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FARM DEPARTMENT.

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SIX YEARS' EXPERIENCE WITH ENSILAGE.

IN the second annual report of this Station, published in 1890, Professor Shelton gives a description of the silos at the College barn and the results of feeding ensilage during the winter of 1888-'89, and although articles on the growing and preserving of ensilage here at the College have appeared from time to time in the *Industrialist*, and other publications, nothing official has been published on the subject since. In the present bulletin a summary is given of the amount of ensilage put into the several silos, together with the average number of animals to which it has been fed, and the loss in the silos, for each of the last six winters, including a portion of the present one.

We have at the College three silos, numbered respectively 1, 2, and 3. No. 1 is 13 feet 5 inches by 9 feet 5 inches, and 18 feet 6 inches high, and holds a maximum of about 33 tons of green corn fodder. No. 2 is 18 feet 3 inches by 13 feet 3 inches, and 22 feet high, and will hold a maximum of 100 tons of green corn fodder. And No. 3 is 17 feet 10 inches by 13 feet 6 inches, and 24 feet high, and will hold a few more tons than No. 2. They

are all constructed alike, being located in the basement of the barn and running to the plates. No. 1 is in a corner, and hence has the stone wall of the barn on two sides, while the other two sides are inclosed by studding and lumber. The stone wall, however, is covered by boards, to make a smooth surface, and the wall only serves the purpose of keeping the studding firm. No. 2 is likewise supported on two sides by stone walls, but No. 3 only on one side.

The silo walls are built on a stone foundation which comes up even with the floor. On this foundation 2 x 10 studding, as high as the silo, is secured, 16 inches apart. It is of the utmost importance that the studding be strong enough to withstand the pressure of the ensilage, and I believe it would have been better to put the studs one foot apart, instead of 16 inches, for although the walls are supported near the middle by the main floor of the barn, they nevertheless spring perceptibly when the silo is full. The studding is lined on the inside first with a layer of boards nailed horizontally and made to fit snugly upon one another so that there should be no crevices. Over this is fastened a layer of tarred paper, in order to still better prevent air passing through, and this is finally covered by a layer of ship lap, the two courses of boards being arranged to break joints. It would have been still better to have used matched lumber for both courses. The outside of the studding is simply covered with a layer of ship lap, leaving the space between the uprights open.

Double doors lead into the silo on the basement floor, and, to facilitate the removal of the silage from the top, a chute is built from the top of the door to the top of the silo. It consists simply of two planks, 2 x 10 inches, fastened on the inside of the silo wall on their edges, about two feet apart. When the silo is filled, short pieces of matched flooring, cut the proper length, are nailed on the free edges of these planks, thus forming a chute or tunnel to the top of the silo. When the silage is taken out, it is thrown into this chute, and falls into a box placed in the doorway, and is then distributed among the cattle in the barn. As the silage is removed, the boards of the chute are knocked off and tacked to the wall, where they remain until wanted when the silo is filled again. Two of the silo floors consist simply of tamped clay; the third is a cement floor, but the clay answers every purpose.

Since it is possible to preserve the silage only by excluding the air, it is of the first importance that the walls be made air-tight, and to attain this end the boards used in the siding ought to be matched. Too much care cannot be taken in this matter; if carelessly put together, the shrinkage of the boards, which always takes place during the summer, produces cracks for the air to get through, with the result that the silage spoils along the silo walls. When a silo is built of stone, it is essential that the walls be made smooth. A rough, uneven surface will, as the silage settles, admit the air and cause decay. Board walls absorb moisture from the ensilage, which

hastens decay of the boards; this can, in part, be remedied by giving the walls a coat of tar each summer, the spreading of the tar being facilitated by stirring in a little gasoline.

ENSILAGE CROPS.

Corn has been the main silage crop, though some sorghum, Kaffir corn and other green fodders have also been used. But I am satisfied that, all things considered, there is no crop which will yield more nutrition to the acre, one year with another, than corn.

For ensilage, we plant somewhat closer than we do when a crop is grown for grain. A rather elaborate experiment in 1891 shows that we got the heaviest yields when the rows were 3.5 feet apart and the stalks 4 inches apart in the row. (See Bulletin No. 30.) The ears will not develop so well at these distances, but they will be so much more numerous as to more than make up what they lose in size. During the period here under consideration, we have used for ensilage a large Southern variety, called Mosby's Prolific, the seed being obtained from the originator, Mr. J. K. Mosby, of Lockhart, Miss. All things considered, this variety has given us the best satisfaction. It grows much larger than corn indigenous to this region. In 1891, on a rich piece of ground, the stalks averaged 12 feet high, and the tallest ones grew over 17 feet high. It is to be noted that, when propagated from seed grown here, it gradually becomes smaller.

We begin to put it in the silo when the grain is in the milk, or soft dough, and, as it takes some two weeks at best to fill the three silos, the grain frequently hardens before we get through. The proper time to cut it is when the grain is in the hard dough and the lower leaves begin to turn yellow; but it is necessary to begin before this stage in order to finish up before the corn dries, especially when a dry, hot spell occurs in the fall, as is frequently the case.

HARVESTING THE ENSILAGE.

Of the several fodder cutters which have been tried here, none have given better satisfaction than a one-horse sledge cutter. It is provided with two knives, which are hinged to the body of the sled, and can be folded in on the sled when not in use. It has been improved and made easier to pull by providing it with four low and broad cast-iron wheels. It is pulled by a single horse, and cuts two rows at a time. Two men stand upon the cutter, each facing a row; as the corn is cut they gather it into armfuls, which they drop in heaps on the ground. A wagon with a low, broad rack follows, on which the corn is loaded and hauled to the silo. The loading of the heavy material is hard work, and we look for the day when a machine will be perfected which can load it directly on the wagon.

Arriving at the barn, it is run through a Ross ensilage cutter No. 13A, with elevator attachment, which raises it some 12 feet to the top of the wall

and dumps it into the silo, where a man spreads and tramps it down around the edges. We prefer cutting in lengths of one-half inch, though it can be run through faster when cut in inch lengths. In the shorter lengths it packs closer and the cattle eat it up cleaner. This process is continued day after day, until the silo is full. The cutter named has a capacity of from 16 to 20 tons a day. The power has heretofore been furnished by a 10-horse-power steam engine, but an electric motor, fed from the college heating plant, will hereafter do the work.

Several plans for covering a silo have been tried, but of them all we have found nothing better than a layer of green grass some six or eight inches thick when settled, spread evenly on top of the silage, and this covered with a few loads of earth, sufficient in weight to pack the grass down closely, and thus exclude the air. Covered in this way, there is comparatively little decayed silage on top when opened up some months later. There will always be some loss by decay, as it is impossible to seal it hermetically. But aside from losses by decay the silage suffers considerable loss in weight, owing partly to the loss of moisture and partly to the destruction of material by the chemical changes which it undergoes.

The number of tons which a given silo will hold depends, of course, largely upon the conditions of the green materials put into it. The more moisture in the corn the more closely the silage is compacted by its own weight, and the greater the capacity of the silo. In all cases a given bulk of silage, say a cubic foot, will weigh more when cut out of the bottom than when taken from the top. But when made from corn at the proper stage of development, the average weight of a cubic foot of silage is not far from 35 pounds.

As to the yield of ensilage, it will vary so much with the soil, the season, the variety of corn and the cultivation it gets, that it is impossible to give reliable data as to what may be counted on in any given year. We have grown ensilage at the rate of more than 20 tons to the acre, and again, in dry years, like 1894 for instance, we did not get one-fourth of that amount. In reasonably favorable seasons, on good soil, with fair culture and with a vigorous variety of corn, it is safe to count on 10 tons to the acre, and it is on this basis that we calculate the area to be planted each year.

With this general statement of the conditions, we will briefly summarize the results of each year.

1889—'90.

The season of 1889 was unusually favorable for the corn crop. The yield of ensilage was heavy, both of corn and sorghum. The cutting began rather early. Silo No. 2 was filled with 96 tons of green corn, from August 23 to September 2; silo No. 1 was filled with 33.95 tons of corn, between the dates of September 3 and 7; and silo No. 3 was filled with 96.5 tons of sorghum, from September 14 to September 25. To get data as to cost per ton to cut, haul and put it in the silo, exact records were kept of the cost of la-

bor. The distance hauled would average about 50 rods. Student labor was paid for at the rate of 10 cents an hour, teams estimated at 10 cents an hour, and time of hired men was worth 12.5 cents an hour. At these rates, it cost $60.08 to fill and cover silo No. 2, or at the rate of 62.3 cents per ton of material put in. Silo No. 1 cost 70.9 cents per ton, and silo No. 3, 50.8 cents per ton.

Had the crop been lighter, or the distance to haul the material further, the cost would, of course, have been somewhat greater, but, under similar conditions, the cost need not exceed these figures on any farm in Kansas, and the probability is that it can, in many places, be materially reduced. It should be noted that the cost of fuel in running the engine is not included in this estimate, nor is there made any allowance for interest on the money invested in machinery, which might properly be added. This silage was fed to an average of 57 head, of all ages.

Silo No. 1 was opened October 14 and fed until November 23, No. 3 was opened November 23 and fed until February 26, and No. 2 was opened February 26 and fed until May 7. Of the 33.95 tons put in No. 1, 28.03 were sound ensilage, 1.89 tons rotten, and 4.03 tons lost in curing. Silo No. 3 contained 96.53 tons of several varieties of sorghum; of this, 76.30 tons were sound ensilage fed to cattle, 10.44 tons rotten, and 9.79 tons lost. Silo No. 2 was filled with 96.33 tons of corn; of this, 62.48 tons were sound ensilage, 15.10 tons were rotten, and 18.75 tons were lost in the silo.

Summarizing these facts, we find that the sound material in the three silos was fed to 57 head of cattle for 205 days, or an average of 29 pounds per head per day. In this, as in all other cases here recorded, the ensilage was fed twice daily—morning and evening. The herd was turned in the yard during the day, where they had access to a rack filled with corn fodder or other roughness. They were, during that winter, fed a very light feed of corn meal, varying from a half pound to a couple of pounds per day per head, in addition to the ensilage.

1890—'91.

The corn crop was cut short in 1890 by dry weather, and the area planted to ensilage corn did not yield enough to fill all three silos. Only silo No. 2 was filled with corn, 100.07 tons being the weight of the green material put in. This silo was opened January 10, and fed until March 24; 85.27 tons were good ensilage, 3.35 tons rotten, and 11.45 tons lost. No. 3 was filled with all manner of green stuff that could be raked together; it contained some sorghum, some corn, some grass, and some 16 tons kohl-rabi leaves. The keeping qualities of this mixture being somewhat doubtful, this silo was opened first. It was fed from November 17 to January 9, inclusive. Of the amount put in, 56.04 tons were eaten, 7.81 tons rotten, and 17.72 tons lost in the silo. The large amount of loss is due chiefly to the watery leaves of the kohl-rabi.

The average number of cattle fed ensilage that year was 43 head, of which fully three-fourths were grown animals. They were fed during 127 days, with an average of 52 pounds per day per head. The large average of the daily feed is due mainly to the poor condition of the mixed ensilage in No. 3, much of which was rejected.

1891—'92.

The year 1891 was again a good crop year, and both of the large silos were filled, chiefly with corn, but each silo contained some sorghum. There were 85.91 tons silage put in No. 2. Of this, 60.24 tons were good ensilage, 14.85 tons were rotten, and 10.82 tons were lost. Silo No. 3 contained 78.74 tons. Of this amount, 47.76 tons were sound, 21.64 tons were rotten, and 9.34 tons were lost in the silo. The unusual amount of rotten silage this year was due chiefly to defective covering.

The sound ensilage in both maintained a herd of 47 head from November 17, when No. 3 was opened, until May 20, when the last in No. 2 was fed out, a total of 184 days. It gives an average of 25 pounds per day per head, and, as in former years, they had access to a rack with dry fodder when in the yard, and a few of the poorest feeders got a little corn meal in addition to the ensilage, not to exceed a pound to a feed twice a day. The total amount put in both silos, 164.65 tons, was raised from 19.07 acres.

1892—'93.

Silage was put in all three silos in the fall of 1892. No. 1 contained a total of 24.45 tons, consisting partly of ensilage corn, partly of sweet corn, and partly of soy beans. When fed out, it was found that 1.22 tons were rotten, 2 tons lost, leaving 21.23 tons. It may be remarked in this connection, that the soy beans made excellent ensilage, which was well liked by the cattle, and the same may be said of the sweet corn. No. 2 contained 77.79 tons ensilage corn; of this, 57.79 tons were sound ensilage, 9.33 tons rotten, and 10.67 tons lost in the silo. No. 3 contained only 46.55 tons, of which 32.97 tons were good ensilage, 8.28 tons rotten, and 5.30 tons were lost in the process of curing. All three silos lasted from November 3 to March 18, 135 days, during which time it was fed to an average of 54 head, or at the rate of 31 pounds per day per head.

1893–'94.

Ensilage was again put in all three silos in the fall of 1893. No. 1 contained 25.02 tons, the bulk of which was corn, and a few tons of Kaffir corn and teosinte. It fed out 21.91 tons of good silage, .55 of a ton rotten, and 2.56 tons were lost in the silo. No. 2 received 86.11 tons, all corn, which fed out 76.07 tons sound ensilage, while 3.77 tons were rotten and 6.27 tons were lost in the silo. No. 3 contained 94.76 tons green corn, of which 83.89

tons were good feed, 3.93 tons were rotten, and 6.94 tons were lost in the silo.

All three silos lasted the herd of 56 head from October 28 to May 19, 6 2/3 months, during which time they were fed an average of 32 pounds per day per head. The silage was excellent—perhaps the best during the period under consideration—and none of the cattle, with the exception of a few young bulls, received any grain whatever, and the coarse feed given them in the yard was practically nothing—simply waste material, which they were allowed to pick over; yet the herd kept in excellent condition.

The total area from which the ensilage was taken measured 25.65 acres, but of this about five acres were in experimental plats, which yielded but little. But taking the whole area of 25.65 acres, the yield of sound ensilage fed out to the cattle, exclusive of waste from all sources, was 7.09 tons per acre; or, at the rate at which they were fed, 32 pounds per day, an acre would last a cow 443 days, or 10 cows 44 days, which, I venture to state, is at least twice as long as the same amount of mature corn and corn fodder would last under ordinary methods of handling.

1894—'95.

The extremely disastrous season of 1894 cut the ensilage crop so short that not only was the area planted to ensilage corn insufficient to fill the silos, but we put in every green thing on the farm, and still had to buy the fodder on several acres from neighboring farms in order to get silage enough. All three silos were filled, but the ensilage was of inferior quality. Even the best of the corn contained but very few ears, and these scarcely half grown, it being necessary to fill the silos unusually early, before the corn dried up. Only two silos, Nos. 1 and 3, have been emptied at this writing. No. 1 was filled with 28.55 tons; of this, 24.47 tons were sound, 1.41 tons were rotten, and 2.67 tons were lost in the silo. We began feeding it October 31 and it lasted to December 14. No. 3 contained 89.85 tons; of this, 73.45 tons were sound, 5.85 tons rotten, and 10.55 tons were lost in the silo, This silo was opened December 14.

Together, the two lasted a herd of 50 head 136 days, or at an average of nearly 29 pounds per day per head. No grain whatever is fed to the stock cattle, and but very little roughness is given them in the yard. Still the herd is in better condition than cattle on the average farm.

SUMMARY OF RESULTS.

Uniting and averaging the results of the experience here detailed, we find that during the six years we have put away 1,046.22 tons, of which 807.91 tons were sound ensilage when taken out, 109.44 were rotten, and 128.87 tons were lost in the process of curing; or, putting it in per cent., 77.2 per cent. of the total amount put in was good feed, 10.5 per cent. was rotten, and 12.3 per cent. lost. This ensilage was fed during a total period

of 990 days, or an average of 165 days each year, to an average of 51 head of cattle. The average daily feed per head for the entire period is almost exactly 32 pounds. These results may fairly be taken to represent ordinary conditions on Kansas farms.

If we estimate that 77.2 per cent. of the amount put in can be taken out sound and available for feeding, or about 1,544 pounds for every ton put in the silo, we find that, at the average feed of 32 pounds per day, one ton will last one animal 48.2 days, or 100 tons will last a herd of 25 head 192 days; and, in a reasonably favorable season, with good soil and good culture, this 100 tons may be grown on about 10 acres. What other method of handling corn fodder will maintain an average farm herd during the long winter season, from grass until grass comes again, on so small an area? It should be noted that, of the cattle fed on ensilage each year, from one-fourth to one-third were young stock, which, of course, did not eat so much as grown cattle, and the amount fed to mature cows should be increased above the average here given accordingly. It may also be noted that the cattle would eat a large portion of the rotten and waste material thrown into the yard. They seem to delight in working over what was thus rejected, when in the yard.

While ensilage has been a most satisfactory feed to cattle, I would in no case recommend that it be fed to breeding bulls. I have repeatedly observed that when bulls have been fed on it they seem to lose virility and become slow and uncertain breeders, from which condition, however, they may again recover when fed on dry fodder and grain.

Ensilage is an excellent feed for dairy cows, but it will occasionally taint the milk, while at other times again it will not affect it. The taint seems to be influenced by the condition of the cow's system. This may, however, be entirely avoided by feeding the ensilage immediately after milking instead of before milking, as is usually the case, the practice in most cases being to feed the cows the first thing in the morning, and in like manner before milking at night. We have adopted the plan of feeding after milking with entire satisfaction.

SOME FORAGE PLANTS.

Crimson Clover.—We have grown small areas of crimson clover for several years, and the effort has invariably resulted in failure. Being an annual plant, and a reputed nitrogen gatherer, it was thought expedient to introduce it in one of the rotations under experiment, but it was found to do so poorly and yield so little that it was practically worthless. It can neither stand our dry summers, nor the cold of our winters. When sown in late summer, as is the practice in the East, where this plant is in favor, we found that only a small per cent. would survive until spring. In no case

has it compared favorably in yield or hardiness with the common red clover. In the eastern counties of the state it may do better, but even there I should not expect it to be worth cultivating, when red clover is so much surer. This has been the tenor of the answers given to numerous correspondents, who, having read the glowing reports of this plant from the East, were anxious to learn what it would do here.

The Flat Pea.— This new forage plant has been grown at the Station on a small scale for the last two years. We had difficulty in getting a stand from the seed. It germinates slowly, and frequently fails altogether. However, when once established, the plants appear to be quite tenacious. Our young, seedling plants withstood last summer's drought and the present winter's cold satisfactorily. The greater number of them are alive at this writing. We have not had fodder enough from them to ascertain their feeding value, but if it can withstand the adverse conditions of the past 12 months, there is some hope that this plant may be useful.

Vicia Vilosa (Sandvetch).—This is an annual plant which has been advertised somewhat extensively during the last few years. We grew it on a small scale this past season; the seed germinated promptly and the young plants grew well for a while, but when the hot, dry weather set in they curled up and died. The plant does not appear to have any value for Kansas; certainly not in unfavorable seasons.

Sacaline.—Concerning this plant I can, perhaps, not do better than repeat what I said in the *Industrialist*, which is as follows:

Many inquiries suggest the propriety of recounting our experience with this new so-called "forage plant" which is being so widely advertised by seedsmen during the present season. This plant was called to our attention a year ago by the reports of a French experimenter, which were partially reprinted in one or two of the leading agricultural journals of America. He called attention to the extraordinary growth of this plant, which he estimated, on the basis of a very few specimens, to have yielded as much as 180 tons of green forage per acre in one season, and stated that cattle to which it had been fed ate it with avidity. It was noted, however, that it grew on rich, moist soil, and it evidently had plenty of room and good culture.

The plant reported on by the Frenchman was said to be from the island of Sachalien, in the sea of Okhotsk, north of the Japanese group, and was a wild species of the buckwheat tribe *(Polygonum Sachalinense)*. It is to be noted that its home is in a cold, moist climate, where the winters are extremely severe, the rainfall heavy, and the atmosphere at all seasons moist. It is also listed among the 34 distinct species of *Polygonum* found in Japan, the conditions here as to moisture being the same as further north, though the temperature is more moderate.

A plant of such extraordinary productive powers, as stated in the French report, with possibilities for usefulness as a forage plant, deserves to be investigated. We therefore procured a dozen plants from Pitcher &

Manda, a nursery firm of Short Hills, N. J., and planted them out in April last. The plants, or rather roots, started to grow promptly, but a late, mild frost killed the shoots to the ground, after they had reached the height of six to nine inches. One-half of the plants did not start to grow again; the remaining six sent up feeble sprouts, which reached a height of 18 to 20 inches before the severe drought of the past season set in, in the latter half of July. When the hot, dry weather came, they ceased to grow, lost their leaves, and apparently succumbed completely.

This is the brief history of one season's trial at this Station with the much-talked-of, over-advertised "Sacaline." The results do not hold out much promise of enormous yields of palatable and nutritious green fodder, which most seed catalogues would lead us to believe this plant will furnish. On the contrary, it seems to be entirely unsuitable to the dry, hot climate of the western states, and the facts as to the climatic conditions of its native habitat would seem to explain its behavior here. One point difficult to understand is, why a plant which has its home in Siberian latitudes should be so sensitive to a very slight frost as ours proved to be. It leaves room for the suspicion that we may not have had the genuine article, but instead a tender species from some southern region. We have recently procured seed from two distinct sources in order to give the plant another trial, but I have but little hope of more favorable results than last season. Whatever it may do in moist climates, I do not believe that a plant from that region can be of any signal value as a forage plant in a dry, hot climate like ours. The seed is imported from Japan, and is costly; and I would advise those farmers who have been prepossessed in favor of this plant by the extraordinary statements in seed catalogues to await further developments before they invest much money in it. Should further trials show it to be a good thing, it will be time enough to get a start in it.

I may add that, while in Japan some years ago, I frequently saw a coarse species of polygonum growing in the volcanic sand and scoria in gulches and mountain valleys. It corresponds to the description given of this "Sacaline." It is a coarse weed, six or eight feet high, and would be one of the last things a farmer would pick out as a forage plant, and if it had any value as such, the Japanese themselves did not know it. Whether it was *Sachalinense* or some allied species I am unable to say, but I suspect that it is the plant which furnishes the seed now being sold here under the name of "Sacaline."

RENOVATING A PRAIRIE PASTURE.

We had an experience in this line two years ago. The prairie pasture on the upper farm had been gradually failing. Owing to a lack of pasture for the cattle, we had been compelled to keep the herd on it longer than ought to have been the case. Sunflowers and bull nettles began to spring up all over it, while the native grasses seemed to be dying. Under these conditions, it seemed desirable to attempt to establish some tame grasses on this prairie land.

Accordingly, the surface was cut up with a disc harrow, weighted and driven over it in several directions, and a mixture of perennial grasses, consisting of orchard grass, timothy, red top, meadow fescue, blue grass, with some clover and alfalfa, was sown broadcast on the loosened surface, harrowed in, and rolled. A timely rain caused the seed to germinate promptly, and in three weeks there was a fine show of green from this seed nearly all over the field. The tame grass appeared to have obtained a splendid foothold, but by the middle of June it became apparent that the prairie grass was disposed to dispute with the tame grasses for the supremacy. It came in thick and grew vigorously and the weak seedling grass began to give way. By September the prairie grass had obtained complete mastery, now standing a foot high and very close in the ground, and none of the weeds which were common in the pasture the previous year were now present. The following year the prairie afforded as much pasture as it probably ever did.

This, it appears to the writer, affords a lesson in renovating native pastures. Take off the stock, scratch the surface early in the spring, and leave it to itself. I believe our farmers in this section of Kansas frequently make a mistake when they attempt to substitute tame grasses for the native pastures. Tame grasses may afford more palatable feed and they usually yield a little feed earlier than the prairie, but they cannot stand the hardships of drought as the prairie grass can, nor do they, with the same treatment as permanent pasture, yield any more or even as much feed.

The prairie grasses are here because they are suited to the conditions, and if we avoid overstocking they will last indefinitely and afford feed even in the driest seasons.