ABSTRACT OF THESIS

UTILIZATION OF BEET TOPS

AS

AFFECTED BY DIFFERENT STORAGE METHODS

Submitted by

A. Allen Heidebrecht

In partial fulfillment of the requirements

for the Degree of Master of Science

Colorado State College

of

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The sugar beet crop is one of the major commercial cash crops in most of the Western States, and the beet top may be considered the first by-product of this crop. Although beet tops have been used successfully in lamb fattening rations to cheapen the cost of feeding, there is still considerable doubt as to the best method of storing.

The objectives of this study were: to determine the utilization of beet tops by lambs as affected by different storage methods; to determine which method of preservation of beet tops is most efficient in nutrient conservation; and to determine more accurately the nutritive value for beet tops in a lamb fattening ration.

Beet tops were stored in a trench silo, in a stack above the ground, in thin, flat rows in the field, in small piles in the field, and in a thin layer on wire racks under shelter.

During the first experiment conducted in 1941-42, the lambs were segregated into five groups of two lambs each. The five groups of lambs were placed on a 120 day feeding test, each group receiving corn, salt (NaCl), and beet tops from one of the lots of beet tops preserved as indicated above. Three digestion balance trials of 14 days each were carried out during the 120-day feeding period. In 1942-43 six lambs were placed in two groups, one group receiving corn, salt, and beet top-stack silage and the other group receiving corn, salt, and beet tops stored in piles in the field. The lambs were fed for a period of 120 days. Two

digestion balance trials of 21 days in length were conducted during this feeding period.

Accurate body weights and weights of feed and water consumption, fecal and urine output were taken during the digestion balance trials. Daily samples of feed, feed refused, feces, and urine were taken and analyzed for dry matter, nitrogen, ash, calcium, and phosphorus in order to determine nutrient utilization.

In order to determine nutrient storage losses in beet tops, samples were taken at intervals of 20 days during the 1941-42 experiment and 30 days during the 1942-43 experiment. The beet tops were analyzed for dry matter, crude protein, ash, calcium, phosphorus, and carotene. Silica and magnesium content of beet tops were determined during the 1942-43 experiment. All analyses were made by accepted chemical methods.

In average apparent digestibility of dry matter, beet tops when fed with corn to fattening lambs ranked in descending order as follows: 1. sheltered beet tops, 2. piled beet tops, 3. beet tops in rows, 4. trench silage, and 5. stack silage.

Highest apparent digestibility and retention of nitrogen was shown by the trench silage lot. Little difference appeared in apparent digestibility and retention of nitrogen between the various dried beet top rations.

There was no appreciable difference between the different dried beet tops and trench silage with respect to retention of calcium and phosphorus.

The lambs receiving stack silage showed the lowest apparent digestibility of dry matter, nitrogen, and ash, and the lowest retention of nitrogen, ash, calcium, and phosphorus.

Beet tops had some laxative effect in all lots.

No appreciable difference was observed between beet tops in piles, in rows, under shelter, and trench silage in conservation of crude protein, calcium, and phosphorus during storage.

Stack silage showed a loss in crude protein and phosphorus.

Trench and stack silages were highest in ash and silica content followed by beet tops stored in field and under shelter respectively.

Beet tops stored under shelter on wire racks retained the greatest quantity of carotene.

T H E S I S

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May 27, 1943

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY A. Allen Heidebracht

ENTITLED UTILIZATION OF BEET TOPS AS AFFECTED BY DIFFERENT STORAGE METHODS.

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

MAJORING IN ANIMAL NUTRITION

CREDITS 10

L. E. Washburn
In Charge of Thesis

APPROVED R C Tom
acting Head of Department

Examination Satisfactory

Committee on Final Examination

R C Tom — Howard Hunter

L. E. Washburn — J. W. Sobiska

Paul R. Frey

V. A. Drake
Dean of the Graduate School

Permission to publish this thesis or any part of it must be obtained from the Dean of the Graduate School.

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INTRODUCTION

The sugar beet crop is one of the major commercial cash crops in most of the Western States. Colorado leads as a sugar beet growing state with an average of 182,000 acres yielding 12.4 tons of beets per acre (16). Colorado is also the leading lamb feeding state, feeding approximately 1,000,000 lambs annually (16).

The beet top, including the crown and leaves, may be considered the first by-product of the beet crop. The green weight of beet tops represents about 70% of the weight of the whole beet and is composed of about 25% crown and 75% leaves (9). The above figures indicate a large tonnage of cheap feed available for livestock feeding. Although beet tops have been used successfully in lamb fattening rations to cheapen the cost of feeding, there is still considerable doubt as to the best method of storing.

One of the most common methods of utilizing the tops is by pasturing. This method is rapidly disappearing because of the waste and loss of tops through trampling, drying, shattering, and blowing during the fall days. Other methods of utilization are the piling of tops in small piles to pasture or to feed later during the drylot period, stacking tops with alternate layers of straw, and by placing in stack, trench, and upright silos. In Europe the tops are sometimes dried artificially for sale as a stock feed (19).

The Problem:

The problem deals with a study of utilization of beet tops by lambs as affected by different storage methods.

Minor Objectives:

1. To show the nutrient losses occuring under different storage methods.
2. To determine which method of preservation of beet tops is the most efficient in nutrient conservation.
3. To determine more accurately the nutritive value for beet tops in a lamb fattening ration.

REVIEW OF LITERATURE

Several experiments have been conducted on beet top feeding by different experiment stations here and in England. However, a review of available literature indicates that there is a limited amount of information on the feeding value of sugar beet tops, especially when fed as the only roughage in the ration and when stored under different conditions.

Beet tops vary considerably in their chemical composition as shown by the following table.

Table No. I Summary of Green Beet Top Analyses

Percentage on Dry Matter Basis							
Crude protein	Crude fat	Fibre	N-free extract	Mineral matter	Ca	P	Source of information
22.81	2.63	10.53	46.49	17.54	1.32	0.34	(12)
10.12	0.50	25.05	43.01	21.32	----	----	(2)
18.35	1.53	13.89	44.03	22.22	----	----	(11)
12.55	2.76	9.92	53.61	21.16	1.32	0.67	(21)

The variations are due to plant differences, edhering soil, and different ratios of crown to leaves.

Although beet tops at topping time contain only about 15% dry matter, the dry material is very rich in protein and carbohydrates and low in fibre. Nearly 25% of the carbohydrate is present in the form of sugar (18). The content of crude oil is small, which according to Woodman (18) is mostly chlorophyll and waxy materials of no feed value.

English workers (21) found the following digestibility coefficients of nutrients when beet tops were fed with chalk and chaffed meadow hay of known digestibility to sheep.

Table No. II Digestibility Coefficients of Nutrients in Beet Tops

Nutrient	% Digestibility	Nutrient	% Digestibility
Dry matter	69.0	N-free extractives	82.6
Organic matter	78.5	Crude fibre	71.1
Crude protein	70.2	Ash	33.4
Ether extract	62.8		

Kellner (7) obtained similar digestibility coefficients. The English trials showed a positive nitrogen, phosphate, and lime balance. Although the daily consumption of lime in beet tops increased during the feeding period, there was no corresponding rise in the lime balance. Woodman (21) suggests that the lime in the tops may be unavailable because of the oxalic acid present. Positive nitrogen, calcium, and phosphorus balances were obtained by Guilbert and Goss (3) in a digestion balance trial with two steers fed beet tops.

Morrison (12) gives the nutritive ratio of sugar beet tops as 1:2.9, indicating that they are a protein or a growth-producing feed. That ratio compares favorably with alfalfa hay.

In a test conducted by Honcamp and Schramm (5) sugar beet leaves prepared as silage lost 31% nitrogen free extract, 10% crude fibre, and 25% starch. Woodman (20) found that beet tops lost about 20% organic matter during fermentation.

Washburn (17) in feeding dried beet tops and salt to three pregnant ewes found that they could be wintered on them provided the ewes were in good condition at the start of the wintering period. Ingraham (6) found that pasturing beet tops without supplementary feed was a satisfactory ration unless scouring developed. Morton, Osland, and Tom (11) found that beet tops replacing all the alfalfa hay in a standard ration for steers caused digestive disturbances after 100 to 120 days of feeding, and Osland (13) in a steer feeding test showed that beet top silage proved impractical when fed during the entire experiment because of rapid spoiling when exposed to the air and because of digestive disturbances and scouring. Morrison (12) states however, that beet top silage is less laxative than fresh tops.

Alberti (1) states that in feeding leaves and tops of sugar beets precautions must be taken to prevent digestive disturbances, toxic phenomena, and osteomalacia that often accompany their use. These disturbances are caused by high content of soluble mineral substances, soil contamination, toxins produced by

soil bacteria, and by the high content of oxalic acid in the leaves. Similar results have already been mentioned. Woodman (19) states that wilting in the field or the artificial drying of beet tops leads to partial destruction of oxalic acid. He further states that beet tops can be fed in larger amounts to ruminants than to non-ruminants because much of the acid is destroyed in the first stomach of ruminants by fermentation. Morrison (12) states that when feeding large amounts of tops, it is advisable to add one ounce of finely-ground limestone or chalk to each fifty pounds of tops, as calcium changes the oxalic acid to insoluble calcium oxalate.

In a Nebraska experiment (4) beet tops were fed to lambs in comparison with the same respective ration without beet tops. The lots fed beet tops made greater gains, required less concentrates and alfalfa hay, and sold at a higher price. However, in a Colorado test (15) beet tops fed to steers with a basal ration of barley, cottonseed cake, and alfalfa hay, the nutritive ratio was too narrow for optimum gains even though the cost per unit gain was lowered.

Four trials conducted with sheep at the Colorado Experiment Station (14) showed that beet tops and alfalfa hay should be fed in combination to secure best results. Maynard (8) found the replacement value of $5.71 per ton of beet tops fed to calves, or $1.16 for the tops from each ton of beets produced. Similar results were obtained in other Colorado tests (10 and 15).

MATERIALS AND METHODS

Equipment:

Ten digestion balance crates were constructed and placed in a well ventilated building located on the College Farm. Each crate was devised to permit the separation and collection of the excreta. The floor upon which the animal stood was made of a strong iron grid through which the excreta passed. The feces was separated out by a sloping screen and the urine passed through the screen into a bottle. A fed-box was constructed in each crate. Watering was accomplished by removable containers.

A balance scale weighing in grams was used to weigh feed and excreta, while a larger scale weighing in pounds was used in determining the weight of the lambs.

The feeds were brought in from the different storage places in sacks and used within 24 hours.

Lambs Used:

For the 1941-42 trial ten crossbred feeder lambs were selected from a flock produced by the Experiment Station. They were dropped in the early spring of 1941 and averaged 63.93 pounds in weight at the start of the test. These lambs were on the range until 30 days before the trial was started. During the 30 days prior to the start of this experiment, they were fed alfalfa hay and yellow corn.

The 1942-43 experiment was conducted using crossbred lambs produced by the Experiment Station and weighing 59.72 pounds at the start of the test. They were also fed for a short time on

alfalfa hay and yellow corn before being placed on experiment. Ewe lambs were used in both experiments for convenience and not to escape trouble from urinary calculi which occurs sometimes in the male animal.

Lamb Weights:

The average of three consecutive daily weights taken at the beginning and end of the 120-day experimental periods respectively was used as the initial and final weight of each lamb.

All weights were taken before feeding, starting at 8:00 a. m. on each weigh day.

Allotment Factors:

The lambs were alloted as to previous gains made, weight, type, condition, breed, and sex. Each lot consisted of two lambs in the 1941-42 trial and of three lambs in the 1942-43 trial. The allotments were made in order to reduce experimental error due to individuality.

Beet Tops Used:

1941-42 Experiment.

Beet tops were purchased from the Agronomy Farm at the College. The beet tops showed a low ratio of tops to tonnage of beets produced, and were not of good average quality because of poor growth and adverse weather conditions at harvest time.

1942-43 Experiment.

The beet tops for this experiment were of good average quality and were purchased from Mr. Schild's farm southeast of Fort Collins.

Storage of Beet Tops:

1941-42 Experiment.

Beet-top trench silage was made by storing green beet tops in a trench silo about 5 feet deep, 7 feet wide, and 12 feet long, allowing fermentation to take place for a period of 14 days before the feeding experiment started.

Beet-top stack silage was prepared by storing green beet tops in stacks and allowing fermentation to take place before feeding. The stacks were about 8 feet long, 6 feet wide, and 9 feet high after stacking.

Sheltered beet tops were prepared by storing green beet tops in a thin layer on wire racks under shelter, allowing maximum air circulation.

Beet tops in rows used in the test were spread out in thin, flat rows in the field to suffer maximum weathering.

Beet tops in piles were prepared by storing the green beet tops in the field in small piles about the size of an inverted wash tub.

1942-43 Experiment.

Beet-top stack silage was prepared by storing green beet tops in a stack 20 feet long and 10 feet wide. The tops were stacked 3 feet high and allowed to settle and again stacked 3 feet high, etc. until the stack was about 9 feet high after it was completed.

Beet tops in piles and under shelter were stored in the same manner as in the 1941-42 experiment.

Other Feeds Used:

Whole yellow corn, graded U. S. Grade No. 2, and salt (NaCl) were fed to each lot.

Rations Fed:

1941-42

Lot 1. Whole yellow corn, beet-top stack silage, salt and water.

Lot 2. Whole yellow corn, beet-top trench silage, salt and water.

Lot 3. Whole yellow corn, beet tops stored in rows, salt and water.

Lot 4. Whole yellow corn, beet tops stored under shelter, salt and water.

Lot 5. Whole yellow corn, beet tops stored in piles, salt and water.

1942-43

Lot 1. Whole yellow corn, beet-top stack silage, salt and water.

Lot 2. Whole yellow corn, beet tops stored in piles, salt and water.

Methods of Feeding:

The yellow corn was fed twice daily, promptly at 9:00 a. m. and 4:00 p. m.

Beet tops were supplied twice a day permitting the lambs to eat all they desired.

Salt was kept before the animals at all times.

The lambs were put on full feed as quickly as possible after the start of the experiment. They were started on 20 grams of corn per head daily and gradually increased to 454 grams per head.

Water was offered to the lambs before each feeding.

Digestion Balance Trials:

1941-42 Experiment.

Three digestion balance trials of 14 days each were conducted during the 120-day feeding period. The first trial was carried out after the lambs had been on their respective rations for 23 days. The second trial was conducted two weeks after the first trial had been completed, and the third trial was run the last 14 days of the experiment.

1942-43 Experiment.

Two digestion balance trials of 21 days each were run during the 120-day feeding period. Thirty days of feeding elapsed before the first trial was conducted. The second trial was carried out during the latter part of the feeding period.

Accurate body weights, weights of feed and water consumption, and weights of feces and urine voided were taken during each digestion balance trial.

Chemical Analyses:

In order to determine nutrient storage losses in beet tops, samples were taken at intervals of 20 days during the 1941-42 experiment and 30 days during the 1942-43 experiment. The beet tops were analyzed for dry matter, crude protein, ash, calcium, phosphorus, and carotene. Silica and magnesium content of the beet tops were determined during the 1942-43 experiment.

During each digestion balance trial, daily samples of feed, feed refused, feces, and urine were taken and analyzed for dry matter, nitrogen, ash, calcium, and phosphorus in order to determine nutrient utilization. During the 1942-43 experiment the feed, feces, and urine were analyzed for magnesium. The beet top samples taken during the digestion balance trials were separated into tops and crowns to determine the consumption of nutrients in each part.

All analyses were made by accepted chemical methods in the chemical laboratory of the Animal Investigations Section of the Experiment Station.

EXPERIMENTAL RESULTS

Beet Top Storage Studies

Chemical Analyses of Beet Tops Stored:

Table No. III Dry Matter Content of Beet Tops Stored under Different Conditions

Year	Sampling Period	Stack Silage %	Trench Silage %	Beet Tops rows %	Beet Tops piles %	Beet Tops sheltered %
1941-42						
	35-day	22.51	32.21	74.54	72.48	78.53
	55-day	24.45	31.79	39.09	42.07	79.24
	75-day	43.29	29.09	36.87	35.93	84.05
	95-day	42.37	33.45	39.72	56.44	84.05
	115-day	38.69	34.04	81.48	81.92	82.08
	Average	34.26	32.12	54.35	57.80	81.70
1942-43						
	Original	17.03			17.03	17.03
	20-day	25.28			45.86	50.72
	50-day	23.41			56.19	86.98
	80-day	38.36			64.49	87.68
	110-day	25.79			59.39	87.68
	140-day	27.43			92.39	92.97
	Average after first 19 days	28.05			63.66	81.62

Beet tops stored under shelter were high in dry matter during most of the storage period, showing little variation because of maximum air circulation about the tops and protection from rain and snow. Both of the silages were low in dry matter and also showed little variation. The large increase in dry matter content

of the stack silage in 1941-42 between the 35th and 75th day shown by Table III can be attributed to samples taken from two different stacks. The same is true of the following series of tables on storage studies. Greatest variation in dry matter was found in tops stored in rows and piles in the field because they were more subject to weathering than tops stored under other conditions.

Table No. IV Crude Protein Content of Beet Tops during Storage

		Percentage on Dry Matter Basis				
Year	Sampling Period	Stack Silage	Trench Silage	Beet Tops rows	Beet Tops piles	Beet Tops sheltered
1941-42						
	35-day	11.57	14.72	13.26	12.99	12.95
	55-day	9.55	13.69	14.72	14.14	14.48
	75-day	15.36	14.17	14.48	13.38	15.56
	95-day	9.93	14.08	13.04	13.34	14.69
	115-day	10.93	14.84	15.28	13.71	15.45
	Average	11.47	14.30	14.16	13.51	14.63
1942-43						
	Original	11.12			11.12	11.12
	20-day	10.71			10.11	9.91
	50-day	9.10			10.63	10.38
	80-day	7.84			10.13	10.37
	110-day	8.94			10.67	9.60
	Average after first 19 days	9.15			10.39	10.07

Table IV shows that there was a loss of crude protein during the first 20 days of storage. There was some variation between tops stored under different conditions. The table shows that the sheltered beet tops averaged higher in crude protein during the

1941-42 storage period than the other beet tops, and slightly lower than piled beet tops in the 1942-43 period. Trench silage compares favorably with the sheltered beet tops, but stack silage was considerably lower in crude protein during both periods of storage. One sample of the stack silage taken on the 75th day during the 1941-42 period was quite high, probably because of poor sampling or because it was the first sample taken from stack number 2. Beet tops stored in rows were higher in protein than the piled beet tops. That might have been due to sampling, since the tops in rows varied considerably. In general beet tops stored in 1942-43 were lower in crude protein than tops stored in 1941-42.

Table No. V Ash Content of Beet Tops during Storage

		Percentage on Dry Matter Basis				
Year	Sampling Period	Stack Silage	Trench Silage	Beet Tops rows	Beet Tops piles	Beet Tops sheltered
1941-42						
	35-day	43.07	32.02	15.90	15.95	15.52
	55-day	42.25	26.86	18.75	18.50	15.52
	75-day	22.12	23.68	22.66	21.78	15.16
	95-day	38.76	25.00	20.58	19.02	14.84
	115-day	27.81	26.59	23.88	19.67	14.97
	Average	35.00	26.83	20.35	18.98	15.20
1942-43						
	Original	19.80			19.80	19.80
	20-day	28.69			23.56	16.40
	50-day	28.43			17.78	18.97
	80-day	54.03			29.53	17.12
	110-day	39.09			34.14	17.82
	Average after first 19 days	37.57			26.25	17.58

Both stack and trench silage showed a high ash content because of the large amount of adhering soil present when stored. Beet tops stored in stack number one were higher in ash than stack number two. The sheltered beet tops were lowest in ash because they did not come in contact with the soil after storage, and because they were dry, thus permitting the original adhering soil to drop off.

Table No. VI Calcium Content of Beet Tops during Storage

		Percentage on Dry Matter Basis				
Year	Sampling Period	Stack Silage	Trench Silage	Beet Tops rows	Beet Tops piles	Beet Tops sheltered
1941-42						
	35-day	0.80	0.99	0.60	0.78	0.55
	55-day	0.78	0.69	0.76	0.69	0.83
	75-day	0.89	0.94	0.64	0.71	0.92
	95-day	1.12	0.94	0.85	0.78	0.88
	115-day	1.35	1.25	0.94	0.83	0.86
	Average	0.99	0.96	0.76	0.76	0.81
1942-43						
	Original	0.63			0.63	0.63
	20-day	0.97			0.82	0.70
	50-day	1.15			0.66	0.79
	80-day	1.22			0.76	0.69
	110-day	1.42			1.07	0.73
	Average after first 19 days	1.19			0.83	0.73

Table No. VII Phosphorus Content of Beet Tops during Storage

Year	Sampling Period	Percentage on Dry Matter Basis: Stack Silage	Trench Silage	Beet Tops rows	Beet Tops piles	Beet Tops sheltered
1941-42						
	35-day	0.21	0.17	0.20	0.23	0.18
	55-day	0.17	0.18	0.22	0.22	0.18
	75-day	0.22	0.19	0.23	0.20	0.19
	95-day	0.15	0.21	0.23	0.25	0.20
	115-day	0.12	0.19	0.25	0.22	0.20
	Average	0.17	0.19	0.23	0.22	0.19
1942-43						
	Original	0.13			0.13	0.13
	20-day	0.19			0.19	0.21
	50-day	0.16			0.16	0.20
	80-day	0.14			0.15	0.22
	110-day	0.15			0.14	0.20
	Average after first 19 days	0.16			0.16	0.21

The stack and trench silage were on the average higher in calcium and lower in phosphorus as compared to the other beet tops as shown in Tables VI and VII. Since there is as much variation in calcium content within the beet tops stored under one condition as there is between the different storage methods, the differences in averages cannot be given great emphasis. However, there is a more narrow ratio of calcium to phosphorus in the dried beet tops. That may be an advantage over both the stack and trench silage.

Table No. VIII Silica and Magnesium Content of Beet Tops during the 1942-43 Storage Period

Year 1941-42 Sampling Period	Percentage on Dry Matter Basis					
	Stack Silage		Beet Tops in piles		Beet Tops sheltered	
	SiO_2	Mg	SiO_2	Mg	SiO_2	Mg
Original	8.06	0.65	8.06	0.65	8.06	0.65
20-day	17.07	0.56	13.11	0.41	7.18	0.54
50-day	17.00		6.70	0.51	8.43	0.42
80-day	40.14	0.61	18.38	0.56	7.47	0.42
110-day	25.19	0.71	21.39	0.95	7.53	0.60
Average after first 19 days	24.85	0.63	14.90	0.61	7.65	0.50

Table VIII shows that stack silage contained considerably more silica than the dried beet tops, however all beet tops were quite high in this mineral. It should also be pointed out that the silage was slightly higher in magnesium, higher in calcium, and lower in phosphorus than dried beet tops.

Table No. IX Carotene Content of Beet Tops during Storage

Year	Sampling Period	Gamma of Carotene per Gram Dry Matter: Stack Silage	Trench Silage	Beet Tops rows	Beet Tops piles	Beet Tops sheltered
1941-42						
	35-day	1.24	0.00	13.04	14.50	34.64
	55-day	0.73	0.00	2.15	4.21	23.77
	75-day	1.95	0.73	1.84	2.69	25.85
	95-day	1.91	0.41	1.49	3.25	25.22
	115-day	1.93	0.17	1.03	3.08	24.17
	Average	1.55	0.26	3.91	5.55	26.73
1942-43						
	Original	101.88			101.88	101.88
	20-day	32.99			30.96	60.39
	50-day	29.39			27.37	31.86
	80-day	23.25			16.02	27.13
	110-day	26.48			7.19	24.69
	140-day	10.86			2.77	21.64
	Average after first 19 days	24.59			16.86	33.14

Although a sample was not taken at the start of the 1941-42 experiment, the 1942-43 test shows that there was a great loss of carotene the first 20 days of storage; this is particularly true in the silage and piled beet tops. Beet tops when stored contained 101.88 Gamma of carotene per gram of dry matter. A fresh green beet top sample was taken which contained 214 Gamma of carotene per gram of dry matter. This indicates about a 50% loss in 48 hours if the sun is shining. Sheltered beet tops remained rather constant in carotene content after the 55th day of storage

and higher throughout the storage period than the other beet tops because of protection from sunlight, weathering, and fermentation. Beet tops stored in piles in the 1941-42 trial were considerably higher in carotene than beet tops in rows because of some protection from sunlight and weathering. The piled beet tops in the first experiment lost carotene much more rapidly than did those in the second experiment. This was probably because of more severe changes in weather during 1941-42. Both stack and trench silage were very low in carotene in the 1941-42 period of storage but the stack silage was fairly high in the 1942-43 test. The stack constructed in the 1942-43 test was much larger and consequently may have prevented some destruction of carotene from oxidation. All analyses point to a rapid destruction of carotene in the silages upon exposure to sunlight and air. The samples were analyzed for carotene by different methods each year.

Table No. X Average Nutrients in the Top Part (Stems and Leaves) and in the Crown Part of Beet Tops as Affected by Different Methods of Storage during 1941-42 Digestion Balance Trials.

Sample	% of D. M. of whole beet top	Milligrams per gram D. M. N	Ash	Ca	P	Ca/P Ratio
T*-Trench Silage	24.12	20.97	370.2	11.97	1.67	7.17
C*-Trench Silage	7.23	23.15	274.6	7.53	2.22	3.39
T-Stack Silage	21.60	16.30	436.5	10.47	1.69	6.20
C-Stack Silage	7.57	21.21	278.0	8.34	1.93	4.32
T-in Rows	32.21	23.65	281.0	10.39	2.21	4.70
C-in Rows	19.01	22.78	152.4	5.26	2.91	1.81
T-in Piles	31.25	23.91	254.0	11.20	2.32	4.83
C-in Piles	17.22	19.78	139.8	5.01	2.46	2.04
T-under Shelter	55.35	23.59	184.7	9.76	1.91	5.11
C-under Shelter	19.28	23.35	137.7	5.06	2.26	2.24

T* = Tops C* = Crowns

Dry Matter.

The relative percentage dry matter of the original beet top present in the crown and tops was determined. Results indicate that there is about a 3 to 1 ratio of tops to crowns in the stack silage, trench silage, and sheltered beet tops, and about a 2 to 1 ratio of tops to crowns in the beet tops stored in rows and in piles in the field. This difference is probably because of some loss due to shattering in the beet tops stored in the field.

Nitrogen.

Table X shows that in comparing the two parts of the beet tops that the crowns in the trench and stack silage are higher in nitrogen than the tops. The opposite situation is apparent in the beet tops in rows, piles in the field, and beet tops stored under shelter. More nitrogen was lost from the tops and crowns of the silages than from the different dried beet tops.

Ash.

The leaves and stems were considerably higher in ash content than the crown. This fact may be considered an advantage for the crowns because the high ash content of the tops might cause considerable disturbance in digestion.

Calcium.

The stems and leaves contained a larger amount of calcium than the crowns which is especially apparent in the dried beet tops. The crown part of the beet tops in stack and trench silage was higher in calcium than in the dried beet tops and the tops contained approximately the same amount in all.

Phosphorus.

The crowns were higher in phosphorus content than the stems and leaves of all the silages and dried beet tops. Table X shows a greater loss in phosphorus in the tops and crowns of the silage as compared to dried beet tops.

Calcium : Phosphorus Ratio.

Leaves and stems varied from approximately a 5:1 to a 7:1 ratio of calcium to phosphorus. Crowns showed a ratio of approximately 2:1 to 4:1. There was a wider ratio of calcium to phosphorus in both trench and stack silage than in the different dried beet tops.

Table No. XI Water, Dry Matter, and Nitrogen Digestion Balance Trial Data

Year	Lot No.	Trial No.	Daily Average per Lamb: Corn Cons. gms.	Tops Cons. gms.	Crowns Cons. gms.	Total D.M. Cons. gms.	Water Cons. gms.	Total Fec. D.M. Exc. gms.	App. Dig. D.M. %	Total N. intake gms.	App. Dig. N. %	N. retn. gms.	N. ret. %
1941-42													
	1	1	382.5	321.5	117.3	821.3	398.6	227.0	72.4	14.78	48.4	3.27	22.12
		2	390.4	264.5	216.7	871.6	640.3	278.9	68.0	17.43	53.2	4.80	27.54
		3	407.5	340.8	195.3	943.6	1731.0	307.2	67.4	18.06	33.2	2.69	14.89
		Average	393.5	308.9	176.4	878.8	923.3	271.0	69.3	16.76	44.9	3.59	21.52
	2	1	382.5	343.4	124.7	850.6	815.0	255.1	70.0	18.58	54.9	5.64	30.36
		2	390.4	322.6	260.7	973.7	1301.1	219.0	77.5	21.42	63.0	9.05	42.25
		3	407.5	866.2	128.3	1402.0	1250.4	347.6	75.2	30.94	65.8	15.21	49.16
		Average	393.5	510.7	171.2	1075.4	1122.2	273.9	74.2	23.65	61.2	9.97	40.59
	3	1	369.8	344.3	185.1	899.2	1526.6	146.3	83.7	18.50	53.4	5.62	30.38
		2	390.4	159.4	202.2	752.0	1388.4	190.8	74.6	15.44	49.4	3.55	22.99
		3	407.5	511.9	285.0	1204.4	2047.1	246.4	79.5	27.99	58.2	13.51	48.27
		Average	389.2	338.5	224.1	951.9	1654.0	194.5	79.3	20.64	53.7	7.56	33.88
	4	1	296.5	417.3	187.1	900.9	1924.6	111.5	87.6	19.34	58.2	6.49	33.56
		2	390.4	322.3	108.4	821.1	2072.5	94.2	88.5	20.44	63.2	8.01	39.19
		3	397.0	481.0	88.3	966.3	2561.1	151.8	84.3	19.92	54.6	5.29	26.56
		Average	361.3	406.9	127.9	896.1	2186.1	119.2	86.8	19.90	58.7	6.60	33.10
	5	1	382.5	331.1	126.0	839.6	1532.8	142.3	83.1	17.11	46.8	3.68	21.51
		2	390.4	265.5	196.3	852.2	1510.6	134.1	84.3	17.95	60.6	5.91	32.92
		3	407.5	281.8	202.9	892.2	1766.8	204.1	77.1	20.27	57.4	6.04	29.80
		Average	393.5	292.8	175.1	861.3	1603.4	160.2	81.5	18.44	54.9	5.21	28.08
1942-43													
	1	1	331.6	284.6	67.5	683.7	958.6	211.6	69.1	12.60	42.1	2.11	16.75
		2	379.4	417.9	105.0	902.3	1091.4	227.3	74.8	14.80	52.7	3.83	25.88
		Average	355.5	351.3	86.3	793.0	1025.0	219.5	72.0	13.70	47.4	2.97	21.32
	2	1	351.0	223.0	61.4	635.4	1575.8	12912	79.7	12.72	56.1	4.22	33.18
		2	312.0	329.0	114.1	755.2	1847.9	163.2	78.4	13.77	57.1	4.97	36.08
		Average	331.5	276.0	87.8	695.3	1711.9	146.2	79.1	13.25	56.6	4.60	34.64

Digestion Balance Trials.

Lot 4 receiving sheltered beet tops showed the highest apparent digestibility of dry matter during the three digestion balance trials of the 1941-42 experiment. The average digestibility of dry matter of the other lots ranked in descending order as follows: Lot 5, Lot 3, Lot 2, and Lot 1. As shown by Table XI little difference was evident between Lots 3 and 5, but there was a definitely lower digestibility coefficient for the stack silage of Lot 1. Stack silage also showed the lowest percentage digestibility of dry matter in the 1942-43 trials. It should be pointed out that the average digestibility values of Lots 1 and 5 of the 1941-42 trials check closely with Lots 1 and 2 of the 1942-43 trials. There seems to be little or no correlation between the apparent digestibility coefficient of the total dry matter and corn consumed. No great difference in consumption of crowns between lots appeared except that Lot 4 consumed less dry matter in the form of crowns than any other lot. This demonstrates that very dry crowns are not very palatable. The lot receiving trench silage (Lot 2) consumed more dry matter than the other lots, indicating that trench silage is more palatable.

The highest average apparent digestibility, the largest average intake, and highest retention of nitrogen was apparent in the lambs receiving trench silage, while the lambs receiving stack silage showed the lowest average apparent digestibility of nitrogen, lowest average retention, and lowest average percentage of nitrogen retained. Little difference with respect to nitrogen

metabolism occurred in the lots receiving dried beet tops.

Table No. XII Consumption, Excretion, Digestibility, and Retention of Ash

Year	Lot No.	Trial No.	Daily Average per Lamb in each Lot: Total Cons. Ash grams	Ash Exc. Feces grams	Ash Exc. Urine grams	Total Exc. grams	App. Dig. Ash %	Ash Retn. grams
1941-42								
	1	1	172.2	113.4	22.0	135.4	34.05	36.8
		2	100.3	129.9	32.3	162.2	-51.71	-61.9
		3	126.0	129.7	32.2	161.9	-10.43	-35.9
	Average		132.8	124.3	28.8	153.2	- 9.36	-20.3
	2	1	106.5	129.7	31.0	160.7	-30.50	-54.2
		2	108.9	92.5	27.7	120.2	13.71	-11.3
		3	335.1	163.6	38.8	202.4	50.85	132.7
	Average		183.5	128.6	32.5	161.1	11.35	22.4
	3	1	72.8	43.3	20.3	63.6	39.28	9.2
		2	57.0	63.4	15.2	78.6	-11.89	-21.6
		3	224.1	76.0	14.5	90.5	65.76	133.6
	Average		118.0	60.9	16.7	77.6	31.05	40.4
	4	1	95.9	25.4	27.3	52.7	73.78	43.2
		2	67.3	21.2	24.9	46.1	68.59	21.2
		3	108.3	33.0	31.8	64.8	69.62	43.5
	Average		90.5	26.5	28.0	54.5	70.66	36.0
	5	1	65.9	40.2	24.7	64.9	36.51	1.0
		2	56.5	39.3	19.8	59.1	3.66	-2.6
		3	98.0	68.2	22.4	90.6	30.44	7.4
	Average		73.5	49.2	22.3	71.5	23.54	1.9
1942-43								
	1	1	123.6	103.6			9.72	
		2	205.7	107.9			47.62	
	Average		164.7	105.8			28.67	
	2	1	78.9	35.9			53.85	
		2	113.7	58.5			48.00	
	Average		96.3	47.2			50.93	

High ash content no doubt has considerable effect upon the utilization of beet tops. It should be pointed out that a sample of refused feed was taken each day from each lamb in a lot and mixed together and analyzed at the end of each trial. This does not give an absolute picture because one lamb may have consumed more ash than the other and therefore the refused feed from each lamb should have been analyzed separately. Because of this possible experimental error and the fact that data for the consumption of salt was not available, Table XII is of limited value; it does show however that the lots receiving silage consumed more ash.

Analysis of the urine as shown by Tables XVIII and XX in the appendix indicates that the high percentage of ash in the ration resulted in an abnormally high elimination of minerals from the body in the urine. No great difference in specific gravity of the urine between lots was shown, however, lambs in the silage lots excreted more urine and consequently more total ash. Specific gravity and pH of the urine varied from 1.0397 to 1.0717 and from 8.55 to 9.37 respectively. This alkaline pH was probably mainly due to the large amount of sodium, potassium, magnesium, and calcium in the ration. Washburn (17) has found the ash from washed beet tops to be a pH of 12.0.

Table No. XIII Consumption, Excretion, and Retention of Calcium, Phosphorus, and Magnesium

Year	Lot No.	Trial No.	Daily Average per Lamb: Total Cons. Ca gms.	Total Exc. Ca gms.	Ca Retn. gms.	Ca Retd. %	Total Cons. Mg gms.	Total Exc. Mg gms.	Mg Retn. gms.	Mg Retd. %	Total Cons. P gms.	Total Exc. P gms.	P Retn. gms.	P Retd. %
1941-42														
	1	1	4.88	4.25	0.63	12.91	---	---	---	---	1.71	1.53	0.18	10.53
		2	4.01	4.81	-0.80	-19.95					2.17	1.74	0.43	19.82
		3	5.98	6.73	-0.75	-12.54					1.98	1.47	0.51	25.76
		Average	4.96	5.26	-0.30	- 6.35					1.95	1.58	0.37	18.70
	2	1	5.40	4.59	0.81	15.00	---	---	---	---	1.81	1.15	0.66	36.46
		2	3.62	3.55	0.07	1.93					2.38	1.28	1.10	46.22
		3	15.53	6.93	8.60	55.38					2.82	1.49	1.33	47.16
		Average	8.18	5.02	3.16	24.10					2.34	1.31	1.03	43.28
	3	1	4.33	1.87	2.46	56.81	---	---	---	---	2.18	1.29	0.89	40.83
		2	2.25	2.43	-0.18	- 8.00					2.09	1.57	0.52	24.88
		3	9.48	3.57	5.91	62.34					3.32	1.92	1.40	42.17
		Average	5.35	2.62	2.73	37.05					2.53	1.59	0.94	35.96
	4	1	4.52	2.06	2.46	54.42	---	---	---	---	1.92	1.07	0.85	44.27
		2	3.04	1.45	1.59	52.30					2.41	0.94	1.47	61.00
		3	6.22	2.47	3.75	60.29					2.31	1.59	0.72	31.17
		Average	4.59	1.99	2.60	55.67					2.21	1.20	1.01	45.48
	5	1	3.79	2.54	1.25	32.98	---	---	---	---	1.94	1.38	0.56	28.87
		2	2.87	1.87	1.00	34.84					2.25	1.20	1.05	46.67
		3	5.67	3.89	1.78	31.39					2.64	1.77	0.87	32.95
		Average	4.11	2.77	1.34	33.07					2.28	1.45	0.83	36.16
1942-43														
	1	1	4.01	4.74	-0.73	-18.20	3.46	2.83	0.63	18.21	1.61	1.48	0.13	8.07
		2	7.43	4.57	2.86	38.49	4.58	3.25	1.33	29.04	1.85	1.53	0.32	17.30
		Average	5.72	4.66	1.06	10.15	4.02	3.04	0.98	23.63	1.73	1.51	0.22	12.69
	2	1	2.44	1.73	0.71	29.10	2.47	1.73	0.74	29.96	1.69	1.22	0.47	27.81
		2	3.13	2.48	0.65	20.77	3.36	2.25	1.11	33.04	1.54	1.19	0.35	22.73
		Average	2.79	2.11	0.68	24.94	2.92	1.99	0.93	31.50	1.62	1.21	0.41	25.27

Generally there was a wider ratio of calcium to phosphorus in the rations of Lots 1 and 2 fed stack and trench silage respectively.

Lot 1 showed an average negative calcium retention for the 1941-42 trials and a negative retention the first balance trial of the 1942-43 experiment. Lot 3 was in a negative calcium balance during trial two while all other lots were in a positive balance during each trial.

All lots maintained a positive phosphorus balance, however, one lamb in Lot 1, Trial 1, in the 1942-43 experiment showed a negative balance for phosphorus of 27.9 milligrams. Lot 1 retained less phosphorus in all trials than any other lot. Very little difference was shown in the other lots in this respect.

Because of some evidence of abnormal calcium metabolism, the consumption, excretion, and retention of magnesium was determined in the 1942-43 trials. During Trial 1, Lot 1 consumed slightly less magnesium than calcium and remained in a positive magnesium balance and a negative calcium balance. During the second trial the same lot showed a high calcium balance and also a high magnesium balance. Lot 2 showed a positive calcium and magnesium balance during both trials. During Trial 1 lamb number three in Lot 1 excreted considerably less magnesium, less phosphorus, and more calcium per gram of urine than any other lamb as shown by Table XX in the appendix. This might be an indication of some metabolic effect as the lamb showed the only negative phosphorus balance and at the same time a high negative calcium balance.

Oxalic acid might have had some effect upon calcium metabolism.

Table No. XIV Consumption, Excretion, and Retention of Silica during 1942-43 Trials

Lot No.	Trial No.	Daily Average per Lamb in each Lot: Total Silica Cons. grams	Silica Exc. in Feces grams	Silica Exc. in Urine grams	Total Excreted grams	Silica Retent. grams
1	1	71.0	68.5	0.05	68.6	2.4
	2	123.7	71.5	0.16	71.7	52.0
	Average	97.4	70.0	0.11	70.2	27.2
2	1	27.6	20.9	0.05	21.0	6.6
	2	67.0	38.1	0.15	38.3	28.7
	Average	47.3	29.5	0.10	29.7	17.7

Silica makes up a very large part of the total ash in beet tops as shown by Tables XVI and XIX in the appendix. The presence of silica is due mostly to adhering soil. Silage possesses more adhering soil and consequently more silica than the other beet tops. According to Table XIV Lot 1 consumed more silica than Lot 2 and showed the highest average retention. Little difference was shown between lots in the excretion of silica in the urine. Both lots showed a considerable increase in excretion of silica in the urine in Trial 2 as compared to Trial 1.

Table No. XV Average Lamb Weights per Lot

Lot Number	1	2	3	4	5
Dates: 1941-42	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
11/30/41	69.84	68.50	58.75	59.08	63.50
12/22/41	60.92	60.59	56.17	55.25	60.25
1/8/42	63.34	66.67	60.17	59.08	55.50
1/19/42	68.25	71.08	63.08	62.00	68.09
2/4/42	72.42	75.25	67.92	67.59	73.42
3/15/42	83.42	86.17	76.50	79.09	82.50
3/30/42	88.58	94.50	82.50	83.09	86.33
Total Gain	18.74	26.00	23.75	24.01	22.83
Ave. Daily Gain	0.16	0.22	0.20	0.20	0.19

1942-43 Lot No.	1	2
	Lbs.	Lbs.
11/30/42	61.83	57.61
12/30/42	57.05	53.28
1/20/43	62.11	59.34
2/19/42	67.56	64.05
3/12/43	73.44	70.05
3/30/43	80.83	80.28
Total Gain	19.00	22.67
Ave. Daily Gain	0.16	0.19

The initial weights of the lambs in Lots 1 and 2 were heavier than the lambs in Lots 3, 4, and 5 in the 1941-42 experiment, and in the 1942-43 test Lot 1 averaged heavier at the start than did Lot 2. This difference in original weights did not seem to cause any great variation in gains as is shown by Lots 1 and 2 of the 1941-42 experiment. The lambs in these two lots were practically the same weight at the start of the test and Lot 2 made larger gains than did Lot 1.

The two lambs receiving trench silage made the greatest gains, followed by the lots receiving the different dried beet tops. The lowest average daily gains during both experiments was made by Lot 1.

All lambs lost weight the first part of each test. This can be attributed to the difficulty in getting the lambs on feed because of new environment and different rations.

A decided increase in gains occurred in both Lots 1 and 2 the last 18 days of the 1942-43 experiment at which time the lambs were placed in lots outside the building. This increase indicates that confinement in digestion balance crates had some effect upon the lambs' metabolism.

Some laxative effect was observed in all lots during the two experiments but not to the extent of being very injurious or showing any great effect on the gains or health of the lambs. The lot receiving stack silage showed slightly more loosness of the bowels than any other lot.

SUMMARY

Two experiments were conducted with lambs relative to the utilization of beet tops as affected by different storage methods.

In average apparent digestibility of dry matter the beet tops ranked in descending order as follows: 1. sheltered tops, 2. piled tops, 3. tops in rows, 4. trench silage, and 5. stack silage.

Lambs receiving trench silage exhibited the highest apparent digestibility, average intake, and retention of nitrogen, while the stack silage lot showed the lowest apparent digestibility, average retention, and percentage retained. Little difference in nitrogen metabolism was apparent in the lots receiving dried beet tops.

The intake of ash was excessively high. An average positive calcium retention was shown by all except Lot 1. All lots showed positive phosphorus balance. A positive calcium and magnesium balance was maintained during the 1942-43 trials.

A tendency toward diarrhea was evident in both experiments.

The highest average daily gain per lamb in the various lots was made by lambs receiving trench silage and the lowest gains by lambs receiving stack silage. There was no appreciable difference in the dried beet top lots with respect to gains made.

Except for ash and carotene, little difference was observed in content and loss of nutrients in the different dried

beet tops. Sheltered beet tops contained less ash and more carotene than beet tops stored under other conditions. In average percentage of dry matter the different beet tops ranked in descending order as follows: 1. beet tops under shelter, 2. in piles, 3. in rows, 4. silages, which were about equal.

Only stack silage showed an appreciable loss of crude protein.

The silages contained the greatest quantity of ash, silica, calcium, and magnesium while beet tops under shelter contained the least amount of these nutrients. Little difference in phosphorus content was found.

Approximately a fifty percent loss of carotene occurred during the first 48 hours after topping. Further loss occurred during the initial 20 days of storage. Sheltered tops retained the highest average carotene content, while the carotene content of dried tops in the field decreased continously. Beet tops in piles retained more carotene than beet tops in rows. The results obtained from studies of the silages do not check conclusively but indicate a rapid destruction of carotene upon exposure.

CONCLUSIONS

Utilization Studies.

In average apparent digestibility of dry matter, beet tops when fed with corn to fattening lambs ranked in descending order as follows: 1. sheltered beet tops, 2. piled beet tops, 3. beet tops in rows, 4. trench silage, and 5. stack silage.

Highest apparent digestibility and retention of nitrogen was shown by the trench silage lot. Little difference appeared in apparent digestibility and retention of nitrogen between the various dried beet top rations.

There was no appreciable difference between the different dried beet tops and trench silage with respect to retention of calcium and phosphorus.

The lambs receiving stack silage showed the lowest apparent digestibility of dry matter, nitrogen, and ash, and the lowest retention of nitrogen, ash, calcium, and phosphorus.

Beet tops had some laxative effect in all lots.

Nutrient Studies.

No appreciable difference was observed between beet tops in piles, in rows, under shelter, and trench silage in conservation of crude protein, calcium, and phosphorus during storage.

Stack silage showed a loss in crude protein and phosphorus.

Trench and stack silages were highest in ash and silica content followed by beet tops stored in field and under shelter respectively.

Beet tops stored under shelter on wire racks retained the greatest quantity of carotene.

RECOMMENDATIONS

Upon the basis of this study the following recommendations can be made regarding the methods of storage and efficiency of utilization of nutrients studied, when beet tops are used in lamb fattening rations.

1. Beet tops should be sheltered, provided only a small amount of tops are to be fed and space is available to shelter them in thin, flat layers to allow circulation about the tops.

2. For the commercial feeder, it would probably be advisable to store beet tops in small piles or in a trench silo depending upon facilities available. If beet tops are stored in the trench silo particular care should be taken to separate as much soil from the tops as possible.

3. When tonnage of tops is great and storage facilities are limited, stacked silage may be used, but greater nutrient losses and less efficient utilization of nutrients must be expected.

APPENDIX

Table No. XVI Analysis of 1941-42 Experimental Feeds

Trial No.	Sample No.	Sample	% D. M.* Original	Milligrams per gram of Dry Matter				
				Nitrogen	Ash	Calcium	Phosphorus	Silica
1	20	Yellow Corn	85.63	18.60	13.28	0.15	2.45	0.10
2	70	" "	85.99	18.82	16.92	0.15	3.30	----
3	146	" "	89.75	17.75	17.65	0.18	2.77	----
1	21A	Tops-trench silage	22.12	18.79	417.26	11.92	1.68	402.80
2	85A	" " "	19.77	23.36	271.07	8.78	1.78	----
3	141A	" " "	30.48	20.76	422.21	15.22	1.54	----
1	22A	Tops-stack silage	22.18	14.68	527.68	10.27	1.73	398.90
2	84A	" " "	18.31	16.63	397.88	9.64	1.82	----
3	142A	" " "	24.32	17.59	384.09	11.50	1.53	----
1	26A	Tops-in rows	32.63	23.20	221.31	8.48	2.27	115.90
2	83A	" " "	17.70	24.10	285.28	9.30	2.11	----
3	143A	" " "	46.30	23.66	336.49	13.40	2.26	----
1	27A	Tops-in piles	37.69	21.74	243.04	9.61	2.16	115.40
2	82A	" " "	25.69	24.85	242.64	10.15	2.18	----
3	144A	" " "	30.38	25.13	276.45	13.85	2.60	----
1	38A	Tops-in barn	56.84	22.92	180.50	8.94	1.91	----
2	81A	" " "	48.45	25.55	181.89	9.12	2.10	----
3	145A	" " "	60.77	22.31	191.68	11.21	1.73	----
1	21B	Crowns-trench silage	5.16	23.03	310.32	7.83	2.47	174.60
2	85B	" " "	12.95	22.23	168.27	3.93	2.01	----
3	141B	" " "	3.57	24.20	345.17	10.82	2.18	----
1	22B	Crowns-stack silage	5.07	21.11	302.70	8.64	2.05	174.90
2	84B	" " "	9.14	22.26	232.65	5.77	1.82	----
3	142B	" " "	8.50	20.27	298.74	10.62	1.92	----
1	26B	Crowns-in rows	20.05	18.48	102.91	4.57	2.54	46.80
2	83B	" " "	14.24	19.77	129.34	4.18	2.49	----
3	143B	" " "	22.74	30.08	225.05	7.03	3.68	----
1	27B	Crowns-in piles	18.26	18.29	99.52	4.91	2.20	44.00
2	82B	" " "	15.42	16.76	116.88	4.08	1.96	----
3	144B	" " "	17.98	24.28	203.08	6.04	3.22	----
1	38B	Crowns-in barn	24.65	19.39	102.60	4.24	1.93	----
2	81B	" " "	13.79	28.63	168.83	4.76	2.80	----
3	145B	" " "	19.40	22.04	141.60	6.18	2.05	----

*Relative percent of dry matter of the original beet top present in the form of dry matter in crowns and tops.

Table No. XVI Contd.

Trial No.	Sample No.	Sample	% D.M. Original	Milligrams per gram of Dry Matter				
				Nitrogen	Ash	Calcium	Phosphorus	Silica
1	23A	Refuse-tops-trench silage	37.74	11.07	705.91	8.37	1.40	532.00
2	87A	" " " "	29.76	16.66	491.59	9.97	1.66	------
3	148A	" " " "	46.24	11.40	715.26	11.97	1.26	------
1	24A	Refuse-tops-stack silage	33.65	12.67	683.87	7.64	1.71	527.10
2	86A	" " " "	39.27	12.10	705.95	8.48	1.70	------
3	147A	" " " "	47.99	14.76	603.26	11.79	1.67	------
1	25A	Refuse-tops-in rows	30.18	18.10	440.45	7.88	2.09	331.70
2	88A	" " " "	35.38	20.78	476.84	10.41	2.39	------
3	149A	" " " "	50.49	23.41	478.34	9.86	2.47	------
1	44A	Refuse-tops-in piles	33.42	17.11	422.01	9.94	1.74	------
2	90A	" " " "	33.71	16.38	539.75	9.24	1.90	------
3	151A	" " " "	46.10	19.73	470.67	10.67	2.07	------
1	45A	Refuse-tops-in barn	52.18	18.02	195.46	9.49	1.56	------
2	89A	" " " "	59.09	19.66	254.84	10.88	1.47	------
3	150A	" " " "	49.62	20.85	219.82	10.98	1.42	------
1	23B	Refuse-crowns-trench silage	2.44	17.18	563.60	13.29	2.05	405.20
2	87B	" " " "	7.26	24.35	252.29	9.05	2.82	------
3	148B	" " " "	0.94	21.24	482.57	12.92	2.07	------
1	24B	Refuse-crowns-stack silage	1.36	20.86	485.87	19.64	4.85	------
2	86B	" " " "	2.10	22.55	572.24	13.14	3.76	------
3	147B	" " " "	5.20	20.83	333.34	10.45	1.93	------
1	25B	Refuse-crowns-in rows	25.16	22.45	112.09	4.42	2.55	51.40
2	88B	" " " "	4.13	27.91	177.63	5.74	3.61	------
3	149B	" " " "	13.00	29.03	200.05	5.89	3.42	------
1	44B	Refuse-crowns-in piles	23.08	20.68	118.86	5.00	2.69	------
2	90B	" " " "	10.02	25.37	150.96	6.40	2.95	------
3	151B	" " " "	17.23	22.11	139.83	6.87	2.56	------
1	45B	Refuse-crowns-in barn	20.31	20.26	111.77	3.78	2.07	------
2	89B	" " " "	12.79	22.60	138.94	5.56	3.04	------
3	150B	" " " "	30.77	22.94	121.84	4.99	2.22	------

Table No. XVII Analysis of Feces 1941-42 Experiment

Trial No.	Sample No.	Sample	% D. M.	Milligrams per gram of Dry Matter				
				Nitrogen	Ash	Calcium	Phosphorus	Silica
1	28	Feces-lamb #1	26.77	32.29	499.49	18.87	6.49	350.6
2	71	" " "	32.62	27.98	483.06	16.63	5.52	-----
3	157	" " "	19.48	42.19	431.73	22.23	4.25	-----
1	29	Feces-lamb #2	21.84	35.12	499.47	18.36	6.96	-----
2	72	" " "	31.07	31.06	443.32	17.85	7.04	-----
3	158	" " "	27.66	36.36	409.58	20.95	5.36	-----
1	30	Feces-lamb #3	21.78	32.85	514.74	16.72	5.15	357.3
2	73	" " "	19.91	35.60	424.85	13.51	6.14	-----
3	159	" " "	21.83	30.03	474.02	19.57	4.29	-----
1	31	Feces-lamb #4	21.69	33.28	499.57	21.42	5.35	343.7
2	74	" " "	19.12	36.83	419.52	18.95	5.41	-----
3	160	" " "	22.54	30.83	467.13	20.10	4.18	-----
1	32	Feces-lamb #5	12.23	73.95	331.62	16.33	9.64	199.5
2	75	" " "	18.86	44.15	315.54	13.03	8.26	-----
3	161	" " "	20.66	48.08	310.68	13.67	7.12	-----
1	33	Feces-lamb #6	19.26	48.00	272.02	10.60	8.01	166.4
2	76	" " "	26.78	38.07	346.27	12.31	8.08	-----
3	162	" " "	21.37	46.67	306.29	15.05	8.29	-----
1	34	Feces-lamb #7	9.07	81.00	233.55	20.39	9.52	94.4
2	77	" " "	8.35	101.76	230.76	16.33	9.84	-----
3	163	" " "	12.89	63.04	215.98	15.52	----	-----
1	35	Feces-lamb #8	11.62	67.01	224.53	17.06	9.28	93.0
2	78	" " "	10.93	61.34	219.43	14.04	9.91	-----
3	164	" " "	16.18	56.91	218.06	16.50	9.16	-----
1	36	Feces-lamb #9	15.15	75.67	267.50	18.79	9.86	145.7
2	79	" " "	21.57	43.53	269.64	13.25	8.29	-----
3	165	" " "	22.59	43.71	326.63	18.35	8.31	-----
1	37	Feces-lamb #10	16.89	53.20	297.25	16.72	9.27	-----
2	80	" " "	13.09	63.09	317.98	15.91	9.28	-----
3	166	" " "	22.06	41.25	340.43	19.27	8.73	-----

Table No. XVIII Analysis of Urine 1941-42 Experiment

Lot No.	Lamb No.	Trial No.	Total Exc. Urine (gms)	Specific Gravity	pH	Milligrams per gram of Urine			
						Nitrogen	Ash	Calcium	Phosphorus
1	1	1	692.50	1.0478	8.85	6.18	40.5	0.0277	0.0124
		2	918.36	1.0511	8.92	5.43	40.2	0.0250	0.0138
		3	947.07	1.0510	8.74	3.92	41.4	0.1099	0.0177
	2	1	440.14	1.0612	8.76	7.90	36.0	0.0594	0.0221
		2	549.71	1.0610	8.85	7.14	50.3	0.0346	0.0233
		3	511.64	1.0595	8.88	5.17	49.3	0.0793	0.0223
2	3	1	909.36	1.0436	8.87	5.67	35.8		
		2	588.93	1.0503	8.82	7.70	41.8	0.0400	0.0166
		3	733.29	1.0528	8.85	5.73	43.8	0.0475	0.0142
	4	1	625.93	1.0513	8.70	6.17	47.1	0.0698	0.0235
		2	669.00	1.0559	8.56	6.52	45.9	0.0748	0.0269
		3	911.93	1.0560	8.82	6.44	47.9	0.0497	0.0157
3	5	1	369.07	1.0597	8.84	9.51	40.8		0.0498
		2	320.50	1.0526	8.70	8.86	37.3	0.0479	0.0390
		3	205.31	1.0602	9.02	8.09	48.0	0.0646	0.0462
	6	1	505.57	1.0613	8.77	10.20	50.4	0.0346	0.0367
		2	457.36	1.0547	8.65	11.67	40.3	0.0528	0.0309
		3	345.43	1.0717	9.00	11.54	55.2	0.0686	0.0355
4	7	1	608.21	1.0540	8.75	7.81	44.8	0.0299	0.0356
		2	489.36	1.0586	8.80	10.02	47.8	0.0565	0.0236
		3	536.79	1.0577	8.90	8.02	50.1	0.0298	0.0185
	8	1	612.50	1.0531	8.64	7.82	44.7	0.0299	0.0408
		2	560.86	1.0564	9.05	8.71	47.2	0.0497	0.0233
		3	736.43	1.0619	8.89	9.33	49.8	0.0546	0.0173
5	9	1	453.36	1.0633	8.79	9.28	50.3	0.0296	0.0371
		2	648.71	1.0397	8.77	6.85	26.4	0.0707	0.0315
		3	604.57	1.0528	8.89	7.94	36.9	0.0698	0.0490
	10	1	526.86	1.0594	8.55	8.26	50.3	0.0323	0.0325
		2	493.29	1.0578	8.55	11.05	45.4		0.0386
		3	514.00	1.0622	9.37	12.39	43.8	0.0692	0.0267

Table No. XIX Analysis of Experimental Feeds and of Feces 1942-43 Experiment

Trial No.	Sample No.	Sample	% D. M.	Milligrams per gram Dry Matter					
				Nitrogen	Ash	Ca	P	Mg	Silica
1	273	Yellow corn	82.51	17.41	16.4	0.44	3.39	1.47	1.4
2	310	" "	83.57	18.38	17.4	0.29	2.87	1.41	0.8
1	269	Tops-stack silage	27.26	15.83	411.3	12.10	1.42	7.57	284.9
2	311	" " "	36.93	14.17	437.3	13.92	1.36	7.27	296.2
1	271	Tops-in piles	50.02	20.27	330.0	9.64	1.46	7.21	170.0
2	313	" " "	56.55	17.31	380.1	10.08	1.34	7.91	254.9
1	270	Crowns-stack silage	17.17	18.24	250.1	9.04	1.83	7.10	121.7
2	312	" " "	21.09	16.67	248.1	10.18	1.78	9.16	108.9
1	272	Crowns-in piles	34.93	15.92	125.2	3.59	1.68	3.80	50.0
2	314	" " "	55.41	14.17	116.9	3.96	1.64	5.16	51.6
1	259	Refuse-Tops-stack silage	37.73	12.22	439.2	12.07	1.49	6.25	328.5
2	315	" " " "	42.23	13.82	481.0	12.63	1.39	7.30	340.4
1	261	Refuse-Tops-in piles	66.19	16.64	358.9	9.92	1.25	6.84	217.9
2	317	" " " "	65.66	14.24	507.3	13.21	1.28	8.18	351.8
1	260	Refuse-Crowns-stack silage	19.19	17.58	255.6	9.13	1.74	5.80	131.6
2	316	" " " "	22.39	14.40	298.3	6.30	1.47	7.57	158.8
1	262	Refuse-Crowns-in piles	48.49	14.95	119.8	3.77	1.55	3.82	47.8
2	318	" " " "	64.94	14.18	117.8	3.51	1.79	3.32	54.5
1	263	Feces-lamb #1	23.33	37.58	492.5	21.90	6.92	10.06	318.6
2	304	" " "	30.73	30.96	465.5	16.68	6.73	13.28	307.3
1	264	Feces-Lamb #2	27.31	32.20	497.3	23.01	7.10	13.99	335.2
2	305	" " "	30.63	31.10	497.3	21.91	5.57	11.02	330.4
1	265	Feces-Lamb #3	26.40	33.14	475.8	21.88	6.72	10.70	315.3
2	306	" " "	35.44	31.77	446.7	21.32	8.45	11.22	295.0
1	266	Feces-Lamb #4	24.77	35.01	267.5	11.47	8.41	8.52	158.6
2	307	" " "	28.35	30.19	426.4	19.45	5.32	11.71	289.5
1	267	Feces-Lamb #5	22.37	39.40	253.4	13.34	10.84	9.25	139.8
2	308	" " "	31.20	37.59	282.0	12.40	9.58	10.26	175.9
1	268	Feces-Lamb #6	20.31	57.25	305.7	14.87	9.03	11.00	180.4
2	309	" " "	23.46	41.52	350.2	12.73	7.27	----	223.0

Table No. XX Analysis of Urine 1942-43 Experiment

Lot No.	Lamb No.	Trial No.	Total Exc. Urine (gms)	Specific Gravity	pH	Milligrams per gram of Urine				
						Nitrogen	Calcium	Phosphorus	Magnesium	Silica
1	1	1	495.52	1.0574	8.65	7.34	0.0317	0.0378	0.9373	0.09
		2	500.48	1.0606	8.78	6.89	0.0674	0.0710	1.0640	0.38
	2	1	530.62	1.0529	8.64	6.97	0.0606	0.0368	0.9245	0.07
		2	639.86	1.0572	8.72	6.85	0.0315	0.0265	1.0061	0.28
	3	1	388.62	1.0564	8.86	5.79	0.0709	0.0147	0.4273	0.13
		2	425.45	1.0618	8.70	8.91	0.0268	0.0287	1.2346	0.21
2	4	1	551.62	1.0495	8.75	5.41	0.0512	0.0317	0.9275	0.08
		2	685.67	1.0513	8.91	4.96	0.0321	0.0212	0.8401	0.26
	5	1	443.57	1.0553	8.82	5.88	0.0470	0.0595	0.9224	0.04
		2	387.86	1.0604	8.62	7.41	0.0358	0.0370	1.0438	0.28
	6	1	673.05	1.0494	8.77	4.19	0.0354	0.0260	0.8285	0.08
		2	433.33	1.0520	8.89	5.47	0.0316	0.0299	1.0372	0.26

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