Corn is an important crop in southwestern North Dakota. Its importance has been increasing in recent years because cattle feeding experiments have shown that corn silage can be used effectively to provide the major part of both wintering and fattening rations.

CORN FOR SILAGE...

RESEARCH AT DICKINSON

By Thomas J. Conlon[1] and Raymond J. Douglas[2]

The popularity of corn as a silage crop for this area has grown steadily for several reasons. No other crop will produce consistently as much high quality feed per acre in this region where the average annual precipitation is just slightly over 15½ inches. This, plus the fact that corn silage can be used effectively to provide a large part of the feeding ration, has increased the importance of corn in southwestern North Dakota.

Corn that is harvested as silage can be stored satisfactorily for several years as a reserve feed supply. Another reason for growing corn lies in the fact that clean corn stubble land produces high yields of small grain. Development of better adapted varieties and hybrids, improved cultural methods and improvement in field forage harvesters have greatly reduced the costs and labor of ensiling the crop.

In 10 years 1940 to 1949 approximately 11 per cent of the corn grown in North Dakota was used as silage.

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Since 1949 the acreage used as silage in North Dakota has increased steadily until now nearly 40 percent of the state's corn crop goes into the silo.

The average annual yield of silage for the period 1940-1949 for the state was 484,000 tons. This compares with over 1½ million tons average annual yield for the years 1950-1956, inclusive. These figures are from the North Dakota Annual Crops Summary report of the Agricultural Marketing Service, U. S. Department of Agriculture.

Corn has always occupied an important place in the experimental work with crops at the Dickinson Experiment Station. It was included in several of the crop rotation and tillage trials established in 1907, the oldest experiments with corn at the station.

Other work with corn has included: Varietal field plot trials to determine the best yielding varieties for this region; corn breeding and selection work; studies to determine the relative production of feed per acre from corn as compared with the highest yielding varieties of each of the other cereal grains; yield trials comparing corn, sorghum and sudan grass for silage production; effects of fertilizer on the yield of corn, and plant population trials to determine the best planting rates for corn in southwestern North Dakota.

Figure 1.—Corn at Dickinson in 1953. Adapted varieties produce 7 to 10 tons of silage per acre in favorable years such as 1953.

The oldest experiments with corn at the Dickinson Station are the crop rotation and tillage experiments, begun in 1907. These trials have adequately demonstrated that:

Corn is a dependable and high producing feed crop in this area.

Since 1907 corn failed only twice, in 1912 when hail destroyed corn and all other grain crops as well, and in 1936 when all crops, including grass and alfalfa, were a total failure because of drouth. No other crop has a better record than corn for dependability.

Corn is one of our highest producing feed crops. Commenting on studies begun in the 1920's and continued through the 1930's to determine the relative production of feed per acre from corn as compared with the highest yielding varieties of each of the other cereal grains, Smith[3] said: "It soon became evident that corn was producing more feed per acre than any other crop at this station. During the dry years in the 1930's it developed that, with few exceptions, corn showed a still greater advantage over the other feed crops in total production of feed during the poor years when feed was usually scarce and high in price."

Yields for the 10 poorest years during the total period these trials were in progress, 1922 to 1943, showed corn to be producing about twice as much as its nearest competitor in digestible feed per acre. Average results for the entire period show corn exceeded its nearest competitor, barley, by 35 percent in pro-

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duction of total digestible nutrients per acre.

In comparing corn production with alfalfa, crested wheatgrass and sweetclover production in the rotation and tillage trials for 50 years, 1907-1956, corn is in the lead here, too. In Rotation 42, a 6 year oats-corn - wheat - alfalfa - alfalfa - alfalfa rotation, corn averaged 3.6 tons of silage per acre, compared with slightly less than ¾ ton of alfalfa per acre average yield from the second and third years' crops. In Rotation 10*, a 5-year oats-corn wheat - crested wheatgrass - crested wheatgrass rotation, (with crested being sown with the wheat) corn has a 50-year average yield of 3.9 tons of silage per acre, compared with 1,377 pounds of crested wheatgrass per acre from the second and third years, cuttings

The picture is practically unchanged in Rotation 11, a 5-year oats-corn-wheat-sweet clover-sweet clover rotation, with corn silage yields averaging 3.3 tons per acre for 50 years and second year sweetclover yields being 1,383 pounds per acre. The 50-year average for the three rotations is: 1,393 pounds hay per acre for the crested wheatgrass, alfalfa and sweetclover plots, as compared with 3.6 tons of corn silage.

Corn variety trials have been an important part of the work with corn at the Dickinson Experiment Station for many years. Trials at present include about two dozen open pollinated varieties and hybrids, some new, potentially promising, strains as well as the older, well established varieties and hybrids now in wide use in the area.

Generally, corn varieties and hybrids with a visual maturity rating of 82 to 85 days produce the highest yields of silage. Corn in this maturity range reaches the hard dough stage of development by silage cutting time more often than do later maturing varieties. The feeding value per acre of varieties that will reach the hard dough stage by harvest time is considerably greater than for varieties which are only in the milk stage at harvest time. According to Hopper[4], corn that has reached the glazed stage of development has produced over 86 percent of its final weight as compared with approximately 68 percent when it is in the milk stage.

Morrison's data show that well matured, well eared dent corn contains 7 percent more total digestible nutrients, 8 percent more total dry matter and .4 percent digestible protein than dent corn that was immature and had not reached the dough stage by silage cutting time.

This means, in order to obtain

TABLE I.—**Corn, Grass and Legume Yields From Several Rotations in the Dickinson Experiment Station Rotation and Tillage Trials, 50-Year Period 1907-1956.**

Rotation	Crop sequence	Average yields corn, tons	Average yields grass or legumes, lbs.
42	Oats-corn-wheat-alfalfa—3 years	3.6	1,413
11	Oats-corn-wheat-sweet clover—2 years	3.3	1,383
10	Oats-corn-wheat-crested wheatgrass—2 years	3.9	1,377
	Acre average for three rotations	3.6	1,393

*Crested wheatgrass was used in both Rotation 10 and 12 beginning in 1928. Previous to 1928, bromegrass was used in both rotations.

[4]Hopper, T. H. Corn for North Dakota, N. Dak. Agr. Exp. Sta. Bul. 207, March 1927.

TABLE II.—**Comparison of Average Composition and Digestible Nutrients in Corn at Various Stages of Maturity, According to Morrison.**[5]

	Percent total dry matter	Percent digestible protein	Percent total digestible nutrient	Number of analyses
Corn, dent, well matured, well eared	28.4	1.3	20.0	211
Corn, dent, well matured, fair in ears	26.0	1.1	17.1	111
Corn, dent, well matured, few ears	26.0	1.1	16.0	28
Corn, dent, immature, before dough stage	20.4	0.9	13.0	80
Corn, dent, immature, southern type corn	19.4	0.8	12.0	21

the highest possible yields of good quality silage from your corn crop in southwestern North Dakota, you should grow a variety or hybrid that has an average maturity rating of 82 to 85 days.

If it is decided to plant a silage blend, the blend should be completely made up of hybrids with a visual maturity rating of 82 to 85 days.

Corn has been compared with sorghum and sudangrass to determine which will produce the most feed under the climatic conditions that prevail in southwestern North Dakota. In this roughage trial corn has been the best feed producer by a wide margin, averaging nearly twice as much tonnage per acre as that produced by either sorghum or sudangrass.

TABLE III.—**Yield Summary—Roughage Production Trial 1951-1956.**

	Average green weight in tons per acre						
	1951	1952	1953	1954	1955	1956	1951-56
Rainbow flint (Mandan strain)	6.51	1.60	9.35	6.47	4.99	4.86	5.63
Nodakhybrid 301	6.79	1.83	7.82	6.89	4.81	4.31	5.41
Rancher sorghum	3.05	1.25	6.81	3.80	0.00	3.80	3.12
Black amber sorghum	2.98	1.59	7.36	3.83	0.00	2.88	3.11
Sweet sudangrass	1.82	1.15	5.76	3.39	0.00	1.72	2.31
Piper sudangrass	------	------	4.42	3.77	0.00	2.05	------

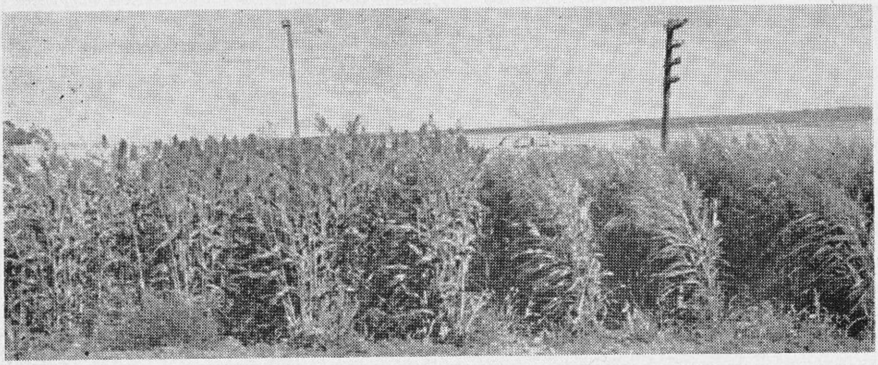

Figure 2.—Sorghum and sudangrass at Dickinson in 1953. Yields from adapted corn varieties are nearly twice as much as yields from the sorghum varieties, even in favorable years such as this.

[5]Morrison, F. B. Feeds and Feeding, 21st Edition, 1951.

Figure 3.—Sorghum at Dickinson in 1955. Culture of sorghum is more difficult than corn in this area.

Figure 4.—Corn at Dickinson in 1955. The 45-year average silage yield from corn on the rotation and tillage plots is slightly over 3½ tons per acre.

The sorghums are not well adapted to southwestern North Dakota, as evidenced by their relatively lower yields in comparison with corn. Some of the conditions unfavorable to the successful culture of sorghum and sudangrass in southwestern North Dakota are: Low annual and seasonal rainfall, lower than optimum mean temperatures during the growing season, a short growing season, and difficulty and uncertainty of getting a satisfactory stand in many years.

Table III is a summary of yield data from the roughage trial since it was begun in 1951.

Rate of planting trials with corn have been conducted since 1954 and the data from this trial are summarized in tables IV and V.

TABLE IV.—**Silage Yields From the Rate of Planting Trial with Corn—1954-1956.**

Spacing in the row, inches	Average yield of Nodakhybrid 301 tons per acre			Average yield of Rainbow flint (Mandan) tons per acre		
	1954	1955	1956	1954	1955	1956
6	6.67	5.67	4.65	7.50	6.50	4.40
12	6.46	5.00	3.33	8.17	5.42	4.21
18	5.96	4.42	4.09	8.09	6.17	3.90
24	5.88	3.17	4.28	6.75	4.54	4.46
LSD at 5 pct.	1.99	1.38	.66	1.52	2.81	1.20

TABLE V.—**Grain Yields From the Rate of Planting Trial with Corn—1954-1956.**

Spacing in the row, inches	Average yield of Nodakhybrid 301 Bushels per acre 1954	1955	1956	Average yield of Rainbow flint (Mandan) Bushels per acre 1954	1955	1956
6	39.9	10.4	10.6	36.0	6.1	8.1
12	38.7	14.0	10.4	39.4	7.7	7.9
18	39.5	12.6	14.0	40.9	8.9	8.7
24	37.2	15.6	17.1	36.7	6.0	17.6
LSD at 5 pct.	5.1	4.4	4.5	6.0	5.1	4.9

A comparison of silage yields for the 3 years shows no significant difference between any of the spacings, but the general yield trend seems to favor the 6 and 12-inch spacings. However, the data on grain yields from this trial show that in the drier years the wider spacings in the row tend to produce more grain. Generally, the yield trend seems to favor the 12 to 18-inch spacing in the row as a good all around planting rate for silage production. The results available from this trial are limited to 3 years and further experimentation may modify these conclusions.

To determine the effects of commercial fertilizer applied regularly in a 2 year corn-wheat rotation, a corn-wheat rotation-fertilizer trial was begun in 1955. Data from this

TABLE VI.—**Wheat Yields—Rotation-Fertilizer Series—1956.**

Wheat yields on:	Yield—bushels per acre Rep 1	Rep 2	Rep 3	Av.	1955	2 yr. av. yield 1955-1956
1. DD cornland, fertilized	2.3	3.2	4.4	3.3	27.8	15.6
2. DD cornland, corn fertilized previous year	3.4	1.5	4.4	3.1	25.5	14.3
3. DD cornland, check	2.1	3.6	2.5	2.7	17.2	10.0

TABLE VII.—**Corn Grain Yields—Rotation-Fertilizer Series—1956.**

Corn grain yields on:	Yield—bushels per acre Rep 1	Rep 2	Rep 3	Av.	1955	2 yr. av. yield 1955-1956
1. SP wheat stubble, fertilized	5.5	2.8	18.1	8.8	23.1	16.0
2. SP wheat stubble, wheat fertilized previous year	7.1	11.0	16.1	11.4	26.0	18.7
3. SP wheat stubble, check	7.1	5.9	15.7	9.6	24.6	17.1

TABLE VIII.—**Corn Silage Yields—Rotation-Fertilizer Series—1956.**

Corn silage yields on:	Yield—bushels per acre Rep 1	Rep 2	Rep 3	Av.	1955	2 yr. av. yield 1955-1956
1. SP wheat stubble, fertilized	2.92	3.12	3.38	3.14	2.98	3.06
2. SP wheat stubble, wheat fertilized previous year	2.70	3.78	4.00	3.49	2.96	3.23
3. SP wheat stubble, check	2.78	3.60	3.28	3.22	2.89	3.05

Figure 5.—This shows the rather typical early season response of corn to fertilization. Generally, however, as the season progresses, the unfertilized corn "catches up" and practically no differences have been noted in yields.

trial were limited to only 2 years, 1955 and 1956, and further experimentation may modify the results of the first 2 years of trial. Wheat yields, in this trial, on cornland fertilized at 125 pounds per acre with 16 - 20 - 0 commercial fertilizer have averaged 15.6 bushels per acre, compared with 10 bushels per acre from unfertilized cornland for the same period. Corn yields, however, have not been increased by the application of 100 pounds of 8-32-0 per acre commercial fertilizer applied in the drill row at seeding time. The preceding tables VI, VII and VIII summarize the data from this trial for 1955 and 1956.

Proper handling of corn at silage cutting time is necessary to reduce waste from spoilage in the silo and in the feed bunks.

Silage should be packed as tightly as possible, and silage cut fine packs best. Pieces ¼ to ½ inch long are about right for best packing. Anything longer than ¾ inch is too long for best results.

Corn should be packed as tightly as possible to make the best quality silage and to reduce the amount of spoilage. A heavy wheel tractor is best for packing in either the trench silo or the above ground bunker type silo. Packing should be continuous during the time the silo is being filled and for several days after the filling is completed. The importance of fine chopping and thorough packing cannot be over emphasized.

Corn cut at the proper stage will contain about 70 percent moisture and will pack and ensile very satisfactorily at this moisture content. If the crop has been frozen, or is too dry for any other reason, add water as the silo is being filled.

If the corn is chopped fine and well packed it probably will not be found necessary to cover the silo unless the silo is to be held for several years as a reserve feed supply. Top spoilage is reduced to a minimum with well cut, well packed corn, and the reduction in spoilage obtained by covering the silo with dirt or manure or any other material will probably not be enough to offset the costs of covering.

Trench type silos dug into the ground, or the above ground bunker type silo, which is essentially a trench built on the surface of the ground, make the most satisfactory kind of silage storage for this area. Dug trench silos have been used very successfully in areas of rolling prairie where silo sites can be selected that will provide natural drainage. In level country where drainage may be a problem, or where high water tables or other factors make the use of the dug trench undesirable, the bunker type above ground is very successful.

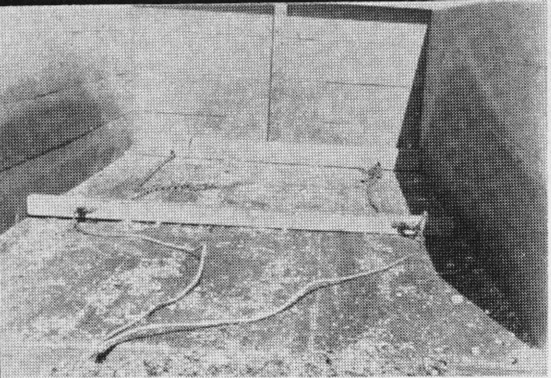

Figure 6.—Inside of wagon used to haul silage from field to silo, with unloading skids in place. Note slack chain between the skids which permits unloading back half of load before front half starts to move.

Figure 7.—Load of chopped corn being pulled off into silo with rig shown in fig. 6. This is a fast, efficient and economical method.

Trench type silos of either the dug type or the above ground bunker type are economical to build. They are preferred because they: (1) provide a large volume of storage cheaply, (2) They are easy to fill, using "dump truck" methods which are rapid, save considerable labor and eliminate the need for a silage blower, (3) Freezing is not a serious problem in such silos, (4) A tractor mounted scoop can be used for removing the silage for feeding, eliminating considerable hand labor, (5) Such silos, particularly the bunker type, can be adapted to self feeding.

If you have a large volume of corn to store, the need for several silos can be eliminated by building your trench wide enough to accommodate your entire crop. One well built trench silo made wide enough and long enough to accommodate your crop is better than two or more smaller trenches.

Well made silage cut when the corn is in the proper stage, chopped fine and packed well in a trench silo, will keep for several years without deteriorating and makes an excellent reserve feed supply.

Acknowledgement: Photographs in this article are by Larkin H. Langford, Assistant Animal Husbandman, Dickinson Experiment Station.