Studies of DRY MATTER CHANGES IN CORN SILAGE DURING STORAGE

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The mass of silage stored in bunker silos should not be considered homogeneous. The variation between layers of silage may be caused by climatic variations during filling and storage, variations in mechanical packing intensity during filling, variations in the maturity of corn silage brought to the silo, and the lack of an effective airtight, moisture-proof cover.

Rain falling during the winter months of 1967 on an uncovered bunker silo in Glenn County greatly increased the moisture content of the upper 4 ft of silage and leached soluble nutrients into the lower layers and possibly out of the silage mass. The TDN content of the upper 2 ft was significantly reduced. Dry matter losses, representing loss in weight of silage, were severe in the upper 4 ft of the silage mass, with greatest losses occurring in the upper foot. Dry matter loss was less severe in the entire silage mass, but averaged 18.8 per cent of the dry weight of the original samples placed throughout the silo.

The percentage of crude protein, crude fiber and ash apparently increases while the nitrogen-free extract component decreases in the upper layers of the silo, possibly due to leaching. However, in reality, the most severe loss in nutrients, and dry matter, in the entire silage mass resulted from surface spoilage through continued exposure to air, involving fermentation, and respiration by spoilage microorganisms. Covering a bunker silo with plastic did reduce losses of dry matter to less than 10 per cent in the 1965 and 1966 studies.

STORING PLANT MATERIAL as silage in bunker, pit, or upright silos can be unprofitable is there is a substantial loss in dry matter during storage, or if a change in the chemical composition of the silage decreases its palatability or digestibility. Exploratory studies of the losses and changes occurring in corn silage during the storage period were initiated in Glenn County in 1965 and 1966. These initial trials culminated in a more complete evaluation in 1967.

Preliminary studies were made of covered and uncovered bunker silos and one upright silo in three storage seasons. These studies indicated that overall variations in dry matter content of plant material stored in the silo, and variations between material found at different levels in the silo, made it nearly impossible to accurately predict the storage loss in a bunker silo in Glenn County by the weigh in-weigh out method. Furthermore, changes in the climatic conditions (i.e. precipitation, evaporation, and relative humidity) during the storage period and at the time of sampling further add to the variability of this method of estimating storage losses. Recognition that this difficulty is a part of any silage loss study led to the test procedure of placing nylon net bags filled with silage at different levels in the silos.

Bunker silo

The 1967 study was conducted on the Rawland DeMille and Sons Dairy in northern Glenn County using a wooden-sided, cement-floored bunker silo. In the test, 104 loosely-woven nylon bags were each filled with 2.2 lbs of freshly chopped corn silage—representative of the same material being packed into the silo at the site the bags were to be buried. Each bag was identified, weighed, placed in moisture-proof plastic bags, sealed and refrigerated. Fifty-two of the bags of chopped corn were submitted for laboratory analysis to determine variations in dry matter, crude protein, and crude fiber content prior to ensiling. The other 52 samples were buried in the silo as it was being filled, and were placed in groups of four. Sites within the silage mass were located by use of a surveyor's level. Thirteen layers, 16 inches apart, were represented. Thus, four columns of 13 bags each were located in the silo. The final layer was placed three days after the first layer. The silo mass was 176 inches deep after filling. By February 14, when the bags were removed, the mass had settled to 128 inches.

The silage was compacted with a 50-

Removing nylon mesh sample bag of corn silage from the silo in tests of silage dry matter losses during storage (bunker silo, Glenn County).

hp wheel tractor with a front-end loader. A 35-hp crawler tractor was used to smooth the rutted surface of the silo after the day's filling. The silo filling proceeded for about six hours each day.

The silo was not covered. During the 130-day storage period, 10.24 inches of rainfall was recorded in Orland seven miles from the silo location.

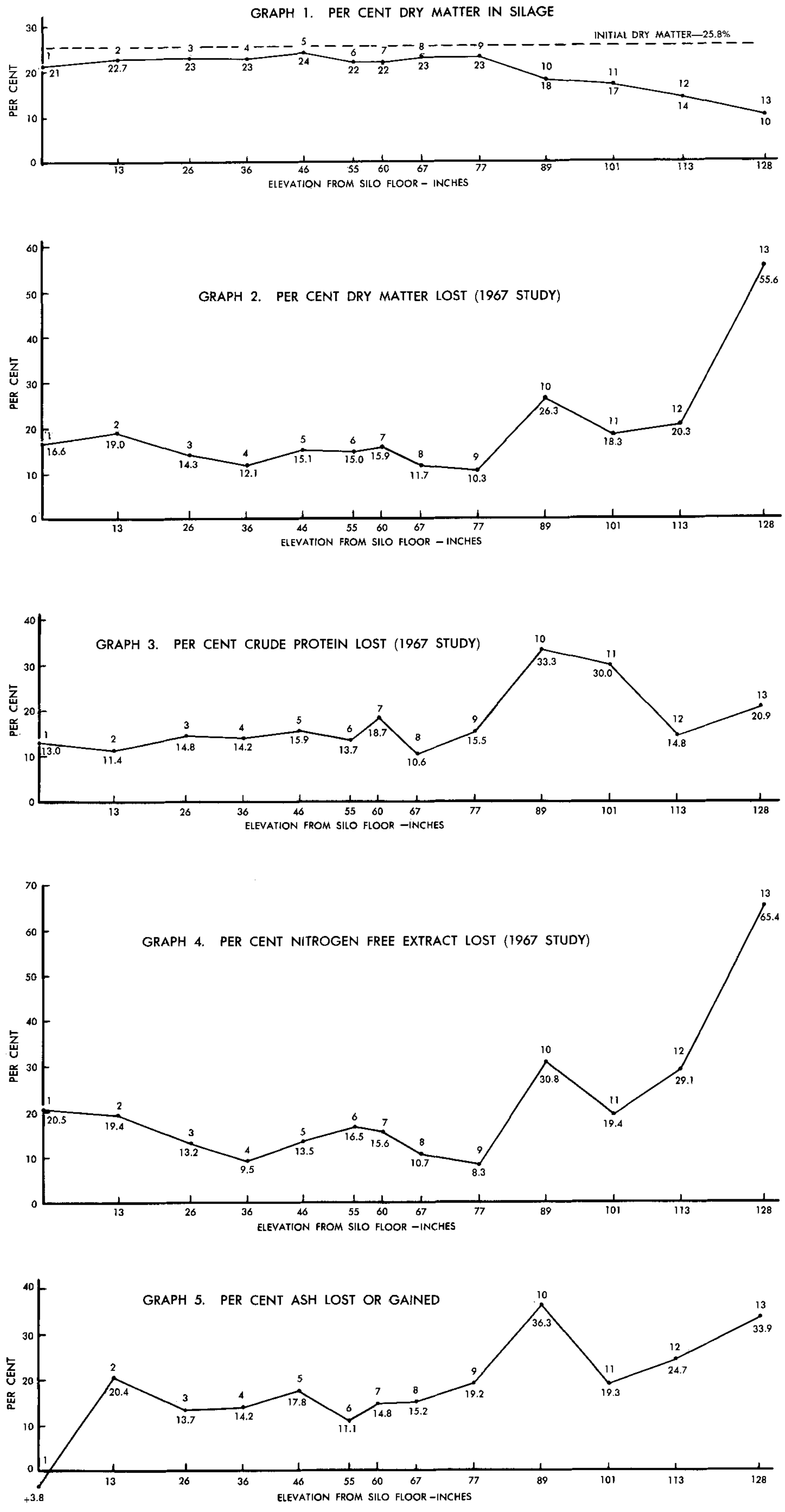
The bags were removed from the silo on February 14 and were immediately placed in moisture-proof containers and refrigerated until they were analyzed at the University of California Agricultural Extension Laboratory, Davis.

Dry matter loss

The 1964–66 studies showed some very interesting trends. The amount of dry matter lost in the upper six inches of the silage mass in uncovered silos was very large, ranging from 50 to 74 per cent of the original material ensiled. This same top six inches, which came from two to three times its depth in original fill material, had a much higher moisture content (indicated by a lower dry matter content) than either the original green chopped corn or the rest of the silage mass. This undoubtedly was a result of the rainfall just before the removal of the samples. There was an indication that soluble constituents were leached and accumulated at various other layers in the silage mass. This was further substantiated by an apparent increase in the percentage of crude protein in the upper 6 inches, which probably resulted from the removal of soluble plant materials from the insoluble fraction. Thus, an apparent increase (16 to 22 per cent) in the crude protein content in the upper 6 inches compared with the 6 to 8 per cent crude protein below 16 inches. In addition, all of the uncovered bunker silos lost approximately 10 per cent of their units of total digestible nutrients (TDN) in the upper six inches (dropping from about 70 per cent TDN to approximately 60 per cent TDN).

Covering the bunker silos reduced top spoilage and dry matter loss sharply in the upper 6 inches; only a 12 per cent loss occurred in covered bunkers compared with 50 to 75 per cent in uncovered bunkers. Furthermore, covered silage maintained its TDN content in the upper 6 inches equal to the green chop and other silage. Leaching from the upper layers was not evident and consequently the upper layers did not increase in crude protein percentage.

Continuous packing to exclude air during filling of bunker silos appeared to



Sample level numbers (1 to 13) are above each point on each graph line.

CHEMICAL COMPOSITION, CORN SILAGE LOSS STUDY—GLENN COUNTY 1967

Location of samples		Chemical composition of ensiled samples—average of four replications						
Level	distance from floor	Crude fiber	Dry matter	Crude protein	Estimated TDN*	Ash	NFE	Fat
	inches	%	%	%	%	%	%	%
13	128	31.6	11.32	12.9	65.8	10.6	43.2	1.7
12	114	34.8	15.84	7.7	68.9	6.7	49.4	1.5
11	101	34.0	18.09	6.4	69.9	6.5	51.2	2.0
10	89	33.3	18.62	6.5	69.8	6.1	52.2	1.8
9	77	28.4	23.7	6.8	70.0	6.4	56.3	1.7
8	67	27.7	24.08	7.3	69.9	6.8	56.8	1.8
7	60	28.3	22.82	7.0	69.9	7.2	55.7	1.8
6	55	28.2	22.95	7.3	69.6	7.4	54.5	2.5
5	46	27.2	24.58	7.1	69.8	6.9	56.6	2.2
4	36	27.1	24.13	7.0	69.9	7.0	57.2	1.8
3	26	27.3	24.08	7.2	69.8	7.2	56.3	1.7
2	13	27.3	23.48	7.9	70.7	7.9	55.3	1.6
1	0	29.3	21.12	7.5	69.6	8.9	53.0	1.3
Average of 52 samples before ensiling		28.4	25.6	7.2	69.7	7.1	55.47	1.8

* TDN estimated using Pennsylvania State University Forage Testing Laboratory formula for corn silage.
Est TDN = 77.07 − (0.75 CP + 0.07 CF)

reduce dry matter losses. For example, a settle-packed tower silo had a much higher dry matter loss than a continuously packed and immediately covered bunker silo. More samples were used in the 1967 study, and the earlier trends were more clearly defined.

The complete proximate analyses of the 52 samples stored at 13 levels in an uncovered bunker silo in 1967 are presented in the table. The table also gives the average chemical composition of the 52 samples not ensiled. The increased water content in the top 4 ft of stored silage was undoubtedly caused by the 10.24 inches of rain which fell during the 130-day storage period, as was the moisture increase in the lower 2 ft of the stored silage. An apparent increase in percentage of crude protein, ash and crude fiber content in the upper few feet of the silage mass apparently resulted from the more rapid leaching of the more soluble nutrients by the rain. Judging from the reduction in the upper layers and the gain in the middle layers of the nitrogen-free extract (NFE), which represents the more soluble parts of the silage, nutrients must be leached from the upper to the middle and lower layers of the silage mass, depending upon each component's solubility. Although run-off was not measured, it is conceivable that some of the more soluble nutrients were leached through the silage mass and lost as part of the silage run-off, as the decrease in dry matter in silage near the floor of the silo seems to suggest.

The most severe losses appear to have occurred as a result of combustion of dry matter in the silage mass, particularly in the upper one-half of the silage. Average losses increase from a low of approximately 15½ per cent in the middle layers to a high of 55.6 per cent in the top layer (graph 2). This severe loss in the upper foot was no doubt due to both the leaching effect of rain and the exposure to air which allows combustion of dry matter into carbon dioxide, nitrogen and other gasses (which are then lost in the air). That the increase in crude protein in the upper two feet is misleading is evident in calculations of the actual amount of crude protein lost (graph 3) on the basis of a comparison of the original and final weights of the silage samples. This loss very closely parallels the loss in dry matter content—except that here the greatest loss occurred 3 and 4 ft from the surface. An average of approximately 15 per cent of crude protein was lost in the bottom 7 feet of the silo —a figure considered excessive by many research workers.

The loss in other chemical constituents beside TDN does not appear excessive until combined with the actual loss in weight of the silage represented in the sample bags. The reduction in per cent NFE (graph 4) in the upper layers indicates a substantial loss of sugars and starches when the dry matter loss is taken into consideration. The changes in ash or mineral content of the various layers reflect the downward movement of these constituents, particularly the increase in ash content of the top layer.

The loss in weight throughout the entire profile of the silage mass averaged 18.8 per cent of the dry weight of the material placed in the silo. Dry weight losses of the original corn silage averaged 38.7 per cent in the upper 4 ft and 55.6 per cent in the upper foot. Losses of this magnitude indicate a need for an adequate cover to protect the silage from air and rain.

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Effects of growth reg of citrus

SUCCESSFUL HARVESTING with mechanical shakers requires a tree with an open-spreading branch structure. A vase-like arrangement of three primary scaffold branches arising from the main trunk at a height of from 24 to 30 inches is ideal. The low, open-centered, spreading canopy thus formed allows fruit to fall to a catching frame with less chance of striking interfering branches.

The natural shape of a citrus tree is nearly spherical. However, when planted in an orchard, citrus trees become somewhat columnar because of crowding. Many of the main shoots of young trees grow upright until they bend from their own weight. Buds along the top of the bending limbs sprout to form new upward growing shoots. The bending branch droops further to form the tree's skirt. The uprights eventually bend and the process is repeated. Thus the tree increases in size and the center becomes filled with haphazardly arranged closely spaced branches. Therefore, the open-scaffold structure needed for shake harvesting must usually be achieved by pruning, which is time-consuming, expensive, and which also delays bearing and decreases yield.

Previous tests

Previous tests with the growth regulator, TIBA (Triiodobenzoic acid) when sprayed on shoots three to five inches in length of vigorously growing, red Delicious apple trees, has been shown to cause the shoots to bend outward and to change the upright growth habit of the tree to one with a more spreading branch structure. Opening the tree in this manner allows a greater choice of scaffold branches for the permanent framework of the tree. Also the increased crotch angle produces a stronger union between the branch and the wood from which it arises.

To determine the reaction of citrus branching to TIBA, four varieties of citrus were treated with concentrations ranging from 25 to 2,000 ppm. Year-old seedlings grown in gallon cans were