

Today's major small grain crop in Iowa is oats. The new Clinton oat promises an acre yield increase of 20 bushels or more over the best varieties available even in 1938.

4. The Fields of Waving Grain

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SMALL GRAIN IN IOWA TODAY MEANS OATS. SINCE THE time that Iowa was settled, the state has led the nation in the acreage planted to oats.

Although oats have been of importance in Iowa for almost its entire history, the kind of oats raised has changed a great deal over the past one hundred years, even the past fifty years. Chiefly responsible in the development of one new variety after another has been the Iowa Agricultural Experiment Station. As early as 1889 the Experiment Station was experimenting with oats, reporting that year on the relative performances of fifteen varieties. In 1908 the Experiment Station, summarizing all the oat variety tests made since 1898, reported on seventy different varieties. In 1912 it reported on forty-eight varieties and in 1918 summarized twenty-two varieties that had been studied for six years and seventeen varieties that had been studied for ten years.

The job of getting out new varieties adapted to the weather and soil of Iowa and the Corn Belt was not begun in an extensive way at the Iowa Station until 1907. It was in 1906 that L. C. Burnett, then a young man of twenty-five from the University of Nebraska, came to the agronomy staff to devote his efforts especially to the oat improvement program. He has continued as an employee of both the Iowa Station and the cereal office of the United States Department of Agriculture. Dr. H. C. Murphy, who also has contributed significantly to the oat improvement program in Iowa, has represented the U.S.D.A. in the oat improvement program since 1928.

By 1930, five new varieties of oats originated by Burnett had been distributed from the Iowa Station. Iowa 103 (Albion) was first distributed in 1913. Next followed Iowa 105 (Richland), an early-maturing, yellow-grained, short-straw, stem-rust-resistant variety, distributed in 1914. Iowar was distributed in 1919, and Iogren in 1922. Iogold,

another early, yellow-grained, stem-rust-resistant, pure-line selection from Kherson, was first distributed in 1927.

These five new varieties developed especially for Iowa conditions were all so-called "pure-line" selections, no hybridization being involved. All but Iogren were selections from the Kherson variety. These varieties were quickly adopted by Iowa farmers in place of the old varieties they had been growing.

Thirty-four different varieties of oats were being grown in Iowa in 1910. Green Russian and Early Champion were more commonly grown than others, although Silvermine and White Russian were grown extensively in a few localities. Kherson, introduced into Nebraska from Russia in 1896, was just coming into its own. In the years immediately following 1910 the acreage of this variety increased markedly. Taking the state as a whole, Early Champion constituted 26 per cent of the Iowa crop, Green Russian 28 per cent, Kherson 8, White Russian 6, and Silvermine 4 per cent.

A second survey, in 1924, indicated that only ten varieties were being grown on an appreciable acreage in practically all parts of the state, and only five on any considerable acreage. Of these five, three were Station varieties: Iowa 103, Iowa 105, and Iowar. The other two were old varieties: Green Russian and Kherson. Over 46 per cent of the oat acreage in 1924 was sown to varieties originated by the Experiment Station. Except for Kherson, most of the varieties which were grown in 1910 had been eliminated entirely. Green Russian, the most important variety in 1910, showed an acreage reduction of considerably over 50 per cent. Iowa 103 was grown more extensively in 1924 than any other variety. It was particularly popular in the southern half of the state. Iowar was second in acreage, with its greatest popularity in central and northern Iowa. Iowa 105, a special purpose oat recommended for planting on the more fertile soils where other varieties were inclined to lodge, was grown very extensively in some areas in north central and northwestern Iowa.

A third survey of oat varieties grown in Iowa was made in 1934. The first of the varieties released by the Station, Iowa 103, had given way to Iowa 105 and to Iogold, both of which possessed considerable resistance to stem rust. Iowar, a variety with no rust resistance which had been popular for a time in north central and northern Iowa, was giving ground rapidly at this time to Gopher, a variety from the Minnesota Station with some tolerance to stem rust. The fact that 70 per cent of the Iowa oat acreage at this time was sown with Station varieties indicates the degree to which Iowa farmers took advantage of the best available varieties.

FARM COMPARISONS

When the first of the new oat varieties was available, farmers throughout the state were invited to test this variety on their own farms in co-operation with the Station, by planting a measured acre in comparison with the variety they were growing.

With the new Station varieties being compared with the old kinds on individual farms in all parts of the state and with the threshing usually done by neighborhood groups, information on the superior performance of these new varieties rapidly became common knowledge. Farmers who made these tests sold seed to other farmers in the locality. It is believed that this method of testing and increasing the seed did much in making farmers variety-conscious. This method of distributing and testing the new Station varieties was continued from 1913 until 1938. The difficulty encountered in threshing a small plot of grain and keeping it free from mixture with other varieties finally led the Station, however, to increase the amount of seed supplied to a given individual. Emphasis shifted to establishing seed increase centers, rather than comparing new varieties with those commonly grown.

A new era in oat improvement in Iowa was initiated by Dr. H. C. Murphy, with his discovery of two varieties with outstanding resistance to crown rust and smut: Victoria in 1929, and Bond in 1931. A continuous search for sources of adequate resistance to crown rust had been under way at the Iowa Station since 1915.

Breeding for disease resistance in oats is not a simple matter. The organisms responsible for the more important oat diseases are made up of numerous strains or races which differ greatly in their ability to attack various oat varieties. There are known to be at least 82 races of crown rust, 13 of stem rust, 31 of loose smut, and 14 of covered smut. The distribution and prevalence of these and other oat diseases does not remain constant. Nature is continually producing new races of the organisms responsible for these diseases. Breeding for disease resistance, therefore, is a never-ending task. Fortunately, there are varieties of oats resistant to each of the known races of both rusts and both smuts of oats. These varieties can be combined to produce new varieties resistant to all or nearly all of these races.

Each year since 1929 all of the newly introduced oat varieties obtained by the United States Department of Agriculture from different parts of the world have been grown at Ames and their resistance or susceptibility to the different diseases determined. In 1929, for example, approximately 1,500 oat varieties and selections, obtained from various sources, were observed for reaction to crown and stem

rusts. One of these, Victoria, found to possess a very marked resistance to crown rust and to smut, came from Uruguay. Another was Bond, one of about 100 varieties newly introduced from Australia. Neither Victoria nor Bond was known to be resistant to crown rust or smut until this fact was determined by Dr. Murphy. These two varieties are now used almost exclusively throughout the United States and Canada as sources for resistance to crown rust and smut. Neither of these varieties in its original form is adapted to production in the United States. They are of great value, however, as parent material for the qualities which they can transmit to their progenies when crossed with other varieties.

The marked superiority of the rust-resistant varieties made possible by crossing Victoria on Richland is indicated by the rapidity with which Iowa farmers have replaced previously grown varieties. The Boone, Tama, Control, and Vicland, for example, are all similar-appearing selections from a cross of Victoria and Richland made in 1930. The first of these varieties, Boone, was released in 1939.

These varieties occupied 67 per cent of the Iowa oat acreage in 1943, 90 per cent in 1944, and 95 per cent or more in 1945. The rapidity of this complete variety turnover is believed to surpass that of any similar change, even that from open-pollinated to hybrid corn.

CLINTON OATS APPEAR

On the basis of the above acreages and the farm price of oats in these different years, Iowa farmers profited by higher yields resulting from the oat breeding work of the Iowa Station to the extent of slightly more than 75 million dollars in the three-year period 1943-45. Profitable to Iowa farmers as these varieties have proved to be, they are being replaced by Clinton oats, a still better variety.

In forty-nine community grain trials in all parts of Iowa in 1945 the average yield of Richland and Gopher was 57 bushels to the acre. Marion, Tama, and Boone averaged over 70 bushels. Clinton excelled them all with 84 bushels per acre. In short, Clinton oats promise an acre yield increase of 27 bushels over the best varieties available in 1938.

Clinton proved its worth in still another respect when Iowa's 1946 oat crop was hit hard by a new *Helminthosporium* disease. Yields dropped on thousands of farms, some as much as 50 per cent.

Boone, Tama, Control, Vicland, and other varieties which had the numerous desirable characteristics passed on to them from Victoria as

a parent, were found in 1946 to be susceptible to *Helminthosporium*.

Clinton, Benton, and Marion were among the varieties resistant to the new *Helminthosporium*. Treatment of all seed oats with New Improved Ceresan dust was recommended as the only thing a farmer could do to obtain partial control of the disease when growing one of the susceptible varieties. Field trials showed that when *Helminthosporium* was present, seed treatment might mean the difference between a very poor crop and a fair yield.

With a new variety, Overland (a selection from a cross of Victoria—Richland x Bannock), badly-diseased seed yielded only 30 bushels per acre. Dusting with New Improved Ceresan raised the comparable yield to 49 bushels—an increase of 19 bushels per acre. Clinton in the same trial yielded 88 bushels per acre.

Fifty-five community grain trials were recorded in 1946. Clinton gave an average yield of 80 bushels per acre. Marion showed 76; Gopher 75; Richland 70; Tama 64; and Boone, 59 bushels per acre. The seed used of Tama and Boone was infected with *Helminthosporium*, but all of the seed was treated before planting. Because 98 per cent of Iowa's 1946 oat acreage was sown to resistant varieties, the rusts and smuts did not appreciably influence the 1946 yields.

The upset written into the oat planning program by the appearance of *Helminthosporium* was that for the first time in the history of the community trials, the old rust- and smut-susceptible Gopher and Richland varieties outyielded Tama and Boone.

When the new Clinton oat was developed, there was the problem of getting enough seed to distribute to farmers. Starting with 25 *pounds*, Clinton oats were increased in one year to 1,207 *bushels*. In the fall of 1943, 25 pounds of seed were shipped to Arizona for a winter crop. There it was sown in October, and from this planting 67 bushels were harvested in May, 1944. This seed was rushed by express to Idaho where it was immediately planted, and 1,207 bushels harvested in August and shipped to Ames.

Iowa farmers grew it under contract during 1945 and in the spring of 1946 more than 24,000 bushels of the seed were distributed to farmers in Iowa, allotted to the various counties on the basis of their 1944 oat acreage. Those who planted Clinton oats were required to sell at least one-half the crop to other farmers for seed, and not to sell more than fifty bushels to any one farmer without the consent of their county seed distribution committee.

The seed could not be sold at more than \$1 per bushel above the

price of U. S. No. 2 oats at Des Moines on December 1, 1945. Every precaution was taken to insure that Clinton oats would be available to Iowa farmers in the shortest possible time, and to assure crops would be handled by farmers who had the soil and equipment to get the most and the best possible seed from that distributed.

In the past the effects of a new variety have seldom been apparent quickly. For example, few variety introductions have had far reaching importance equal to that of the Kherson, introduced into Nebraska from Russia in 1896. Although Kherson had become an important variety in Iowa in 1910, its greatest influence was as the parent of other varieties. The four varieties distributed from the Iowa Station prior to 1930—Iowa 103 (Albion), Iowa 105 (Richland), Iowar, and Iogold—are all pure line selections by Burnett from the Kherson. The Richland, in turn, was one of the parents of the disease-resistant varieties Tama, Boone, Control, Vicland, and others. The Kherson contribution to the Clinton variety is regarded as of still greater importance, for the Clinton stems back to a cross made by Murphy in 1932 between Bond and D-69. The D-69 is a selection from a cross made by Dietz in 1918 of rust-resistant Richland and Green Russian.

The production of superior new varieties is not a short-time program. It was seven years after the pure line oat improvement program was inaugurated by Burnett at the Iowa Station before the first variety went out—Iowa 103 in 1913. Iogold, the last of these varieties (not released until 1927), came from a plant selected in 1906. The crown rust and smut resistance of the Victoria variety was discovered by Murphy in 1929, but it was ten years before the first variety resulting from the use of Victoria as a parent in crosses went out from the Station—Boone in 1939.

The parents of Clinton oats have an even longer history. The crown rust and smut resistance of Bond, one of the parents, was discovered by Murphy in 1931, fourteen years before Clinton was obtained. The other parent of the Clinton represents work continued over an even longer period—work that it seemed for many years was not to yield any economic returns. Of many crosses and selections made by Dr. S. M. Dietz in 1918, none of which came into commercial use, two were used by Murphy in 1932 to cross with the Bond. These were the selections D-67 and D-69. Both of these got their stem rust resistance from the Richland and Green Russian varieties crossed by Dietz. Richland was Burnett's pure line selection out of Kherson, first selected by Burnett in 1906 and released to Iowa farmers as a new variety in 1914.

WHEAT

Iowa is not a wheat-growing state today, in spite of the relatively large acreage grown in the earlier years of its history. The farmers who broke the Iowa prairies seeded them to wheat for the quick harvest of needed food and because wheat could rather easily be transported to a ready market, providing a cash income. Changing market and economic conditions, the greater prevalence of wheat diseases, and increased profitableness of other products of Iowa farms all contributed to the rapidly diminishing importance of wheat.

Iowa lies in a peculiar position with reference to the principal wheat-producing areas of the Midwest. The spring wheat area on the north, the hard wheat area on the west, and the soft wheat area on the south and east, all find their limits within the borders of Iowa. The boundaries of these areas are not well defined, however, each different type fading out as the profits from it, compared to other crops and other types of wheat, diminish. The boundaries change from time to time as a result. The history of these shifting boundaries, together with the causes for such shifts, constitute the history of wheat production in Iowa.

When the land between the Mississippi and the Missouri rivers was taken up by pioneer farmers, all of the territory now known as Iowa was in the spring wheat area, and continued so until nearly 1900. In 1860, thirty-four counties reported winter wheat being grown, but in only five of these counties was it considered a dependable crop. As better, more hardy, winter varieties were introduced, their acreage expanded, but it was 1912 before the winter wheat acreage equaled that of the spring varieties. Since that time, the winter wheat acreage usually has been consistently larger than that of spring wheat. The apparent reason for this change was the replacement of the soft red varieties by the hard red Turkey wheat, which was much more winter-hardy and produced a high quality of flour.

So far as is known, the late George W. Franklin, of Atlantic, was the first Iowan to grow this type of wheat. Before his death Franklin described his connection with Turkish wheat as follows:

In 1855 I bought a load of rye from a man and sowed a field I wished to put to clover. In the fore part of the next summer when the rye was heading out I discovered that a large percentage of it was wheat. Having a portion of the field extending in a neck, I concluded to remove the rye from that part of the field and get some seed of the wheat. By the appearance of the heads I observed that it was not Odessa, but that it was some very hard variety, heavily bearded, not known in this part of the country. That fall I sowed this seed and it lived and gave good returns. There was still some rye in it. On a sandy knoll I observed that both rye

and wheat killed out, and this led me to the belief that it was as hardy as rye, and so I advertised it for years.

I kept on sowing this wheat, removing the rye each year as it headed out until I got it practically free from rye. From the year 1886 I began sending it out to other states and all over Iowa under the name of Hardy Turkey Red winter wheat.

When I first introduced it the millers would not give within 5 to 10 cents per bushel as much for it, claiming that it was too hard for milling purposes. As the years rolled by it became quite plentiful and the millers learned how to mill this hard wheat. Our yields have been from 22 to 42 bushels per acre. Have never had any of this variety winter kill, but have lost some on account of exceedingly dry weather in winter.

While every Iowa county now reports the growing of winter wheat, by far the heaviest concentration is to be found on the bottomlands of the Missouri and the Mississippi, and along the Iowa River and its tributaries in central Iowa. A very limited acreage of spring wheat is found in the northern half of the state, where the crop is used largely as poultry feed.

The largest acreage of winter wheat in Iowa was the 1919 crop of 864,588 acres. This has declined steadily until in 1945 the acreage was but 120,000. The largest acreage of spring wheat, 1,539,391, was the 1899 crop. In 1945 it amounted to only 3,000 acres.

BARLEY

Barley usually has been a profitable crop in about fifteen northwest Iowa counties, but in the state as a whole it has never been very popular. Only twice during the last fifty years, in 1901 and again in 1928, has the acreage reached six hundred thousand, and in only seven of these fifty crops has the yield averaged as much as thirty bushels per acre. By 1945 the acreage had dropped to three thousand.

The problem of barley production under Iowa's relatively high moisture and temperature is one of disease, chiefly scab. This organism grows readily on corn and wheat as well as on barley. It winters on cornstalks in the field and thus in Iowa, where more than 50 per cent of the land is planted to corn, we have an ever-ready source of infection. As yet no disease-resistant varieties are available, and other control measures have not been effective.

RYE

Rye has never been an important grain crop in Iowa. The largest acreage in any one year was 222,000 in 1897. The 1945 acreage was approximately 12,000. Only the winter variety has been planted in Iowa. Rye is relatively better adapted than other small grains to sandy, infertile soils. The varieties generally grown in Iowa are extremely winter-hardy, so it is possible to seed later in the fall than

any of the winter wheat varieties. As in pioneer days, much of the winter rye acreage seeded is used for pasture in the very early spring, and sometimes also in the fall.

FLAX

Fiber varieties of flax were among the first crops introduced from Europe and were grown for home use on most American farms as late as 1840. Fiber flax has long since disappeared for all practical purposes from American agriculture. All of the flax acreage in Iowa is of the seed type, for processing into linseed oil and meal. In Iowa the peak acreage of 322,778 was reached in 1885. As the new land disappeared, the acreage decreased gradually for about twenty years and then very rapidly fell to only 10,000 acres in 1915. Since 1925 there has been a small but consistent increase and with the war needs for oil seeds, flax acreage exceeded 300,000 in 1941 and 1943. The important flax area in Iowa lies in a dozen or so counties in northwest Iowa.

As with the small grain crops, disease has been of primary importance in the production of flax. Until varieties resistant to flax wilt were developed at the North Dakota Station about 1900, flax was thought to be a crop that could be grown only on virgin soil. Now that the wilt disease is better understood and resistant varieties have been developed, flax is grown successfully in the northern area in farm rotations.