# EC33-136 Corn in Nebraska

P.H. Stewart
*University of Nebraska at Lincoln*

D.L. Gross
*University of Nebraska at Lincoln*

T.A. Kiesselbach
*University of Nebraska at Lincoln*

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# CORN in NEBRASKA

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## INDEX

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P. H. STEWART, D. L. GROSS, AND T. A. KIESSELBACH [1]

Corn is Nebraska's most important crop. Of the nearly 19 million acres under cultivation in the state, over 10 million acres or more than 50 per cent is normally planted to corn. This is three times the acreage of wheat, four times that of oats, and ten times that of barley. The 10-year average acre yield of corn for this state is 25.8 bushels compared with 26.9 bushels for the entire United States. Nebraska, with an average annual crop of approximately 258 million bushels, usually ranks third among all states in the total production of corn, being exceeded by Iowa and Illinois.

Figure 1 shows the distribution of corn in Nebraska. The eastern one-third of the state produces by far the largest percentage of the crop altho corn is increasing in importance in the western part.

Burt county leads in yield per acre with an average of 40 bushels over a 10-year period. Cuming county ranks second with 39 bushels and Washington county third with 38 bushels per acre. Figure 2 shows the 10-year average yield of corn for each Nebraska county.

## FACTORS IN PROFITABLE CORN PRODUCTION

All corn growers are in competition, one with another. Nebraska farmers compete with those of other corn belt states. Within the state, corn growers in eastern Nebraska on high priced land, are in competition with those in western Nebras-

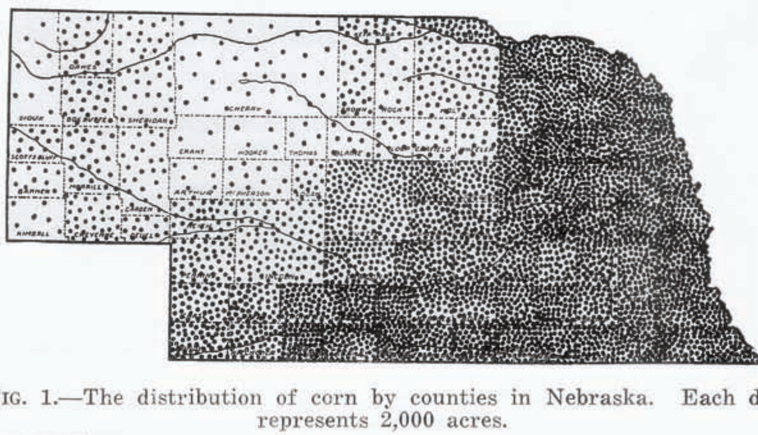

FIG. 1.—The distribution of corn by counties in Nebraska. Each dot represents 2,000 acres.

[1] Extension Agronomist, Assistant Extension Agronomist and Agronomist, respectively, at the University of Nebraska, College of Agriculture, Lincoln.

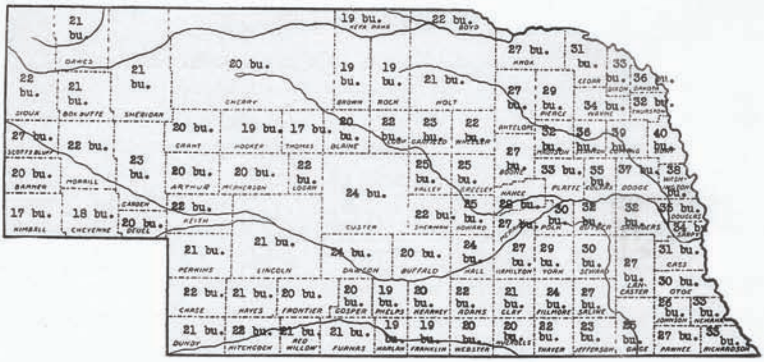

FIG. 2.—The 10-year average yield of corn for the different counties of Nebraska.

ka on relatively cheap land. Within a township, neighboring farmers vie with each other to see who can produce corn the most efficiently.

The individual farmer can do very little about the price of corn on the market. For the most part, unless he sells his crop through livestock, he must accept the local market price. He can, however, by his own efforts, influence to a considerable extent, the cost of raising a bushel of corn.

Suppose, as it is shown by Figure 3, it costs 40 cents per bushel to produce corn which sells at 50 cents locally. There is then a margin of 10 cents profit. If the grower is to increase his bushel profit at this price, it must be done through lowering the cost per bushel. This may be accomplished in

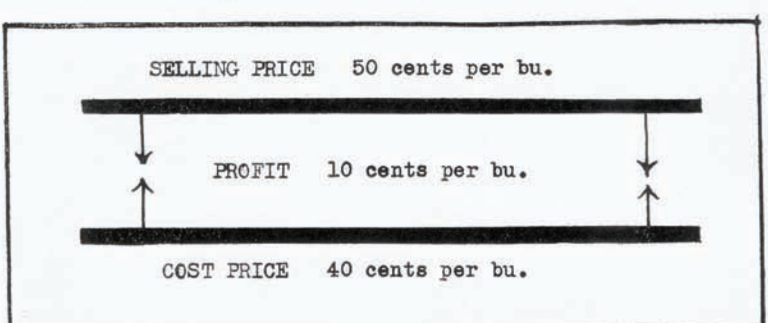


FIG. 3.—Since the individual farmer cannot influence the market price of corn, his only opportunity to increase his profit is to lower the cost of growing the crop.

two ways: (1) by increasing the yield of each acre of corn through the use of higher yielding seed, better cultural practices, and crop rotation and field management designed to conserve moisture and increase soil fertility; and (2) by maintaining at least the same yields but reducing the costs of growing the crop by the use of more economical machinery and power. During periods of low prices, good practices are even more important than during periods of high prices when even poor methods are likely to show some profit. The man who raises a high yield at a reasonable cost per acre has a low cost per bushel. He has more of an opportunity to make a profit than his neighbor who has lower yields and the same labor and land costs.

## SEED

The yield of corn is greatly influenced by the kind of seed used. Varieties grown side by side may vary greatly in production due to inherent yielding ability, adaptation, selection and breeding.

### Fertilization and Inheritance

Corn is naturally a cross fertilized plant and in this respect differs from oats, wheat, and barley. The kernels develop from the pistillate flowers on the young ear shoot, after their individual fertilization by pollen from the tassels. It is necessary for each silk to be pollinated separately otherwise there will be missing grains on the ear. Thus the embryo of a kernel of corn receives its inheritance in like proportion from the plant on which it is developed and from the plant which produced the particular pollen grain which fertilized it.

In selecting desirable seed ears in the field, one is able therefore to base judgment on only one parent — the plant which produces the ear. The various kernels on an ear of corn may have been fertilized by chance with pollen from many different plants. The kernels of an ear may therefore vary greatly in their inheritance.

Due to cross fertilization, new combinations of hereditary characters are continually being produced. This results in great variation between the corn plants in an ordinary field, even though much care is taken to plant ears which look alike and come from similar stalks. Because of its hybrid nature and the fact that there is a wide variation in the characteristics of stalks and ears in any given field, corn is more easily changed by selection than any of the other cereal crops. By the annual selection of seed for a period of years from plants having similar vegetative and ear characters, a strain of corn with a predominance of certain definite characters can be

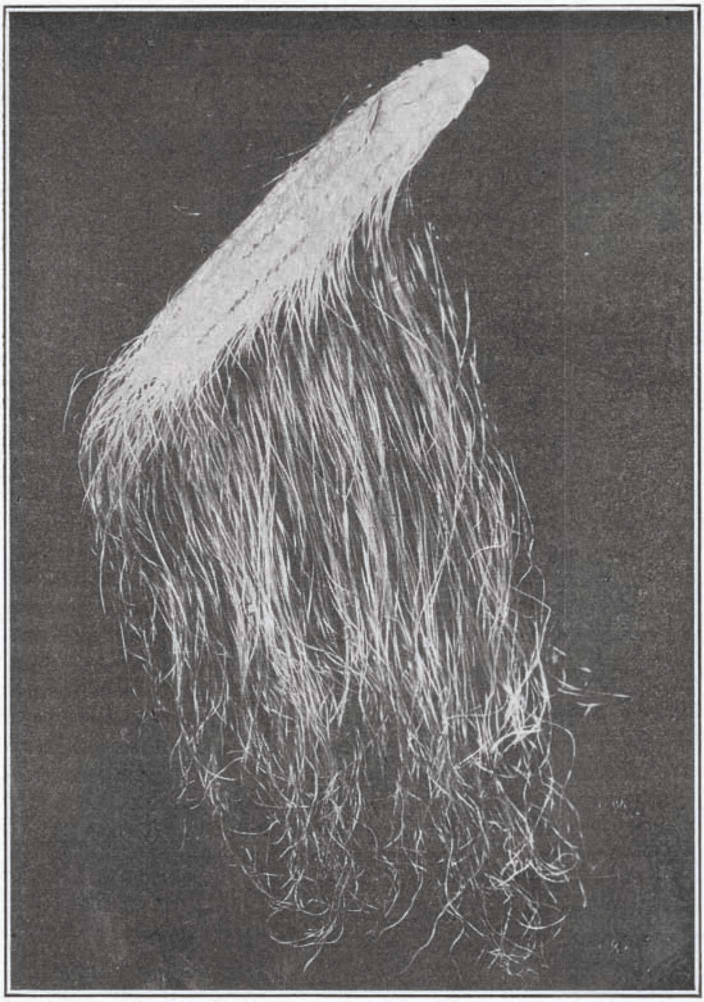

FIG. 4.—An ear of corn at silking time. Every kernel has its silk and must be fertilized separately. This is accomplished by individual pollen grains produced in the tassel, which fall upon the silks where they germinate and grow very slender tubes through the silks to the embryo sacks at their base where fertilization is completed.

developed. Thus two farmers living on adjoining farms may start with identical seed, yet in a few years their corn might be quite unlike in yield and appearance due to differences in selection standards which are followed in picking seed ears. The changes due to selection may or may not improve the corn, depending on how the changed plants fit the local environmental conditions. Since corn is normally cross fertilized, too close and long continued selection as to ear type may tend toward inbreeding with some reduction in the vigor and yield of the crop.

### The Adaptation of Corn to Climatic Conditions

A well adapted variety of corn is one having hereditary characteristics with respect to earliness of ripening, vegetative size, leafiness, and soil moisture requirements which fit it well to local conditions. The highest yielding varieties for any particular locality are those which normally make full use of the average growing season and the available soil moisture and yet ripen before the first killing frost in the fall. Corn grown in a certain community for a long period, if properly selected, becomes adapted by means of survival of the fittest and thru selection by the grower, thus coming more and more into harmony with the local environment. The growing of well adapted corn is of great importance to the farmer.

Corn suited to one part of Nebraska may not be adapted to other areas. The combined effect of available soil moisture, altitude, and latitude of any given locality are the chief factors which determine the type of corn best suited for that particular area. Farmers in counties having plenty of rain, a low altitude and southern latitude can raise a much taller, later maturing and larger eared type than those in regions with scanty rainfall and a short growing season.

The average annual rainfall for Nebraska varies from 32 inches in the southeastern part to 16 inches in the western

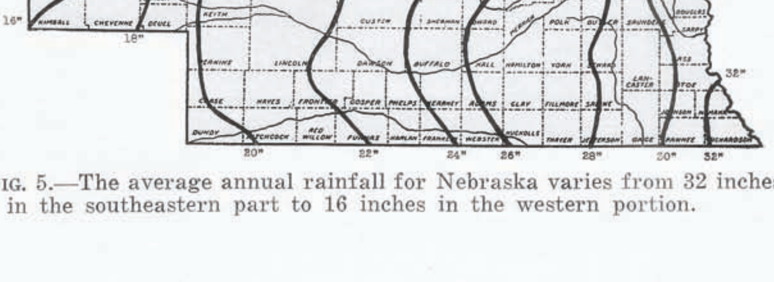


FIG. 5.—The average annual rainfall for Nebraska varies from 32 inches in the southeastern part to 16 inches in the western portion.

part. (Figure 5.). Much of this precipitation comes in the form of heavy rains during the growing season, more than 68 per cent falling in April, May, June, July, and August. The amount of July and August rainfall is an important factor in determining the yield of the corn crop. The average monthly precipitation for the state is shown in Figure 6.

The altitude of Nebraska increases rather gradually from 840 feet in the southeastern corner to an extreme of 5,340 feet along the Wyoming line in Banner county. An increase in elevation tends to produce lower temperatures which result in later frosts in the spring and earlier frosts in the fall.

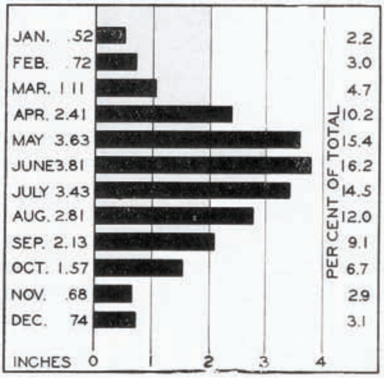


FIG. 6.—The average monthly precipitation for Nebraska. Nearly 70 per cent falls during the growing season.

Since Nebraska is some 207 miles wide, the range in latitude causes considerable difference in temperature between the southern and northern borders of the state. It is estimated that as one travels northward from the south border of Nebraska, the growing season averages one day shorter for each 10 miles. The combined effect of latitude and altitude results in a growing season of about 170 days in southeastern Nebraska as compared to less than 128 days in the northwestern part of the state. (Figure 7.)

Farmers in western Nebraska well know that seed corn brought from eastern Nebraska will not mature, and on the uplands may not even develop sufficiently to produce ear shoots. Corn adapted to western Nebraska conditions must be short stalked, low-eared, early ripening, and bear ears with relatively shallow flinty kernels. In the eastern part of Nebraska later maturing, taller growing strains with larger ears and deeper kernels are grown.

Altho corn grown in a locality for a number of years tends to become adapted, there is considerable variation in the corn being grown by different farmers in a given county. Careful tests have shown as much as 15 to 20 per cent difference in the yields of local farmers' varieties. There is also a difference among varieties in regard to lodging, size and strength of ear shanks, freedom from disease, quality, barrenness, and suckers.

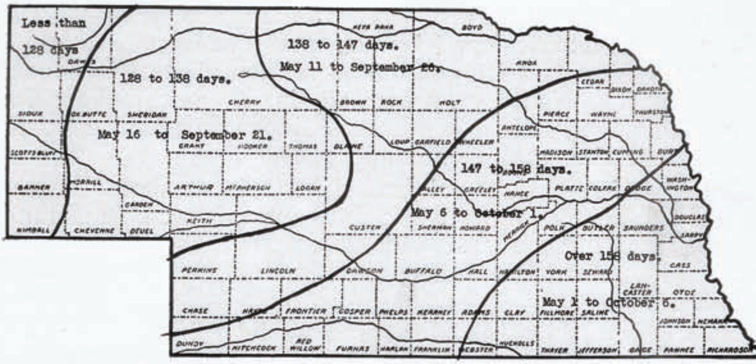


FIG. 7.—Average killing frost dates and length of frost free periods for various sections of Nebraska.

Adaptation to soil types does not seem important in this state. Certain bottomland soils, because of their more favorable soil moisture and atmospheric conditions, may be more suitable for large strains of corn than the surrounding uplands. By planting locally grown bottomland seed on the bottomlands and upland seed on uplands, providing both have been equally well selected from a high yielding variety or strain of corn, serious inadaptation may be avoided.

## VARIETIES OF CORN

It is not wise to depend too much on variety names since widely different strains and selections may be developed from a variety. There may be as much difference in the yielding ability of various farmers' strains within any particular variety as between entirely different varieties.

Yellow corn contains a vitamin not found in white corn and therefore gives better results when fed to livestock, particularly hogs and chickens, which are not on pasture or getting a good quality of green hay.

The following general information on varieties is of interest.

### Yellow Dent Varieties

The most important yellow dent varieties grown in eastern Nebraska are Reid, Leaming, Cattle, Krug, and Minnesota 13. In western Nebraska, locally adapted strains without varietal names prevail.

Reid Yellow Dent, is by far the most widely grown variety in this state. Most Nebraska farmers prefer a yellow corn and Reid has been popular in filling this want. It predominates in eastern Nebraska, and even in central and western

Nebraska early strains of this variety are grown. Reid yellow dent was developed by the Reid family of Illinois by crossing a large reddish colored corn with an early maturing yellow variety. Nebraska grown strains of Reid Yellow Dent vary widely in type and appearance depending on the locality and the selection they have undergone.

*The Leaming* variety originated in Ohio at about the time that Reid Yellow Dent came into prominence in Illinois. Typical Leaming ears are tapering with rather large butts, and have somewhat rounder, thicker, and narrower kernels than Reid.

*Catle corn,* a long, slender-eared variety with wide, thick, and relatively shallow kernels, is grown rather extensively in certain eastern Nebraska counties such as Douglas, Washington, and Dodge and is found scattered over much of eastern Nebraska. It closely resembles a variety grown 40 years ago which was known as Longfellow or Long John, and it may have been developed from this variety. The name Cattle Corn may have been applied to it because the length and diameter of ear made it easy to break for cattle. It is reported to have been widely grown by the Standard Cattle Company at Ames, Nebraska, and may have taken its name from their distribution of it. It is easy to husk and popular among cornhuskers for that reason.

*Krug corn,* was originated by George Krug of Woodford County, Illinois. It is supposed to have been developed by selection from a cross of a Nebraska grown Reid Yellow Dent with Goldmine and an Illinois strain of Reid Yellow Dent. Krug corn has been selected for very heavy, solid, and rather slender ears with smooth, dimple dented, horny kernels. It is now widely grown in Illinois and Iowa where it has made an excellent record in variety tests. It is difficult to select ear samples of Krug corn to meet show corn standards. The shelled corn, however, is very heavy, often testing 60 to 63 pounds per bushel.

*Minnesota 13,* an early maturing yellow corn, is grown extensively in western Nebraska and for early feed in eastern Nebraska.

### White Dent Varieties

There is a very common idea among corn growers, particularly in the South Platte section of the state, that white varieties will stand more drouth and do better on thin soils than yellow varieties. However, in tests where well adapted strains of yellow and white varieties were grown in comparison, such superiority was not apparent.

White varieties grown extensively in Nebraska are St. Charles, Silver Mine, Boone County, Johnson County, and Blair White.

*St. Charles White,* a red cob corn, is the most extensively grown white variety in the state. It originated in St. Charles County, Missouri. Much St. Charles White corn is found from Gage County west in the South Platte area of Nebraska.

*Silver Mine,* as most commonly grown, is a medium early maturing variety developed by J. A. Beagly of Illinois and first distributed extensively in 1895.

*Boone and Johnson County White* are grown to a limited extent in the eastern and southern parts of Nebraska. On the whole, they are both somewhat later maturing than Silver Mine and St. Charles altho this may not always be the case due to selection.

*Blair White,* a slender eared variety, was first distributed by Aye Bros. of Blair, Nebraska. It was developed by a Washington County farmer as a fairly early maturing variety for eastern Nebraska.

#### Flint and Flour Varieties

These two types of corn are grown to a limited extent particularly in the western part of Nebraska. They mature earlier than the common dent varieties, the ears are produced very low on the stalk, and the plants have a tendency to sucker much more than ordinary corn. The lowness of the ears and the fact that the shanks are large and hard to break makes this type of corn inconvenient to husk. For this reason they are grown largely for hogging down purposes and for fodder.

The ears of flint and flour corn resemble each other in appearance but are strikingly different in kernel texture. Typical flint kernels are extremely hard and glassy, while those of the flour type are very starchy and soft in texture. It is for this reason that the latter type is commonly referred to as soft corn. The ears of both types are normally long and slender having 8 to 12 rows of broad, thick, shallow kernels.

There are many varieties of both flint and flour corn differentiated principally by color, size and shape of ear, number of rows and texture of kernel. Practically all colors common to corn are found in the flint varieties. In the flour type, the most common colors are blue, red and white.

In western Nebraska, flint and flour corn yields fairly well in comparison with the common dent varieties of that section. In a six year test at the North Platte Experiment Station, the various flint and flour varieties have yielded about 3 bushels less on the average than the standard sub-station white strain. It is possible that farther west and north from this point these types of corn would yield relatively better as compared to dent strains.

### Yield of Corn Varieties

Carefully conducted tests show that there is a wide variation in any one season, in the yield of different varieties and strains of corn that are being grown in any community. Certain lots may yield as much as 20 per cent more than others. These differences in yield during any given season may be due to two factors; first, the chance effect of climatic conditions of the season, and second, a difference in the hereditary yielding ability of the corn.

Weather conditions are seldom uniformly favorable for the entire growing season. Usually, due to extremely hot windy weather or to drouth, or a combination of the two, certain varieties or strains of corn which are in a critical stage of development just at that particular time are seriously injured. Other varieties due to their having already passed the critical period of "shooting" and pollination or having not yet reached that stage, may be greatly benefited by a change in the weather or by timely rains. Because of this chance effect of weather conditions at critical times for corn fertilization and development, certain varieties may rank high in yield during one season only to rank low when grown under different conditions.

In a five-year test of farmers' varieties of corn, the highest yielding lots for the 5-year period averaged 76 bushels per acre compared to 62 bushels for the lowest yielding lots, a difference of 14 bushels. During this period, however, certain lots ranked near the top in some seasons while in other years they were low in yield, depending on weather conditions at a certain time in their development. This chance effect of weather is an important factor in producing wide variations in the yields of different lots of corn which vary in their length of growing season.

Tests show, however, that among varieties or strains which are similar in length of growing season and hence affected alike by seasonal weather conditions, certain lots show a definite superiority due to hereditary yielding ability. Krug Yellow Dent, which in a 5-year test at the Experiment Station at Lincoln, has ranked above all varieties in yield, is an example. This corn has doubtless been so developed that it has especially favorable characteristics which cause it to yield well under a wide variety of conditions.

It is likely that certain farmers have outstanding strains which, on the average, yield well above the corn of their neighbors. It would seem to be worth while to carry on local variety tests over a series of years, to locate, if possible, these superior yielding strains.

## EAR AND PLANT CHARACTERISTICS

The adaptation and yielding ability of corn for a certain locality may be appraised more accurately by considering the type of plant and ear than by variety name, due to the fact that there exist many regional strains of the common varieties. The matter of variety name may therefore have little significance as an indicator of the value of any lot of corn for certain areas. In addition to selecting strains having an ear type which is suggestive of local adaptation, growers may, thru selection, influence corn in respect to the strength of stalk, leafiness, height and position of the ear, size and length of shank, root system, number of suckers, and general vigor of growth.

### Ear Types

Tests have shown that relatively long slender ears with horny kernels of medium depth outyield large, rough, soft starch, and somewhat deeper kerneled types. During the past 10 years, many farm demonstrations comparing these two types have been conducted. In more than 200 comparisons of so-called rough and smooth types of seed ears selected from farmers' seed supplies and planted under uniform field conditions on farms of the state, the smoother types have outyielded the rougher ear types from 10 to 15 per cent.

Smooth and somewhat more slender seed ears tend to produce plants which are less leafy, earlier ripening, less inclined to be barren, and, on the whole, more efficient in the use of the available fertility and soil moisture than large rough-eared types selected from the same field or crib. Strains of the smooth type also tend to produce better stands, mature earlier, and are of higher quality than later, larger-eared, rough-kerneled types.

Nebraska corn growers are now quite generally selecting smoother and somewhat more slender seed ears than they did 15 to 20 years ago. The fact that Nebraska farmers were not bothered much during recent years with soft, immature corn and frost injured seed, indicates that they picked somewhat earlier maturing types of seed than was common as late as 15 years ago.

It is no doubt possible, by continuous selection of smooth, early ripening seed ears, to develop a strain of corn that is too

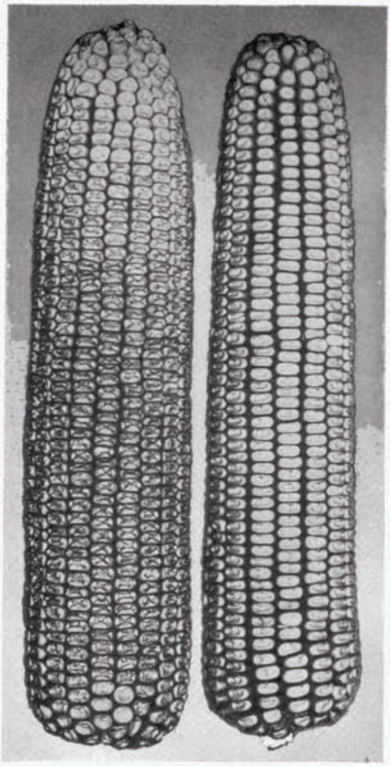

FIG. 8. — Under Nebraska conditions, seed ears such as the ear on the right have outyielded types represented by the ear on the left when selected from the same lot of seed.

early to make full use of the average growing season of the locality. Such corn would in all probability yield less than somewhat later, rougher strains. It seems wise in picking seed, to select sound long ears of medium diameter with smooth, horny kernels of the greatest depth permissible without having more than a small cap of soft starch. By following this procedure, corn will be kept as late as local climatic conditions permit and yet the high yield and high quality of well adapted corn will be maintained.

It is significant that in the 9 years of the Nebraska 10-Acre Corn Yield Contest, during which time 13 men each grew over 100 bushels per acre, the highest yielding fields were without exception grown from seed ears medium to smooth in indentation and of the relatively slender type. In the Market Corn Class of the State Corn Show in which field run ear corn was shelled and judged from the standpoint of market corn, the smooth heavy type of grain has placed at the top each year. Altho under some conditions certain animals may prefer soft starch types of corn, tests indicate that pound for pound there is no difference in the feeding value of soft as compared to hard starch types.

### Relation of Other Ear Characteristics to Yield

In selecting seed ears there are a number of ear characteristics to which farmers usually give consideration. Some of these have an influence on yield but others merely please the eye or fancy of the grower.

Seed ears with bright lustre and good weight are preferred. Lustre suggests good maturity, high germination, and adaptation. Weight in seed ears likewise reflects maturity, adaptation, and a hard starch composition of the kernels.

Most farmers prefer cylindrical ears to those which taper considerably, although tests fail to show any difference in yield provided the ears are similar in other respects. Ears having straight rows are preferred because of greater kernel uniformity and a more attractive appearance. Ears having tips well covered with kernels which indicates that they grew under relatively favorable conditions are preferred because of appearance. Such ears have no greater seed value than ears with exposed tips.

The shanks of seed ears should be of sufficient size to support the ear under normal conditions. Farmers using corn picking machines are interested in strong shanked corn. The selection of seed ears with larger shanks tends to reduce the percentage of ears on the ground at husking time.

Many farmers give much consideration to the shelling per cent of individual ears as indicated by the depth of kernel. Deep kerneled ears often have soft starch kernels and by weight have a shelling per cent no greater than ears with somewhat more shallow horny kernels. Tests in a number of states show that high shelling per cent for seed ears does not indicate a high yield per acre. Seed ears having a somewhat lower shelling per cent may produce enough more ears per acre to more than offset the deficiency in shelling per cent.

There is a rather common opinion that corn grown in a locality for a number of years tends to "run out." Tests fail to indicate that this is true. Properly selected corn should tend to improve for its locality. It is not advisable to plant extensively, seed corn shipped in from a considerable distance without first growing it on a small scale to determine its adaptation to local conditions. Seed corn may be brought in more safely from the north and west than from the south. In eastern Nebraska, because of the low altitude, corn may be brought from the same latitude to the east with little likelihood of serious inadaptation. The length of growing season required for maturity, the vegetative size of the plants and the growth habits determine to a large degree the results secured from shipped-in seed.

## FREEZING INJURY AND FIELD SELECTION OF SEED

Selecting seed ears in the field previous to a hard freeze has advantages in addition to the assurance of securing seed of good germination. It is possible to select ears from strong, sturdy, healthy and sucker-free stalks and to pick ears which grow at the desired height. Low eared stalks tend to be earlier in maturity than high eared stalks. The husk covering of the ear can also be observed. Continued selection along these lines may result in hereditary improvement.

Freezing injury to the seed depends upon its moisture content, the minimum degree of temperature, and the duration of exposure to cold. Seed corn with less than 15 per cent moisture will withstand any normal low temperature. At the time of ripening ear corn contains approximately 40 to 45 per cent moisture and is easily injured. Corn containing over 20 per cent moisture is likely to be injured by moderate freezing temperatures and entirely killed in case of severe freezing. The longer the exposure to cold, the lower the temperature and the higher the moisture content the greater the injury to germination is likely to be. Ears selected for seed should be stored in a well ventilated place and hung or laid in such a way that they will dry out quickly. Various kinds of hangers or racks may be used for seed corn depending on the place in which it is to be stored.

FIG. 9.—Field selection permits the grower to select ears from strong, sturdy, healthy and sucker-free stalks and to pick ears which grew at the desired height.

## TESTING SEED CORN

It is always a good plan to make a germination test of seed corn before planting. If 85 per cent or more of the kernels show strong germination, the seed is usually considered satisfactory for planting. In Nebraska, corn ordinarily matures well before extremely cold weather. In occasional years, however, unusually early cold weather extending over several days severely injures the germination of corn. Under such circumstances, it may be advisable to make a germination test of each individual seed ear. The germination can usually be improved by rejecting ears which show discolored germs.

The rag doll tester is a cheap, quick and efficient method to use for the test. By marking off and numbering squares on the cloth, this type of tester may be used for testing individual ears. Racks which hold the ears in systematic order, while they are being tested, assist in quickly locating individual ears after the test is completed. More detail regarding seed corn testing is given in Nebraska Extension Circular 127.

## HYBRID CORN

It has been pointed out that often the corn grower can improve his corn by selecting seed in the field. However, due

FIG. 10.—Inbred lines are produced by sacking tassels and shoots followed by fertilizing the silks with pollen from the same plant. When handled in this way, the inbreds are reduced in size and vigor. Each inbred line becomes uniform in appearance and inheritance.

FIG. 11.—Each row of corn represents a self-fertilized line which has been inbred for several generations. Continued inbreeding usually results in reduced size and yield and extreme uniformity of plant and ear characteristics. When favorable hybrid combinations are made between these inbred lines, such hybrids are produced as shown in figure 12.

to natural cross pollination, certain objectionable characters which are hereditary in corn such as lodging, tendency to sucker, disease susceptibility, and barrenness can not be eliminated entirely by even the most careful field selection.

Corn breeders, by a system of inbreeding corn for 6 or more years until so-called self fertilized lines or inbreds are secured, are able to eliminate many of the characters which retard yields and which result otherwise in unfavorable development. Corn is inbred in such a program by covering the shoots and tassels with paper bags and later hand pollinating the silks with the pollen from the same plant. Plants produced from inbred seed usually are reduced greatly in vigor, size and yield. After corn has been inbred for a series of years, the plants from each resultant self-fertilized line become uniform in their inheritance and characteristics. Certain inbred lines which show undesirable characters such as sterility, lodging, disease susceptibility, marked suckering tendency, and lack of drouth and heat resistance, are discarded. The most desirable appearing inbreds are chosen for crossing with each other to produce hybrids, some of which are likely to prove superior to the original variety. The superiority of the hybrids can be proved only through actual trial in the field. A combination of two inbreds is known as a single cross, while a combination of 3 or 4 inbred lines is known as a double cross. Commercial hybrid seed is commonly double crossed seed.

Table 1 shows a summary of the yields at the Nebraska Experiment Station and in out-state cooperative tests of some of the most promising hybrids compared with commercial hybrids and open pollinated varieties or strains of corn. As an average for the 5 years during which time 19 different tests were conducted, the 5 best hybrids yielded on the average 78 bushels per acre compared to 66 bushels for the 5 best varieties, a difference of 12 bushels or 18 per cent. Commercial hybrids from other states, during the same period, yielded 1.6 bushels or 2 per cent more than the 5 best varieties. Good hybrids, in addition to making a higher yield, also may be expected to have a more uniform height of ear, to produce fewer suckers and barren stalks, and to lodge less than ordinary varieties.

FIG. 12.—A field of corn produced by hybrid seed. Good hybrids not only outyield ordinary varieties but they also have stronger stalks, fewer suckers and barren plants, and are more uniform in ear and plant height.

It is not expected that farmers will develop inbreds for the production of hybrid seed corn. This work will be done mostly at Experimental Stations which will supply interested corn growers with foundation seed, consisting ordinarily of two single crosses from which, in a natural crossing plat, they can produce hybrid seed for themselves and perhaps a surplus for sale to others.

The average increased yield that favorably situated eastern Nebraska farmers may reasonably expect to get from good hybrid seed suited to the locality, is about 8 bushels per acre, where an ordinary variety makes 40 to 50 bushels. With corn at 40 cents on the market, this would make an added return of $3.20 per acre. It is expected that hybrid seed can be produced or purchased at approximately $3.00 to $5.00 per bushel. Since a bushel of seed will plant about 8 acres in eastern Nebraska, this would make a cost of about 50 cents per acre for such seed.

TABLE 1.—*Summary of comparative yields of corn hybrids and varieties grown in co-operative tests, 1927-1932*

| Year | No. of tests | Yield per acre | | | | |
|---|---|---|---|---|---|---|
| | | All varieties and hybrids in test | | Five best varieties and experimental hybrids and commercial hybrids | | |
| | | Varieties | Hybrids | Varieties | Experimental hybrids | Commercial hybrids |
| | | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* |
| 1927.... | 3 | 74.5 | 74.0 | 75.4 | 82.4 | 77.0 |
| 1928.... | 3 | 59.6 | 65.9 | 62.6 | 76.3 | 73.0 |
| 1929.... | 4 | 70.7 | 78.9 | 75.3 | 87.5 | 74.0 |
| 1930.... | 4 | 57.8 | 65.9 | 65.6 | 76.0 | 61.0 |
| 1932 | 5 | 50.3 | 57.1 | 52.2 | 67.9 | 54.0 |
| Av. Bu. .............. | | 62.6 | 68.4 | 66.2 | 78.0 | 67.8 |
| Per cent ............ | | 100 | 109 | 100 | 118 | 102 |

**Corn grown from hybrid seed by ordinary field pollination should not be used for planting regardless of how fine it may look, as its yielding ability will be greatly below that of the original hybrid seed and probably even below that of an ordinary good variety. It is necessary to produce the hybrid seed each year by controlled crossing or else use old seed.**

## SOIL FERTILITY AND ROTATIONS

Land planted to corn or other cultivated row crops loses its fertility more rapidly than that planted to small grains. This greater loss is brought about by erosion, and by the more rapid decomposition of soil organic matter resulting from cultivation. Experiments show that the loss of soil by erosion may be great on land planted to corn. This loss in years of heavy rainfall may exceed 100 tons of soil per acre on land with but a medium slope. The loss of the surface soil in this manner removes much of the organic matter and nitrogen. The problem of maintaining soil fertility, therefore, is a very important one to corn growers, especially those having rolling land, or land which erodes easily.

Due to differences in rainfall and other climatic conditions, rotations and cultural practices vary in different parts of the state. In eastern Nebraska where corn is the major crop and where rainfall is relatively high, a rotation which includes a legume at frequent intervals is commonly accepted as not only economical but highly advisable. This holds true also for irrigated and subirrigated valley lands farther west. Because of less favorable climatic conditions over most of central and western Nebraska, a rotation which includes legumes must be handled more cautiously.

### Importance of High Yields

High yields are necessary to economical corn production. Under average conditions, the cost of growing a bushel of corn is in nearly direct proportion to the yield. Corn may be produced for as little as 10 cents per bushel, or the cost may be as high as $1.00 or more per bushel, depending largely upon the yield per acre. Consideration of methods of soil management which influence yields is therefore of great importance. In some years of unfavorable moisture conditions, corn on very fertile soil fires badly and yields relatively low. Profits of any significance made from corn growing, however, come only from relatively high yields produced on fertile soil. Poor soil will not produce significant profits even though weather and soil conditions are ideal. Corn grown on a fertile field may return as much profit to the grower in one favorable year, as a poor field might return in ten or twenty years.

### Rotations and Crop Sequences

In eastern Nebraska, many corn growers have demonstrated that rotations which include a legume are essential to the maintenance of high soil fertility and high yields. Winners in the eastern section of the Nebraska 10-acre corn yield contest during the last nine years, grew their winning fields on land which averaged but 2 years from a legume or grass. Their yields during this time varied from 72 to 108 bushels per acre. These men, for the most part, carried on

FIG. 13.—Land planted to corn or other cultivated row crops loses its fertility more rapidly than that planted to small grains.

fairly systematic rotations with sweet clover, alfalfa or red clover, and kept their soil at a reasonably high state of fertility. The legumes added nitrogen to the soil and built up or maintained the organic matter. Soils high in organic matter absorb rainfall more quickly, and have a greater resistance to erosion than do run-down soils.

In regions where climatic conditions are relatively less favorable, a less frequent use of a legume in the rotation is advisable. The history of the several hundred fields entered in the Corn Yield Contest during a nine-year period reflects a wide difference in rotation practice between eastern, central and western Nebraska. During the 9-year period, the eastern fields averaged but 5 years from a legume or grass crop. For central and western Nebraska, the corresponding figures are 22 years, and 17 years, respectively. The history of the winning fields in the contest, however, indicates that for central Nebraska legumes may be used with safety at more frequent intervals than is indicated above. The nine year average for the winning fields was approximately 10 years since the land was in legumes. Fertility added by a legume crop in central and western Nebraska apparently lasts over a longer period of years than in eastern Nebraska.

The most common rotation in eastern Nebraska is that of two years of corn and one year of small grain. Where winter wheat is grown as one of the major crops the rotation is more often two years of corn followed by two years of small grain. In the western part of the state, corn enters the rotation at less frequent intervals. It is common farm experience in eastern Nebraska that after corn is grown on land for two years in succession, subsequent corn yields are less satisfactory unless a small grain or other crop intervenes. This, of course, might not be true on certain rich bottom land or on other land high in fertility. The continuous growth of corn for several years on such land may be adverse, particularly if small grains are likely to lodge badly.

Experiments at North Platte Substation show that small grains do better after corn or potatoes than after small grain. This is because moisture conditions are usually more favorable on corn or potato land, and because nitrates are more available. At that station, a corn-winter wheat rotation has shown the most profit. The yield of winter wheat following corn averaged 20 bushels per acre when corn was removed before the wheat was seeded, and 16 bushels when the wheat was drilled between the corn rows. The yield of other grains following corn and other small grain is shown in Table 2.

TABLE 2.—*Average yield of crops in different sequences at North Platte Experiment Station. 25-year average*

| | Following corn | Following small grain |
|---|---|---|
| Corn | 22 Bu. | 20 Bu. |
| Winter Wheat | 20 Bu. | 17 Bu. |
| Oats | 30 Bu. | 25 Bu. |
| Barley | 19 Bu. | 19 Bu. |
| Spring wheat | 13 Bu. | 11 Bu. |

Data taken from Nebr. Exp. Sta. Bulletin, No. 279.

#### Sweet Clover

In eastern Nebraska, where corn is the principal and, on the whole the most profitable crop, a short time rotation is desirable. There is no legume which suits this purpose better than sweet clover. For soil building purposes, sweet clover is more widely used than any other legume. On many farms in the more eastern counties, a three-year rotation consisting of sweet clover seeded with a spring small grain followed by two years of corn has been adopted. By repeating this rotation every three years, soil fertility can be maintained at a level consistent with the average rainfall. A rotation of this kind involves the plowing of the sweet clover at the beginning of its second year's growth. Farm practice has demonstrated that it is best to plow the clover in the spring of the second year when it is from 6 to 8 inches high. A taller growth is likely to dry the soil excessively thus increasing the danger of drouth injury to the corn when it reaches the critical stage in late July and August. It may also in dry springs prevent the preparation of a good seedbed. On the other

FIG. 14.—A 6 to 8 inch crop of second year sweet clover will add about 75 per cent as much nitrogen as a matured growth. This field is being plowed too late if it is to be planted to corn as the heavy growth has used much soil moisture.

hand, if sweet clover is plowed before it has made a good start in the spring, many of the plants may survive and cause trouble in cultivation. Earlier plowing also reduces the amount of fertility added. Experiments indicate that sweet clover plowed when it is 6 to 8 inches high, will add about 75 to 80 per cent as much nitrogen as a full two year's growth.

It is a common practice in eastern Nebraska to plow second year sweet clover rather shallow early in May, and then list the land to corn. Corn planted in this way grows somewhat more slowly in the early part of the season than that planted on the surface. The plants are usually less leafy, produce fewer suckers, and thus soil moisture is conserved for use later in the season when the demand is heavy.

Sweet clover grown in central and western Nebraska is commonly left on the land for two full years. The greater difficulty of getting stands in these areas, and the greater value of a sweet clover seed crop as compared to the returns from other crops, accounts in a large part for the difference in practice. In those sections, corn is more likely to be injured by drouth following a legume crop, and for this reason the sweet clover is often followed by an early maturing small grain.

### Alfalfa

Many of the highest yielding fields in the Corn Yield Contest have been on newly broken alfalfa land. Fields broken from alfalfa of several years standing, retain their fertility for a long period. One instance is on record where the effect on grain yields is still apparent after 20 years of cropping. Alfalfa is therefore an important legume from the standpoint of soil improvement. It is apparent, however, that short rotations with alfalfa are less practical than those with sweet clover. Other factors also favor a long time rotation where alfalfa is used. The establishment of a good stand of alfalfa is relatively expensive, and often uncertain. Once a good stand is secured, it is usually advisable to leave it so long as it produces well, since ordinarily it is one of the most profitable crops. On upland or on other land that is not sub-irrigated or subject to overflow, alfalfa will nearly if not completely exhaust the available subsoil moisture to a depth of 25 or more feet in a period of from 4 to 6 years. This results in low yields of alfalfa for an indefinite period thereafter on soils so affected. Corn and small grain crops grown in the alfalfa rotation are not so adversely affected by this deep subsoil moisture depletion since their roots grow only to a depth of 4 to 7 feet. The seeding on upland farms of a greater acreage of alfalfa than is needed for ordinary farm use is therefore not advisable considered from the standpoint of future crop management.

FIG. 15.—In Eastern Nebraska many of the highest yielding fields in the Corn Yield Contest have been grown on newly broken alfalfa land. Alfalfa is not well adapted, however, to short rotations.

### Red Clover

In eastern Nebraska red clover is grown to a considerable extent as a rotation, hay, and pasture crop. It is not adapted to the less humid sections of the state. Some farmers prefer to use red clover in the rotation rather than sweet clover because red clover makes a better quality hay. The preference for red clover is greatest, however, in sections where much of the soil is low in lime and where it is more difficult to obtain good stands of sweet clover. When red clover is used in the rotation, it is usually left for two years. The second year growth is used for hay and for seed production. Farm experience indicates that two years of red clover adds less nitrogen and organic matter to the soil than two years of sweet clover. Improvement in soil tilth on extremely heavy soils is also less pronounced after red clover than after sweet clover.

### Other Legumes

Such legumes as soybeans, cowpeas, vetch, lespedeza, and alsike clover are used very little in Nebraska for rotation purposes. This is not because some of these do not have merit, but because sweet clover, red clover, and alfalfa are better adapted and more productive under most conditions. The use of vetch on very sandy soils where the clovers do not do well is worthy of consideration. Lespedeza may have a place on very thin acid soils. Alsike clover does nearly as well as red clover on the limited acreage of acid soils in southeastern Nebraska. Soybeans and cowpeas, for the most part, are not adapted for rotation purposes in Nebraska.

### Barnyard Manure

On some farms where the growing or fattening of cattle and sheep is an important enterprise, manure represents a significant item in the maintenance of soil fertility. This is true, however, only in the more humid sections of the state or under irrigation. In the western half of the state, manure, like legumes, must be used cautiously. Spreading manure rather thinly both in eastern and western Nebraska is advisable from the standpoint of safety. Corn on land that has recently received a heavy coat of manure is likely to fire badly in dry seasons.

Manure not only adds nitrogen to the soil, but returns a large part of the mineral elements taken from the soil by the crops from which the manure was produced. The quality of manure from the standpoint of its plant food content depends upon the kind of crops used in the feed and bedding, and upon the conditions under which it is produced.

Legume hay or straw used as feed or bedding increases the nitrogen content of manure over that made from other common crops. When manure is allowed to heat or become leached by rains, part of the plant food elements is lost.

### Commercial Fertilizers

Experiments with commercial fertilizers on corn in Nebraska have usually failed to give increased yields sufficient to be profitable. Practically no commercial fertilizers are used on corn in this state. There is a possibility that certain western Nebraska irrigated soils may respond to phosphate fertilizers sufficiently to justify their use.

## CULTURAL PRACTICES

Various practices are followed in preparing land for corn. The previous crop, lay of the land, texture of the soil, and rotation plans determine to a great extent the best methods for local conditions.

### Time and Manner of Seedbed Preparation

Where corn follows small grain, early fall plowing or listing helps to eradicate weeds, thereby conserving moisture and preventing the land from becoming foul. Fall listing has the advantage over fall plowing in that soil blowing is reduced. Fall plowed land, particularly on fields low in or-

FIG. 16.—Early fall or early spring plowing for corn helps to control weeds, and tends to develop more available plant nutrients in the soil. Land which is inclined to blow should not be fall plowed. Early spring plowing is preferred on fertile soil.

ganic matter, often blows badly during the winter and spring months.

In tests at the Nebraska Experiment Station at Lincoln, corn on fall plowing has yielded less on the average than on spring plowing. This is thought to be due to the fact that more nitrates and other plant food elements are available on fall plowed land which results in a greater growth of the corn plants and consequently an increased danger from drouth injury during adverse seasons. In northeastern Nebraska, due to more favorable climatic conditions, corn on fall plowing might be expected to yield higher than on spring plowing, particularly on land rather low in fertility.

Corn on early spring plowing has yielded higher at the Nebraska Experiment Station at Lincoln than that on late spring plowing even though the land plowed late was disked to prevent weed growth. Plowing at a depth of 6 to 7 inches seems to give the best results. Table 3 shows the results of experiments on seedbed preparation over a 6-year period at Lincoln. During dry springs it is often difficult to secure a good seedbed on land plowed late in the spring. Harrowing behind the plow or at the end of each half day's work is usually advisable on all spring plowing.

In central and western Nebraska during seasons when moisture is present to start weed growth on stubble fields after harvest, fall listing is a good practice. This practice conserves the moisture which otherwise would be used by weed growth. Fall plowing is less desirable in central and western Nebraska than listing since fall plowed land is more likely to blow badly.

TABLE 3.—*Seedbed Preparation for Corn. 1922-1927. Nebras- Experiment Station, Lincoln*

| Manner of seedbed preparation | Average yield per acre | |
|---|---|---|
| | Bushels | Per cent |
| Surface planted (checked). | | |
| Fall plowing. | | |
| 7 inches | 31.3 | 87 |
| Early spring plowing. | | |
| 5½ inches | 32.8 | 91 |
| 7 inches | 36.0 | 100 |
| Late spring plowing. | | |
| 7 inches, preceded by early disking | 34.2 | 95 |
| 7 inches | 31.6 | 88 |
| Listed (drilled). | | |
| Double listed (Fall and spring) | 33.8 | 94 |
| Double listed (Spring) | 34.7 | 96 |
| Single listed—double disked ground | 34.0 | 94 |
| Single listed—hard ground | 33.3 | 93 |

Data taken from Nebraska Exp. Sta. Bul. No. 232.

Where corn follows corn, the disposal of the corn stalks of the previous crop is a problem, particularly if the growth is heavy. Nearly one-half of the nitrogen and phosphorus of a corn crop is contained in the stalks. While the mineral elements such as phosphorus and potassium are not lost to the land when the stalks are burned, the nitrogen is lost and much potential organic matter is destroyed. Whenever possible, corn stalks should be pastured or cut up and plowed under to furnish organic matter to the soil.

A sharp disc or corn stalk cutter should be used to cut up the stalks. Disking also helps to loosen the soil and to put it into shape to catch and absorb rainfall, thereby decreasing run-off.

FIG. 17.—The use of a sharp disk, in addition to cutting up the stalks, loosens the soil and puts it into shape to catch rainfall.

### Listing Versus Surface Planting

Listing has been on the increase in Nebraska during the past 10 years. It is estimated that about 30 per cent of the corn grown in Nebraska is surface planted and about 70 per cent is listed. Surface planting is confined chiefly to the eastern one-third of the state and is most common in the northeastern section.

When corn follows legume crops such as alfalfa or red clover, or where sweet clover is plowed under in the spring of its second year, the land is sometimes plowed shallow and then listed to corn. This practice is increasing in the state since listing tends to retard stalk growth and thereby decreases the danger of damage from firing and drouth if the season is unfavorable.

The amount of labor required for listed corn is somewhat less than that necessary for surface planted fields. In the eastern section of the Nebraska ten-acre corn yield contest, 33 men who listed put in 4.2 man hours per acre up to husking time, compared to 6.1 man hours for 49 men who surface planted their fields. It is somewhat easier to operate multiple row cultivators in listed corn than in surface planted corn.

At the Nebraska Experiment Station at Lincoln, there has been little difference in the yield of listed as compared with surface planted fields. At the North Platte Station, listed corn has outyielded surface planted corn about 20 per cent. It is commonly believed that in central and western Nebraska listed corn will, on the average, outyield surface planted fields.

On rolling land unless care is taken to list across the slope, listed fields tend to wash badly, thus reducing the stand of corn. On level lands listed fields tend to drown out somewhat more. Some farmers feel that it is easier to keep weeds out of surface planted corn, due to the fact that it is possible to cross cultivate. This is particularly true on fields foul with weeds.

Furrow opener attachments designed to open furrows by means of disks attached to the shoes or runners on corn planters are used to some extent in eastern Nebraska. In tests at the Nebraska Experiment Station at Lincoln, corn planted with furrow openers failed to show any superiority over ordinary surface planted or listed fields.

FIG. 18.—Surface planting corn with the ordinary check row corn planter. This method of growing corn requires somewhat more labor per acre than listing.

**Methods and Rates of Planting**

At the Nebraska Experiment Station at Lincoln, there has been no difference in the yield of drilled compared to checked surface planted corn when the rate of planting per acre was the same. These results were secured on relatively weed-free land. On very weedy land, checked corn probably could more easily be kept clean by cross cultivation.

At Lincoln, as an average for 14 years, planting at the rate of 3 stalks per hill has given the highest yield as shown by Table 4. The best rate of planting may vary somewhat with the fertility of the soil and whether upland or bottomland in so far as this affects the soil moisture supply. The type of corn, too, may influence the best rate of planting; small early varieties should be planted somewhat thicker than large late leafy types.

For central and western Nebraska upland conditions, a stalk every 24 inches in the row appears to make a satisfactory stand. On bottomlands, the rate of planting may be somewhat thicker. Under irrigation, a rate of planting comparable to favorable eastern Nebraska conditions is desirable.

TABLE 4.—*The relation of rate of planting to the yield of a standard variety of corn. 1914-1917 and 1920-1932. Nebraska Experiment Station, Lincoln*

| No. of plants per hill | Per 100 plants | | | Yield of shelled corn per acre | |
|---|---|---|---|---|---|
| | 2-eared stalks | Barren plants | Suckers | 14 yr. ave.* | 17 yr. av.† |
| 1 | 27 | 3 | 114 | 37.3 | ...... |
| 2 | 12 | 4 | 55 | 46.5 | 44.0 |
| 3 | 5 | 15 | 22 | 49.5 | 46.5 |
| 4 | 4 | 25 | 15 | 46.8 | 43.1 |
| 5 | 3 | 35 | 6 | 44.1 | 41.5 |

* Yields for the 14-year average are for years 1914-1917 and 1920-1929.
† Yields for the 17-year average for years 1914-1917 and 1920-1932.

While it is good farm practice to try to secure as uniform a stand of corn as possible, tests show that there can be some variation in the distribution of plants without materially affecting the yield so long as there are the desired number of plants per acre. Table 5 shows the results of experiments wherein the number of corn plants per acre was uniform but the number per hill was variable. These data show that fields planted uniformly to 3 kernels per hill yielded no more than comparable fields in which successive hills contained 1, 2, 3, 4, and 5 plants or 2 and 4 plants. From these results it is concluded that no great alarm need be felt in case stands are somewhat uneven, though it is considered good practice to strive for uniformity.

TABLE 5.—*Relation of uniformity of plant distribution to yield of corn. 14-year average. Nebraska Experiment Station, Lincoln*

| Type of stand | Distribution of plants in successive hills | Total No. of plants per acre | Yield of shelled corn per acre Bu. |
|---|---|---|---|
| Alternating.......... | 2–4 | 10,668 | 50.6 |
| Alternating.......... | 1–3–5 | 10,668 | 49.3 |
| Alternating.......... | 1–2–3–4–5 | 10,668 | 50.0 |
| Alternating.......... | Average of above | 10,668 | 50.0 |
| Uniformly............ | 3 plants | 10,668 | 49.9 |

Deficient stands of corn are due to various causes such as poor seed, poor seedbed, worms, squirrels, injury in cultivation and soil washing. Many fields entered in the Nebraska Corn Yield Contest had their yields reduced because of thin, spotted stands. A special effort to secure a uniform stand by the use of good seed, a well prepared seedbed and careful planting, is therefore of importance.

In western Nebraska where winter wheat and corn are grown extensively, some farmers now follow the practice of leaving every other row of corn blank and adjust the width of rows so that the disk and wheat drill may be used between them. Growing clean corn in this way approaches fallow so far as soil moisture conservation is concerned. Machinery can be used more efficiently and larger acreages of wheat can be handled where corn is planted in this way. Sometimes the corn is planted somewhat thicker in the row to make up for

FIG. 19.—In western Nebraska some corn is planted in wide spaced rows which permits the use of the ordinary disk and grain drill between the rows in growing a corn-winter wheat rotation.

skipping every other row. When corn is planted at the normal rate with every other row left blank, the yields at both North Platte and Lincoln have been about 75 per cent of that of normal planting. Corn planted by doubling the rate in the row so that the normal number of plants are grown per acre but with every other row left blank has yielded from 85 to 90 per cent as much as corn planted in the usual way. The corn roots seem to spread into the blank space and to a large degree make use of the available water in this area. The practice of wide spacing is used only in western Nebraska where winter wheat is grown extensively and in this area it appears to have considerable merit.

### Time of Planting

Tests covering 11 years at the Nebraska Experiment Station on the effect of time of planting corn, fail to show any consistent results in favor of early, medium, or late planting. During some seasons early planted corn yielded much more than late planted corn while during other seasons the reverse was true. The timeliness of rains, and the occurrence of drouth, hot winds, and of killing frosts are usually the deciding factors in determining the yield from corn planted at a certain time. Data show that over a period of years, there is little difference in the average yields of early, medium, and late planted corn even though there is a very wide variation during certain seasons. By spreading the planting season over a considerable period of time, so as to have early, medium and late planted corn, a farmer can reduce the risk of having a very poor corn crop in any year as weather conditions are likely to be favorable for at least a part of the acreage. In case the corn is all to be planted at approximately the same time as in a field that is to be cross cultivated, reasonably early planting is preferred as this insures earlier ripening and superior keeping qualities.

### Cultivation

The main reason for cultivating corn is to destroy weeds. Working the land with a disk or harrow previous to planting is often the most important operation in keeping corn fields free of weeds. The ordinary harrow often can be used very advantageously as a weed killer before and after planting surface planted corn. It can also be used to good advantage on listed corn. It covers the land rapidly and cheaply.

Table 6 shows the results of cultivation tests at the Nebraska Experiment Station at Lincoln. In these tests, corn in

TABLE 6.—*The relation of manner and frequency of cultivation to yield. 6-year average. Nebraska Experiment Station.*

| Treatment | Av. yield of shelled corn per acre. Bu. |
|---|---|
| No cultivation, weeds allowed to grow | 7.1 |
| Scraped to control weeds | 35.1 |
| 3 normal cultivations | 35.9 |
| 4 normal cultivations | 37.2 |
| 4 normal cultivations, and 2 later cultivations | 35.2 |

which weeds were allowed to grow made 7 bushels compared to 35 bushels for fields kept clean by 3 normal cultivations. Corn kept clean by merely scraping the soil to destroy weeds yielded almost as much as that cultivated in a normal way. Tests over a longer period than is covered in Table 6 indicate that scraped land yields somewhat less than cultivated soil due probably to a difference in runoff of rains. Extra cultivations following normal "laying by" did not increase the yield. All of these data as well as those secured in other states show that weed eradication is the main purpose of cultivation. Yields are not increased by cultivating the fields beyond what is necessary to keep them clean. Fields which become weedy soon after they are "laid by" may be benefited by additional cultivation. Weeds are extravagant users of water and fertility and their presence may greatly reduce the corn crop.

FIG. 20.—The ordinary harrow often can be used very advantageously as a weed killer before and after planting corn.

On the whole, it seems advisable to cultivate corn no deeper than necessary to kill the weeds. There is apparently no advantage so far as yield is concerned in ridging corn at the last cultivation.

The rotary hoe, a relatively new tractor pulled tool for use on corn is used to some extent in eastern Nebraska. If horse drawn, it is less satisfactory than if tractor pulled as a rather high speed is essential to its successful operation. If the season is not so wet as to prevent the use of the rotary hoe before the weeds get well established, it appears to be a rapid economical means of tending corn. During wet seasons which allow the weeds to become well rooted, the rotary hoe does not uproot and kill them.

FIG. 21.—Experiments show that the main purpose of cultivation is to eradicate the weeds.

**Growing Corn Under Irrigation**

Under irrigation where soil moisture is not a limiting factor it is very essential that the soil for corn be kept at a high level of fertility. The overhead costs in growing corn under irrigation are high and it is only by producing maximum yields that the costs per bushel of corn can be kept low. The frequent use of legume crops in the rotation is very essential.

Irrigation is frequently delayed so long that corn is injured by dry weather and does not fully recover. It is wise to be prepared to irrigate promptly. Later irrigations should

FIG. 22.—Maintaining soil fertility at a high level and irrigating promptly and sufficiently so as to prevent drouth injury are essential to growing corn most profitably under irrigation.

be frequent and heavy enough to furnish a plentiful supply of water in the upper 5 or 6 feet of soil during the entire growing season. If an adapted variety of corn is planted, there is no danger that a plentiful supply of water will unduly delay the maturity of the crop.

Some farmers under irrigation plant corn in closer spaced rows than usual. There appears to be little, if any, advantage in this practice as it complicates irrigation and the use of machinery. If a thicker stand of corn is desired this can be secured by closer spacing in the row. It is possible to grow satisfactorily a larger later maturing corn under irrigation than can be grown on adjacent dry lands.

#### Harvesting and Storing Corn

Most of the corn grown in Nebraska is husked from standing stalks and cribbed. It is estimated that not more than 1 per cent of the total crop is cut for silage and an additional 3 per cent for fodder. A rather small amount of the crop is snapped or "slip shucked." Such corn is used chiefly for grinding for cattle.

Most of the corn husked in the field is picked by hand altho corn picking machines are now available, which do a very satisfactory job if the corn stands up well. Stiff stalked varieties and hybrids with strong shanks are particularly desirable when machines are used. Mechanical pickers work best when the weather is damp. Records show that, on the average for an entire season, 2-row corn pickers cover about 1.6 acres per hour while single row pickers husk 0.9 of an acre per hour. The economy of using corn picking machines depends on the price of corn and the cost of labor for hand picking.

### Cribbing Corn

Corn is ordinarily safe to crib when the moisture content has been reduced to 30 per cent or less. Usually corn is stored in covered wood cribs. However, much corn is stored in temporary wire or slat cribs placed on a wooden floor. Ear corn which is to be fed or shelled soon after picking is often merely piled on the ground in long ricks. Usually corn stored in temporary cribs is shelled out for feed or market before spring rains start, although this is not always the case. Unless corn is well stored there is likely to be considerable loss from weathering, rotting, rodents, and general waste.

FIG. 23.—Much corn is stored in temporary wire or slat cribs. If the corn is placed on a wooden floor and shelled out during late winter or early spring, such cribs are practical and economical.

### Soft Corn

In some years, corn fails to mature properly before frost. This results in soft corn of poor quality difficult to store and market. When corn contains more than about 30 per cent moisture at cribbing time, extra precautions must be taken to prevent it from spoiling. Special ventilators should be placed thruout the crib to facilitate the movement of air. These may be made in a number of ways from lumber or from studding covered with wire. Clean husking is advisable when storing corn which contains a high per cent of water. On the basis of dry matter, soft corn appears to have a satisfactory feeding value.

The addition of salt at the rate of one pound to 100 pounds of soft corn tends to reduce molding in the crib. This amount of salt does not interfere with the feeding value of the corn. The feeding value of rotten and moldy ears is lower than that of sound corn. Spoiled corn, if fed, may be dangerous to the health of animals.

In years of soft corn, husking should be delayed as late as is practical. The frequency of soft corn years has been reduced by the use of better adapted varieties.

### Shrinkage

The loss of weight of cribbed corn due to natural moisture shrinkage must be considered when holding corn for higher prices. When corn is sold thru the regular market channels, and where local elevator prices are based on grade, the loss

FIG. 24.—A modern corn crib with elevator on an eastern Nebraska farm.

of weight due to moisture shrinkage is largely offset by the improvement in grade. Shelled corn sold directly to feeders, however, ordinarily moves on the basis of 56 pounds per bushel regardless of the moisture content. Consideration of the moisture content of the grain, during the different months and the probable shrink each month is therefore important. Ordinarily corn will shell when the moisture content has fallen to about 20 per cent. From this point one can expect a shrinkage of approximately one per cent a month until about March first, depending on the season. As the weather warms, the rapidity of shrinkage increases, the greatest amount of loss taking place in April. Under Nebraska conditions, well stored and ventilated ear corn ordinarily reaches a fairly stable moisture content of from 12 to 13 per cent by about June 1st to 15th. One thousand bushels of ear corn containing 20 per cent moisture in December therefore will shrink to about 920 bushels by early summer. Where such corn would sell for 50 cents per bushel in December, it would need to bring 54 cents to 55 cents in June to break even, not figuring carrying costs and other losses due to weather damage, rodents, etc. These latter items together with the loss from moisture shrinkage would make it necessary to sell the corn for 56 cents to 57 cents in the summer in order to break even with a 50 cent December price. In some years, corn has considerably less than 20 per cent moisture in December.

### Grades and Standards

Moisture is an important factor in determining the grade of corn. Table 7 shows the requirements as to moisture and other factors for the various grades of shelled corn as established by the U. S. Department of Agriculture.

A bushel of ear corn is estimated to occupy 2.5 cubic feet of space and a bushel of shelled corn 1.25 cubic feet. The legal weight per bushel is 56 pounds for shelled corn and 70 pounds for dry ear corn. It has been estimated that a bushel of snapped corn occupies about 3.5 cubic feet although this may vary considerably with the quality of corn and method of snapping. There is no standard weight for a bushel of snapped corn. Weights of from 72 to 85 pounds are used, depending upon the moisture content and amount of husks.

TABLE 7.—*U. S. Department of Agriculture Standards for Shelled Corn. Grade requirements for white, yellow, and mixed corn*

| Grade No. | Minimum test weight per bushel | Maximum limits of — | | Damaged corn | |
|---|---|---|---|---|---|
| | | Moisture | Foreign material and cracked corn | Total | Heat damage |
| | *Lbs.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| 1 | 55 | 14.0 | 2 | 2 | 0.0 |
| 2 | 53 | 15.5 | 3 | 4 | 0.1 |
| 3 | 51 | 17.5 | 4 | 6 | 0.3 |
| 4 | 49 | 19.5 | 5 | 8 | 0.5 |
| 5 | 47 | 21.5 | 6 | 10 | 1.0 |
| 6 | 44 | 23.0 | 7 | 15 | 3.0 |

Sample grade—Sample grade shall be corn, which does not come within the requirements of any of the grades from No. 1 to No. 6, inclusive, or which has any commercially objectionable foreign odor, or is heating, hot, or is otherwise of distinctly low quality.

[1] The corn in grades Nos. 1 to 5, inclusive, shall be cool and sweet.
[2] The corn in grade No. 6 shall be cool, but may be musty or sour.

### Pasturing Off the Corn Crop

It is a common practice to pasture off corn with hogs, sheep or beef cattle. About 6 per cent of the total crop is used in this way in Nebraska. When cattle or sheep are turned into corn fields, hogs are usually used to clean up the field at the end of the season. Cattle are more commonly turned into corn fields after husking to clean up the corn that is missed and to pasture off the stalks. Sheep, and especially, lambs, are used to advantage in corn fields to clean up the weed

FIG. 25.—Hogging down corn is a practical and efficient way to harvest the crop.

growth. They also eat the lower leaves of the corn and later consume the ears. The practice of using lambs in this way is increasing somewhat.

Hogs are used more commonly than other livestock to pasture off a corn crop. The practice is an economical one. It saves the labor of husking and the manure left in the field tends to maintain soil fertility. When pasturing is properly managed, but little corn is wasted.

Some farmers plant soybeans in corn to be hogged off with the thought that this legume crop helps balance the ration. Tests show that a considerable growth of soybeans in corn tends to reduce the yield of the corn, and interferes somewhat in keeping the field free of weeds. Feeding tests show that, even though soybeans are present, they do not entirely replace tankage or other protein concentrates. Soybeans tend to produce soft pork. On the whole, the practice of growing soybeans in corn for hogging off seems to have little merit under Nebraska conditions.

### Silage

Silage is less popular in Nebraska than in many of the other important corn growing states. The relative cost of silage compared to legume hay is the fundamental reason

FIG. 26.—A trench silo ready for filling. This makes a very practical and inexpensive silo.

why fewer silos are used in Nebraska. The recent development of the trench silo and the general satisfaction secured from pit silos have increased the interest in and use of silage in this state.

Under Nebraska conditions standard varieties of corn grown for grain production are recommended for silage purposes. The greatest amount of feed per acre is ordinarily produced by corn of this kind. Corn for silage should be nearly matured when cut. The ears should be well glazed and dented. Corn injured by drouth may be used very advantageously for silage.

## POWER AND MACHINERY IN RELATION TO COSTS IN CORN PRODUCTION

It will be recalled that in the discussion of the cost of raising corn (pages 4 and 5) it was pointed out that one way to increase the profits is to hold costs low by the efficient use of time saving machinery. However, there is no profit in saving time unless it is put to profitable use elsewhere. On Nebraska farms, the time saved in tending a certain acreage of corn by the use of multiple row machinery, may be used in two ways, first, by tending more acres of land, and second, by taking care of livestock or other farm enterprises.

### Machinery and Labor Trends

Records from the Nebraska Ten-Acre Corn Yield Contest show that Nebraska farmers are taking advantage of time-saving machinery, and that this has resulted in a more efficient use of time and an apparent lowering of the cost of raising corn.

In the Corn Yield Contest, the use of 2-row or larger cultivators has indicated the general trend toward the use of larger machinery. Table 8 shows that there has been an increase in the use of larger cultivators, a more general use of tractors, and a trend towards listed corn during the years of 1924 to 1932. All of these changes have made it possible to produce an acre of corn with less labor and time. The amount of time used per acre of corn up to husking is shown in Table 9. The figures show more than a 40 per cent reduction in the amount of man labor expended per acre of corn in 1932 as compared to 1924. In 1924, eastern Nebraska farmers put in 8.9 man hours per acre up to husking time compared to 5.3 man hours in 1932. On this basis, a farmer in eastern Nebraska who could tend 80 acres in 1924 with his own individual labor, could handle in 1932 approximately 135 acres in the same amount of time. In central Nebraska,

TABLE 8.—*Machinery Trends—Nebraska Corn Yield Contest*

| Year | Per cent of contestants using 2-3-4 row cultivators | | | | Per cent of contestants using tractors | | | | Per cent of contestants listing corn | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Eastern | Central | Western | Irrigated | Eastern | Central | Western | Irrigated | Eastern | Central | Western | Irrigated |
| 1924 | 25 | 50 | 75 | ...... | .... | .... | .... | .... | 30 | 50 | 73 | .... |
| 1925 | 34 | 74 | 86 | ...... | 45 | 5 | 23 | .... | 30 | 74 | 70 | .... |
| 1926 | 60 | 100 | 90 | 100 | 18 | 0 | 17 | 0 | 42 | 100 | 75 | 66 |
| 1927 | 63 | 81 | 85 | 100 | 32 | 6 | 11 | 6 | 43 | 70 | 90 | 100 |
| 1928 | 69 | 78 | 100 | 100 | 48 | 9 | 38 | 30 | 52 | 65 | 100 | 90 |
| 1929 | 77 | 91 | 92 | 95 | 58 | 19 | 39 | 66 | 50 | 80 | 96 | 90 |
| 1930 | 86 | 90 | 88 | 100 | 63 | 22 | 68 | 70 | 52 | 80 | 88 | 80 |
| 1931 | 74 | 97 | 92 | 100 | 53 | 31 | 62 | 60 | 53 | 83 | 92 | 75 |
| 1932 | 82 | 99 | 100 | 100 | 62 | 27 | 60 | 50 | 40 | 82 | 100 | 90 |

a farmer could handle 100 acres in 1924 and 190 acres in 1932. In western Nebraska, the figures would be 150 acres in 1924 and 250 acres in 1932.

Due to more level land, less rainfall and a somewhat lighter textured soil, central Nebraska farmers can produce corn with less labor per acre than eastern Nebraska farmers as is shows in Table 9. Likewise western Nebraska farmers raise corn with still less labor per acre than central Nebraska corn growers. This tends to equalize the costs per bushel in the different parts of Nebraska even though yields decrease westward in the state.

TABLE 9.—*Hours of man labor expended on an acre of corn up to husking as shown by records from the Nebraska 10-acre Corn Yield Contest. 1924 to 1932*

| Year | Eastern Nebraska | Central Nebraska | Western Nebraska | Irrigated Nebraska |
|---|---|---|---|---|
| 1924 | 8.9 | 7.0 | 4.5 | .... |
| 1925 | 8.3 | 5.8 | 4.3 | .... |
| 1926 | 7.6 | 4.3 | 4.2 | 7.2 |
| 1927 | 6.9 | 5.4 | 3.9 | 6.0 |
| 1928 | 6.4 | 4.7 | 2.3 | 7.9 |
| 1929 | 6.2 | 3.6 | 2.9 | 6.2 |
| 1930 | 5.6 | 4.1 | 2.9 | 6.4 |
| 1931 | 5.9 | 3.7 | 3.3 | 5.5 |
| 1932 | 5.3 | 3.7 | 2.7 | 6.4 |

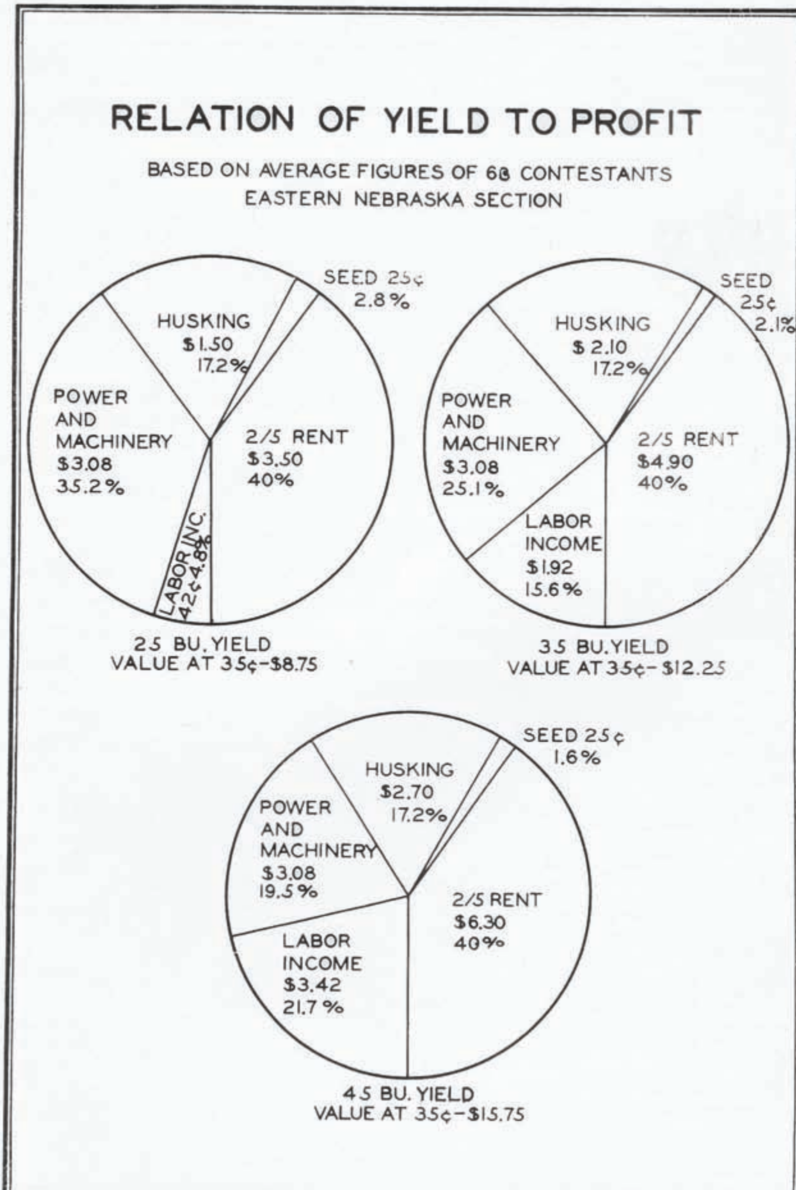


FIG. 27.—These figures based on the actual records of 68 eastern Nebraska farmers in the Corn Yield Contest show the relation of yield per acre to profit in growing corn. Corn is figured at 35 cents per bushel and labor and rental costs at current prices. The labor income represents the net acre income to the grower after paying all costs. The figures are based on growing and husking corn and do not include shelling and marketing costs.

#### Variation in Acre Costs

Records from the corn yield contest show a wide variation in the costs of growing an acre of corn depending on the type of machinery and cultural methods used. Table 10 shows some comparable labor costs of men in the Nebraska Corn Yield Contest. One corn grower (A) put in 2.8 man hours per acre in growing an acre of surface planted corn compared to 13.3 man hours per acre for (G). In another case, one man (D) put in 1.3 man hours on an acre of listed corn compared to 9.3 man hours for another (I). Table 10 gives other comparisons. The total costs per acre, husking included, figured on the basis of current costs show a variation of from $3.31 per acre on corn making 60 bushels compared to $9.38 for corn making 72 bushels per acre, depending largely on the cultural methods and machinery used.

When labor and corn are cheap and plentiful and machinery high in price, it is less important to use large machinery than when opposite conditions prevail. However, when it is difficult to secure money to pay for hired help even though it is cheap, and large, efficient machinery is already at hand, then it is wise to make full use of it. This will result in lower costs per bushel of corn produced.

TABLE 10.—*Comparison of labor expended per acre of corn up to husking time, by certain eastern Nebraska corn growers*

| Farmer | Manner of planting | Man hours per acre | Horse hours per acre | Tractor hours per acre | Yield per acre bu. | Total cost per acre—Husking included |
|---|---|---|---|---|---|---|
| | | Low Labor Costs | | | | |
| A | Surface planted | 2.8 | ...... | 2.74 | 66 | $5.02 |
| B | Surface planted | 3.5 | 18.8 | ...... | 73 | 4.75 |
| C | Surface planted | 4.6 | 21.1 | ...... | 88 | 5.74 |
| D | Listed | 1.3 | ...... | 1.3 | 60 | 3.31 |
| E | Listed | 1.8 | 5.1 | 0.5 | 88 | 4.05 |
| F | Listed | 3.4 | 16.2 | ...... | 73 | 4.49 |
| | | High Labor Costs | | | | |
| G | Surface planted | 13.3 | 32.8 | 2.0 | 72 | 9.38 |
| H | Surface planted | 13.0 | 37.0 | ...... | 90 | 8.50 |
| I | Listed | 9.3 | 24.0 | ...... | 66 | 5.92 |
| J | Listed | 8.6 | 26.7 | ...... | 63 | 6.02 |

Since all farmers are in competition in growing corn, it is necessary for each corn grower to use the methods which hold costs down yet give good results under his local conditions, measured in terms of yield per acre. (Fig. 27.)

The use of large machinery permits efficient use of time. A reduction in time per acre does not mean that a poor job of farming is done. Men in the Corn Yield Contest who were low in labor costs did as good work, so far as cultural practices were concerned, as did those who put in much more time per acre.

The timeliness of doing a certain job in growing a crop is of the greatest importance. Disking, harrowing or cultivating at a certain time is often much more effective than the same operation at a less opportune time. This calls for judgment and managerial ability on the part of the farmer and in many cases justifies the use of large machinery.

## CORN DISEASES AND INSECTS

The rotation of corn with legumes and other crops is an aid in the control of those diseases and insects which attack corn. There are several diseases to which corn is subject, chief of which is smut. This disease is propagated by spores, minute microscopic spherical bodies, which have the capacity to germinate in a manner somewhat similar to ordinary seed. It is by this means that it infects the growing corn plant. These spores become widely scattered thruout the fields by the aid of the wind. A frequent point of smut infection is at some injured place on the plant. Fields of corn severely injured by high winds, hail storms, or by late cultivation ordinarily show a high per cent of smut infection. Since the corn plant is not subject to infection from the seed itself, treatment of the seed before planting is of no avail so far as smut control is concerned.

Experiments in Nebraska fail to show any benefit from the treatment of well selected seed corn to prevent diseases and to improve germination. The ordinary well selected seed that is used on the average farm of Nebraska does not carry disease organisms to a degree that is detrimental to germination or to the development and yield of the plants.

There are a number of important insects which attack corn, among these are corn ear worms, corn root worms, cut worms, grasshoppers, and chinch bugs. The western corn root worm which is most common in this state can be controlled by the use of a rotation in which corn does not follow corn. There is no practical control for the corn ear worm. Damage by this insect varies greatly with climatic conditions. Cut worms of various kinds; grasshoppers and chinch bugs often do very serious damage in local areas.

Detailed information on the control of these and other insects which attack corn can be secured from the College of Agriculture.

There are no practical treatments for seed corn to protect it in the field from squirrels, insects or birds.

## THE UTILIZATION OF THE CORN CROP

About 90 per cent of the corn produced in the United States is fed to livestock. In Nebraska 75 per cent of the crop is consumed in the counties where it is produced. The greater part is fed to hogs and cattle. Nearly 100 per cent of the corn used in livestock feeding is consumed in the form of grain, fodder and silage. A very small amount is fed in the form of corn gluten and corn oil cake.

Although only 10 per cent of the corn crop is used in the manufacture of commercial products, this amount, because of the huge crop produced annually, represents a very important item in trade and commerce. Between 250 and 300 million bushels of corn annually find their way into commercial channels where they are used in the manufacture of thousands of products.

The corn kernel is composed of three main parts, the hull or outer covering, the endosperm and the germ. In the conversion of corn into its many products, these parts of the kernel are separated and each part is used for special purposes. The germ is compressed and the oil removed. That remaining after the oil is extracted is known as oil cake or oil meal, and is used for livestock feed. The oil is used in the manufacture of table oils, glycerine, soap, and rubber substitutes. The endosperm or main body of the kernel furnishes the principal corn products, such as the starches, sugars, syrups, gluten feed, etc. The hull is of little importance, being used as corn bran, or mixed with the gluten feed.

In more recent years the use of the corn stalk and the cob have come into prominence as raw material for the manufacture of various products such as wall board, paper, chemicals, etc. The cost of harvesting the stalks and delivering them to the manufacturing plants has retarded the development of this industry.

A few of the more common products made entirely or in part from corn are as follows:

| | | |
|---|---|---|
| Corn meal. | Starch. | Varnish. |
| Corn flakes. | Glue. | Glycerine. |
| Hominy. | Gum labels. | Mucilage. |
| Sugar. | Gun cotton. | Buttons. |
| Syrup. | Oils. | Dyes. |
| Beverages. | Paper. | Chemicals. |
| Alcohol. | Wall board. | Soap. |
| Cob pipes. | Rubber substitute. | Candy. |
| Explosives. | Face powder. | Grease. |
| Charcoal. | Wax. | |

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