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R. H. Emberson

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TEN LESSONS

ON

THE STUDY OF INDIAN CORN

A MODEL EAR.

PREPARED BY M. F. MILLER

AND

ARRANGED BY R. H. EMBERSON,

Both of the College of Agriculture, University of Missouri,
Columbia, Mo.

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FOREWORD.

These lessons on Indian Corn were prepared by Prof. M. F. Miller of the Missouri Agricultural College, with some very slight modifications by myself. They were prepared especially for use in the rural schools and I am sure that rural school teachers will find them very helpful.

In these outlines no mention is made of any text book, but it should not be inferred from this that a book is not desirable. On the contrary it is earnestly recommended that the teacher make the largest use of the adopted text on Agriculture. The lessons of the text should be selected to correspond with the work in the outlines; for example, if the school is studying corn, select those lessons in the text that relate to that subject. By this means both the text and the outlines can be used to the greatest advantage.

For the present, the work should be given to the pupils of the seventh or eight grades, or years, which should be combined in this subject at least. Teachers will probably find it preferable to give two lessons a week, thirty-five or forty minutes in length, rather than daily lessons of fifteen or twenty minutes in length.

The subject-matter of these lessons may be given by the teacher in short talks, or the facts may be presented in question form or brief statements placed on the board. Pupils should be encouraged to get information from books, papers, bulletins—from all sources. Encourage the spirit of inquiry, observation, experimentation; this is worth more than the facts learned. Insist that pupils discuss the things studied and that they put their thoughts in clear oral or written discourse.

Use the note book. Pupils should make a record of each fact considered and each conclusion reached. This will make them careful and discriminating.

Above all, try to get pupils to appreciate their environment and to make the largest, wisest use of those things which they see and handle daily.

R. H. EMBERSON,
Department of Rural Education,
College of Agriculture, University of Missouri,
Columbia, Mo.

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LESSON I.

THE HISTORY AND USES OF INDIAN CORN.

Indian Corn is a native of America. Columbus found it being grown by the Indians at the time of the discovery of this continent. It has been found in many of the mounds of the ancient Mound Builders, showing that many of the ancient people of America cultivated this plant.

Its early use was undoubtedly for human food; the ears of that time were small and inferior to the fine, large ears of the present time. This great improvement in the quality has been brought about by the continual selection of the better ears for planting and by a more careful attention to the matter of soil preparation and cultivation. It shows very plainly what proper methods of culture and selection will do. The Indian warrior whose time was given to hunting, fishing and fighting always left the growing of the corn to his faithful wife or squaw. She had no means of preparing the land except by digging it up with a clam-shell or scratching it with a crooked stick and there is little wonder that the ears produced were small and few in number.

With the coming of the white man, the plow, the corn-planter and the cultivator, a great advance was made in the methods of culture and the result was at once shown in the great improvement in the yield and quality of the crop.

Corn is today the greatest American crop. Four fifths of the world's corn crop is grown in this country. The number of bushels produced in the United States, in 1908, was over 2,500,000,000.

Missouri produced in 1908, over 200,000,000 bushels, worth from \$75,000,000 to \$100,000,000.

The uses to which corn is put are many. By far the largest amount is fed to live-stock on the farms where it is grown. Immense quantities of it are used for human food in various forms, such as corn-bread, hominy, corn-meal mush, and a large number of the so-called breakfast foods. From the grain is manufactured starch and also oil which is used for table purposes, mixing paints, lubricating purposes, manufacturing soap and other things. Glucose or syrup is one of the important corn products. It is heavy, transparent and not so sweet as cane syrup and has little if any flavor. In solid form it is called

grape sugar. Rubber is another one of the corn products; it is used in the manufacture of boots, shoes, machine belts, linoleums, etc. The pith of the stalk is used for padding for war ships to protect them from the effects of cannon balls.

Suggestive Questions.—Of what country is corn a native? What was the quality of the early variety as compared with the present? What has brought about this improvement? Why did the Indians make no improvement in the cultivation or quality of corn? Give the number of bushels grown in Missouri, in 1908, and calculate its value at current prices. Write a short paper to The Uses Of Corn.

LESSON II.

THE CORN PLANT (The Roots and Leaves).

How many people who have seen corn fields every year during their entire lives, have really given any notice to the way in which the corn plant grows? How many know of what use the blades, the tassel, the silks, and the roots are to the plant. And how many realize that a knowledge of how the plant grows is of great value to the farmer, in giving it just the attention it needs at the various seasons of the year, in order that it may produce the largest amount of grain? People are just learning that such knowledge not only makes the growing of corn a great deal more interesting, but enables the farmer to produce more corn per acre.

The plan of nature in guiding the growth of the plant seems to be primarily that of producing grain and every effort is centered on that object. The roots extend downward and sidewise into the soil for the purpose of gathering mineral foods and moisture. The complete manner in which these roots penetrate the soil is such that there is rarely a cubic inch of soil in the upper four feet that hasn't one or more small roots passing through it. It has been shown that on an average corn plant, the total length of root if they were all placed end to end would reach 1-4 of a mile. Everyone has noticed how dry the ground in a corn field gets, late in the summer when the plants are large and when the rainfall is deficient. This shows the great power of the roots in removing moisture from the soil. Take a spade and dig into the soil near the stalk of corn and notice how many roots there are and how close they come

to the surface. Later in the season notice too, the brace roots put out from the joint just above ground in order to brace the plant in the wind.

The blades are frequently called the digestive organs of the plant, for in these we find the plant food which is brought up by the roots being digested and combining with certain substances absorbed or breathed in by the leaf from the air. It is in the leaf that the starch is manufactured which is later transferred to the kernels on the ear where it is stored. To remove any of the leaves from a corn plant when they are green and the plant is growing would be to greatly reduce its power of forming grain. A good growth of healthy leaves is therefore essential to a large production of corn.

Have you ever noticed the wavy margins of the corn blades? These are made so in order that the leaf may bend sidewise readily in the wind and not be torn or injured. The sheaths of the leaf which surround the stalk gather water which the plant absorbs directly through the stalk. A great deal of moisture from the dew and light showers is thus used that might otherwise be lost.

Count the number of blades on several stalks of corn and notice how they vary in length and width. Notice too, how they are produced from the joint, one on one side and the next on the other.

SUGGESTIONS FOR HOME STUDY.

Select ten corn stalks for a study. Count the number of joints and blades. Are they even or odd? How high do undeveloped ears grow on the stalk? Notice the shape of the stalk below the ear; above it; state the difference. Count the number of shucks on the ear. Compare with number of blades above the ear. Count the number of joints on shank of ear and compare with number of joints above the ear.

Find ten average stalks. Measure height. Find average height. Where is the ear found, nearest the top or base of stalk?

See if the largest ears are on the largest stalks. What are the advantages of large blades?

Dig up a full grown stalk of corn, being careful to break as few roots as possible, and study the root structure of the

plant. Notice how brace roots form; how high do the brace roots extend?

Note.—Teachers should write to the Department of Agriculture, Washington, D. C., and secure a copy of Farmers Bulletin, No. 199, on Corn Growing, The Germination of Seed Corn, No. 253 and the bulletin on The Use of Illustrative Material in Teaching Agriculture in Rural Schools, which is a reprint from the Year Book of Agriculture, 1905. A postal card will secure these valuable bulletins which should be read by all the pupils of the seventh and eighth grades of the rural schools.

LESSON III.

THE CORN PLANT (The Tassel and the Ear).

The manner in which a perfect ear of corn is produced is the most interesting part of the growth of a corn plant. Notice that every kernel has one silk fastened to its tip and that it runs down between the rows and out to the tip where they creep out at the end of the husks? This is all for a purpose. What is it?

You have seen the tassels creep out from the roll of blades at the top and soon after, spread out, opening a large number of little sacks from which a fine yellow dust floated into the air. Each particle of this dust, called pollen, if magnified by a powerful magnifying glass is seen to be a little ball, like a small seed. In order that the cobs of the corn may bear kernels, it is necessary that one of these small pollen grains fall on each silk projecting from the husks of the ear. The silks are moist and the pollen grains stick to them and sprout, as it were, sending a tiny tube like a root, down the whole length of the silk to the young kernel when it immediately begins to grow. This is what is known as the process of fertilization in corn, and it is necessary to the production of kernels.

Sometimes pollen grains from a white variety will blow on to the silks of a yellow variety and the result is a mixture which shows in the white caps on the yellow kernels. If pollen from a yellow variety falls on the silks of a white variety the kernels will show yellow sides. Every boy has noticed this mixing where white and yellow varieties of corn are planted side by side. These light pollen grains will blow long distances in the wind and it is therefore very common to find occasional mixed kernels in almost every corn field.

Examine a number of ears for mixed kernels. Notice also at the tips or butts of the ears where some kernels whose silks have come out too early or too late and have failed to be fertilized thus preventing their development.

POLLEN SACKS AND THE POLLEN GRAINS COMING FROM THEM
(HIGHLY MAGNIFIED).

Go to the corn field and notice how the ears come out just at the attachment of a leaf with the stalk. See how many stalks can be found with two good ears, or with one good ear and a nubbin. Notice that where there are two well developed ears this is usually on stalks which are not crowded in the row but have more room to grow and gather food and moisture than the average.

Notice that most of the ears hang over when they are ripe. Those that stand up allow water to run down into the husks and do not dry out well. They frequently mould. What does this suggest to you in selecting seed corn? Notice that some stalks bear no well developed ears. This is usually due to the fact that they haven't had enough plant food and moisture due to crowding or to weeds or to dry weather or to poor cultivation.

CORN SILKS SHOWING POLLEN GRAINS FALLING ON THEM.

Figure how many bushels per acre corn will make if it averages two stalks in a hill three feet eight inches each way and if each ear weigh 3-4 of a pound.

Make an estimate of the number of acres of corn planted in your school district. Taking the number of bushels per acre, as determined in the above problem, calculate the number of bushels that were produced in your school district. Estimate its value at the current prices paid for corn.

If it costs \$16 to raise an acre of corn, including interest, taxes, labor, etc., calculate the rate of gain or loss per acre.

LESSON IV.

WHAT IS A GOOD EAR OF CORN?

Ears of corn vary greatly in character and when the kernels from a particular kind of ear are planted, the stalks produced, grow ears very much like the one planted. Consequently if one is to grow the best kind of corn, the best ears should be

EARS SHOWING WIDE, MEDIUM AND CLOSE SPACE BETWEEN
ROWS.

selected for seed. It is just as important therefore to know what a good ear of corn is in growing corn as to know what a good animal is when we are raising animals.

A good ear of corn may be described as follows: The ear should be from 9 to 10 1-2 inches long and from seven to seven and one-half inches around, measured at a point 1-3 the distance from the butt to the tip. It should be practically the same diameter from end to end; that is it should not be distinctly tapering. The rows of kernels should be straight and the kernels should be of such a shape that they will fit tightly together with no furrows left between the rows. The butts should be well rounded out with kernels evenly arranged around a cup shaped cavity about one inch across. The tips should be well filled out to the end with deep, even kernels. The kernels of the ear should all be very nearly the same size and shape. They should be wedge shaped but not pointed; they should have large, smooth hearts or germs, not blistered or discolored. The length of the kernel should be about 1 1-2 times as great as its width at the widest part and it should be of the same thickness from one end to the other. The kernels should show no mixture with corn of the opposite color. The cob should be of medium size, neither very large nor very small.

Secure a number of ears of corn and notice the faults of each. Pick out the ones that are most nearly perfect. Take an ear and write a description of it telling in what points it is good and in what points it is imperfect.

LESSON V.

JUDGING CORN (Single Ears).

To learn to recognize a good ear of corn quickly it is usually necessary to practice judging a number of ears as to their quality. To become an expert judge of livestock one must see them often and must observe their good and bad points. The same is true of ears of corn; but just as anyone can become a good judge of stock by giving the matter attention, just so can one become a good judge of corn.

Lay five ears of corn on the table and try to pick out the one having the least number of faults. Go over the various points of the ear as given in Lesson 4, in the description of a good ear, and place that ear which is most nearly perfect on the left. Put the next best one second, the third best third, and so on. In what ways is No. 1 better than No. 2? Give the good and bad points of each ear.

In finding the depth and shape of the kernel, pick out a number of kernels from one side of the ear near the middle and lay them with the germs up in order to compare the kernels of the various ears. This will also show the size of the cob. Look for mixed kernels. Remember that in white corn the yellow color due to mixing with yellow corn, shows on the sides of the

SAMPLE OF BUTTS, TIPS AND COBS. THE TIP ON LEFT IS IDEAL, IN MIDDLE FAIR, ON THE RIGHT POOR. THE BUTT ON THE LEFT IS TOO SMALL, ON THE RIGHT TOO LARGE, IN THE MIDDLE GOOD. THE COBS ON LEFT ARE TOO SMALL, ON THE RIGHT TOO LARGE, IN THE MIDDLE GOOD.

kernels rather than on the caps, while in yellow corn the mixed kernels show white caps. This mixture is very undesirable where one wishes to grow pure varieties.

Cobs should be red in yellow corn and white in white corn, with the exception of St. Charles White which has a red cob.

THE KERNELS OF THE TOP ROW ARE TOO SHORT, THOSE OF THE SECOND ROW TOO LONG AND SLIM, THOSE OF THE THIRD AND FOURTH ROWS ARE GOOD.. THE BOTTOM ROW SHOWS GERMS OF DIFFERENT SIZES.

LESSON VI.

CORN SCORING.

At Fairs and other places where corn is shown for premiums it is customary to show 10 ears together as a sample. Consequently in judging such samples ten ears must be considered instead of a single ear. To help in this judging a card giving a scale of points arranged to represent the different characters of the ears is used. This is called a score card and the one that is used in Missouri is as follows:

Scale of Points.

Maturity and soundness	10
Uniformity of ears	10
Length	10
Circumference	5
Purity of cobs	5
Purity of kernels	5
Uniformity of kernels	10
Shape of kernels	10
Character of germ	10
Space between rows	5
Butts	5
Tips	5
Size of cob	10

Total 100

How to Use the Score Card.

Maturity and Soundness. (10.)

An ear that is not mature will not be perfectly tight. This is best determined by giving the ear a slight twist. The kernels should all be sound and free from decay. For every ear not perfectly mature and sound, cut the exhibit one point.

Uniformity of Ears. (10.)

All ears in the sample should be as nearly alike in every way as possible. This is very important. They should be the same in size, in color and in character of kernel. For every ear strikingly different from the average cut one point.

Shape of Ears. (10.)

Ears should be practically the same diameter from one end to the other. For each ear that is distinctly tapering cut one point.

Length. (10.)

Ears should be between 9 and 10 1-2 inches in length. For every ear that is under 8 1-2 inches or for every ear that is over 10 1-2 inches, cut one point.

Circumference. (5.)

Ears should be from 7 to 7 1-2 inches around measured at a point 1-3 the distance from butt to tip. For each ear less than 7 inches or over 7 3-4 inches cut one-half point.

Purity of Cob. (5.)

Yellow corn should have red cobs and white corn, white cobs (with the exception of St. Charles White). A single ear with a cob of the wrong color bars an exhibit from competing for prizes.

Purity of Kernel. (5.)

For every mixed kernel in the exhibit cut one-fourth point.

Uniformity of Kernels. (5.)

All ears should have kernels of approximately the same size. For every ear having kernels larger or smaller than the average cut one-half point.

Shape of Kernels. (5.)

Take out two kernels from the middle of each ear. Cut one-half point for each ear having poorly shaped kernels.

TEN GOOD EARS OF CORN.

Character of Germ. (10.)

Examine kernels of each ear as to the character of germ and cut one point for each ear having poor germs.

Space Between Rows. (5.)

For each ear having wide furrows between the rows of kernels, cut one-half point.

Butts. (5.)

For each poor butt cut one-half point.

Tips. (5.)

For each poor tip, cut one-half point.

Size of Cob. (10.)

For each ear having a cob either too large or too small, cut one point.

Add together the total number of points cut and subtract from 100. This gives the number of points the sample scores.

Score a number of samples and find the ones scoring highest.

Get several samples of ten ears each. Each pupil should score them by himself, making note of the sample that scores the highest, the next highest, etc.

Pupils should compare their scoring and discuss the subject freely. It is not the scoring so much as the close observation of the corn that is desired.

LESSON VII.

THE KERNEL.

A kernel of corn is a small store-house of material from which nature grows a new corn plant. The part called the germ contains a small plant ready to grow when the necessary moisture, air and warmth are supplied. The material stored in the kernel consists of starch, oil and protein which are used as food for this small plant until it develops roots large enough to gather food from the soil and its leaves are large enough to digest this material which the soil supplies.

By cutting open a kernel with a knife the germ may readily be separated from the more starchy part and a close examination of this germ will show an oily character since the germ contains most of the oil of the kernel. The white starch and the more horny starch, may readily be seen. The quantity of this horny starch determines the hardness of the kernel. Many farmers object to corn with kernels that have a great deal of this horny part as it is harder for animals to chew. Such corn contains more protein than that containing a large amount of the white starch however, and usually makes stronger, thriftier stalks when planted.

One can tell a good deal about the strength of germination of kernels by a careful examination of the germ. If the germ shows a fresh oily appearance when cut open and if the outside is smooth, fresh, and not blistered, this indicates that it will grow well. If it is discolored, either on the outside or on the inside, and if the outside is blistered or rough it will very probably not grow well.

Lay twenty-five kernels side by side on the table with germ side up and pick out the ones of the best shape and with the

best germs. Cut off the point of the kernel with a knife or bite it off and pick out the kernels which look like they would not grow.

KERNEL SHOWING DIFFERENT PARTS.

LESSON VIII.

THE TESTING OF SEED CORN.

To be sure that corn will grow it is often necessary to test it for strength of germination. Take a shallow box a foot and a half square, such as an old table drawer, and half fill it with sand. Cut a piece of muslin that will just fit the box

and mark it off with a lead pencil into squares 1 1-2 inches each way. Begin in the upper left hand corner and number these squares. Wet the sand in the box with clean water and lay the cloth on it.

Secure as many ears of corn as there are squares on the muslin and lay them in a row on a shelf or board numbering from left to right. Now take ten kernels from ear No. 1 and place in square No. 1, ten kernels from ear No. 2, and place in square No. 2 and so on until the squares are filled, laying all the kernels flat on the sides. Take the kernels from different parts of the ear. Cut another piece of muslin just to fit the box and lay carefully over the corn. Moisten with water. Take some heavy cloth (sacks or whatever is handy), and lay on top, wetting down well. Keep in a warm place for 4 or 5 days moistening the cloth covers occasionally.

At the end of this time carefully roll back the cloth covers and notice which ears have germinated strongly and which ones have kernels that have failed to germinate. An ear having kernels that sprout weakly or one having two or more kernels that fail to sprout will not do to plant. Examine such ears and see if the germs look bad. Compare them with the good ears as to the character of the germ.

Another way to make this experiment is to fill a cigar box with sand. Drive tacks in the edge of the box, two inches apart; divide the sand into sections by stretching a string around the tacks, and push the kernels into the sand.

LESSON IX.

HOW A CORN KERNEL GROWS.

A kernel of corn will sprout or germinate when kept warm, moist and supplied with air, as has been shown in the preceding lesson. Secure a box six inches deep and a couple of feet long and fill with sand. In this, plant kernels of corn 3 inches apart and one inch deep. Moisten well with water and set in a warm place. At the end of two days, dig up a kernel near one end of the box, wash off the sand carefully and make a drawing showing the sprouts that have started. The fourth day dig up another and make a similar drawing. Likewise the sixth, eighth and ten days. Study each plant carefully as it is dug up. Compare the drawings and see how the plants have developed.

You will notice that a kernel first sends out a single sprout from the tip end of the germ and a little later one appears from the other end. From the first sprout a single root at first develops but in a few days two more roots make their appearance, thus giving three strong roots to fasten in the soil and gather food which the plant will begin to need just as soon as that stored in the seed is used up.

Notice too, that as these three roots develop they throw out fine hairs near the ends. These are for sucking in the water and dissolved mineral plant food from the soil.

The sprout which grows from the upper end of the germ forms the leaves. The unfolding of these leaves is readily observed as they push through the soil to the light.

It is very interesting to notice that no difference in what position the kernel is placed in the soil, the roots always turn downward and the leaf sprout turns upward. This is readily shown by planting a kernel with the tip end up and then digging it up just after the leaves have appeared above ground.

Since the leaves of the plant must always appear above ground where there is sunlight, before any amount of growth will take place, the soil should be made fine and loose before planting so that the plant will have little difficulty pushing its way through. Poor soil preparation is often responsible for poor stands and poor yields of corn. There is an old saying that "corn is half tended before it is planted," meaning that the preparation of a proper seed bed is one of the most important things in growing corn and that where it is properly prepared the corn is easy to cultivate and keep free of weeds.

The depth at which corn should be planted is determined largely by the amount of moisture present, or in other words those conditions which will cause the kernels to sprout and come up quickly. If the ground is moist and mellow, one to one and a half inches is deep enough. If it is dry on the surface it may be necessary to plant the corn three or four inches deep to get it into moist soil where it will sprout. The deeper it is planted the harder it is for it to get up, however, and it is much better to plant it near the surface if the soil is moist. Try planting kernels at one, two, three and four inches deep in moist sand to observe the time required for each to come up.

LESSON X.

WHY CORN IS CULTIVATED.

Most people think that corn is cultivated simply to kill weeds, and while this is the main reason it is not the only one. It is necessary to keep the corn free of weeds if it is to make its best growth, especially on dry seasons, since the weeds are great robbers of both moisture and food. If they are allowed to grow the corn will usually not get enough food and moisture and will not make the largest growth and yield. The best time to kill weeds is just as they are starting and before

A BUSHEL OF GOOD CORN.

they are firmly set in the soil. A good plan is to run a harrow over the corn just after it is up. This will destroy a few corn plants but not many and it will kill almost all the young weeds that are usually just starting. Sometimes it is well to harrow two or three times when the corn is young, but this must soon be followed with a cultivator which stirs the surface of the soil 3 or 4 inches deep, pulverizes it, breaks any crust formed by a rain and lets the air down into the soil.

This stirring of the surface soil is a great benefit to the corn, besides the mere killing of the weeds. Air is necessary to the proper growth of the roots and this loosening of the surface allows the air to enter more freely. This is very im-

portant, especially on those soils that tend to run together and become compact.

But there is another important reason for cultivation and that is to save moisture. Where a soil is hard and settled together and has a crust on it, as is usually the case after a heavy rain, the water creeps to the surface, evaporates into the air and is thus lost for the use of the growing corn. This is especially true late in the cultivating season when it is apt to be dry. If this surface is stirred and made loose and porous, this layer of loose earth acts just as a blanket thrown over the soil and holds the moisture for the use of the corn. This is very important on dry seasons. On wet seasons this cultivation for saving moisture is not so necessary. It is then largely a matter of killing weeds.

One mistake that is often made in cultivating corn is to cultivate too deep, especially late in the season. If you dig down a few inches out from the row, when corn is two or three feet high, you will find the roots within two or three inches of the surface. A cultivator running four or five inches deep will break a large number of these roots on which the corn is depending for its moisture and food, thus greatly injuring it, especially if the weather is dry. If the season is wet, this injury is not so great, and on such times where the weeds have gotten a start it may be necessary to cultivate deep to remove them. Deep cultivation is also sometimes necessary on hard, compact soils but on most upland soils, on average seasons, the last plowings should be only about three inches deep.

Have you ever noticed the lower corn blades die after a deep plowing on a dry season? This was because the roots were broken in large numbers and a considerable share of the moisture and plant food thus cut off from the plants. The more we study about the way a corn plant grows therefore, the better we know how to care for a corn crop.

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