position on stalk, kind of shank, shape and color of grain and cob, size of cob, filling out of butts and tips, number of and distance between rows of kernels, and length and circumference.

*Position on Stalk.*—The position of ear on stalk should be tolerably low down, for two reasons: (1) because the stalk will be less liable to be blown down, as the ear will have less leverage, thereby averting the injury caused by lying on the ground; and (2) because if at a convenient height it can be gathered with a great deal more ease and at considerable less expense.

*Shank.*—This should be of sufficient size and strength to hold the ear well and in a rather drooping position, so that rain will be shed and hence prevented from running into the ear and causing the grain to rot, as would often be the case if the ear were held in an upright position.

*Shape.*—The cylindrical ear (Fig. 1—c) is the best type, as it is the one that yields the highest percentage and the largest total amount of shelled corn. The rows of kernels should run parallel the full

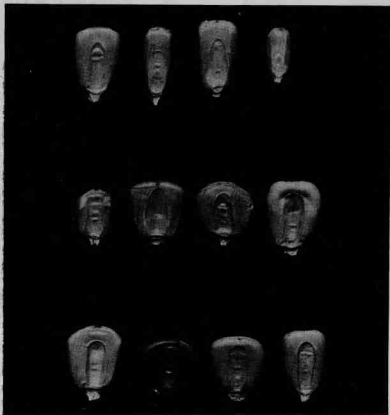


FIG. 5.

length of the cob without change in shape or diminution in size, or but very slightly. If the ears are tapering (Fig. 2—b) there is a suppression of yield, due to one or both of two causes, viz.: (1) diminished size of kernels at the tips, and (2) dropping of rows of kernels.

In planting, the small kernels at the butts and tips of ears should be discarded. They are less likely to germinate, and when they sprout

the vitality of the young corn plants from them is less than those from better developed seed, as the amount of plant food in the latter is insufficient to develop plants of sufficient size and vigor to secure with facility food for themselves from the soil before that stored up in the kernels has become exhausted.

*Color.*—Yellow corn should have a deep-red cob, while white corn should possess a white one, and any variation from these types is indicative of crossing of varieties. The market price of meal or grits made from white corn with red cobs is lower because of particles of the red cobs getting into the corn and being ground in with meal, giving it a reddish cast.

*Size of Cob.*—A medium-sized cob is the best, because it yields the largest proportion of corn to cob. If the cob is small, of necessity the number of grain rows is restricted, and when large the proportion of corn to cob is reduced. The best size cob is shown in Fig. 3—a, Fig. 3—c is too large, while Figs. 3—b and 1—b are too small.

*Length and Circumference.*—The length to circumference should be about as 4 to 3, i. e., if the ear is 8 inches long its circumference should approximate 6 inches, measured about one-third the way from the butt to the tip, to produce the largest yield. Too large circumference usually indicates small kernels of low vitality and poor feeding value.

*Filling-out of Butts and Tips.*—The more perfectly ears are filled at butts and tips, the larger the percentage yield of corn. It is possible, by rigid selection of ears filled compactly at butts and tips, to increase materially within a few years the annual yield over corn in which no consideration is given to these characteristics. In Fig. 4 is shown poorly and well tipped ears.

*Number and Distance between Rows of Kernels.*—The number of rows to the ear should be large and the distance between rows small to secure the largest yields. A wide *sulcus*, or distance between rows, indicates a reversion to an inferior type that will not justify the farmer of to-day in growing. In Fig. 1 is strikingly shown the difference in the solid setting of corn on (c) and (a). In (c) there is little or no space between the rows, while in (a) there is considerable.

#### *Kernels.*

The corn kernels may be divided into four parts: (a) the hull or outer layer; (b) the hard, flinty portion next to the hull and lying principally on the sides; (c) the white, floury portion occupying the crown; and (d) the germ, which is situated on the side of the kernel, facing the tip of the ear. The hard, horny portion contains the larger proportion of the protein (flesh-forming food), while the white, floury

part at the crown is rich in carbohydrates (which is the fattening and heat producing portion of the grain, mainly starch), and the germ carries a greater part of the oil and is also rich in protein. In making seed selections for high percentage yields, the kernels should be of a medium wedge shape, but not too long and sharp, for such a form not only "wastes space at the cob and restricts the size of the germ," but indicates inferior quality and low vitality. The wedge-shaped kernel is the one that fills more compactly than any other the space between the grain rows.



FIG. 6.

In Fig. 5 is shown good and bad forms of kernels. Kernels 1 and 12 are the best forms, while all the others are poor. Also in Fig. 6 is a proper-shaped kernel, photographed four times natural size. Its arrangement is shown on cob, Fig. 3—a.

It is always wise to test the germinating power of seed corn, especially if it is imported. It can be done as follows: Take two ordinary plates, fill one with sand saturated with water, and place 100 representative kernels, points downward, in the moistened sand,

and then place the second plate over the first and set aside in some warm place. Keep the sand moist, and in from five to seven days 95 per cent. of the kernels should have sprouted. If much less than this per cent. germinate, the seed cannot be relied upon as safe to use.

*Summary.*

1. In improving seed corn, obtain first the best yielding variety available and which is adapted to your soil and climatic conditions, and from this select seed for increasing the yield, having in mind the following characteristics:

2. Size and general form of stalk, the number of ears it bears and their attachment to and location on the stalk.

3. The shape of the ear (cylindrical form being preferable), its comparative length and circumference, the color of cob and grain, size of cob, filling of butts and tips, number of rows of corn on ear, and the distance between rows, size and form of kernel, are important and should be carefully observed.