11-1914

The Pit Silo

C. Larsen

BULLETIN No. 154 NOVEMBER, 1914

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANICS ARTS

DAIRY HUSBANDRY DEPARTMENT

THE PIT SILO

BROOKINGS, SOUTH DAKOTA

The Mitchell Publishing Company, Mitchell, S. D.

GOVERNING BOARD

Hon. A. E. Hitchcock, President.....Mitchell, S. D.
Hon. T. W. Dwight, Vice President....Sioux Falls, S. D.
Hon. A. M. Anderson.....Sturgis, S. D.
Hon. August Frieberg.....Beresford, S. D.
Hon. Frank Anderson.....Webster, S. D.

STATION STAFF

T. W. Dwight.....Regent Member
A. M. Anderson .....Regent Member
E. C. Perisho.....President of College
James W. Wilson.....Director and Animal Husbandman
N. E. Hansen.....Vice Director and Horticulturist
James H. Shepard.....Chemist
C. Larsen .....Dairy Husbandman
A. N. Hume.....Agronomist and Supt. of Sub-Stations
J. G. Hutton.....Assistant Chief of Agronomy
M. Champlin.....Assistant Agronomist and Collaborator
Howard Loomis.....Agronomy Analyst
Matthew Fowlds .....Assistant in Crops
J. D. Morrison...Crops, Detailed by U. S. Department
..... of Agriculture
J. M. Fuller.....Assistant and Dairy Bacteriologist
E. H. Hungerford.....Dairy Analyst
Howard W. Gregory.....Assistant Dairyman
Perry Clifford.....Assistant Dairyman
Guy E. Youngberg.....First Assistant in Chemistry
R. A. Larson.....Secretary and Accountant
E. I. Fjeld.....Bulletin Clerk and Stenographer

BRIEF INSTRUCTIONS FOR BUILDING A PIT SILO.

by

C. Larsen.

The pit or underground silo is useful in the semi-arid sections and on high locations. Where the ground is low, where irrigation is practiced and where the rainfall is great, seepage water will interfere with its usefulness.

The pit silo can be built with common home labor. The cost is very low. When once properly built a pit silo is long lived, it never rots, it never blows down, and the silage never freezes in it during the winter.

The pit silo can be filled with an ordinary feed cutter costing only about $60. A 6 H. P. engine is large enough for running the cutter. Several neighbors may own such a cutting outfit and co-operate in filling their silos.

SIZE OF THE SILO.

First determine the size of silo to build. This in turn depends on the number of cattle and the length of time they are to be fed. The following table gives some information on this point:

No. of Cows	Length of time	Tons of silage required	Approximate size of pit silo to build
For 6	9 months	32 tons	10 ft. x 23 ft. deep
For 8	9 months	43 tons	12 ft. x 22 ft. deep
For 10	9 months	54 tons	12 ft. x 26 ft. deep
For 12	9 months	65 tons	14 ft. x 24 ft. deep
For 14	9 months	76 tons	14 ft. x 26 ft. deep
For 16	9 months	86 tons	14 ft. x 29 ft. deep
For 18	9 months	97 tons	16 ft. x 26 ft. deep
For 20	9 months	108 tons	16 ft. x 28 ft. deep
For 22	9 months	118 tons	18 ft. x 25 ft. deep
For 25	9 months	135 tons	18 ft. x 28 ft. deep

LOCATING THE SILO.

First locate the silo on a suitable place. It should be handy for feeding. If convenient, locate on the south side

of the barn or shed. Do not dig the pit too close to the barn. It should be at least 6 feet away.

Then locate and drive a peg in the center. With another stake having one end fastened to the center peg, mark out the circumference of the silo as illustrated below.

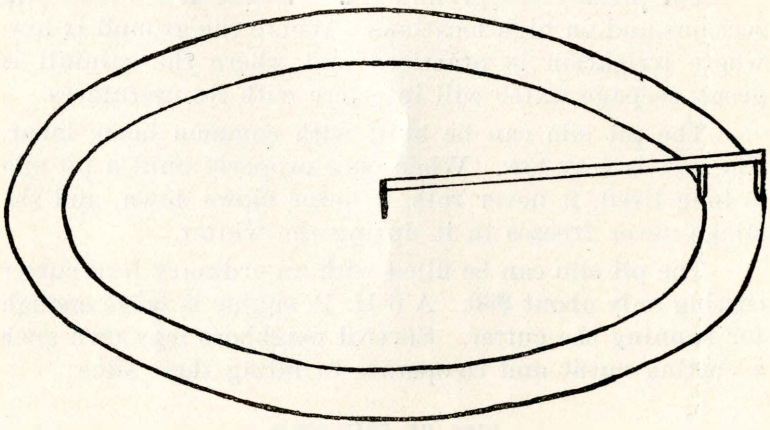

FIG. I.

Marking the Circumference of Pit Silos Before Digging Trench for Concrete Curbing

MAKING THE CURBING.

Proceed to dig out a trench forming the circumference of the silo. Make this trench from 1½ ft. to 3 ft. in depth. The concrete should rest on solid ground, and be about 14 inches wide at the bottom. At the top it it need not be over 6 or 8 inches wide. This curbing should be straight on the side next to the silo, and slant in from the bottom on the outside.

The circumference of the curbing of a 12 ft. diameter silo will be about 38 ft. If the trench is 2 ft. in depth and averages 9 inches or three-fourths of a foot in thickness,

then it will hold about 57 cu. ft. of concrete. For this concrete, about 2.1 yards or two good sized loads of clean gravel and about 11 sacks of cement, are needed.

The cement and gravel should be thoroughly mixed before any water is added.

Use clean gravel and make the concrete in the proportion of 5 of gravel to 1 of cement. Add enough water, and mix until the concrete has a suitable consistency, so it will pour. Do not add strong alkali water. It will weaken the concrete. It is better to have the concrete a little too wet than to have it too dry. If the ground or sides of the trench is very dry, then wet the dirt before the concrete is put in.

Fill the trench with this concrete. Extend the concrete curbing about 6 inches above the surface of the ground, so dirt can be graded around the silo and enable the surface water to drain away.

Put a few square headed bolts into the concrete to which the sill for the roof can be fastened. If properly put in, this concrete curbing may be used as a foundation for a silo to extend above ground, should additional silo room be needed.

This concrete should be reinforced with a few strands of barb-wire, about six rounds, each about six inches apart. This is not necessary, but it will strengthen the curbing.

EXCAVATE AND PLASTER.

When the concrete curbing has "set," then proceed to dig out the dirt. Dig down 6 ft. and plaster the side. Apply two coats, each about ½ inch in thickness. If the plastering is done each 6 ft., then no scaffolding is necessary. With a long handled shovel, a man can throw the dirt out to a depth of 12 ft. When this depth has been reached, it is necessary to have a plank platform on one side of the silo, about 10 feet from the surface of the

ground, or to have a windlass or some other simple hoisting device for raising the dirt out of the pit, as illustrated below.

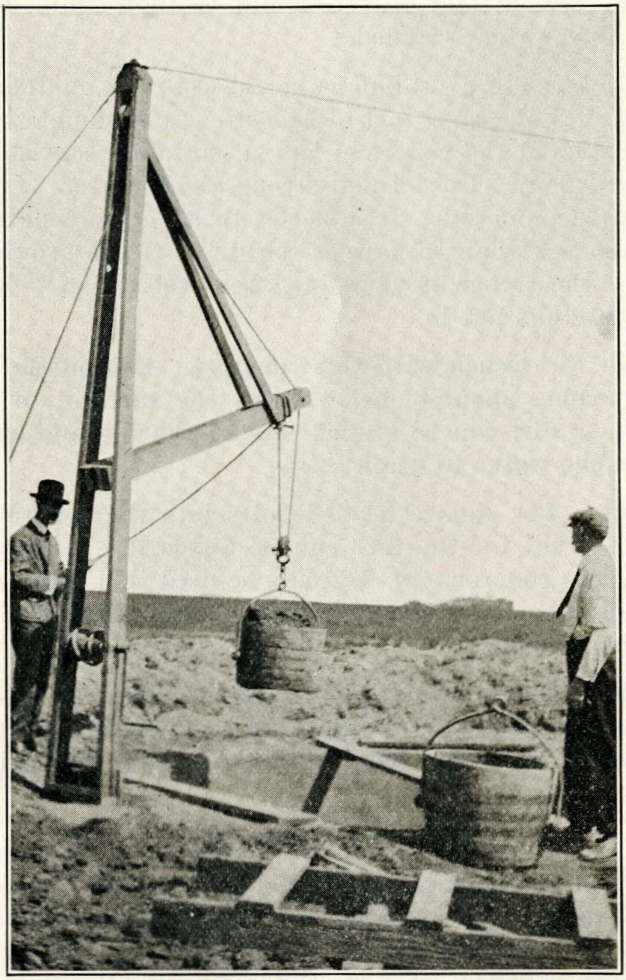

FIG. II.
Hoisting Dirt While Digging Pit Silo—(Courtesy of Dakota Farmer)

A rough dirt wall will require more concrete than will a smooth one. For this reason, the man who digs the pit should make an effort to have the wall straight and as

smooth as is consistent with rapid work. An experienced digger, and in the average subsoil, will have no difficulty in digging such a wall without any other guide than the eye. Should it be found necessary, a straight pole may be placed perpendicularly in the center of the pit. By means of a horizontal arm, having a hoe or spade fastened at one end, and the other end fastened to the center pole, in such a way as to swing around, the pit can be dug straight, and the sides can be made smooth. This method is to be especially recommended when a silo of large diameter is dug.

The mortar used for plastering should be made of 2 parts of clean sand and one part of cement, with enough soft water to make it of suitable consistency to adhere to the dirt wall.

If the silo is 26 ft. in depth and 12 ft. in diameter, then there will be about 1000 square feet to plaster. If two coats of cement plaster are applied each about ½ inch in thickness, then about 84 cubic feet of mortar are required. About 3 yards of clean sand and about 40 sacks of cement will be needed. If the wall is dry, wet it before the cement mortar is applied.

The total amounts of gravel, sand and cement needed for a silo 26 ft. in depth and 12 ft. in diameter are about as follows:

For curbing, 2.1 yards clean gravel (2 loads) and 11 sacks of cement.

For plastering, 3 yards clean sand (3 loads) and 40 sacks of cement.

This coat of plaster on the dirt wall may be put on considerably thinner. Each applied coat could be made as thin as ¼ inch in thickness. This would lessen the cost of the silo considerably, but it would also lessen the strength and durability.

If the subsoil is shaley, and crumbles when exposed

to the weather, it may be difficult to make the plaster adhere by the ordinary method of plastering. In such a case the mortar may be thrown on, and then smoothed. In extreme cases fine-meshed woven wire, or the regular steel lath, may be fastened to the dirt by means of wire hooks driven into the side. Then no difficulty will be encountered in making the cement mortar adhere. This, however, will add to the cost of the silo.

The bottom of the silo may be covered with a two inch layer of concrete. This, however, is not necessary. The silage may rest directly on the ground. A small amount of bottom silage may mold and spoil. From a practical standpoint, this amount of spoiled silage is so small, that it need not be considered.

If the labor necessary for digging the silo has to be hired, and a heavy coat of cement plaster is used, then a pit silo is about as expensive as an ordinary silo.

COVERING THE PIT SILO.

The pit silo should be covered in some way to prevent any one from falling into the pit, to prevent rain, snow and other foreign matter from entering, to protect the silage from freezing, and to protect the silage wall from being exposed to the elements. This latter is likely to cause caving.

The cheapest and simplest way of covering a pit silo, probably is to place a post on the side of the silo farthest from the barn. The post should be at least 8 feet above the ground. Nail a 2x6 plank (having straight grain) to the side even with the top of the post. The other end is fastened to the side of the shed or barn. This 2x6 placed edgeways above the center of the silo furnishes a good support for the top of the rafters, and also for fastening a device for hoisting the silage out of the silo. The lower end of the rafters can be fastened to the sill on top of the concrete curbing. This frame work may be covered with

a composition roofing or with sheet galvanized iron, or with boards and shingles.

The rafters may also be placed so that all of the upper ends are fastened, and meet at a point directly above the center of the silo. The lower ends are nailed to the plate bolted on the top of the foundation. The roof in this case is similar to the roofs put on ordinary silos. More labor is perhaps required for building a roof of this kind.

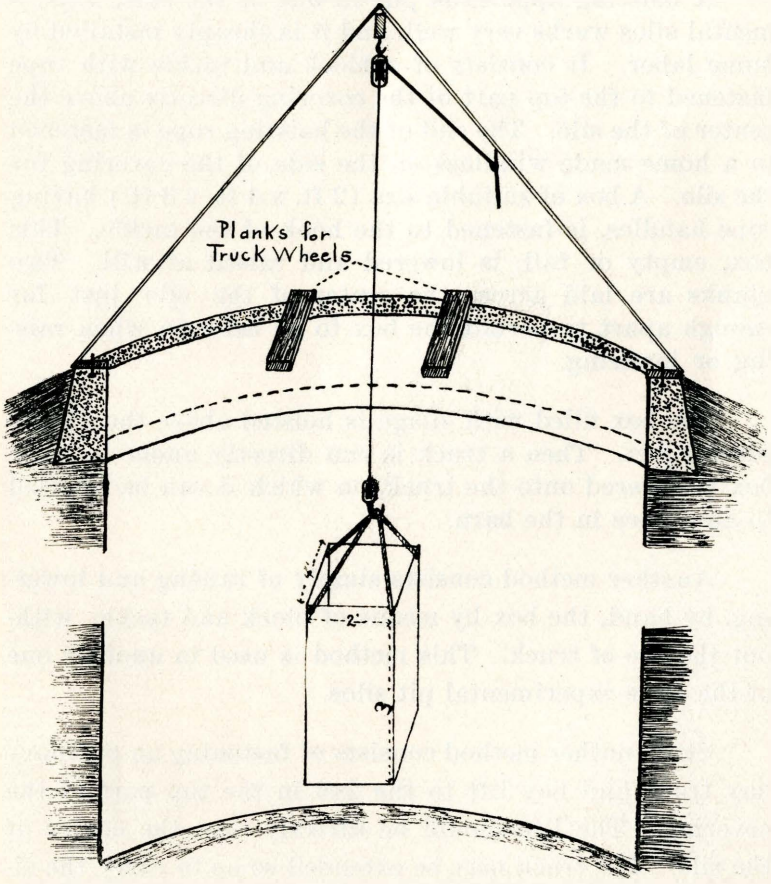

FIG. III.

Hoisting Apparatus for Getting Silage Out of Pit Silo

HOW TO GET SILAGE OUT.

Getting the silage out of a pit silo is not difficult. There are several ways by which this can be accomplished. The first 12 feet of silage can be thrown out with a pitchfork. If the silo is small and only a few cows are being fed, then the silage can easily be carried out in a box or in sacks. If a considerable number of cows are fed silage, then some hoisting device should be installed.

A hoisting apparatus put in one of the state experimental silos works very well, and it is cheaply installed by home labor. It consists of a block and tackle with rope fastened to the top part of the covering directly above the center of the silo. The end of the hoisting rope is fastened to a home made windlass on the side of the covering for the silo. A box of suitable size (2 ft. x 4 ft. x 3 ft.) having rope handles, is fastened to the hook of the tackle. This box, empty or full, is lowered and raised at will. Two planks are laid across the center of the silo just far enough apart to permit the box to go between when raising or lowering.

The box filled with silage is hoisted above the planks several feet. Then a truck is run directly under it. The box is lowered onto the truck, on which it can be wheeled to any place in the barn.

Another method consists simply of raising and lowering, by hand, the box by means of block and tackle, without the use of truck. This method is used in another one of the state experimental pit silos.

Still another method consists of fastening an ordinary hay track and hay lift to the 2x6 in the top part of the covering. The lift should be directly over the center of the silo. The track may be extended so as to carry the silage to any part of the barn. This method is more expensive, and is not necessary.

DO NOT PERMIT COST TO DELAY.

If it is impossible to secure about $40 with which to purchase the necessary material for the above described silo, do not on this account refrain from digging a pit silo. Dig the hole in the ground anyhow, and fill it with some green feed. In many sections of South Dakota the subsoil is hard and in some instances shaley. Such ground will stand for years without caving. If the wall is not plastered, a small amount of silage on the outside next to the dirt will mold, but compared to the amount of good feed obtained, this is of little consequence. If time permits, dig it now. If not now, then plan to remove the first few feet of dirt in the fall before frost, then dig at it a little all winter during spare time. The following spring the silo will be completed and ready to fill, either with spring, summer or fall crops.

DANGER OF POISONOUS GASES.

There is but slight danger from poisonous gases in pit silos. The greatest danger is during filling. At this time the green silage ferments and forms carbonic acid gas. This gas is heavier than air, and therefore tends to settle near the bottom of the quiet air in the pit. If the silo is left for any length of time, partially filled, the owner should take the precaution of lowering a lighted candle before entering, or to stir up the air by means of a limb of a tree, or with any other contrivance that will cause the air in the pit to move and mix. While the silo is full or nearly so, and after the silage has been in the silo about a month, there is very slight danger from poisonous gases in a pit silo. In the four state experimental silos dug in different parts of the state no trouble has been encountered from this source.

CHIEF ADVANTAGES OF SILOS

1. Green feed of some kind such as kaffir corn, milo maize or ordinary corn can always be raised. These crops

make the very best of silage. Matured grain crops cannot always be relied on, while crops suitable for the silo can. If all crops should fail, then Russian thistles or other green weeds may be put into the silo. They will produce splendid feed.

2. Only little more than one-half of the nutrients of corn is in the ear. Why not obtain good use of the other half in the stalk by putting it into the silo?

3. Silage can be fed during the winter, during the summer or during the whole year. It can be kept over from a large crop season to a short crop season. With one or more silos it is not necessary to sell cows because of feed shortage.

4. Silage is healthful for cows and for young stock. Cows, freshening in the fall, and fed on silage and alfalfa hay, make a combination of farming for profit, and for sure and safe results, that is difficult to beat under South Dakota conditions.

5. The silo puts rough feeds into a form which cows and other live stock can handle most economically. South Dakota is distantly removed from central markets. To avoid expense of marketing our bulky field crops, the roughage must be concentrated into animal products.

FILLING THE SILO.

When the corn begins to dry up, then cut with a corn binder. At this stage the lower part of the stalk and leaves and inner part of the husk have started to wilt, and about one-half of the kernels have dented. This is the best stage at which to cut corn for silage. It may, however, be cut at almost any stage, and splendid feed results.

In case of prolonged drouth, hail, early frost, or late spring, it may be necessary to cut the corn crop, and put it into the silo earlier. The most and the best silage, however, results from normally matured corn as described above.

Dry corn fodder may be converted into a splendid feed by cutting and putting it into the silo. Corn fodder in this condition should have water added, as it is packed into the silo. Care should be taken to have all of it wetted uniformly so that no dry pockets remain. If not uniformly moist, then there will be pockets of moldy and spoiled silage. Additional packing is also necessary. The dry cut corn fodder is lighter, and does not pack so well in the silo as does green corn fodder.

Do not tie the bundles of corn too large. The corn binder should be adjusted to tie small bundles. These handle easier, and they pass through the silage cutter without much separation.

These corn bundles may be hauled in a hay rack having the sides and ends removed. A truck wagon is handy. It obviates lifting the bundles too high.

If the cornfield is close to the silo, the following filling crew works economically:

4 teams and men for hauling corn fodder.
2 men in the field pitching bundles.
1 man to help unload at the silage cutter.
1 man distributing and packing silage in silo.
1 man to look after gasoline engine and feed cutter.
Such a crew can cut about 80 tons of silage in one day.

SEALING THE SILO.

One or two days after the silo has been filled, the contents will have settled. If possible the filling machinery should be left in place a couple of days so that the silo can be refilled.

During the first week after filling, the owner should make it a point to go into the silo every day and thoroughly tramp the silage down. Otherwise the silage below will settle and leave the top part open or porous. This admits air into the surface silage, and causes it to spoil. It is a good plan to wet the surface silage a little every day when the tramping is being done. This will help to pack the top silage and exclude air.

In addition, cover the surface of the silage with a layer of building paper. This, if properly put on, helps to exclude air.

Another surface covering used is cut straw. Run a load of straw through the silage cutter the last thing. Distribute this straw on the top of the silage, wet it and tramp it down.

Never feed any large amount of spoiled silage. When the silo is opened the spoiled silage should be hauled to some place where the cattle cannot obtain access to it. Moldy and spoiled silage is likely to poison the cows.

SUCCULENT FEEDS IMPORTANT FOR COWS.

Silage may be fed to all kinds of live stock, but it is pre-eminently a feed for dairy cows. In order to obtain the best possible results from a dairy cow, a succulent feed of some kind must be fed.

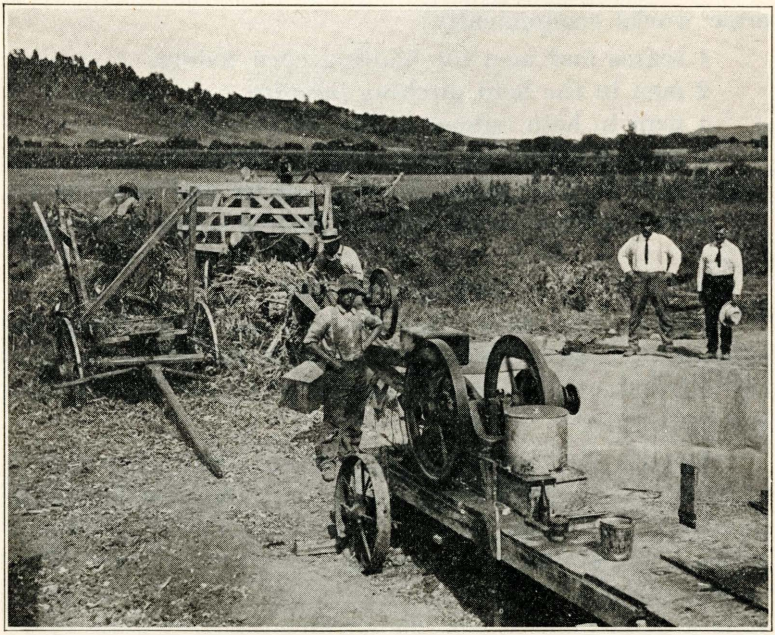

FIG. IV.

Filling One of the Experimental Silos in Western South Dakota

There are several kinds of succulent feeds suitable for cows. Green grass or pasture is probably the best. Soiling crops, such as green alfalfa, green oats and field peas, and green corn, etc., make good succulent feeds for dairy cows. These latter crops cannot be fed during the winter. They are especially suitable for supplementing shortage of pasture during late summer and fall. Considerable labor also is required in feeding these crops extensively. Roots of the various kinds are good succulent feeds for dairy cows, but are expensive to raise. Besides, very few farmers in South Dakota are prepared to keep roots and protect them from frost during winter.

Silage is cheap and healthful when properly fed, handy to feed anytime during the year, and crops for silage can be grown anywhere in South Dakota.

AMOUNT OF SILAGE TO FEED.

An average cow weighing about 1,000 pounds will eat from 30 to 40 pounds per day. Silage alone should not be fed to dairy cows. Corn silage is a fat and heat producing food. It does not contain enough of the milk and muscle producing elements. Corn silage, alone, is not a balanced ration. Some hay, preferably alfalfa, should be fed in connection with it. In addition to the 30 pounds of silage an average cow will eat about 15 pounds of hay daily.

All of the common feeds may be classified into two groups:

First: the feeds rich in fat and heat producing substances (fats and carbohydrates).

Second: the feeds rich in milk and muscle producing substances (protein).

The chief common feeds rich in fat and carbohydrates are:

Concentrates: corn, barley, rye, wheat, speltz, millet;

Roughages: corn silage, corn fodder, prairie hay, timothy hay, and millet, cane, milo-maize, kaffir corn.

The chief common feeds rich in protein are:

Concentrates: Oats, bran, oil-meal, cotton-seed meal, gluten feed, beans, peas.

Roughages: Alfalfa hay, clover hay, pea hay.

A dairy cow should receive some of the feeds belonging to each class. For instance; corn silage and alfalfa hay constitute a balanced ration. Prairie hay and corn-silage do not make a balanced ration. If these two roughages are fed, then some of the concentrates rich in protein should be fed, such as oats, bran, or oil-meal.

COMPOSITION OF SILAGE

Four experimental pit silos were built in different parts of western South Dakota. One was built near Newell, one near Rapid City, one near Philip and one near Highmore.

Two of these silos were filled with corn partly green, one was filled with corn and Russian thistles and the other was filled with dry corn, and water added to it.

During the winter, while feeding was in progress, samples of these silages were sent to this experiment station to be analyzed, with the following results:

Silo	Moisture	Ash	Crude protein	Ether extract	Crude fiber	Nitrogen free extract	Acidity	Remarks
Newell Pit Silo..	50.74	2.21	3.98	1.44	8.46	33.17	1.58	From partly green corn fodder
Rapid City Pit Silo	62.57	1.65	3.80	0.73	7.17	24.08	2.03	From partly green corn fodder
Ida Pit Silo	78.33	0.93	1.47	0.73	5.74	12.80	1.20	From dry corn fodder, water added
Philip Pit Silo ...	63.02	8.54	6.96	0.47	7.83	13.18	0.11	From corn fodder and Russian thistles
College Dairy Farm, Brookings	70.09	1.88	2.68	0.74	6.54	18.07	2.10	Silage from college dairy farm

From the above analysis it will be noticed that the silage from normal corn fodder in western South Dakota is richer than is the silage from corn fodder in eastern South Dakota.