FOREWORD

This bulletin is dedicated to the memory of the late Professor George R. Hyslop, who was largely responsible for the development of corn production in Oregon.

“Prof” started experimenting with corn at a time when the majority of Oregonians thought that corn could not be produced in the state. He proved that corn could be grown successfully if the proper varieties and selection methods were used. It was through his efforts and under his supervision that a corn breeding project was started in Oregon. As a result of this research project, Oregon-grown seed of adapted hybrids has been made available to Oregon growers. Professor Hyslop constantly urged farmers to plant more corn. He was of the opinion that, in view of the need for cultivated crops and because of high freight rates, Oregon growers could grow the corn being fed in the state more profitably than they could ship it in.

The corn acreage of Oregon is a permanent memorial to the vision of this man who was so vitally interested in the future of Oregon agriculture.

Wm. A. Schoenfeld, Director
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>5</td>
</tr>
<tr>
<td>Field Corn Production in Oregon</td>
<td>7</td>
</tr>
<tr>
<td>Climatic Factors in Corn Production</td>
<td>8</td>
</tr>
<tr>
<td>Oregon Corn Growing Areas</td>
<td>9</td>
</tr>
<tr>
<td>Corn Soils</td>
<td>10</td>
</tr>
<tr>
<td>Corn Improvement</td>
<td>10</td>
</tr>
<tr>
<td>Hybrid Corn</td>
<td>11</td>
</tr>
<tr>
<td>What Is Hybrid Corn?</td>
<td>12</td>
</tr>
<tr>
<td>How Hybrids Are Produced</td>
<td>12</td>
</tr>
<tr>
<td>Hybrid Corn in Oregon</td>
<td>14</td>
</tr>
<tr>
<td>Hybrid Yield Trials in Oregon</td>
<td>15</td>
</tr>
<tr>
<td>Hybrids to Grow</td>
<td>15</td>
</tr>
<tr>
<td>Oregon Hybrid 100</td>
<td>17</td>
</tr>
<tr>
<td>Oregon Hybrid 355</td>
<td>17</td>
</tr>
<tr>
<td>Oregon Hybrid 525</td>
<td>17</td>
</tr>
<tr>
<td>Oregon Hybrid 570</td>
<td>19</td>
</tr>
<tr>
<td>Oregon Hybrid 695</td>
<td>19</td>
</tr>
<tr>
<td>Maintaining Soil Fertility in Corn Rotations</td>
<td>19</td>
</tr>
<tr>
<td>Crop Rotation</td>
<td>19</td>
</tr>
<tr>
<td>Barnyard Manure</td>
<td>20</td>
</tr>
<tr>
<td>Green Manure and Crop Residues</td>
<td>21</td>
</tr>
<tr>
<td>Commercial Fertilizers</td>
<td>22</td>
</tr>
<tr>
<td>Culture</td>
<td>23</td>
</tr>
<tr>
<td>Preparing the Seedbed</td>
<td>23</td>
</tr>
<tr>
<td>Planting Corn</td>
<td>24</td>
</tr>
<tr>
<td>Time of Planting</td>
<td>25</td>
</tr>
<tr>
<td>Depth of Planting</td>
<td>25</td>
</tr>
<tr>
<td>Rate of Planting</td>
<td>27</td>
</tr>
<tr>
<td>Cultivating Corn</td>
<td>27</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS—Continued

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suckering and Topping Corn</td>
<td>28</td>
</tr>
<tr>
<td>Corn for Silage</td>
<td>29</td>
</tr>
<tr>
<td>Rate of Planting for Silage</td>
<td>29</td>
</tr>
<tr>
<td>Varieties for Silage</td>
<td>29</td>
</tr>
<tr>
<td>Stage of Maturity at Harvest</td>
<td>29</td>
</tr>
<tr>
<td>Harvesting Silage</td>
<td>30</td>
</tr>
<tr>
<td>Filling the Silo</td>
<td>30</td>
</tr>
<tr>
<td>Harvesting Corn for Grain</td>
<td>30</td>
</tr>
<tr>
<td>Hand or Machine Picking</td>
<td>30</td>
</tr>
<tr>
<td>Hogging-down Corn</td>
<td>31</td>
</tr>
<tr>
<td>Storing Corn</td>
<td>32</td>
</tr>
<tr>
<td>Drying Corn</td>
<td>33</td>
</tr>
<tr>
<td>Insects Attacking Corn</td>
<td>34</td>
</tr>
<tr>
<td>Corn Ear Worm</td>
<td>34</td>
</tr>
<tr>
<td>Spotted Cucumber Beetle</td>
<td>35</td>
</tr>
<tr>
<td>Wireworm</td>
<td>35</td>
</tr>
<tr>
<td>Corn Diseases</td>
<td>36</td>
</tr>
<tr>
<td>Smuts</td>
<td>36</td>
</tr>
<tr>
<td>Other Diseases</td>
<td>37</td>
</tr>
<tr>
<td>Use Treated Seed</td>
<td>37</td>
</tr>
<tr>
<td>Treating Seed Pays</td>
<td>37</td>
</tr>
<tr>
<td>How to Treat Seed</td>
<td>38</td>
</tr>
<tr>
<td>Cost of Production</td>
<td>40</td>
</tr>
</tbody>
</table>
SUMMARY

Corn, one of the few native American crops, has been grown in Oregon for many years. The Oregon Agricultural Experiment Station established a corn improvement program in 1908.

Climatic conditions in general are not as favorable for corn production in Oregon as in the corn-belt area of the United States. Low summer temperatures and the low rainfall during the growing season are the principal limiting factors. Since climatic conditions are not entirely ideal for corn production, it is particularly important that adapted varieties be planted and proper cultural methods followed.

Corn provides a much needed cultivated crop for Oregon areas to which it is adapted, and is a profitable crop to grow on fertile soils considering the quantity and quality of feed produced as either grain or silage.

Corn hybrids have largely replaced open pollinated varieties in Oregon as hybrids have proved to be higher yielding, to be less subject to lodging, and to produce better quality grain. Adapted hybrids are now available for all Oregon corn growing areas.

Corn does best on fertile soils. It is essential, if high yields are to be obtained, that soil fertility be maintained and improved by proper crop rotations, and by the use of barnyard manure, green manure, crop residues, and commercial fertilizers.

Corn land should be plowed at least a month before planting time and preferably sooner. Early plowing allows time for nitrates to become available and allows many weeds to be killed before planting time. Fall plowing is not advisable in the more humid sections of Oregon.

The seed bed should be worked thoroughly and deeply to eliminate large air spaces and break up clods. The final preparation should leave a smooth surface of approximately two inches of finely pulverized loose soil.

Early planting is advisable. Corn should be planted as soon as danger of frost is past and the soil has warmed up. Corn does not germinate well if soil temperatures are below 50°F.

Corn should be planted 3 kernels to the hill, on soils of average fertility, in 42 inch rows with the hills 42 inches apart in the row if the corn is checked or the kernels should be
dropped 14 inches apart if it is drilled. A lighter rate of planting should be used on poorer soils if the corn is to be used for grain. Heavier rates of planting may be used for silage corn on fertile soils.

Corn should be cultivated frequently enough to control weeds. Deep cultivation is not advisable.

Suckering and topping of corn have both been found to reduce yields in many instances and are not advised.

Methods of growing corn for silage are in general similar to those used in producing corn for grain. Varieties similar in time of maturity or only slightly later than those used for grain should be planted for silage. Late maturing varieties are too high in moisture content and too low in percentage of grain at harvest time to produce a good quality silage.

Mechanical pickers can be of profitable use for picking larger acreages of corn. The cost of the machine is probably prohibitive unless 50 or more acres per machine can be picked annually. Hogging down is one of the most economical ways to harvest small acreages of corn.

Corn containing up to 35 per cent moisture can be cribbed in small cribs providing adequate ventilation. Corn with a higher moisture content and corn to be shelled and sold during the fall or early winter should be dried artificially. All seed corn should be dried artificially immediately after it is husked.

The insects usually causing most damage to corn in Oregon are the Corn Ear Worm and the Cucumber Beetle. The Ear Worm can be controlled by treating the silks with mineral oil containing pyrethrum but the cost of application is prohibitive for large acreages of field corn. No completely effective control methods are known for the Cucumber Beetle, but some new materials that appear promising are now being tried.

The corn smuts and seedling diseases are the most destructive diseases of corn in the state. No specific controls for corn smuts are known but crop rotation and complete plowing under of old stalks and trash are helpful. Seed treatment is helpful in controlling seedling diseases, and in experimental trials has increased yields by an average of 4 bushels an acre.

The cost of producing a bushel of corn is closely associated with yield per acre. High yields per acre usually go with low cost per bushel, as a large portion of the acre costs are approximately the same regardless of yield per acre.
Field Corn Production in Oregon

By

R. E. Fore

FIELD CORN PRODUCTION IN OREGON

The early history of corn production in Oregon is largely un-known. Corn is a native American crop and may have been tried in Oregon by the Indians. The crop was being widely grown throughout the country at the time America was discovered. Corn was certainly brought to Oregon by some of the first settlers from the corn growing areas of eastern United States. The first attempts to grow corn in Oregon were not too successful as many of the varieties tried were not adapted and the necessary cultural adjustments to different climatic conditions were not too well understood.

A survey of the corn growing possibilities of Oregon made in 1908 by Scudder* indicated that the majority of a representative group of farmers were of the opinion that corn could not be grown profitably in the state. An extensive yield trial was started in the same year under the direction of Professor Scudder, in which a large number of varieties from various parts of the United States were tried. Two varieties—Minnesota No. 13, a yellow dent, and Minnesota No. 23, a white dent, were selected as the most promising. These varieties were improved by further breeding and selection by the Experiment Station and were for many years the standard varieties for western Oregon.

The corn improvement program started in 1908 under the direction of Professor Scudder was continued by the late Professor Hyslop and his associates at the central experiment station, Corvallis, and by a number of the superintendents of the branch experiment stations. Improved selections of a number of midwestern open pollinated varieties became commonly grown in Oregon throughout the years. Strains of Golden Glow, McKay’s Yellow Dent, and Minnesota No. 13 were most common in western Oregon. Early strains of Reid’s Yellow Dent and Silvermine were widely grown in eastern Oregon. The improvement program was primarily with open pollinated varieties until 1936, when extensive yield trials with corn hybrids were started and a breeding program for developing new improved hybrids established.

Corn hybrids were first grown in Oregon on a commercial scale about 1938. The use of hybrid seed has increased rapidly since that

time and at present hybrids are grown on more than two-thirds of the corn acreage in the state. Open pollinated varieties are expected to be entirely replaced by hybrids within the next few years.

CLIMATIC FACTORS IN CORN PRODUCTION

Corn is grown under widely varying climatic conditions but paradoxically is rather exacting in its climatic requirements. It is grown in areas having widely different temperature, rainfall, and soil conditions, because adapted strains have been developed by years of selection. Each specialized strain or variety is rather limited in its adaptation, and will usually not produce well in areas differing in climatic conditions.

The most nearly ideal climate for corn production in the United States is found in the midwestern area generally known as the “Corn Belt.” Data given in Table 1 show climatic comparisons between the Corn Belt area and Oregon. Data from weather stations at Ames, Iowa; Urbana, Illinois; and Lincoln, Nebraska, were selected as typical of Corn Belt conditions. These data are compared with data from some of the more important corn-growing areas in Oregon. The average July temperatures are indicative of differences in summer temperature between the various areas. Corn requires mean summer temperatures between 70° and 80° F. for best growth. Average summer temperatures in western Oregon are approximately 65°. Night temperatures during the growing season are lower in nearly all sections of Oregon than in the Corn Belt. The corn-growing areas in Umatilla and Malheur counties of eastern Oregon have climates more nearly comparable to Corn Belt conditions than other sections of Oregon. Even in these areas night temperatures are often too low for best corn growth.

Oregon corn-growing areas also differ markedly from Corn Belt conditions in distribution of rainfall. The total annual rainfall in Oregon, with the exception of the eastern Oregon areas, compares favorably with the total annual rainfall throughout the Corn Belt. Precipitation during the growing season, however, is light in all sections of Oregon. During the months of July and August, which are the critical months in the growth of corn so far as moisture requirements are concerned, the Corn Belt states have an average rainfall of from 6 to more than 7 inches, while the rainfall in Oregon during the same months varies from \( \frac{1}{2} \) inch to approximately \( \frac{3}{4} \) inch. These data indicate the necessity of growing corn in Oregon on soils that hold moisture well or where irrigation is available. Corn can be
grown successfully on the more fertile soils of western and southern Oregon without irrigation, but irrigation is a necessity in the low-rainfall areas of eastern Oregon.

The length of growing season or frost-free period in most sections of Oregon compares favorably with the length of growing season throughout the Corn Belt, although near Grants Pass and in the eastern Oregon areas the season is somewhat shorter. The length of growing season in Oregon can be said in general to be favorable for corn production, but early-maturing varieties are necessary, particularly in western Oregon, because of cool temperatures.

Corn is an important crop in Oregon although the climatic conditions are not entirely ideal. Most Oregon areas are short on cultivated crops because of the high acreage of noncultivated seed and grain crops being grown. Climatic conditions in the state favor weed growth. Cultivated crops are essential as an aid in controlling weeds and in keeping the soil in good tilth. Corn fits well in the rotation as a cultivated crop and is much needed in Oregon for this reason. Corn is also a profitable crop to grow on fertile soils considering the quantity and quality of feed produced as either grain or silage.

*Table 1. Comparison of Climatic Conditions in Three Corn Belt States and in Various Oregon Areas*

<table>
<thead>
<tr>
<th>Location</th>
<th>Average July temperature</th>
<th>Average length of growing season</th>
<th>Average precipitation July-August</th>
<th>Annual precipitation</th>
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<tr>
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<td>159</td>
<td>6.77</td>
<td>30.48</td>
</tr>
<tr>
<td>Urbana, Illinois</td>
<td>75.5</td>
<td>180</td>
<td>6.58</td>
<td>35.54</td>
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<tr>
<td>Lincoln, Nebraska</td>
<td>78.0</td>
<td>180</td>
<td>7.32</td>
<td>27.31</td>
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<tr>
<td>Corvallis, Oregon</td>
<td>65.9</td>
<td>191</td>
<td>0.75</td>
<td>40.06</td>
</tr>
<tr>
<td>Forest Grove, Oregon</td>
<td>66.1</td>
<td>164</td>
<td>0.88</td>
<td>45.88</td>
</tr>
<tr>
<td>Roseburg, Oregon</td>
<td>67.4</td>
<td>234</td>
<td>0.52</td>
<td>30.49</td>
</tr>
<tr>
<td>Grants Pass, Oregon</td>
<td>70.0</td>
<td>152</td>
<td>0.36</td>
<td>23.21</td>
</tr>
<tr>
<td>Jacksonville, Oregon</td>
<td>70.8</td>
<td>190</td>
<td>0.63</td>
<td>24.69</td>
</tr>
<tr>
<td>Vale, Oregon</td>
<td>72.6</td>
<td>124</td>
<td>0.46</td>
<td>8.64</td>
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<tr>
<td>Hermiston, Oregon</td>
<td>74.2</td>
<td>163</td>
<td>0.40</td>
<td>8.07</td>
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* Data from U. S. Department of Agriculture Yearbook of Agriculture, 1941.
† Averages are based on records for periods of from 25 to 40 years.

OREGON CORN-GROWING AREAS

Corn growing in the Willamette Valley, which area produces more corn than any other in Oregon, is limited to some extent by low temperatures during the growing season, by lack of precipitation during the summer months, and by the fall rainy season. It is therefore necessary to produce early-maturing strains, to plant as early as possible, and in some cases to irrigate. Climatic conditions in the corn-growing areas of Jackson, Josephine, and Douglas counties in southern Oregon are quite similar to those of the Willamette Valley, except that summer temperatures in general are slightly higher and the grow-
The principal corn-growing areas in Malheur and Umatilla counties in eastern Oregon have a more nearly ideal climate for corn production, although night temperatures are often too low during the growing season and the length of growing season in a portion of the area is a little short. Small acreages of corn are grown in other areas of the state, such as some of the valleys in Baker and Union counties, and in some of the coastal counties. Climatic conditions in these areas are in general less favorable than in those mentioned above.

**CORN SOILS**

Corn requires a fertile, well-drained, loamy soil that holds moisture readily. It is often said to be a rich land crop; however, corn growing in Oregon is probably limited more by climatic conditions than by type of soil. The majority of the more fertile soils in Oregon are suitable for corn production, assuming that climatic conditions are favorable and the water supply adequate. Some of the soil series well adapted to corn are Chehalis, Newberg, and Willamette in the Willamette Valley and Douglas County; Neil, Medford, and Columbia in southern Oregon; Payette and Malheur in Malheur County; and Ritzville and Sagemoor in Umatilla County. Some of the heavier soils will produce good corn providing the soil is high in fertility and drainage is adequate.

**CORN IMPROVEMENT**

The Oregon Agricultural Experiment Station has been working with corn for many years, developing and testing adapted strains and determining the best cultural practices under Oregon conditions. Selection for earliness and other characters was started in strains of the Minnesota No. 13 and Minnesota No. 23 varieties in 1908. Yield trials for the purpose of determining strains and varieties best adapted have been conducted annually. Experiments on tillage methods, time of planting, seed treatments, and methods of harvesting, storing, and drying corn have been conducted. Experiments up to 1936 were largely with the open-pollinated varieties of corn, although a few hybrids had been included in yield trials in previous years. Since 1936 experimental work has been mostly along the line of producing and testing new adapted hybrids. Adapted hybrids have definitely proved to be superior to the best open-pollinated varieties in all Oregon areas and now have practically replaced these varieties.

During the years in which open-pollinated varieties predominated many adapted strains were developed by individual growers as well
as by the Experiment Station. Growers found that the adaptation of open-pollinated varieties could be changed by a few years of careful seed selection. One or more growers in nearly all communities developed adapted strains for their own use, and many supplied seed to neighbors. The best seed of open-pollinated varieties could usually be obtained from a grower's own field or from a neighbor, as the seed being produced and selected in the community was likely to be best adapted to local climatic conditions. Although large numbers of different strains were thus developed and became known under different names, the number of varieties from which the strains were developed was rather limited.

The recent rapid increase in use of hybrid seed corn has changed markedly the practices of growers in obtaining good seed. The problem of growing and obtaining good seed was largely up to the individual grower when open-pollinated varieties were being produced. Each grower had to select and care for his own seed, and could usually obtain the best possible quality of seed by selecting it from his own field. The production of hybrid seed corn is a highly technical problem, requiring a large amount of labor and knowledge as well as considerable expensive special equipment. Hybrid seed, therefore, is produced by a very few growers. The majority of corn growers prefer to purchase seed annually from someone who is specializing in seed corn production. As hybrid seed maintains its uniformity and high productivity for only one generation, it is necessary for growers to purchase new freshly crossed seed each year. A grower can be certain of obtaining good seed by purchasing certified hybrid seed that has been bred for the climatic conditions in his locality. The use of such adapted hybrid seed is enabling growers to increase yields per acre by 25 per cent or more, with very little increase in the cost of production.

HYBRID CORN

The development and use of hybrid seed corn has come about as a direct result of research work and advances in knowledge of genetics, the science of heredity. The rapid practical application of genetic principles to corn breeding has been possible because of several characteristics of the corn plant. Pollination in corn can be controlled by pulling the tassels from plants used as female parents, thus allowing all pollen to come from a second strain of corn. Each plant produces a large amount of seed, and only a small quantity of seed is needed to plant an acre. These facts make it possible to produce new, freshly crossed seed each year at a reasonable cost.
What is hybrid corn?

Hybrid seed corn is the product of crossing inbred or self-pollinated lines, and only seed so produced can properly be termed hybrid. Inbred lines used in producing hybrid seed are developed from ordinary corn by plant breeders through years of carefully controlled breeding experiments. Many thousands of inbreds must be developed and tested. A few of the best inbreds are selected and purified for use. These inbreds can be perpetuated and are crossed in a certain definite manner each year to produce hybrid seed. Hence, although the inbred lines from which hybrids are produced usually come from open-pollinated varieties, seed produced by crossing the open-pollinated varieties themselves cannot be properly termed hybrid seed and cannot be expected to give the same results as a true hybrid.

How hybrids are produced

The development of new hybrids is a task for trained plant breeders, and in actual practice is accomplished by plant breeders connected with the United States Department of Agriculture, the various state experiment stations, or large commercial seed companies. The length of time and the vast amount of careful detailed handwork necessary make the task a prohibitive one for the majority of corn growers.

The first step in producing hybrid seed is the development of inbred lines. Plots of open-pollinated varieties or, in some instances, commercial hybrids are planted for the breeding work. The breeder must control pollination rather than allow the corn to be pollinated by wind-blown pollen as is the case under ordinary field conditions. This is accomplished by bagging the shoot or young ear before the silks appear. A special bag put together with waterproof glue is used for this purpose. Several thousand of the best plants in the cornfield are so bagged. When the silk is about two inches long under the bag and when the tassel is shedding pollen, the pollen is collected in another bag and placed on the silks of the same plant. The ear from each of these self-pollinated plants is harvested and shelled separately. The following year, the seed from each ear is planted in an individual row and again the best plants in selected rows are self-pollinated. This process is continued for from five to seven years, large numbers of the poor inbreds being discarded each year. The inbreds are reduced in size, vigor, and yield during the period of inbreeding but become uniform in their characteristics. These inbreds will remain pure as long as they are self-pollinated or grown in isolated plots, and can be used for making the same cross year after year.
Figure 1. Self-pollinating inbred corn. The shoot or young ear is bagged before the silk appears to prevent wind pollination. Pollen is collected by bagging the tassel.

Figure 2. Self-pollinating inbred corn. The pollen is put on the silks of the plant from which it was obtained by hand.
The inbred lines must be tested by actually making crosses to determine which will produce good combinations. The usual tests are crosses between the inbreds and an open-pollinated variety and crosses between the various inbreds themselves. Only the better appearing inbreds reach this final testing stage, but many of these are found to produce poor hybrids and must be discarded during the final tests.

Several types of corn hybrids have been produced and used commercially. These are known as topcrosses, single crosses, three-way crosses, and double crosses. A top cross is produced by crossing an inbred line with an open-pollinated variety. Single crosses, three-way crosses, and double crosses involve two, three, and four inbred lines respectively. The double cross at the present time is most commonly used for field corn hybrids as it has been found to be more adaptable and lends itself readily to the production of large quantities of seed.

Two years are required to produce double crossed seed after the inbreds to be used have been purified and selected. Two single crosses are produced and these are crossed to produce the double crossed seed. Designating the inbreds as A, B, C, and D, inbreds A and B are crossed by interplanting rows of each in an isolated field and pulling the tassels from one strain before they shed pollen. Inbreds C and D are crossed the same year in a separate, isolated field. The seed saved from the detasseled plants in both fields—or, in other words, the two single crosses A x B and C x D—are crossed the second year by interplanting them in an isolated field and detasseling one strain. The plot in which this seed is produced is usually planted with one male row to each four female rows so that the seed is obtained from four-fifths of the field. The seed harvested from this plot is sold as commercial hybrid seed corn.

Hybrid seed maintains its high yield and uniformity for only one generation. Hence, growers must purchase new, freshly crossed seed each year. An experiment was conducted during the 1941 season at Corvallis in which yields of first and second generation hybrid seed were compared. Differences in yield in favor of the first generation hybrid averaged 17.7 bushels per acre on Chehalis soil and 11.8 bushels per acre on Willamette soil. Similar results have been obtained by midwestern experiment stations.

Hybrid corn in Oregon

In the corn belt states of the midwest, 90 to 99 per cent of the corn acreage is planted to hybrid seed. Hybrid corn was first grown in Oregon on a commercial scale in 1938. The acreage planted to hybrid seed is increasing as rapidly as it did in the midwest. For
example, approximately 5 per cent of Oregon's corn acreage was planted to hybrid seed in 1939. The percentage increased to approximately 16 in 1940, 30 in 1941, 45 in 1942, 55 in 1943, and 60 in 1944.

The Oregon Agricultural Experiment Station and Extension Service have made rapid increase in acreage of hybrid corn possible by determining through yield trials which hybrids were adapted to the various corn-growing areas of Oregon, by breeding adapted hybrids, by making parent stock and hybrid seed available, and by making information available to growers. A breeding program for the purpose of producing adapted inbreds and hybrids was started in 1936 by the Oregon Agricultural Experiment Station. Yield trials were established at Corvallis and in the various corn-growing counties of the state to determine which hybrids were adapted to the various areas. Parent stock for the production of adapted hybrids has been obtained from other experiment stations or developed by breeding and is being maintained by Oregon Agricultural Experiment Station. This parent stock is available and is being supplied to Oregon growers who are making the final cross and selling the hybrid seed.

**Hybrid yield trials in Oregon**

Several hundred different hybrids have been tested in the corn-growing areas of Oregon but few have proved to be adapted. These trials emphasize the necessity of obtaining adapted seed as many of the hybrids tested have been too low yielding or too late in maturing for Oregon conditions. Yield data, obtained at Corvallis, Oregon, for a seven-year period on four hybrids that have been found to be adapted to the Willamette Valley, are given in Table 2.

**HYBRIDS TO GROW**

It is particularly important that a hybrid adapted to the locality in which it is to be grown be selected as the adaptation of a hybrid cannot be changed by the grower. Hybrids are produced by crossing inbreds and each time the same inbreds are crossed the same result is obtained. The grower buys freshly crossed seed each year and must be sure he is obtaining seed of an adapted hybrid.

New improved hybrids are constantly being produced and are replacing the older ones as they prove their worth. Hybrids now commonly grown in Oregon will probably be replaced in the future by improved ones being developed and tested by the Oregon Agricultural Experiment Station.

Hybrid seed produced by various commercial seed companies in Oregon and other states is available in some areas of Oregon. Some of these hybrids have been thoroughly tested and have proved
Table 2. Yield in Bushels per Acre of Four Hybrids Compared to Minnesota No. 13 for a Seven-Year Period

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<th>1943</th>
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<td>Oregon Hybrid 525</td>
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<td>28.0</td>
<td>59.7</td>
<td>85.2</td>
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<td>Oregon Hybrid 355</td>
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<td>25.2</td>
<td>23.1</td>
<td>46.2</td>
<td>72.6</td>
<td>63.6</td>
<td>42.1</td>
<td>45.5</td>
</tr>
<tr>
<td>Minnesota No. 13</td>
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<td>16.1</td>
<td>23.1</td>
<td>46.8</td>
<td>74.4</td>
<td>53.4</td>
<td>33.9</td>
<td>44.6</td>
</tr>
<tr>
<td>Oregon Hybrid 100</td>
<td>59.3</td>
<td>48.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* Two-year average.
Many hybrids being produced in other states, however, are not adapted to Oregon conditions. Therefore, it is advisable for growers to check carefully on the adaptation of new hybrids before planting them on a large scale. New hybrids should generally be planted on a small experimental scale so that adaptation can be determined before large acreages are seeded.

The hybrids of which Oregon-grown certified seed is available are discussed briefly in the following paragraphs. These hybrids, with the exception of Oregon Hybrid 100, are practically identical with the Wisconsin hybrids of the same numbers. The inbreds used in the production of these hybrids were obtained from midwestern experiment stations but have been grown in Oregon for several years. All of these hybrids are yellow dent corn. White corn is not recommended in Oregon as it is deficient in vitamin A and therefore is less valuable for feed than the yellow corn.

**Oregon Hybrid 100**

Oregon Hybrid 100 was produced by the Oregon Agricultural Experiment Station from two inbreds started but not entirely purified by the North Dakota Station, one line from Wisconsin and one from Minnesota. Hybrid 100 was distributed primarily because of its early maturity. It is adapted as a grain type to sections of western Oregon requiring exceptionally early maturity and to the major portion of the Willamette Valley as an early-maturing type. This variety is a good one to plant for either hogging off or early harvest preceding the planting of a fall-seeded crop. It can be expected to yield best when planted early in the spring, but will usually mature in the Willamette Valley when planted as late as June 1. Grain yields may be expected to be somewhat lower than those of the later maturing hybrids in areas where these hybrids are adapted. It is a short-stalked type not well adapted to silage production.

**Oregon Hybrid 355**

Oregon Hybrid 355 is approximately a week later in maturity than Hybrid 100. It is adapted to the major portion of the Willamette Valley as a medium-early grain type and gives fairly good silage yields in some areas. It appears to be particularly well adapted to the upland soils of Clackamas, Marion, and Linn counties.

**Oregon Hybrid 525**

Hybrid 525 is probably the most widely adapted hybrid being grown in Oregon. It is adapted to the major portion of the Willamette Valley for both grain and silage and to the southern Oregon areas as an early-maturing grain type. It is approximately 10 days
Figure 3. Hybrid corn grown on irrigated land in eastern Oregon.
later in maturity than Oregon Hybrid 355, and is a full season variety in the Willamette Valley. This hybrid is a rank grower on good soil and produces good silage yields.

**Oregon Hybrid 570**

Oregon Hybrid 570 is practically the same in maturity, grain yield, and adaptation as Oregon Hybrid 525. Under some conditions this hybrid produces a somewhat ranker growth and has more foliage than Hybrid 525. Hence it is preferred by many growers as a silage type. Hybrid 570 has given excellent results in some of the corn-growing valleys of Baker County as well as in the Willamette Valley.

**Oregon Hybrid 695**

Hybrid 695 is adapted to the southern Oregon corn-growing areas in Jackson, Josephine, and Douglas counties and to the areas in eastern Oregon requiring a medium-early maturing corn. It is an excellent hybrid for either grain or silage production. This hybrid cannot be recommended for general use in the Willamette Valley as it is too late in maturity for this area. It can be used for silage, however, in a few communities having most favorable growing seasons, provided it can be planted by approximately May 1.

**MAINTAINING SOIL FERTILITY IN CORN ROTATIONS**

Corn can be grown successfully on a wide variety of soil types but is rather exacting in fertility requirements. Corn requires a plentiful supply of plant nutrients and organic matter. Soil fertility can be maintained and improved by proper rotation and by use of barnyard and green manures, crop residues, and commercial fertilizers.

**Crop rotation**

Crop rotation is essential in any good system of permanent agriculture. A good rotation increases yields and quality; helps control weeds, diseases, and insects; is an aid in maintaining soil fertility, curtailing losses by erosion, and distributing labor; and diversifies farm income. The best rotation for a given area depends on climatic conditions, adapted crops, market demands, type of soil, number and kind of livestock on the farm, and other factors. The rotation should include legume soil-building crops and cash crops. It should include both cultivated and noncultivated crops.

Corn is a good cultivated crop to include in rotations in the Oregon areas to which corn is adapted. More cultivated crops are
needed in the areas that have been producing large quantities of non-cultivated seed crops such as vetch, crimson clover, ladino clover, peas, and grasses.

The exact rotation that will work best must be determined for each individual farm and will vary depending on individual needs. Corn, as a general rule, should follow a legume or grass crop in the rotation. Best results are usually obtained by planting the corn following a legume as the organic matter and nitrogen content of the soil is usually highest at this point of the rotation. Corn requires plentiful available nitrogen over a long period of time since the plant grows actively from the time it is planted until well into September, usually about 3½ to 4 months. Small grain crops, if included in the rotation, fit in well following corn. It is often possible to prepare a seedbed for grain following corn without plowing the soil, particularly if fall grain is planted. A satisfactory seedbed for fall grain seeded after corn can be prepared by diskimg alone, thus saving the labor of plowing.

Barnyard manure

One of the cheapest and most practical methods of increasing corn yields is liberal application of manure to the soil. Manure is a good source of organic matter and plant food. The value of manure exceeds the value of nitrogen, phosphorus, and potash contained in it as it improves the physical condition, water-holding capacity, aeration, and temperature relations of the soil by adding organic matter.

Manure applied before the corn crop in the rotation will usually give the greatest returns as corn yields are increased more by applications of manure than are the yields of some other crops. The manure can be readily applied to the soil before the corn crop. It is usually applied before plowing as more time is allowed for the manure to rot and become incorporated with the soil.

Manure, as a general rule, should be applied as early in the spring as possible. Considerable nitrogen and moisture are necessary to break down or rot strawy manure and if the manure is applied late in the season, the breaking down process may rob the growing crop of nitrogen and moisture. Heavy late applications of manure may, in some cases, actually result in lowered yields for one season. This is especially true in dry springs and on land that cannot be irrigated. Applications as high as 20 tons of manure per acre have been applied to some soils but it is usually more profitable to use lighter applications and cover more land. Yields do not increase in direct proportion to the amount of manure applied. With limited quantities available, it is usually better to apply from 5 to 10 tons per acre.

The increased yields that may be obtained from the use of
manure in combination with lime or phosphorus are indicated by the data given in Table 3. The data in this table were taken from three different experiments in which manure was applied alone and in combination with various commercial fertilizers. In each case, the yield of corn silage from the highest yielding treatment in the experiment is given in comparison with the average yields from plots receiving no manure or fertilizer. An average increase in yield of 1.98 tons of corn silage was obtained in these experiments.

As manure is low in phosphorus, it is often profitable to add a phosphorus fertilizer when manure is applied. The phosphorus can be applied with the manure by putting it on the top of each spreader load, by broadcasting it directly on the soil, or by applying it with a fertilizer attachment on the corn planter. The amount of phosphorus needed varies with different soils but can usually be supplied by annual applications of 200 to 300 pounds of superphosphate per acre.

Green manure and crop residues

Green manure is a term applied to crops turned under green for soil improvement. They often serve first as cover crops or for pasture and hay and afterward for green manure. Legume crops are best for green manure as they obtain nitrogen from the air, and hence add nitrogen as well as organic matter to the soil. The plowing under of legume crops will improve both the physical condition and fertility of the soil, and thus will increase corn yields.

When corn is to follow crops harvested in the summer or early fall, the land can be seeded to such crops as vetch, vetch and oats, vetch and rye, or vetch and barley to be plowed under in the spring.

<table>
<thead>
<tr>
<th>Soil and treatment</th>
<th>Yield</th>
</tr>
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<tbody>
<tr>
<td>Willamette</td>
<td></td>
</tr>
<tr>
<td>Manure 10 tons, lime 2 tons</td>
<td>8.76</td>
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<tr>
<td>Check average</td>
<td>5.33</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Manure 15 tons, lime 2 tons</td>
<td>8.29</td>
</tr>
<tr>
<td>Check average</td>
<td>6.41</td>
</tr>
<tr>
<td>Dayton</td>
<td></td>
</tr>
<tr>
<td>Manure 10 tons, superphosphate 250 pounds</td>
<td>6.11</td>
</tr>
<tr>
<td>Check average</td>
<td>4.87</td>
</tr>
</tbody>
</table>

* Data from Bulletin 387, Oregon Agricultural Experiment Station, Twenty-Two Years of Soil Fertility Investigations in the Willamette Valley.

Rye seeded alone will make a good cover crop and supply large quantities of organic matter. Crops such as these are of value in conserving the plant foods that become available during the winter and would be leached out of the soil unless taken up by growing
plants. Winter cover crops are also of value in preventing erosion.

All crop residues such as straw, stover, and spoiled hay should be returned to the soil. The practice of burning straw stacks and stubble fields is a deplorable one as it robs the soil of needed organic matter and plant food. Under ordinary conditions, any material plowed under will increase crop yields. It is possible, however, for the plowing under of large quantities of straw to cause a temporary depressing effect on the productivity of the soil. The organisms causing decay require nitrogen and moisture. If the supply of nitrogen or moisture available is limited, there may not be enough to supply the growing crop. Such temporary depression can usually be avoided by applying nitrogen fertilizer and irrigating.

Commercial fertilizers

The use of some commercial fertilizers is usually necessary to maintain or improve soil fertility. The amount and kind of commercial fertilizer needed depends on the individual soil, the type of rotation followed, the amount of manure and green manure used and other factors. In other words, the fertilizer problem is largely an individual problem and must be solved by the grower for his particular conditions. No general recommendations to fit all Oregon conditions can be made.

Fertilizers most generally needed for corn in Oregon are those containing nitrogen and phosphorus. Potassium is usually needed only on peat or very sandy soils. When liberal applications of manure are applied, only phosphorus may be necessary. A deficiency of nitrogen is associated with a stunted plant growth and a yellowed appearance. An application of nitrogen can be expected to be profitable on corn in cases where sufficient plant growth is not being obtained.

The supply of available phosphates in some Oregon soils is low and with cropping a need for available phosphates develops in most soils. Phosphorus, applied to deficient soils, may be expected to increase grain yields and hasten maturity.

Commercial fertilizers usually give greater responses when dropped beside the hill of corn than when broadcast. Some trials have indicated that 100 pounds applied by the hill will often increase yields of the immediate crop as much as 200 pounds broadcast. Fertilizers should be applied at corn-planting time by means of a fertilizer attachment on the corn planter. The fertilizer should be dropped beside the hill rather than directly on the seed as fertilizer in contact with the seed is likely to burn the young seedlings.

Applications of as low as 100 pounds per acre of Ammo-Phos 16-20 or 100 pounds of superphosphate have been found to give
excellent results on some soil types when applied with a planter attachment at corn planting time. Most soil, however, will benefit from applications as high as 200 pounds per acre. Heavy concentrations of fertilizer near the hill may lower germination or burn the seedlings enough to stunt them. If heavier applications of fertilizer are needed, it is usually advisable to broadcast all or part of the fertilizer and work it into the soil before planting the corn. The fertilizer may be applied in a band beside the row with a planter attachment when corn is drilled. Recent experiments indicate that in some cases best results from fertilizers can be obtained by applying the fertilizer at the bottom of the plow furrow when the soil is plowed. This work is, however, still in the experimental stage.

CULTURE

Preparing the seedbed

Early spring plowing is essential in corn production for two reasons: (1) to allow a supply of nitrates to build up and (2) as an aid in weed control. Plowing aerates the soil and creates favorable conditions for the growth of bacteria that break down organic matter and make plant food available. A good supply of available nitrates is essential to rapid growth of the corn seedlings. Early plowing allows weed seeds to germinate and the weeds can be killed by cultivation before planting time. The killing of as many weeds as possible before planting will lessen the amount of cultivation needed later in the season to keep the corn clean. The early killing of weeds is also of value in building up the nitrate supply. If the weeds are allowed to grow until planting time, they will use up large quantities of nitrates that would otherwise be available for use by the corn seedlings. Corn land should be plowed at least a month before planting time and preferably sooner.

Fall plowing is as a rule not advisable in the more humid sections of Oregon. Fall-plowed land, in regions of high winter rainfall, is subject to serious erosion and leaching. Land that is rolling or subject to flooding is likely to be ruined through loss of the top soil if left bare during the winter. A natural or planted cover crop should be grown on such land to protect it from erosion. Leaching on soils not subject to erosion can be largely prevented by growing a cover crop. Fall plowing may be satisfactory in some of the low rainfall areas of Oregon but cannot be recommended for the high rainfall areas.

Plowing depths of 6 to 8 inches have been found to be best under most conditions. This depth is usually sufficient to allow any stubble or plant growth to be turned under and not deep enough to bring to the surface subsoil that may be lacking in organic matter.
and plant food. Plowing to greater depths or subsoiling has seldom shown any advantage. Some variation in depth of plowing from year to year is advisable on most soils to prevent the development of an impervious plow pan. Spring-plowed corn land should be harrowed immediately after plowing and worked as often as necessary between plowing and planting time to keep the weeds under control.

It is essential that a good seedbed be prepared before corn is planted. No set rules can be given as to the number of times the soil will have to be worked or as to the best implements for preparing the seedbed. The soil should be pulverized deeply to break up the clods and to pack it sufficiently to eliminate large air spaces. Ordinarily it is not advisable to use a roller on land to be planted to corn as many soils are packed too tightly by a roller. In case the soil is very cloddy, however, rolling may be necessary. The final preparation of the seedbed should be immediately before planting to avoid excessive drying out or the chance of rain packing the seedbed after it is prepared. The final harrowing or dragging should leave a smooth surface of approximately two inches of finely pulverized loose soil and should be at right angles to the direction in which the corn is to be planted so that the planter marker furrow will be distinct.

Planting corn

Larger acreages of corn are usually planted with two-row horse-drawn planters although tractor-drawn planters planting up to four rows at a time are sometimes used. Small acreages may be planted with a one-row planter or hand planter. Most corn in Oregon is surface planted rather than listed or planted in furrows. Listing, or furrowing with a double moldboard plow before planting, is successful in some of the drier sections of the United States but is not advisable in Oregon.

Corn is planted either in drill rows or checked in hills. Drilled corn can be cultivated only one way while checked corn can be cultivated both ways across the field. Most experiments indicate that practically the same yields can be expected whether the corn is drilled or checked when comparable amounts of seed are used and provided weeds can be equally controlled with both methods. It is, however, more difficult to control weeds in drilled corn. On fields badly infested with weeds, it is usually advisable to plant corn in check rows. Some growers prefer to drill corn for silage, using a heavier rate of seeding than is normally used for grain planting. Yields of forage are increased by this practice in some cases, but overly thick planting may reduce the quality of silage by increasing the number of plants bearing only nubbins or no ears.
Time of planting

The best time to plant corn varies in different sections of Oregon and varies with the season. Early planting as a general rule will give highest yields and will allow the corn to mature and be harvested before fall rains set in. Corn can be planted earlier on sandy soils than on heavy soils. Seed treated with approved seed treatment materials can be planted earlier than nontreated seed. The seed treatment helps in the control of diseases that attack the seed and young seedlings after planting. Treated seed will often come through cold, rainy periods that will cause nontreated seed to rot.

Planting dates in various parts of Oregon vary from early April to late May. No best date can be set, even for one section, as the date will vary with the soil type and from season to season. Corn should be planted, as a general rule, as soon as the danger of frost is past, when the soil has warmed up, and a good seedbed can be prepared. Corn will not germinate well if the soil temperature is below 50°F. It is often possible to judge the time of planting by the stage of growth of natural vegetation in the area. For example, farmers in certain sections say that it is time to plant corn when the leaves on the oak trees are the size of a squirrel's ears. The stage of growth of leaves or other vegetation is a good guide to planting time in many cases as the rate of growth depends to a large extent on the temperature. Data from date of planting trials conducted on Chehalis soil during the 1940, 1941, and 1942 seasons are given in Table 4. The higher yields and lower moisture content in each season were obtained from the first planting date indicating that in some seasons, at least, early planting is preferable. In all cases, the percentage of moisture in the corn at harvest time increased progressively from the early to late planting dates. These trials were conducted on sandy river-bottom soils that warm up early in the spring. Heavier soils do not warm up as quickly and, as a general rule, should be planted slightly later than sandy soils. All seed used in these trials was treated with an organic mercury seed-treatment material.

Depth of planting

Corn should usually be planted from 1 to 2 inches deep. There is no advantage in planting deeper unless the topsoil is dry. As the seed must be planted deep enough to be in moist soil if good germination is to be obtained it may be advisable in dry springs to plant deeper than 2 inches. Some growers plant deep under the mistaken impression that deep-planted corn will have larger, deeper root systems. Regardless of how deep the seed is planted, the permanent root system is developed just under the surface of the ground.
<table>
<thead>
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<th>Year</th>
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<tbody>
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<td>5/17</td>
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<tr>
<td>Yield per acre, bushels</td>
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<td>Total moisture, per cent</td>
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<td>49.3</td>
<td>52.9</td>
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<td>5/10</td>
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<tr>
<td>Yield per acre, bushels</td>
<td>52.9</td>
<td>55.6</td>
<td>59.6</td>
</tr>
</tbody>
</table>

* All yields are calculated on a 15 per cent moisture basis.
Rate of planting

Checked corn is usually planted in hills 42 inches apart each way with 3 kernels per hill. To drill corn at the same rate in rows 42 inches apart, the kernels should be dropped 14 inches apart in the row. It is sometimes possible to increase yields on the more fertile soils by planting closer than 14 inches in drilled corn, although this practice is rarely advisable unless irrigation is available or the corn is to be used for silage. On less fertile soils, corn should be planted at the rate of 2 kernels per hill or drilled with the kernels 21 inches apart. Thin planting will result in larger ears, better quality grain, and in some cases slightly earlier maturity.

The amount of seed required to plant an acre varies with the rate of planting and the size of seed. With average size seed, approximately 8 pounds per acre are required.

Cultivating corn

Many experiments on cultivation of corn have been conducted by experiment stations all over the United States. All indicate that the principal purpose of cultivation is to kill weeds and that the frequency and depth of cultivation should be governed by weed growth. Many of these experiments have compared plots in which weeds were not controlled, plots in which the weeds were cut with a hoe at the surface of the ground, and plots cultivated in the normal manner. Yields were lower in all cases in which weeds were allowed to grow, but no significant differences in yield were found between plots on which the weeds were cut with a hoe and cultivated ones.

The weed control problem is a serious one in all of the corn-growing areas of Oregon. Moisture and temperature conditions are favorable for weed growth, and most areas are short on cultivated crops because of the high acreage of noncultivated seed crops being grown. Many of the common weeds are extremely difficult to control unless the land is planted to cultivated crops frequently.

Weeds can be killed most cheaply before corn planting and before the corn is too big to stand harrowing. Several crops of weeds can be killed before planting on early plowed land. Corn can be harrowed with a spiketooth harrow when necessary from the time the corn is planted until it is 3 to 4 inches high. The spiketooth harrow is an excellent tool to use in breaking crusts formed by heavy rains shortly after planting. Harrowing as soon as the ground is dry enough will prevent the formation of a crust or break up any crust that has formed and will thus allow the germinating corn to emerge from the soil. Small weeds can be killed with a harrow until the corn is 3 to 4 inches tall with little or no injury to the corn,
provided the corn is not harrowed at the time it is emerging from the soil. The use of a harrow for the first cultivation is economical as a large acreage can be covered in a short time.

The number of cultivations necessary depends on weed growth. It is necessary to keep weeds under control as corn cannot compete with weeds for moisture and soil nutrients. Under ordinary conditions, 2 to 4 cultivations are sufficient.

Corn should not be cultivated deeper than is necessary to kill weeds. The small feeder roots of corn fill all the space between rows from the time the corn is approximately knee high and usually come close to the surface. Deep cultivation cuts off these roots and thus limits the amount of moisture and food the plants can obtain. Deep cultivation, particularly late in the season, is likely to reduce yields. Surface cultivators with blades or sweeps are excellent for corn cultivation although shovel cultivators can be used with little damage provided the shovels are not set too deep. Cultivation with a one-horse cultivator after the corn is too large for a two-horse cultivator is not advisable except in weedy corn. Large weeds remaining in the field after the corn is "laid by" should be removed by hand pulling or hoeing.

SUCKERING AND TOPPING CORN

Suckers or tillers on corn plants should not be removed. Some growers in the past have made a practice of pulling the suckers under the mistaken belief that the suckers rob the main plant and that the removal will result in larger ears and higher yields. Suckers are only produced when plenty of plant food and moisture are available. The removal of suckers injures the plant and usually causes a reduction in yield. Many experiments have been conducted on the removal of suckers and in all cases the yields from suckered plots have been the same or lower than plots in which the suckers were not removed. The same results in general have also been obtained with sweet corn.

The practice of topping corn or cutting off the part of the stalk above the ear is general in some sections of Oregon. There are two reasons for the practice: (1) the tops are used for feed and (2) it is thought that the removal of the tops will hasten maturity. Removal of the tops has been found to reduce yields and to have little or no effect on the time of maturity. Losses in yield from topping are usually more than enough to offset the feed value of the tops. Hence the practice of topping corn is not advisable.
CORN FOR SILAGE

Approximately one-half of the corn grown in Oregon is used for silage. Corn properly stored in the silo saves more of the feed value of the plant than is possible by any other method. Silage is a palatable feed for many classes of livestock and can be fed with practically no waste. General methods of growing corn for silage differ little from those used in producing corn for grain.

Rate of planting for silage

Corn can be planted a little thicker for silage than for grain. Smaller ears are obtained from thick planting but the total yield of grain and stover is usually somewhat greater. The best rate of planting depends on the fertility of the soil, the variety of corn, and the amount of moisture available. On fertile soils, corn for silage can be drilled with the kernels spaced 9 to 12 inches apart in the row, or checked with 4 kernels per hill. Many growers prefer to drill corn for silage as drilled corn can be more easily cut with a corn binder.

Varieties for silage

Medium early maturing varieties that will produce well dented ears by silage cutting time are preferable. Late maturing varieties will in some cases produce a greater total tonnage per acre than medium early ones but usually produce practically the same or a smaller amount of total digestible nutrients. The increased tonnage sometimes obtained is largely water rather than dry matter. Some growers use late maturing varieties because of the greater tonnage obtained. Their purpose is defeated as they have to handle a larger tonnage to get the same amount of feed. Silage produced from late maturing varieties is usually of relatively low quality due to the high moisture content and the low percentage of grain. There is no advantage in growing the very late maturing types for silage. Varieties the same or only slightly later in maturity than those used for grain should be grown for silage.

Stage of maturity at harvest

Corn should be cut for silage when the kernels are well dented and the lower leaves have started to turn brown. The best quality of silage is obtained when the grain contains approximately 50 to 55 per cent moisture. The kernels will be in the hard dough stage at this time. The total amount of dry matter increases rapidly as the corn nears maturity and is greatest at this stage. Corn allowed to reach a more mature stage is likely to be too dry for silage.
Harvesting silage

Corn for silage usually is cut with a corn binder, hauled to the silo on wagons or trucks, and fed through a silage cutter having a fan attached to blow the chopped material into the silo. Small acreages are sometimes cut by hand or with a sled cutter. Hand cutting is a tedious labor-consuming process and is not advisable if any other means of harvesting is available.

Harvesters that will cut, chop, and elevate the chopped corn into wagons in the field have been developed in recent years. Although expensive, these machines are practical for larger acreages and are great labor and time savers. The cost may be prohibitive for smaller acreages unless two or more growers can purchase or use the machine together.

Filling the silo

Corn for silage should be cut in short lengths preferably 1 to 4 inch in length. Longer pieces will not pack well in the silo and may cause spoilage. Longer lengths also result in more wastage in feeding.

It is essential that the corn be distributed evenly and firmly packed in all parts of the silo as air pockets will cause spoilage. The outlet spout should be shifted to all parts of the silo to prevent the heavier pieces from settling at one side and the lighter portions at the other.

Corn cut at the right stage will not require the addition of water. If it is necessary to use corn that is too mature for silage, however, the addition of some water may be necessary.

Waste through spoilage at the top of the silo can be prevented to a large extent by covering the top with finely cut, well packed, wet straw. Tarpaper covered with a thin layer of cut corn stover can also be used.

HARVESTING CORN FOR GRAIN

Hand or machine picking

The majority of corn grown for grain in Oregon is husked by hand although the use of mechanical corn pickers is increasing. The mechanical picker is a great labor saver and is economical for larger acreages. The cost of the machine is probably prohibitive unless at least 50 to 100 acres can be picked annually per machine. Small acreages of corn can be husked by the grower without additional help.

Varieties that mature and can be harvested early in October are desirable, particularly in western Oregon where heavy rains start early in the fall. Corn loses moisture very slowly under field condi-
tions after the rainy season starts. Corn that is too late in maturity is likely to sour and mold in either the field or crib. Immature corn must be dried artificially and will be of low quality even after drying. Corn will usually be ready to harvest early in October if planted in the proper season and if varieties of the proper maturity are used.

Figure 4. Hogging down early corn in western Oregon.

Hogging-down corn

Hogging down is one of the most economical ways to harvest small acreages of corn. Hogs make just as economical gains in the cornfield as in dry lots if a protein supplement is supplied. Corn can also be harvested with steers or lambs but steers should be followed by hogs to prevent waste.

Hogging down is a good method of harvest under dry conditions but wastage is likely to be excessive in wet weather. It is advisable, in areas having early fall rains, to use an early-maturing strain of corn so that harvest can be completed before the fields become too wet.

Wastage of hogged down corn can be lessened by fencing the field into small areas of a size that can be cleaned up in two or three weeks by the number of animals used. The time required to hog
down an acre will depend on the yield, and the number and size of hogs used. Twenty 125-pound pigs will clean up an acre of corn yielding 40 bushels per acre in approximately 15 days.

**STORING CORN**

Corn containing up to 35 per cent moisture at harvest can be cribbed in small cribs that are provided with adequate ventilation. Corn dries out sufficiently in the field in some of the drier sections of Oregon to be stored in large cribs similar to those used in the corn belt of the Middle West. Practically all of the corn grown in the western part of the state, however, normally has a moisture content of at least 30 to 35 per cent at harvest. It is difficult to mature corn with a lower percentage moisture in this area because of the cool weather during the growing season and because the fall rains start so early in the fall.

Many western Oregon growers have successfully stored corn in small cribs constructed so as to provide adequate ventilation. The type of crib in most general use has slatted sides, is 4 feet wide at the bottom, tapering up to 6 feet at the top, and is constructed with a ventilator through the middle. The crib can be built in any convenient length.

![Figure 5. A good type small corn crib for the higher rainfall areas of Oregon. Note the metal strip around the bottom to keep out mice.](image-url)
Spoilage of cribbed corn can often be prevented or lessened by sorting the corn as it is cribbed. Some ears considerably above the average in moisture content will usually be found. Molds will start growth on the wet ears and spread to the drier corn. These ears should be sorted out and fed immediately.

**DRIYING CORN**

Corn grown in western Oregon must be dried artificially if it is to be sold as dry-shelled corn during the fall or winter. Although corn may keep on the ear without spoilage in small cribs, it will not dry out sufficiently to shell and keep as shelled corn until late in the spring because of the humid weather and relatively high winter temperatures. In occasional seasons it is impossible to mature most varieties of corn sufficiently to keep over winter in cribs, and the corn can be saved only by artificial drying. Corn with an average moisture content above 35 per cent will usually have to be dried artificially.

Many types of driers are used successfully for drying corn. Hop, prune, and walnut driers can easily be adapted for corn drying and are being used by many growers. Where sufficient quantities of corn are being produced, it will be profitable to construct a drier especially for corn. Detailed information on drying both shelled and ear corn is given in Oregon Station Bulletin 352.*

The length of time required to dry corn depends on the original percentage of moisture, the drying temperature, and the quantity of air passed through it. Temperatures as high as 160° to 170° F. have been used successfully for drying feed corn. Ear corn can usually be dried in 48 hours or less when temperatures of 160° are used with force-draft driers. Corn should be dried to 15 per cent moisture or less.

The cost of drying varies with many factors, but some growers report having dried feed corn for as low as $5.00 per ton. Oregon producers can dry corn for less than the freight charge on corn shipped in from the Midwest as freight rates usually run about $10.00 per ton.

Seed corn should always be dried immediately after harvest. Molds develop rapidly on corn with a high moisture content and are likely to injure germination or vigor of the seed. The growth of disease organisms can be stopped by drying corn to a moisture content of less than 15 per cent immediately after the seed is picked. Seed corn should be dried at a temperature of 110° F. Higher tem-

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*Price and Branton, Corn Drying, Bulletin 352, Oregon Agricultural Experiment Station.
peratures are likely to injure the seed. Force-draft driers are preferable to natural draft driers for drying seed corn as the corn can be dried more rapidly. The length of time required to dry seed corn varies with many factors but usually at least 60 to 72 hours will be required to reduce the moisture to less than 15 per cent when a temperature of 110° F. is used.

**INSECTS ATTACKING CORN**

The numerous insects that attack corn in Oregon cause considerable damage annually. The control of corn insects has received little attention because insects do not, as a general rule, cause complete loss of the crop over large areas. The most widespread and destructive insects are the corn ear worm, cucumber beetle, and wireworms.

The control of corn insects, particularly those attacking the underground parts, is difficult and no specific control methods are known for some. New insecticides such as DDT are now in the experimental stage, but appear promising. Crop rotations and good clean cultural practices are helpful in keeping most insects under control.

**Corn Ear Worm**

The Corn Ear Worm is found in all corn-growing areas and is responsible for considerable damage in practically all seasons. The adult, a brown moth, lays eggs on the corn silks or tassels. The larvae feed on the silks, eating into the ears as they grow. In badly infested fields, several worms may be found per ear. The insects overwinter in the pupal stage in the soil or under trash and rubbish. General cleanup measures and fall plowing have been recommended as control measures but are of doubtful value as the insects breed so rapidly during the summer months that the reduction in population brought about by these means is seldom noticeable.

The Corn Ear Worm can be effectively controlled by treating the silks with mineral oil containing pyrethrum after the silks have been pollinated. This method is practicable under certain conditions for sweet corn and for small plots of field corn being grown for seed or other special purposes. The cost of application is too great to make the method practicable under most conditions for commercial field corn. The oil must be applied to the silks of each ear with an oil can or other device that will deliver approximately 1 cubic centimeter (about ½ teaspoonful) of oil per squirt. The oil must not be applied until after fertilization has taken place. Applying oil too soon is likely to interfere with fertilization and result in ears having
only scattered kernels. The proper time to oil is after the silks have wilted and started to turn brown at the tips; usually 3 to 4 days after the silks first appear. It is necessary to go through the field two or more times to catch the majority of the silks at the proper stage. One man can treat approximately an acre per eight-hour day. The cost of oil and pyrethrum to treat an acre is approximately $3.50.

**Spotted Cucumber Beetle**

The adult of the Spotted Cucumber Beetle, *Diabrotica 11-punctata* (Mannerheim), formerly called the western 12-spotted beetle, is well known to Oregon growers as the insect is found in nearly all areas of the state and attacks a large number of crops. The beetle is approximately ¼ inch long and is yellowish-green with black spots on its back. The insect overwinters in the adult stage. The larvae are usually present in the soil about corn-planting time and attack the roots of the young corn seedlings. They eat the roots and sometimes bore into the stalk, taking out the growing point. Extensive damages from the larvae have been noted in isolated fields in some seasons.

The adult beetles are particularly damaging to corn silks and tassels about pollination time. When infestation is heavy, they often eat the silks before they are pollinated, causing ears with scattered kernels due to lack of pollination.

No very effective control methods for the cucumber beetle are known, although experimental trials with the new insecticide DDT appear promising. The larvae are in the soil and cannot be reached with ordinary insecticides. Dusting with calcium arsenate has been recommended as a control for the adult beetle but is not always effective. The beetles can be driven out of the cornfield by the dust but usually come back in a short time and apparently feed on new growth rather than that covered by the arsenate. Calcium arsenate dust has been found to be injurious to corn silk under certain conditions.

**Wireworm**

The wireworm is the immature or larval stage of one of several species of the click beetle. The adult lays eggs in the soil generally in May or June. The eggs hatch in 3 to 4 weeks and the larvae live and feed in the soil. They do little damage the first season but feed on the roots of crops the following years. The insect remains in the larval stage from three to six years, pupating and changing to an adult in the summer or fall. Wireworms are difficult to control as they are in the soil and cannot be reached by ordinary insecticides. Soil fumigants such as carbon disulfide and crude naphthalene have been used with some success but the cost of materials and application
is too great to justify the use of such materials on large acreages. Flooding of land has proved successful when properly used on land that can be flood irrigated. The soil should be covered to a depth of 2 to 3 inches for at least a week during a period of hot weather. A good kill cannot be obtained unless the soil temperature at a depth of 6 inches is 70°F or above. Plowing to a depth of 9 inches during July or August and allowing the dry soil to lie undisturbed for several weeks has been helpful in some cases.

Wireworms build up rapidly in seedings of red clover or sweet clover but appear to be fairly effectively controlled by growing alfalfa.

**CORN DISEASES**

Corn in Oregon is relatively free from diseases, although considerable loss, due to various diseases, occurs annually. The corn smuts and seedling diseases are the most common. Some of the ear and stock rots, common to the Corn Belt area of the Middle West, have been found in Oregon but have not caused serious damage to date.

**Smuts**

Two types of smut, the common smut, *Ustilago zeae* and head smut, *Sorosporium reilianum*, are found in corn in Oregon. These diseases cause severe damage in local areas but are not serious in the state as a whole. The two types of smut can be distinguished from each other by general appearance and method of attacking the plant. The common smut may attack any aboveground portion of the plant causing large smut galls, which are greyish in color at first, but turn black as the spores mature. The common smut appears on the leaves, stalks, tassel, or ear, but seldom causes complete barrenness, although it may do so if the ear is attacked in an early stage. The head smut usually attacks the ear or tassel. When young ears are attacked, the entire husk is filled with smut spores and no grain is produced. A diseased tassel will usually be completely filled with smut spores. Head smut often causes the formation of abnormal proliferations in the form of extra leaves or small plants growing from the parts that should develop into ears and tassels. Head smut has been known to cause up to 80 per cent loss of yield in a few isolated fields.

No specific methods of controlling the corn smuts are known. The organisms causing both common and head smut are largely soil borne and hence cannot be controlled by seed treatment.
Smut spores overwinter in the soil on old corn stalks and ears, manure or rubbish. Soil-borne spores of the head smut attack the young seedlings. When the temperature becomes warm enough in the summer, the spores of common smut germinate, producing conidia or summer spores, which are blown about by the wind and cause new infection.

Crop rotation is helpful in keeping these diseases in check. In areas in which smut is bad, corn should be planted on soil that has not been in corn for several years and should be as far away from land that has been in corn recently as possible.

The complete plowing under of all old stalks and trash is helpful in controlling smut as spores while buried will not germinate. Some spores will live for several years, however, and infection may result from spores turned up during later seasons.

Infection is usually less in corn grown on fertile soils that are well balanced in plant foods, although in some cases damage appears heaviest on soils excessively rich in nitrogen. Conditions favorable for a steady growth of the plant usually result in less loss from smuts than if the plant growth is slowed up by lack of moisture or food nutrients.

The most practicable method of controlling corn smuts is by the use of resistant varieties. Some hybrids now in common use are resistant and plant breeders are constantly developing new strains having more resistance.

Other diseases

The group diseases causing greatest loss to corn growers of Oregon are probably those causing seedling diseases. These disease organisms are present on the seed or in the soil and attack the young seedling as the kernel germinates, either killing the seedling or stunting the plant so severely that it will not produce a normal yield. The seedling diseases appearing to cause most loss in Oregon are Penicillium, Aspergillus, scutellum rot, and Giberella. Some of these organisms also cause ear rots but loss from ear rots are usually low. Two other disease organisms, diplodia and fusarium, commonly causing seedling disease and ear rots in the midwestern Corn Belt have been found in Oregon but have not been serious. Pythium root rot has also been found in the state.

USE TREATED SEED

Treating seed pays

The treatment of seed corn with a good seed disinfectant material has proved successful in controlling many of the seedling dis-
eases of corn. Treated seed can often be planted earlier than non-
treated seed as the disinfectant lessens the chances of seed rotting
during wet cold weather not favorable to germination. Seed treat-
ment is not effective in controlling diseases such as corn smut that
attack corn later than the seedling stage.

The Illinois Station* reports an average increase in yield of 3.9
bushels per acre for a four-year period from the use of Semesan Jr.,
one of the most commonly used seed disinfectants. Trials for a
two-year period at Corvallis, Oregon, with the same material showed
an average increase in yield of 4 bushels per acre for treated seed.
The cost of the material is less than 2 cents per acre even when pur-
chased in small quantities. The amount of increase in yield due to
seed treatment varies somewhat with seasonal conditions but consid-
ering the small cost of material a grower can scarcely afford to plant
nontreated seed. Average increases in yield of from 2 to 4 or more
bushels per acre can be expected annually.

The majority of hybrid seed now on the market is treated by
the grower before being sold. Most seed producers consider seed
treatment a good form of insurance. They know that adverse con-
ditions at the time the seed is germinating may cause poor stands
even though good seed is planted and want to give their seed every
possible advantage. Growers purchasing seed should check to see if
it is treated and if not should apply the disinfectant material before
planting the seed.

**How to treat seed**

All of the seed treatment materials now in common usage are
in dust form. The dust should be applied at the rate recommended
by the manufacturer with either a barrel treater or one of the continu-
ous process type treaters. **Do not attempt to mix the dust with a
shovel** as it is almost impossible to obtain a good coating of the seed,
too much dust is lost in the air and the method is extremely danger-
ous to the operator.

All possible precautions to avoid inhaling the dust should be
taken. A respirator fitting closely over the nose and mouth should
be used. The mixing should be done out of doors or in a building
with open doors on both sides. The dust contains a cumulative
poison and even small amounts inhaled over a long period of time
may be harmful.

It is essential that all treated seed be kept away from animals
as the materials used for treatment are poisonous. Any treated seed
not planted should be destroyed or stored where it can not be reached
by livestock.

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Seed treatment materials now available are not cure-alls, being effective for only certain seedling diseases. The materials are not effective against insect damage nor against diseases attacking later than the seedling stage. Seed treatment is certainly not a substitute for good seed but usually increases yields even when good seed is used. Treatment cannot, however, be expected to make dead seed germinate.

**COST OF PRODUCTION**

A cost of production study on corn silage was conducted by the Farm Management Department, Oregon State College, during the years 1925, 1926, and 1927. Data obtained were reported in Oregon Station Bulletin 251 in 1929. Principal items of cost in corn production were found to be labor, cost of horse or tractor use, interest on land, taxes, machinery depreciation, and materials. The largest single item of cost was for man labor. The cash cost amounted to only 37 per cent of the total cost of producing corn silage. Although corn production requires a large amount of labor, the labor is spread over a long season and with smaller acreages can be taken care of by the grower and his family with very little cash outlay. A grower, of course, must figure his own labor in calculating the cost of production, but the fact that the cash does not have to be paid out at a definite time is often an advantage.

The cost of production on a ton basis showed a striking relationship with yield per acre. The average cost of production for 29 growers producing less than 4 tons per acre was $12.08 per ton. Nineteen growers produced yields above 10 tons per acre at an average cost of $5.03 per ton. These data are shown graphically in Figure 7.

Although no detailed cost of production studies have been made in Oregon on the production of corn for grain, data obtained from a corn yield contest held in connection with the Oregon State Corn Show in 1939 and 1940 show very definitely the association of low cost per bushel with high yield per acre. The per acre cost of production varied little within a given area and was practically the same regardless of yield, but low yield was always associated with high cost per bushel. For example, in 1940 the grower producing the highest yield in this contest produced 125 bushels per acre at a cost of 19.5 cents per bushel. The lowest yield in the contest in the same year was 26 bushels per acre at a cost of 61 cents per bushel.

Costs per bushel or per ton are reduced as yields increase because a high percentage of the total production costs are the same regardless of yield. All operations, such as plowing, preparing the
seed bed, and cultivating must be taken care of and require the same amount of labor whether the yield per acre is 20 or 80 bushels. Increased yields due to improved seed, higher soil fertility, or improved cultural practices will increase profits provided expenditures necessary to bring about the increased yields are not exorbitant.

Figure 6. Champion exhibit in the Hybrid Yield Contest, Oregon State Corn Show, 1940. This exhibit represents the field run corn from three acres entered in the contest. This corn, grown on irrigated land, averaged 125.69 bushels per acre.

Increased use of improved machinery such as tractors, tractor-drawn tools, and picking machines in recent years has materially reduced the number of man and horse hours required to produce an acre of corn. A survey* made in Champaign and Piatt counties in the state of Illinois for the period of 1920 to 1938 indicated that during this period the man hours required per acre had been reduced from 14 to 8 and the number of horse hours from 33 to 7. During the same period tractor hours per acre increased from .5 to 4 hours. The total cost of production during the period 1920-1924 was $29.86 per acre and in 1938 was $17.53 per acre. The reduction in man and horse hours and to some extent the reduction in acre costs was due to increased tractor use and to the use of picking machines.

* R. H. Wilcox, The Cost of Producing Corn. Illinois Farm Economics No. 56, January 1940. Department of Agricultural Economics, University of Illinois.
The use of tractors and picking machines in Oregon is increasing rapidly. Most farms can profitably use a tractor even if the corn acreage is small, as the tractor can be used in producing other crops. Corn pickers can also be used profitably for larger acreages of corn. It is doubtful, however, whether a mechanical picker should be used unless approximately 50 acres or more can be picked per machine annually.

Figure 7. The cost of corn silage is reduced as the yield increases. From Bulletin 251, Oregon Agricultural Experiment Station, *Cost of Producing Silage and Kale*. 