Sunflowers Under Irrigation in Montana

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A Plot of the Early Mammoth Strain of Sunflowers Developed at Montana Experiment Station

BOZEMAN, MONTANA
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Sunflowers Under Irrigation in Montana

Sunflowers give a larger yield of silage than any other crop grown in the higher irrigated valleys of Montana. This, together with the fact that the silo is rapidly coming into more general use throughout the state, creates a demand for crops that will give larger yields and thrive where others fail to produce satisfactory returns. In the higher altitudes, where the season is short, crops are needed that mature early and produce a tonnage of nutritious silage sufficiently great to warrant their use in replacing present lower-yielding crops.

Corn, the great grain and forage crop of the middle west, is not so productive in the Rocky Mountain regions where the high altitude shortens the growing season. The man who wishes to use a silo that he may save more of his crop for winter feed demands a high-yielding crop with good feeding value. Sunflowers seem to come the nearest to filling these requirements and are the best-yielding crop grown for silage in the northern section and higher valleys of the west.

The use of sunflowers for forage is a relatively new practice. The Montana Experiment Station was the first to point out the possibilities of this plant as a forage crop when in 1915 sunflowers were grown on the Experiment Station farm; the green plants cut up with a feed cutter were eaten quite readily by dairy cows. The following year, in addition to using some of the crop for soilng purposes, tests of the feeding value of sunflower silage were undertaken. The results of these tests indicated that this plant also had very promising value as a silage crop. The high yield and the readiness with which the cows ate the forage, whether as a soilng crop or as silage, showed that sunflowers promised to be a valuable addition to Montana's agriculture, particu-
larly on irrigated land. In this initial test the Mammoth Russian sunflower was used.

PRELIMINARY TESTS UNDER IRRIGATION

Preliminary tests with sunflowers were started by the Agronomy Department of the Montana Experiment Station in 1915. The work was conducted under irrigation at Bozeman to determine how the crop would react to the soil and climatic conditions common to the higher irrigated valleys of the state. The first crop was planted on May 21st of that year, in drills 20 inches apart, using 12 pounds of seed per acre. The season was unusually wet and it was not necessary to irrigate. The crop was cut September 29th, 131 days after planting. At that time the average height of the plants was 112 inches and the seeds were in the middle-dough stage. The green weight of the crop produced was 36.8 tons an acre.

The results obtained in 1915 were so promising that sunflowers were planted again the following year. The same method of seeding was followed as in 1915—drills 20 inches apart seeding 12 pounds to the acre. The crop was planted on June 6th and irrigated July 24th. The harvesting was done September 12th, only 98 days after planting, the warm season of 1916 having forced the growth much faster than during the previous year. When harvested the crop averaged 109 inches in height and the average yield of green silage material was 31 tons an acre.

The large yields and apparently high quality of the sunflower crop as shown by these preliminary tests led to the starting of some definitely planned work in order to test the relative returns from sunflowers planted in different ways.

ADAPTATION TO SOIL AND CLIMATE

Sunflowers grow well over a wide range of soil and climatic conditions. Soils ranging from clay and silt loams to those containing large amounts of sand are suitable for their culture. However, like most plants, sunflowers do best on a rich loam, but they will adapt themselves to poorer soils. This does not mean that the soil may be dry, poor, shallow, and rocky; for sunflowers fail completely upon land of this kind. Their growth in Montana depends largely on the amount of water received. On the dry-land farm their growth is limited because they are not especially drought-resistant. The crop responds
larly on irrigated land. In this initial test the Mammoth Russian
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cause they are not especially drought-resistant. The crop responds
readily to irrigation and outyields all others on our irrigated farms. Sunflowers grow well in cool weather and endure ordinary frosts in the spring and fall with little or no damage, thus making them superior to corn in regions of high altitude and short growing season.

**EFFECT OF SUNFLOWERS ON SOIL FERTILITY**

Although sunflowers are said to be "hard on land," data thus far obtained from studies at the experiment farm at Bozeman show that, pound for pound, sunflowers remove about the same amount of plant food as do our other farm crops. However, the fact that sunflowers under favorable conditions produce a very large tonnage per acre makes them a crop that is rather exhaustive of the available plant food. For this reason crop rotation and the use of barnyard manure are advised.

**VARIETIES AND YIELDS**

The commercial varieties of sunflowers most commonly grown are Mammoth Russian, Black African, Jumbo, and White Beauty. The principal variety grown in the United States for silage pur-

![Fig. 2.—Typical seeds of the leading sunflower varieties](image-url)
poses is the Mammoth Russian. This variety usually has a single stalk with comparatively few branches and one head averaging 8 inches in diameter. The seeds are approximately ½ inch long and ¼ inch wide. They vary in color from almost pure white to black; most of them, however, are white with longitudinal streaks or bands of gray or black. The Mammoth Russian is a vigorous, heavy-stemmed variety with large leaves and produces heavy crops of seed which have a high oil content.

The Black African is one of the earliest-maturing varieties at this station. It shows possibilities as a seed producer but does not grow as tall as the Mammoth Russian and is only fair in silage production. It produces large black seeds.

The Jumbo grows taller than any other variety tested in Bozeman but spreads less and is coarser than the Russian varieties. The seeds are white and white with black stripes.

White Beauty has large white seeds and is a good oil producer. The plants do not grow so tall as the other varieties mentioned and the yield of forage is somewhat less. It is apparently a better variety for oil than for silage.

Experiments to determine the relative yielding value of the different sunflower varieties are being conducted at this station. Table I gives the results of the most promising varieties over a two year period. These tests are being continued and more conclusive results will be available later.

EARLY MATURITY IMPORTANT

The early tests with Mammoth Russian sunflowers showed that the seed was a mixture of several different types. Because of the short season and the fact that the crop must be well over 50 per cent in bloom before the best quality of silage can be made, it was apparent that early-maturing varieties were most desirable. An attempt was therefore made to isolate several of these with the hope that an early, comparatively short-stalked and heavy-leaved type could be found and fixed. Such a type of plant would be more easily harvested and thus more valuable to the farmers in the sunflower-producing sections of the state.

Several different types of Mammoth Russian have been selected and tested with the result that a high-yielding, early-maturing strain, which we have designated as Early Mammoth (Montana No. 2031), has been developed. This strain matures from one to two weeks earlier
TABLE I.—YIELDS OF LEADING SUNFLOWER VARIETIES GROWN AT BOZEMAN DURING 1922 AND 1923.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Montana number</th>
<th>Tons per acre</th>
<th>1922</th>
<th>1923</th>
<th>Average</th>
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<tbody>
<tr>
<td>Mammoth Russian</td>
<td>2010</td>
<td></td>
<td>21.75</td>
<td>**23.31</td>
<td>22.53</td>
</tr>
<tr>
<td>White Beauty</td>
<td>2037</td>
<td></td>
<td>20.02</td>
<td>23.21</td>
<td>21.61</td>
</tr>
<tr>
<td>Early Mammoth Russian</td>
<td>2031</td>
<td></td>
<td>20.49</td>
<td>21.37</td>
<td>20.93</td>
</tr>
<tr>
<td>Jumbo</td>
<td>2032</td>
<td></td>
<td>18.42</td>
<td>22.70</td>
<td>20.56</td>
</tr>
<tr>
<td>Giant Russian</td>
<td>2007</td>
<td></td>
<td>17.11</td>
<td>22.94</td>
<td>20.03</td>
</tr>
<tr>
<td>Black African</td>
<td>2043</td>
<td></td>
<td>19.83</td>
<td>19.19</td>
<td>19.51</td>
</tr>
<tr>
<td>S. P. I. 47805</td>
<td>2110</td>
<td></td>
<td>18.01</td>
<td>20.50</td>
<td>19.70</td>
</tr>
<tr>
<td>Black Manchurian</td>
<td>2002</td>
<td></td>
<td>18.96</td>
<td>14.21</td>
<td>16.58</td>
</tr>
<tr>
<td>Keurpho</td>
<td>2109</td>
<td></td>
<td>*19.66</td>
<td></td>
<td>19.66</td>
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Varieties grown in triplicate one-fiftieth acre plots except where noted. *Single plot. **Average of two plots.

than ordinary commercial seed of the parent variety. Seed of the Early Mammoth is not available in the open market at present, but small lots for increase have been distributed to farmers in various parts of the state.

SOURCE OF SEED

In the higher valleys of the western part of the state, where most of the sunflowers are grown, little or no attempt has been made to grow seed. At present, therefore, much of the sunflower seed used in Montana is imported from the three important seed-producing areas, namely, southeastern Missouri, southern Illinois, and the San Joaquin Valley of California. It is quite probable, also, that some seed from foreign countries finds its way into the state, since in recent years there has not been enough sunflower seed produced in the United States to meet the demand. Obviously it will be necessary to use seed from outside sources until Montana growers produce sufficient to supply the local needs. Good sunflower seed may be produced under irrigation in the lower altitudes of eastern Montana and it may be possible to establish seed supplies in that region sufficient to meet the requirements of western Montana growers. The problem, however, is to get a strain that will satisfy both the seed grower and the silage producer. This is a problem on which we are working.

SPECIAL PROBLEMS

The relative cost of growing corn and sunflowers has not been studied. It seems, however, that the difference is not great enough to be of much importance. That some trouble may be experienced from
insect pests and diseases attacking sunflowers is evident from discoveries already made. The problem of sunflower wilt is being studied at this station. It is hoped that growers, being forewarned, may be forearmed against this and other troubles. The best methods of harvesting are also receiving additional attention.

PREPARATION OF LAND FOR PLANTING

The preparation of land for planting sunflowers is in general the same as for corn. Land intended for sunflowers should usually be plowed in the fall and left without further tillage until spring. As soon as field conditions are favorable for tillage operations in the spring, the land should be harrowed; or, if it has become firmly packed, disk ing will be necessary to prevent the surface from crusting. If not plowed in the fall, it should be plowed early in the spring and harrowed immediately. The ground should be given sufficient tillage to form a seed-bed that is mellow on top and compact underneath.

TIME OF SEEDING

During the past five years sunflowers have been sown each year on eight different dates to determine the effect of time of planting upon the yield. The plantings were begun as early as practical in the spring and continued at approximately one-week intervals. Observations on the growth of the crop, which are shown in Table II and Figure 3, warrant the recommendation that sunflowers should be planted as soon as the ground becomes sufficiently dry and warm to permit the preparation of a satisfactory seed-bed. In the higher altitudes where the season is short, early planting is especially important.

In districts where corn is grown, sunflowers may usually be planted two or three weeks before it is safe to plant corn, owing to the

<table>
<thead>
<tr>
<th>Average date of seeding</th>
<th>1918</th>
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<th>1920</th>
<th>1921</th>
<th>1922</th>
<th>Average</th>
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<tr>
<td>May 6</td>
<td>39.7</td>
<td>17.8</td>
<td>29.6</td>
<td>16.7</td>
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<tr>
<td>May 13</td>
<td>25.8</td>
<td>8.2</td>
<td>27.0</td>
<td>9.0</td>
<td>34.2</td>
<td>20.6</td>
</tr>
<tr>
<td>May 20</td>
<td>21.5</td>
<td>8.1</td>
<td>19.2</td>
<td>7.6</td>
<td>28.6</td>
<td>17.0</td>
</tr>
<tr>
<td>May 27</td>
<td>26.6</td>
<td>6.7</td>
<td>17.9</td>
<td>9.0</td>
<td>25.2</td>
<td>17.1</td>
</tr>
<tr>
<td>June 4</td>
<td>36.8</td>
<td>6.1</td>
<td>16.4</td>
<td>14.1</td>
<td>15.6</td>
<td>17.8</td>
</tr>
<tr>
<td>June 11</td>
<td>37.2</td>
<td>14.9</td>
<td>15.8</td>
<td>16.4</td>
<td>18.4</td>
<td>20.5</td>
</tr>
<tr>
<td>June 18</td>
<td>22.0</td>
<td>10.0</td>
<td>11.2</td>
<td>6.1</td>
<td>18.0</td>
<td>13.8</td>
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<tr>
<td>June 25</td>
<td>9.4</td>
<td>15.6</td>
<td>7.2</td>
<td>17.2</td>
<td>12.4</td>
<td></td>
</tr>
</tbody>
</table>
fact that sunflowers will stand considerable frost with little or no injury. Early planting is advisable as it will increase the length of the growing season. In Russia, where sunflowers have been cultivated for many years, they are seeded in the spring as soon as the frost is out of the ground. When the soil is dry they are seeded in the late fall and allowed to remain in the ground until spring when they sprout with the first warm weather.

**RATE AND METHOD OF SEEDING**

The rate and method of seeding depend upon the amount of moisture available. An even stand is desirable under all conditions. Seven to ten pounds (nine to thirteen quarts) of seed per acre have given good results under average methods of seeding at this station.

The most practical way of planting sunflower seed is with the ordinary grain drill. A sufficient number of the feed spouts should be stopped up to permit of planting in rows the desired distance apart. Where a corn planter is available this implement can be used to advantage.

Figure 5 shows the green weight per acre of the total sunflower
plant when grown in rows at varying distances apart. It will be noted that the highest average yield—24.8 tons of silage per acre—was obtained from the rows 36 inches apart. Other experiment stations, including Wyoming and Saskatchewan, Canada, have obtained good yields from planting in rows 36 inches apart. The rows 24 inches apart were evidently too close to allow the best development of the crop. The Washington Experiment Station recommends planting in rows 42 inches apart. This spacing was unfavorable in tests made at Bozeman during 1917 and 1918. Further tests of the 42-inch spacing and also of broadcasting are in progress and the results will be watched with interest.

DEPTH OF SEEDING

The depth of seeding is determined by the kind of soil, the moisture content, and the time of seeding. The seed should be planted at a depth of 1½ to 3 inches. The deeper seeding should be practiced on the lighter soils and early spring seeding should be shallower than late seeding.

CULTIVATION

Sunflowers respond to cultivation as quickly as does corn and the method of tillage is much the same. Cultivation should be practiced
to destroy weeds, to create and maintain a granular clod mulch, and to provide other favorable conditions for the growing plant. Weeds should not be allowed to grow, since they use moisture and plant food needed for the crop. Weeds are most easily destroyed at the time of germination and cultivations should be given frequently so as to keep the field clean. If a crust forms on the soil, a light harrowing will help to obtain a good stand. The early cultivations should be rather deep with shallower cultivating thereafter. The ordinary corn cultivator or the shallow-running duck-foot type of weeder is recommended for this week. The frequency and character of the cultivations will depend upon local conditions.

IRRIGATION

Where the crop is irrigated, water should be applied before the plants show signs of wilting. Water should never be allowed to stand on the soil. There are few plants that are injured sooner than cultivated sunflowers when water is allowed to stand on the field for any
length of time. The New Mexico Experiment Station reports that where water stood for one entire day and heated on the heavy soils, the sunflowers were killed. While the conditions in Montana are somewhat different, this is a problem that must be kept in mind when applying irrigation water.

At the Huntley Experiment Farm three irrigations were given sunflowers seeded May 21, 1918, water being applied uniformly to the field on July 9th, August 2d, and August 8th. In 1919 five irrigations were given. The number and character of irrigations will necessarily have to be determined to a large degree by the grower. The large growth produced and the consequent high rate of water loss in dry regions mean a correspondingly high water requirement.

**Fig. 6.—Giant Russian sunflower, a short, stocky, yet high-yielding variety which is harvested with comparative ease**

**TIME OF HARVESTING**

Investigators conclude that sunflowers should not be cut for silage until 50 to 60 per cent of the plants are in bloom. If harvested earlier the silage has a lower feeding value and there is also a greater loss of juices. Good sunflower silage is usually a dark olive-brown
color, much darker than corn or sorghum silage. In texture it compares favorably with corn silage when the sunflowers have been harvested at the right stage of maturity and stored properly. Most of the complaint regarding the texture of sunflower silage is the result of harvesting the crop too late. When the plants have been allowed to stand until the seeds are mature, the stems become woody and do not soften in the silo. The plants lose many of their leaves and the hard, woody stalks are difficult to pack firmly. On the other hand, if cut too early, the high moisture content may result in a water-logged, high-acid silage of poor quality.

**METHOD OF HARVESTING**

Any one who has had experience in harvesting sunflowers is aware of the difficulties encountered in handling the crop, particularly on irrigated land. Under irrigation the sunflowers grow tall and tangle badly, and it is often a difficult task to harvest them to advantage. Sunflowers grown on dry land do not grow so tall and the corn binder may be used more conveniently.

Ordinary corn-harvesting machinery is satisfactory, in most cases, for the harvesting of sunflowers. The corn binder does good work and may be used to advantage where the stalks are not too tall and coarse. The bound bundles are easier to handle and feed into the cutter. In some cases a one or two-row sled has been used to advantage. A two-row sled may be made with runners 24 to 30 inches apart

![Fig. 7.—The use of the corn binder is the most satisfactory method of harvesting sunflowers.](image-url)
Fig. 8.—When sunflowers are firmly rooted and standing, the sled with a stationary knife may be used for cutting.

Fig. 9.—Hand-cutting is slow and expensive but necessary if the sunflowers have lodged and become tangled.
with the platform 42 to 56 inches wide in the rear, tapering to 24 to 30 inches wide in front. Knives are attached to each side and two men stand on the platform, gathering the sunflowers as they are cut. When the stalks are too large for the corn-harvesting machinery, the corn knife may be used. Everything possible should be done to reduce to a minimum the amount of hand work required.

A new type of ensilage harvester is now being manufactured which offers possibilities for the harvesting of sunflowers, although it was designed primarily for corn. This machine is drawn through the field and cuts off the stalks in the same manner as any ordinary corn binder. Instead of being tied in bundles the stalks are delivered directly to the knives where they are cut into the desired length. The freshly cut silage is conveyed into a wagon and hauled to the silo without being touched by hand at any time during the process. The silo is filled by means of a blower; or, if the silo is not too tall, an ordinary dump elevator may be used.

The Montana Experiment Station has not had an opportunity to use a machine of this type in harvesting sunflowers for silage. It is
believed, however, that the machine has possibilities that may justify its use in cases where a large acreage of sunflowers is grown.

FEEDING VALUE OF SUNFLOWER SILAGE

Feeding value of the silage must be considered as well as the yield. Several experiment stations, notably those of Montana, New Mexico, and Washington, and also Manitoba Agricultural College and the University of Saskatchewan—all report favorable results on feeding sunflower silage to dairy cows. However, silage made from sunflowers is not without its faults. In the vicinity of Billings and on the Huntley Project certain growers have been unable to make good silage from this crop. At the Huntley Experiment Farm, near Osborn, sunflower silage proved to be inferior to that made from corn. Because of the low percentage of fermentable sugar in the sunflowers, the ensiled crop spoiled and livestock refused to eat it. Studies have been undertaken at the Montana Experiment Station to determine the cause of the variation in the sugar content.

Sunflower silage has a peculiar odor which is rather strong, resinous, and somewhat sour but not offensive. This odor may be one of the reasons why cattle sometimes hesitate to eat the silage when it is first offered to them.

In recent work reported* by H. A. Schoth, assistant agronomist in forage crop investigations for the Bureau of Plant Industry, United States Department of Agriculture, cooperating with the Oregon Agricultural College, results showed that the addition of a little salt made the sunflower silage much more palatable. The stock in the feeding test readily consumed the silage to which 5 pounds of salt per ton had been added. The use of salt in these tests increased the palatability of the silage at a minimum of cost without reducing the nutritive value.

SUNFLOWERS AS A SOILING CROP

Sunflowers have been fed as a soiling crop to dairy cows by a number of experimenters with good results. The plants are usually cut for this purpose when about half of them are in bloom, and must be run through a cutter before they can be used to advantage. Some have objected to the extra labor of cutting for soiling purposes, but

*Journal of the American Society of Agronomy, November, 1923.
these objections are not serious when the value of such feed is considered.

The Montana Experiment Station compared sunflowers with corn as a supplement to pasture during the latter part of the grazing season. Both crops were cut as needed and run through a silage cutter before being fed to dairy cows. The animals ate the green sunflowers readily, kept up their milk flow, and apparently did well on the feed. The conclusion reached was that under the conditions of the experiment as described the sunflowers and corn were of equal feeding value.

A more extensive feeding test has been carried out at this station, comparing sunflowers and corn as soiling crops. Six cows were fed all of the chopped sunflowers they would eat and another six cows all the chopped corn they would eat. Both lots had access to a small pasture and in addition received the same grain ration. At the close of the test the corn was in the roasting-ear stage and the sunflowers were about 40 per cent in bloom. The average daily production for the cows fed sunflowers was 39.4 pounds of milk and 1.41 pounds of butterfat, and for the cows fed corn, 38.1 pounds of milk and 1.38 pounds of butterfat.

During the feeding period of 28 days each cow fed sunflowers lost 7.8 pounds and those fed corn, 20.4 pounds of live weight. The slight difference in results favoring sunflowers is no doubt due very largely to the fact that one cow in the corn-fed lot went "off feed" during the period. The results seem to confirm those of the first test and justify the conclusion that sunflowers may be used effectively as a soiling crop for dairy cows.*

USES OF SUNFLOWER SEED

Most people do not realize that the greater part of the sunflower seed consumed in this country is fed to poultry. Approximately four million pounds of this seed is used annually by forty of the large poultry feed manufacturers, according to reports received by the Bureau of Agricultural Economics, United States Department of Agriculture. Many small feed dealers and elevator men make poultry feed mixtures containing sunflower seed, but the quantity used by them is relatively small. Some sunflower seed is fed to farm animals as a "conditioner," some to birds, and in some Russian settlements

*See Montana Experiment Station bulletins 131 and 134.
people eat the seeds much the same as American people eat peanuts. A much smaller amount is used for these purposes, however, than is used in mixed poultry feeds.

Practically no sunflower seeds have been crushed for oil in the United States, although some foreign countries find it profitable to use some of the seed for this purpose. When pressed cold, sunflower seed produces fairly good table oil. The seed cake resulting from the expression of the oil is used as a concentrate in feeding cattle and horses.

SUMMARY

Because sunflowers give a larger yield of silage than any other crop grown in the higher irrigated valleys of Montana, they are an extremely valuable addition to the agriculture of the state. A yield of 36.8 tons of silage per acre the first year the crop was grown immediately won the interest of investigators.

Sunflowers are adapted to a wide range of soil and climatic conditions. They are especially frost-resistant but not extremely resistant to drought.

Although sunflowers are said to be "hard on land," data thus far obtained from studies at the experiment station at Bozeman show that, pound for pound, sunflowers remove about the same amount of plant food as our other farm crops.

The Early Mammoth (Montana No. 2031) is an early-maturing, high-yielding strain of value to growers in short-season localities.

Sunflowers should be seeded two or three weeks before corn is planted. At Bozeman seedings made during the first week of May have given the highest yields.

The best yields have been secured at the Montana Experiment Station when drilled in rows 26 inches apart. Seven to ten pounds of seed per acre are required.

The ordinary grain drill with enough holes stopped up to plant in rows 36 to 42 inches apart may be used to advantage for seeding when a corn-planter is not available.

Sunflowers make the best silage if harvested when 50 to 60 percent of the plants are in bloom.
Good results have been obtained from using sunflowers as a soiling crop for dairy cows when 40 per cent of the plants are in bloom.

Ordinary corn-harvesting machinery is satisfactory, in most cases, for harvesting sunflowers.

Several experiment stations report favorable results on feeding sunflower silage to dairy cows. However, some difficulty has been encountered in limited sections of Montana. The value of sunflowers as a reserve feed when other crops are scarce should not be overlooked.