THESIS

on

A Comparison of Kale and Corn Silage in the Dairy Cow's Ration

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INTRODUCTION

Succulence has for a long time received merited recognition in the satisfactory compounding of dairy cattle rations. Dairymen have been continuaàly striving to imitate pasture conditions throughout the late fall, winter, and early spring by introducing various silage and soilage crops into their feeding systems.

In those sections of the United States where dairying is the chief enterprise, where the size of the individual herd warrants a silo, and where the land is rich and the growing season long and warm, corn silage has been found most economical and practical as a source of needed succulence.

Throughout Western Oregon, particularly in the Willamette Valley section, climatic and soil conditions are not favorable to high yields of corn silage. This fact, coupled with the relatively small size of the individual herd of dairy cows in the state, has made a silo impractical in a great many instances. The problem naturally presents itself as to the best method of remedying this condition.

Thirty-eight years ago, Mr. Richard Scott, of Milwaukie, Oregon, introduced into the Willamette Valley the first plantings of Thousand-headed kale. Since that time the acreage of this green, succulent, and high-yielding soilage crop has been gradually increasing. The acreage of kale in the State of Oregon at the present time is approximately 7,500 acres, on a total of 15,000 farms--an acreage per farm of one-half acre.

Dairymen have frequently inquired as to the relative feeding values of corn silage and kale, fed alone and in combination. The demand seemed to be prevalent for experimental work along this line.

In order to determine the comparative feeding values of corn silage and Thousand-headed kale, alone and in combination, a series of experiments that covered four years, 1925-1926, 1926-1927, 1927-1928 and 1928-1929, have been carried out at the Oregon Agricultural Experiment Station.

HISTORICAL REVIEW

Comparative Compasition of Kale and Corn Silage--

The following tables (I and II) give the average percentage composition of kale and corn silage, as determined by various investigators:

Table I

Average Percentage Composition of Kale

D.M.	Ash	Protein	Fiber	N.F.E.	Fat	Reference
11.3	1.90	2.40	1.50	5.00	0.50	Henry and Morrison---(1)
11.3	1.84	2.40	1.54	4.98	0.53	Withycombe and Bradley----(2)
12.8	1.70	1.60	2.80	6.40	0.30	Bond----------(3)
11.3		1.90		4.70	0.30	British Columbia---(4)
11.3	1.85	2.40	1.54	4.98	0.53	Kent and Stockwell--(5)
12.2	1.39	2.38	1.87	6.18	0.38	Jones and Brandt-----(6)

Table II

Average Percentage Composition of Corn Silage

D.M.	Ash	Protein	Fiber	N.F.E.	Fat	Reference
26.30	1.70	2.10	6.30	15.40	0.80	Henry and Morrison---(1)
18.92	1.19	1.74	4.23	10.75	1.01	Withycombe and Bradley----(2)
26.04	1.49	2.23	5.32	16.40	0.64	Jones and Brandt-----(6)
25.31	1.35	2.27	5.27	15.74	0.70	Jones and Brandt-----(7)
29.72	1.50	2.45	7.19	17.71	0.87	Kentucky-------(8)
29.45	2.34	2.13	7.85	15.72	1.42	South Carolina---(9)
26.93	2.06	2.69	5.72	15.75	0.71	California----(10)

The striking feature of these tables is the apparent contrast between the two succulents in percentage of dry matter. There is approximately two and one-third times as much dry matter in one hundred pounds of silage as there is in a similar amount of fresh kale.

It is evident from Henry and Morrison's (1) analyses figures that over 21% of the dry matter in kale is crude protein and almost 17% of the dry matter is ash. These figures are in direct contrast to 7.98% crude protein and 6.46% ash in the dry matter of corn silage. One

can readily see from these figures that kale contains relatively large amounts of crude protein and ash.

The variance of Bond's (3) figures from others given in Table I, may be partially accounted for by the difference in variety of kale analyzed and difference in the environment under which the experimental plants were grown. His analyzed were made on Marrow-stem kale, grown in Great Britain.

Jones and Brandt (6) found that approximately 19.5% of the dry matter of Thousand-headed kale, grownin the Willamette Valley, was crude protein, and that almost 11.5% of the dry matter was ash. They also emphasized the fact that there was a relatively wide range in dry matter between kale and corn silage.

Feeding Trials Comparing Kale and Corn Silage--

Primrose McConnell (11), writing of a Monmahaki Experiment in the Journal of New Zealand Department of Agriculture, gives some rather interesting data on feeding trials with kale under the conditions of New Zealand. An experiment has been carried out at the Monmahaki Experimental Farm at the request of the Eltham branch of the New Zealand Farmer's Union. The object was to discover the fodder most favorable for tiding the cows over the dry season without the labor and expense

of cutting and hauling off, as is necessary when maize is grown.

The feeding of the fodder was carried out for 36 days. The milk yield was weighed morning and night. Each fodder was fed to the same cows for a period of six days at a time only, so as to eliminate the effects of a change of weather as far as possible. At the end of each six days, the cows were immediately started on a different fodder. The weight of the milk during any of the six days on each of the fodders was an average of the last three days only, as the first three days were more or less under the influence of previous feeding. The fodders were carted off and fed to the cows immediately after the morning's milking, each cow receiving about 70 pounds.

The average daily milk production on Bhuda kale was 25.6#, on Thousand-headed kale 25.3#, and on rape 24#. The Bhuda kale gave slightly higher average milk yields, but at the same time gave much lower yields per acre. Taking all the good and bad points of the fodders and blancing them, the author stated that Thousand-headed kale undoubtedly stood at the top, as far as this particular experiment was concerned, as it gave the second highest average yield of milk, the highest yield of fodder per acre and proved itself more resistant

to droughts and parasites.

The most interesting point in McConnell's conclusions was his statement that "none of the three fodders used in this trial could compare with maize or millet, even taking into consideration the heavier drain on the soil by maize, and the fact that it must be cut and hauled off." When the experiment with the three fodders was brought to a close the cows were immediately put on maize. The effect was magical, according to McConnell, for in two days there was an increase in the daily average milk yield per cow of 2½ pounds. The New Zealand data does not indicate, however, how lasting this apparent increase on maize actually was, or whether some other contributing factors might have played an important part in causing this initial increase in milk flow when first placed upon maize.

Graves (12), at the Oregon Station, carried out an experiment comparing kale and corn silage as to their relative feeding values in the dairy cow's ration. Three groups of cows were fed, and the experiment was carried out in three periods. During the first period all of the three groups received a basal ration that consisted of oat and vetch hay, kale, and a grain mixture of 4 parts dried beet pulp, 3 parts alfalfa-molasses meal and one part oil meal. During the second period one-half

of the digestible nutrients fed in the form of kale to Group 1 were replaced by a like amount of digestible nutrients in the form of corn silage, while all of the digestible nutrients fed in the form of kale to Group 3 were replaced by a like amount in the form of corn silage. The substitutions were made on a dry matter basis, there being approximately two-and one-half times the amount of dry matter in a pound of corn silage as in a pound of kale. Group 2 continued on the basal ration as in the first period. During the third period, all three groups received the basal ration. The following data shows the average production of each group during each period:

Table III

Ave. Production	Group	Period	Lbs. Milk	Succulence
" "	I	I	17.2#	All Kale
" "	I	II	16.9#	½ Kale ½ Silage
" "	I	III	17.0#	All Kale
" "	II	I	23.8#	All Kale
" "	II	II	23.7#	All Kale
" "	II	III	24.1#	All Kale
" "	III	I	24.6#	All Kale
" "	III	II	22.5#	All Silage
" "	III	III	21.9#	All Kale

Table III seems to indicate that the milk flow was maintained somewhat better when the succulence was either all kale, or one-half kale and one-half corn silage. However, the relative value of the two feeds as a stimulant to the milk flow was not equal according to the author, when it was considered that two and one-half pounds of kale were fed to each pound of corn silage. The author also concluded that silage would be found the more economical for milk production in most localities.

Kent and Stockwell (5) conducted an experiment at the Oregon Station to determine if the digestible dry matter of kale would largely replace that of a grain ration of bran and shorts. Two lots of three cows each were selected from the college herd and placed under the same conditions, other than the amount and kind of feed they received. The animals were selected with regard to size, amount of milk they were producing at the time the experiment started, fat content of the milk, and stage of lactation.

The basal ration consisted of 15# vetch hay, 7# bran and shorts, equal parts by weight, and 30# kale. The experimental ration was the same except that the kale was increased one pound per day for 45 days and for every five pounds increase in the amount of kale fed, the grain was decreased half a pound. This kept the amount of

digestible dry matter approximately the same for both rations. Group 1 was fed the experimental ration and Group 2 the basal ration. After the kale had been increased to the extent that Group 1 would not consume any more, they were held at this point for seven days and milk and butter sampled.

Group 1, on the experimental ration, produced a total of 5,258# milk and 295.94# of fat in the eleven weeks period, and Group 2, on the basal ration, produced 5,519# of milk and 226.53# of fat in the same time. Group 1 decreased on an average of 13.18# of milk per week and 0.72# fat per week for the period, while Group 2 decreased on an average of 7.9# of milk per week and 0.45# fat per week for the eleven weeks.

The authors concluded from this data that the entire grain ration could not be replaced with one of kale, even though the kale contained as much digestible nutrients.

It is to be noted that only six cows were used in this trial, and that Group 1 evidently excelled Group 2 in butter-fat production by a wide margin, even prior to the test. When this fact is recognized, the wide spread in production of butter-fat between the two groups while on this trial can partially be explained.

Effect of Kale on Flavor and Odor of Milk and Butter--

Milk--Menze (13), without showing experimental data, advises strongly against feeding kale prior to milking, but thinks feeding after milking is the only safe way to avoid tainting and to prevent feed flavors in the milk.

McConnell (7) fed an average of 70# of kale to cows immediately after milking. A pronounced unpleasant feed flavor was produced both in the milk and in the butter. The butter was a very inferior product.

Graves (12) found that when kale was fed two hours before milking that a distinct flavor was noticeable in the milk.

Kent and Stockwell (5), in a series of tasting tests, involving 390 separate samples judged by men of the department, other faculty members, and students showed that kale when fed after milking, did not affect the flavor of the milk. There were a great many who expressed their opinions as to which milk they preferred, but none were able to detect a feed flavor.

Babcock (14), at the Government Station, Beltsville, Maryland, found that the consumption of 14.8# of kale out of 15# fed before milking produced an abnormal flavor and odor in the milk. The consumption of 22.8# of kale out of 30# fed just one hour before

milking, increased the abnormal flavor of the milk to a considerable extent. Practically no effect on either the flavor or odor of the milk was produced when the average consumption immediately after milking was 22.8# of kale out of 30# fed. These results were based on 886 opinions on 174 samples of milk. At the time of feeding, in this case, the kale was 15 to 18 inches in height and had not as yet headed. The variety used was Thousand-headed kale.

Butter--Kent and Stockwell (5) accompanied their kale experiment with a trial to determine if kale produced off flavors in butter. They proved rather satisfactorily under the conditions of their experiment that when kale was fed after milking with reasonable care, it did not impart any characteristic or objectionable flavors. It was found that 28.3% of those tasting the butter samples actually preferred the heavy kale butter; 29.2% the light kale butter, and 42.5% had no choice at all.

Factors Concerned in Growing--

Temperature--Hyslop (15) states that under the average conditions in Western Oregon, kale will survive when covered with snow. When not provided with a snow cover kale will be injured by a temperature of 13

degrees above zero Fahrenheit.

Soil--Workers at the Oregon Station (16) recommend for the best results with kale, a deep, well-drained, rich loam soil, throughly tilled, and heavily manured. A long narrow, slightly sloping field, running along side of a piece of sod ground, or a wide sodded fence row, or one of the farm lanes, is preferable, as the hauling may then be done on the firmer ground during the wet winter weather. The kale ground should preferably be fall plowed, but can be plowed in the spring after being heavily manured during the winter. Transplanting ordinarily can be done to the best advantage during the month of June. Plants to be transplanted are grown from seed planted in narrow drill rows during late March or early April. Sandy loams are good for the seed bed from which the plants are removed for transplanting, as the roots come out in entirety with small loss of the plants after setting out.

Cost per acre and ton--Selby (17), after making several years study of conditions in the Willamette Valley, states that the net cost of kale per acre was $68.48, the average yield 18.1 tons, and cost per ton $3.78. This in comparison to corn silage at a net cost per acre of $42.23, average yield 5.7 tons, and net cost

per ton $7.40. Heavy labor charges of man and horse types bring the net cost per acre of kale up fairly high, but the high yields per acre cut the price per ton down to a considerable extent.

4
Special Values of Kale in Nutrition--

Effect of Kale on Mineral Metabolism--Brandt, Miller and Jones (18) made a quantitative study on the balance of nitrogen, sulphur, phosphorous, chlorine, calcium, magnesium, potassium, and sodium with three liberally milking cows during the early lactation period. They were receiving a ration of red clover hay, oats and vetch silage, and grain. In the second period, two cows received this basal ration plus bone meal, and the third cow was given the basal ration plus kale.

Each of the cows lost significant amounts of calcium and phosphorous from their body supply when on the basal ration. When bone meal was added to the ration, the animals stored calcium and phosphorous so that the negative balances were changed to positive.

Kale alone increased the milk flow and the absorption of total solids from the intestine. Negative phosphorous balances were changed to one of phosphorous equilibrium and maintained accordingly while the kale was fed.

The changing of the negative phosphorous balance to one of maintaining a phosphorous equilibrium through the feeding of green kale seemed to be very noticeable. This apparently was due to some specific effect of the green feed, as examination of the data shows that it could not be explained entirely on the basis of increased phosphorous intake. In comparing the digestibility of phosphorous during the two periods it was observed that during the kale period, 38.6% of the phosphorous was absorbed from the intestine as compared to 28.1% during the period when kale was not fed.

Though there was greater calcium assimilation, a positive calcium balance was not obtained through the feeding of this green feed; perhaps the absence of a calcium supplement did not produce ideal conditions for calcium absorption. The greater absorption of calcium could possibly be accounted for by the increased plane of calcium intake and general increase in metabolism.

From the observations of the authors--kale was superior to green pasture or silage in causing an increase in milk yield. Kale in this trial evidently caused a higher proportion of potassium to be absorbed from the alimentary tract, but the increased urinary potassium led to a negative balance.

High Iron Content of Kale--

Iron has been found to be a very essential element in normal nutrition of animals by Sherman (19), Waddell, Elvehjem, Hart, and Steenbock (20), and Whipple and Robscheit-Robbins (21).

As a carrier of oxygen, and as an activator of cell functions, iron has significance out of all proportion to the normal amount found in the body.

Rose (22) gives the following comparative share make-up of milk, and two green, leafy foods known to contain large amounts of iron:

Table IV

Food Material	Weight (Grams)	Protein Shares	Calcium Shares	Phosphorous Shares	Iron Shares
Milk	144.5	1.90	7.56	3.05	0.70
Kale	434.8	5.91	40.08	5.93	26.09
Spinach	418.4	3.51	12.22	6.48	30.12

The above table shows kale to be unusually high in both iron and calcium, having nearly as much iron, and calcium to the extent of three times the amount found in spinach. Kale also has twelve times as much iron as does milk.

Pregnancy and lactation make special draughts on the iron supply of the body. Sherman (19) estimates that in the case of human nutrition the iron requirement is increased three milligrams per day. He concluded that a suitable iron allowance for pregnancy and lactation in humans would be 20% above the ordinary requirements.

According to Sherman (19), the efficient use of iron depends on a liberal supply of calcium in the body--a large amount of calcium in the feed along with iron insures iron economy. In kale, we have a green, leafy plant, rich in both iron and calcium--elements necessary for normal nutrition and especially essential during pregnancy and lactation in all species.

A Large Proportion of Protein in Kale is Digestible--

Withycombe and Bradley (2) secured data indicating that a large proportion of the protein in kale is digestible, an average of 80.63% being obtained from four tests with cattle. The percentage of digestibility of the other constituents is also normal or above, with the exception of the ash, which they found to be present in excessive amounts in kale. They found that the ash content of the feces of each animal gradually increased during each successive day of the experiment.

Vitamin A and Vitamin D Content of Kale--

Golding, Soames and Zilva (23) used six dairy Shorthorn cows from the herd of the National Institute for Research in Dairying at Reading, Great Britain, for their 1925-1926 experiment to check the hypothesis that the presence of green fodder in the ration of a cow increased the vitamin A content of the milk, whereas it had only a slight effect on the anti-rachitic factor.

The animals were divided into three groups but the milk from each cow was kept separate. Up until the time of the start of the trial, the cows were placed on a basal ration of mangolds, oat straw and a meal mixture. One group continued on the basal ration, another received kale instead of roots, while the third group received the basal ration plus a daily dose of cod-liver oil. The cod-liver oil dose was started at 2 oz., was increased after 8 days to 4 oz., after another 19 days to 6 oz., and the final dose of 8 oz., was given after an interval of 21 days, and continued to the end of the experiment.

The cows were kept in well ventilated stalls where the access of light was very poor and exposure to direct sunlight was excluded. The animals were milked twice daily, and their walk from their stalls to the milking shed was their only exercise.

The results show that by administering cod-liver oil to cows kept on a diet rigorously restricted in the fat-soluble vitamins during the winter, the vitamin A and D content of the butter was greatly enhanced. On the other hand, when this basal diet was supplemented with kale, there was an increase in the vitamin A content of the butter but the anti-rachitic value remained unaltered.

Their experiment was instituted with the definite purpose of demonstrating the differential influence of the feeding of cod-liver oil and of kale to cows during the winter in the anti-rachitic potency of the butter, and consequently extreme diets were chosen independently of their practical application.

The results of this work are directly in line with the results secured by Chick and Roscoe (24) and Luce (25). The former authors concluded after a series of experiments that the vitamin A content of milk is at its maximum when the cow is on fresh green food (pasture or grass) and least when on winter feed of cereals and roots. They stated that the anti-rachitic property of milk depends on sunlight and that they had found from experiments that the vitamin A content does not depend on sunlight. Luce (25) in her trials found that the diet was the main factor influencing the growth promoting

value of milk. A cow receiving fresh grass has milk possessing a higher growth promoting value than a cow fed upon dry fodder which is deficient in fat-soluble vitamins. The anti-rachitic value also depends upon the diet of the cow according to Luce's results. The milk from a pasture fed cow had a definitely higher anti-rachitic value than milk produced when she was kept in a dark stall and fed green grass.

Nitrogen Allotted to the Diamino Acids and to Proline and Oxy-proline in Kale is Fairly High--

Davies (26), at the Cambridge School of Agriculture, found the natural Order Cruciferae afforded a means of developing the study of the difference in the protoplasmic proteins of plants not only within a genus, but also of differences possible within a species. Thus, proteins were studied from the following varieties of the cabbage species (Brassica oleracea L.): Marrow-stem kale (Brassica oleracea var.) from stems and leaves separately, Kohl Rabi (Brassica oleracea var. caulo-rapa). Also, the proteins from the leaves and roots, respectively, of white turnips (B. napo-brassica) were isolated and studied.

The distribution of nitrogen in the samples were carried out in duplicate, and the results obtained are tabulated in Tables V and VI:

Distribution of Nitrogen in some Plants
of the
Brassica Species

(Percentages of Total Nitrogen)

Table V

Plant	Extracted N.%	Pro.N. %	Amino N. %	Other N. %	Unext. N.%
Cabbage	84%	21%	9.3%	53.7%	16%
Kohl Robi	90%	10%	8.6%	71.4%	10%
Kale Leaves	91%	14%	9.7%	67.3%	9%
Kale Stems	60%	10%	8.3%	41.7%	40%
Turnip Leaves	95%	29%	10.2%	55.8%	5%
Turnip Roots	69%	13%	8.8%	47.2%	31%

Table VI

Coagula From	Amide N.%	Humin N.%	Argi-nine N.%	Hist-idine N.%	Lys-ine N.%	Cys-tine N.%	Amino N. of Fil-trate
Cabbage	7.49	3.82	13.33	8.29	7.55	1.18	47.05
Kohl Robi	6.57	5.43	14.45	8.37	7.23	1.26	46.91
Kale Leaves	6.90	3.66	14.72	8.02	7.78	1.35	47.14
Kale Stems	7.53	5.29	15.10	7.56	6.91	0.98	46.97
Turnip Leaves	6.95	5.17	13.67	8.63	7.52	1.02	49.30
Turnip Roots	6.77	5.04	15.17	7.23	8.86	1.01	46.81

Examination of these tables show that the coagulable protein in the juices of these plants have practically identical distribution of nitrogen and the nitrogen allotted to the diamino acids and to proline and oxy-proline is fairly high. It was evident that the amounts of these acids present in the Brassica oleracea proteins were quite large. Just what significance this latter fact may have in the nutritive value of kale has yet to be determined.

EXPERIMENTAL WORK

Factors Involved in the Problem of Kale vs. Corn Silage--

1. Comparative Feeding Value--Based on milk and butter-fat production and gain or loss in body weight.
2. Most economical amount of kale to feed.
3. Effectiveness of a combination of the two feeds.
4. Effect on products--milk and butter.

Four feeding trials have been carried on at the Oregon Experiment Station during the years from 1925 to 1929 inclusive, with one or more of these factors in mind. Discussions of the experiments by years follow:

Experiment I--1925-1926

Object of experiment--

The object of the initial experiment was to determine as nearly as possible the value of kale as a supplement or part of the dairy cow's ration in contrast to corn silage. Kale was found to be a common crop grown in Western Oregon and utilized quite extensively in the feeding of dairy cattle. No conclusive tests had hitherto been carried out to show its actual feeding

value when compared with corn silage. Practical dairymen contended that corn silage could not take the place of kale for milk production.

Plan of experiment--

Twelve cows were selected and divided into two groups, A and B, as nearly equal as possible on the basis of breed, age, stage of lactation, stage of gestation, and milk and butter-fat production.

Both groups received alfalfa hay, and a grain mixture of two parts barley, two parts oats, and one part of cocoanut meal. The amounts of hay and grain fed remained the same throughout the trial.

After a preliminary period of seven days, the cows in Group A were fed corn silage for 4 weeks. Following a transition period of a week, they were given kale on a pound for pound basis for the second 4 weeks period. They were then returned to the original silage ration for the final four weeks of the trial, after allowing a week as a change period.

The cows in Group B were fed kale for four weeks after allowing 7 days as a preliminary period, and were then changed to corn silage on the basis of 7 pounds of corn silage for each 8 pounds of kale fed during the first period. Following a transition period of 1 week, the group was then returned to the original kale ration.

The ration of each cow was balanced at the start of the test according to her nutritive needs. In order to have a basis for comparision it was planned to feed the same amount of dry matter in the form of kale and of silage throughout the experimental trial. According to Henry and Morrison's (1) analysis, there is approximately two and one-third times as much dry matter in silage as in kale, consequently it was planned to feed as large an amount of kale as the cow would consume and the change to corn silage made on the dry matter basis. However, analyses made early in the trial indicated that the kale was much higher in dry matter and the corn silage much lower in dry matter than normal. Therefore the original plan of feeding on the dry matter basis according to the analyses of Henry and Morrison was altered and the feeds fed on the dry matter basis according to this new analyses.

Accurate records of feed given and consumed were kept throughout the entire trial. The amount of milk produced was carefully weighed and recorded. Butter-fat tests were made at the beginning of the trial and every two weeks thereafter. The cows were weighed on three consecutive days at the start and the end of each experimental period. Observations were made daily to note any abnormalities appearing in any

of the experimental animals.

Discussion of Data--

The following summary table (Table VII) shows the average amount of succulence consumed, dry matter consumed, and milk and butter-fat produced by each group by periods.

Table VII (Cont.) shows the average number of pounds of the two feeds required to produce one pound of milk, pounds of milk produced for every pound of dry matter consumed, pounds of feed required to produce one pound of butter-fat, pounds butter-fat produced for every pound of dry matter consumed, and the net gain or loss in weight per group per period.

Table VII is interesting, in that it shows the production of two groups of cows--one fed normal amounts of corn silage and kale, and the other group fed more than twice the amounts of succulence given the first group. This table plainly indicates that Group B was over-fed on both silage and kale.

Taking Group A as the normal fed group, we find that the pounds dry matter consumed was greater in the case of the silage periods, but the production of milk and butter-fat was greater on kale.

Table VII

Feed	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
Group A				
Corn Silage--Per.1	3,343	527.55	3,467.1	134.23
Kale---------Per.2	3,750	441.76	3,724.5	158.48
Corn Silage--Per.3	3,436	821.88	3,865.8	164.22
Ave. Periods 1 & 3	3,389	674.71	3,666.4	149.22
Group B				
Kale---------Per.1	9,058	1066.99	4,640.4	195.19
Corn Silage--Per.2	7,864	1722.68	3,964.1	177.54
Kale---------Per.3	9,212	1075.18	3,772.8	174.34
Ave. Periods 1 & 3	9,135	1071.08	4,206.6	184.76

Table VII (Cont.)

Feed	#Feed to 1# Milk	#Milk to 1# D.M.	#Feed to 1# B.F.	#B.F. to 1# D.M.	Weight Change
Group A					
Corn Silage--Per.1	0.964	6.572	24.90	.254	89
Kale---------Per.2	1.000	8.431	23.02	.358	96
Corn Silage--Per.3	0.888	4.703	20.92	.199	44
Ave. Periods 1 & 3	0.926	5.637	22.91	.2265	22.5
Group B					
Kale---------Per.1	1.952	4.349	46.46	.182	178
Corn Silage--Per.2	1.984	2.301	44.29	.103	106
Kale---------Per.3	2.440	3.509	52.83	.162	127
Ave. Periods 1 & 3	2.195	3.929	49.64	.172	25.5

In the case of Group B, the over-fed group of cows, the table shows that the average consumption of dry matter was higher on silage than on kale, but the production of both milk and butter-fat was higher on kale. The table also indicates that doubling the amounts of succulence caused an increase in production. The increase in production resulting from the heavy feeding of kale more than off-set the cost of the additional kale fed to this group. The feeding of large quantities of kale in this case was considered economical. However, it was not economical to feed such large quantities of corn silage, since the increase in production did not warrant such heavy feeding.

Tables I and II in the Appendix give the individual, average and total milk and butter-fat production and feed consumption, and net gain or loss in weight. They show that during the kale periods the average production per cow was 713.9 pounds of milk and 31.06 pounds of butter-fat in contrast to 705.0 pounds milk and 29.75 pounds of butter-fat produced on corn silage.

In the case of Group A, the group normally fed, there is very little difference between the two feeds in respect to the number of pounds required to produce one pound of milk. More milk was produced per

pound dry matter on kale than on silage. The amount of feed that was required to produce one pound of butter-fat was nearly the same. The pounds of butter-fat produced per pound of dry matter consumed was half again as much on kale as on silage. The gain in weight of 96 pounds on kale was in sharp contrast to a loss in weight of 22.5 pounds on corn silage.

Group B, the over-fed group, gave results indicating that a trifle more kale than silage was needed to produce one pound of milk. In this case the amount of succulence fed was double that fed Group A. Cows receiving kale produced almost double the amount of milk per pound of dry matter consumed as they did when fed corn silage. It required a trifle more kale than silage to produce one pound of butter-fat, but the pounds of butter-fat produced per pound of dry matter consumed was greater on kale. It will be noted in Table VII (Cont,) that Group B showed a gain in weight of 116 pounds when fed corn silage, but lost 26.5 pound in weight when fed kale. This is in direct contrast to the results shown by Group A fed smaller amounts of kale and corn silage. Heavy feeding of succulence in the form of kale seemed to cause a loss in body weight, while heavy feeding of corn silage resulted in a gain in body weight.

Charts I and II, derived from Tables X and

CHART I

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1925-1926
Group B

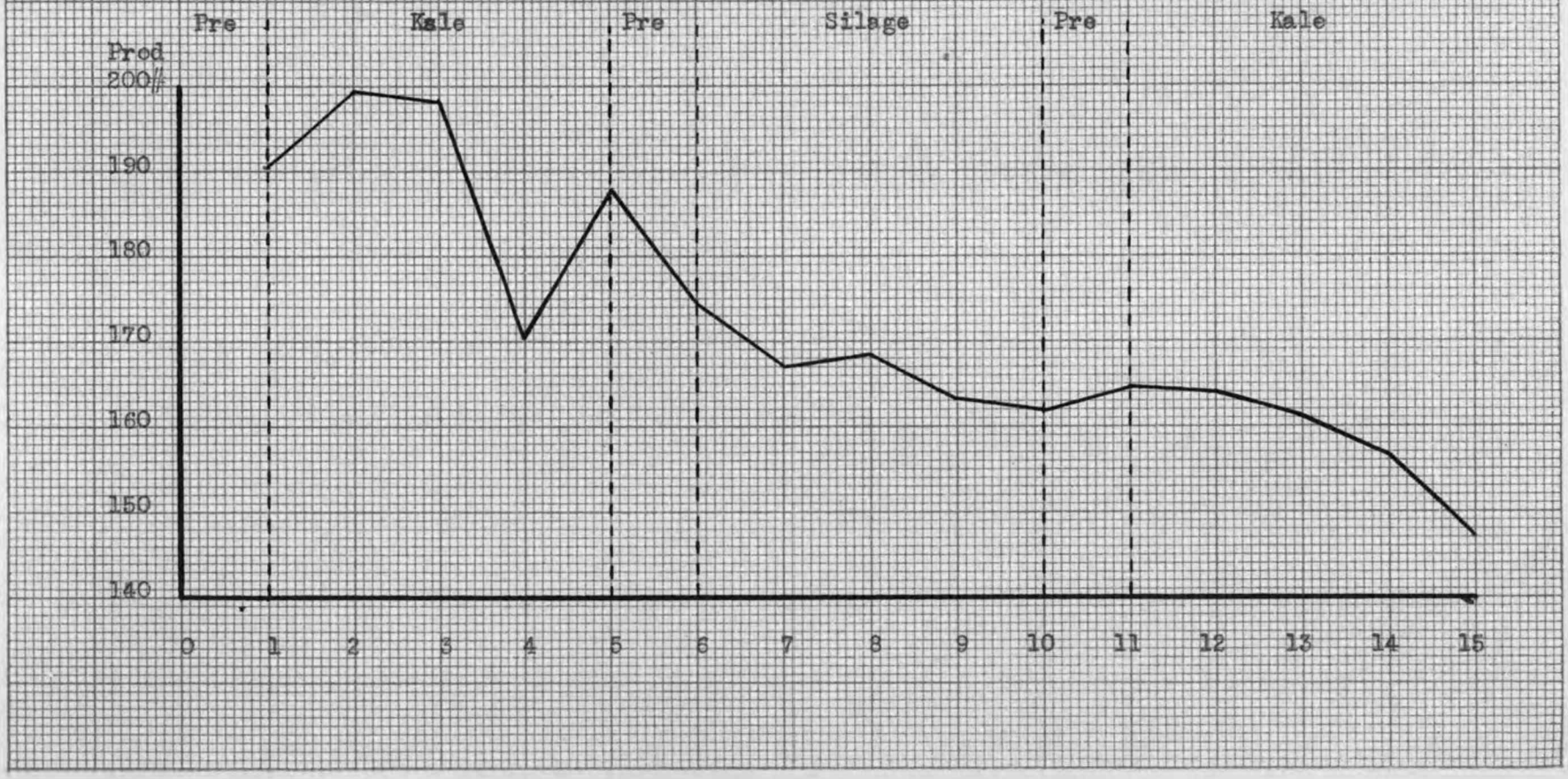
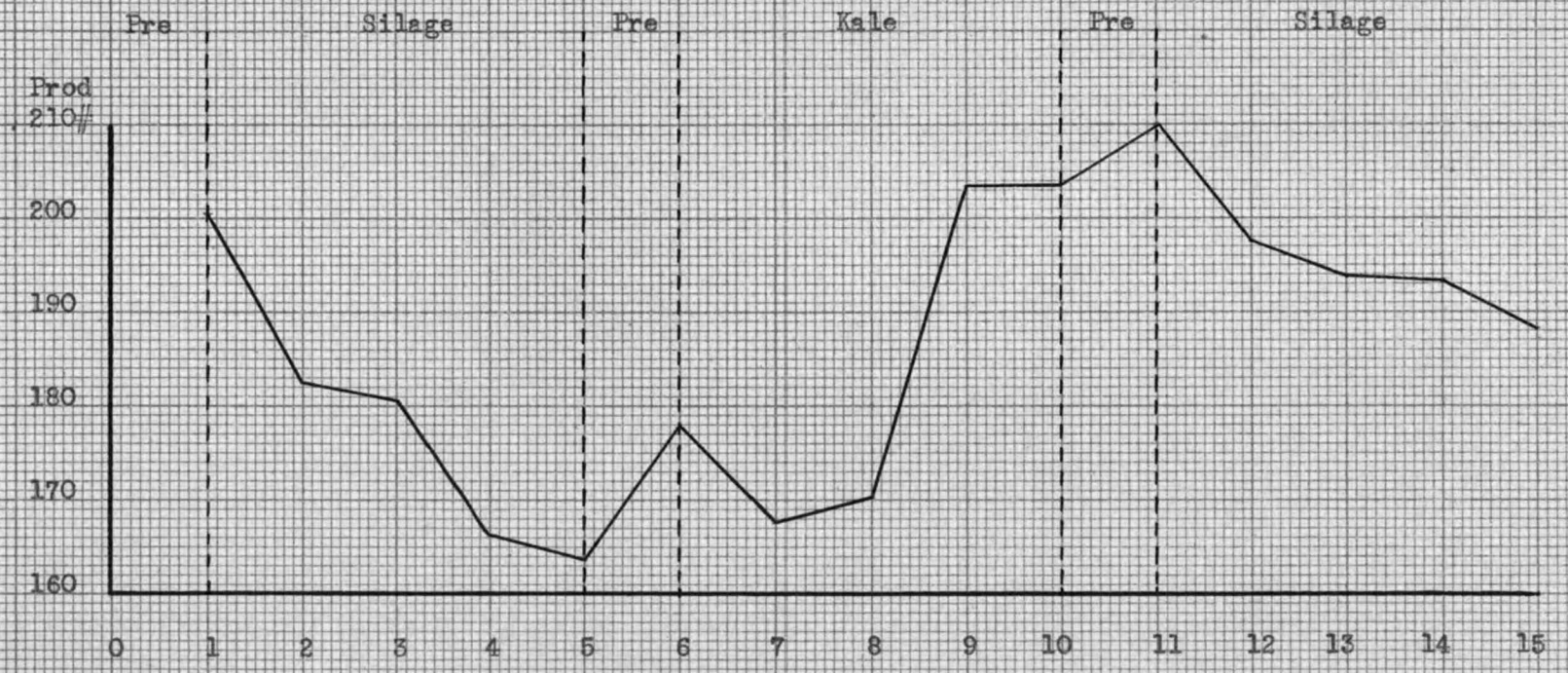


CHART II

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1925-1926
Group A



Note--Cow 232 replaced Cow 218 at end of 8th week

XI in the Appendix, give the plotted average weekly milk production of all animals included in the experiment and show the trend of production throughout the entire trial, including the production during the preliminary periods. In the case of the kale groups, the average decline in milk production from the first week to the fourth week of the period was 5.43%. In the case of the corn silage group, the decline was 6.17%. These figures indicate a tendency for the cows to decline faster during silage periods than during kale periods.

Tables XIX, XX, XXI, and XXII in the Appendix, give the mean production, standard deviation, probable error of the mean, and the true mean production of milk and butter-fat for all the kale and for all the silage periods of the 1925-1926 trial. The true mean of the milk production during the kale periods was 713.97# ± 33.12# in contrast to 706.0# ± 38.58# for corn silage. The figures for the true mean of the butter-fat production on kale was 31.06# ± 1.24# in contrast to 29.75# ± 1.38# for corn silage. These figures were worked out for the purpose of checking the foregoing figures and in order to determine if the results secured were significant. In all cases the spread between the mean and probable error was great enough to make the results significant.

Summary of the experiment--

The results of the 1925-1926 trial seemed to indicate that one pound of kale was about equal in feeding value to one pound of corn silage. However, it must be pointed out that the kale used in this trial was a great deal higher in dry matter than normal, while the corn silage was considerably lower than normal in dry matter.

The feeding of large quantities of kale resulted in an increased production. This production was economical in the case of heavy feeding of kale. The feeding of large amounts of silage resulted in an increase in production that was not economical.

Kale appears to have a higher feeding value than its dry matter analysis indicates, from the results secured in the 1925-1926 experiment.

Experiment II--1926-1927

Object of experiment--

The object of the second year's experiment was identical in all respects to that of the first year's work, namely, the comparison of kale and corn silage as to feeding value for dairy cattle.

Plan of experiment--

Fourteen cows were selected and divided into two groups as equally as possible on the basis of age, breed, stages of lactation and gestation, and milk and butter-fat production.

All of the cows received clover hay, which had been chopped into a silo, and grain, according to the amount of milk produced. The grain mixture consisted of equal parts of barley, oats, mill-run, and cocoanut meal. They amounts of hay and grain fed remained constant throughout the trial.

The cows in Group A were fed kale for a period of four weeks following a preliminary period of seven days, and were then changed to corn silage for a second period of 28 days. A week was allowed for the changing from kale to corn silage.

The cows in Group B were fed corn silage

for a period of four weeks following a preliminary period of one week. After a trnasition period of one week, changing from corn silage to kale, they were continued on kale for four weeks. The ration of each individual cow was determined at the start of the test and kept the same throughout the trial, except for the change from one succulent feed to another.

Accurate records of milk production, feed given and consumed, weights at the start and at the end of the experimental periods, and butter-fat tests were kept. Butter-fat tests for a 24 hour period were made every two weeks. Daily observations were made on all animals and any abnormal conditions noted.

Discussion of data--

In Table VIII is shown the average amount of succulence consumed, dry matter consumed, and milk and butter-fat produced by each group by periods.

Table VIII (Cont.) gives the average number of pounds of the two feeds required to produce one pound of milk, pounds of milk produced for every pound of dry matter consumed, pounds of feed required to produce one pound of butter-fat, pounds of butter-fat produced for every pound of dry matter consumed, and the

Table VIII

Feed	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
Group A				
Kale---------Per.1	10029.2	1432.17	4214.4	197.07
Corn Silage--Per.2	5007.0	1457.04	3836.2	200.60
Group B				
Corn Silage--Per.1	5463.8	1589.97	3760.5	169.58
Kale---------Per.2	10856.0	1550.24	3532.2	170.06
Ave. Kale Periods	10442.6	1491.20	3873.3	183.56
Ave. Silage Periods	5235.4	1523.50	3798.3	185.09

Table VIII (Cont.)

Feed	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	#B. F. to 1# D. M.	Weight Change
Group A					
Kale---------Per.1	2.37	2.93	50.89	.137	59
Corn Silage--Per.2	1.31	2.63	24.96	.137	55
Group B					
Corn Silage--Per.1	1.45	2.36	32.31	.107	100
Kale---------Per.2	3.05	2.15	63.83	.109	89
Ave. Kale Periods	2.71	2.54	57.36	.123	74
Ave. Silage Periods	1.38	2.50	28.58	.122	77.5

net gain or loss in weight per group per period.

As Table VIII indicates, kale and corn silage were fed on a two and one-third to one ratio during this particular year's trial. The average amount of dry matter consumed per group per period was slightly greater in the case of the corn silage periods. On the other hand, a larger amount of milk was produced when kale was fed. Butter-fat production was slightly in favor of corn silage.

A glance at Table VIII (Cont.) shows that in the case of pounds of feed necessary to produce one pound of milk or butter-fat, it required approximately twice as much kale as it did of corn silage. The pounds of milk produced to pounds of dry matter consumed was practically the same in the case of both feeds. There was very little difference when it came to the effect on body weight of the animals--both feeds caused a gain of approximately 75 pounds per group per period.

Charts III and IV, derived from Tables XII and XIII in the Appendix, give the plotted average weekly milk production of all animals included in the experiment and show the trend of production throughout the entire trial, including the production during the preliminary periods. In the case of the kale periods, the average decline in milk production from the first

CHART III

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1926-1927
Group A

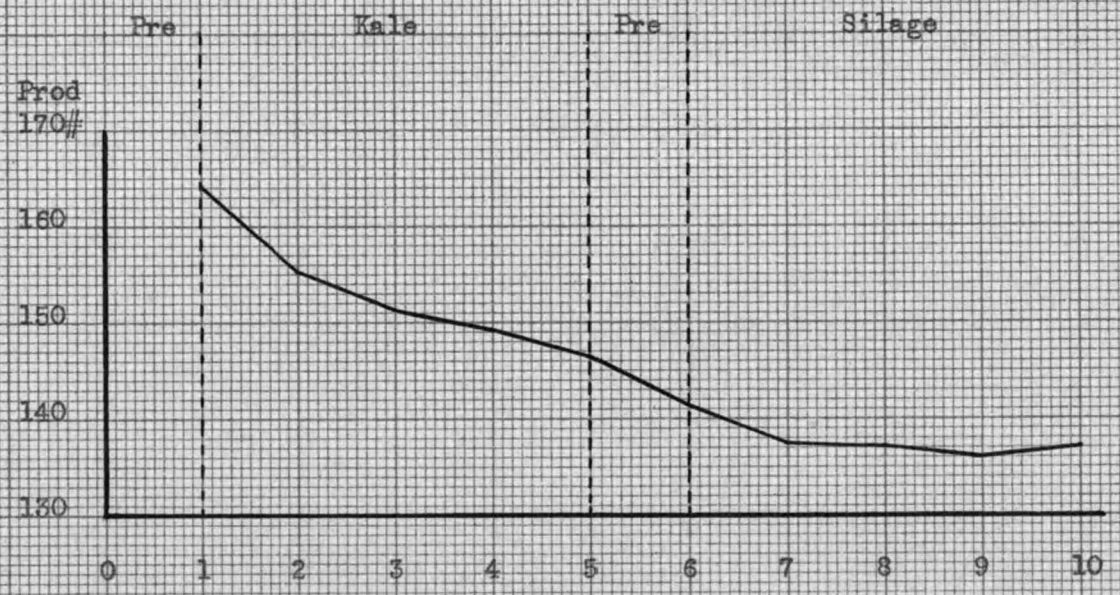
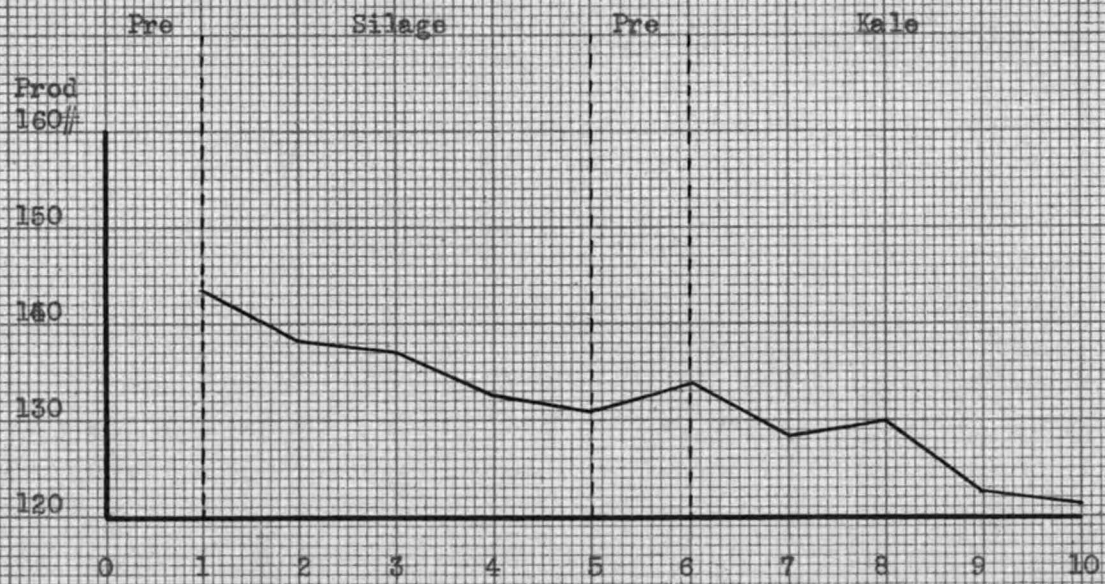


CHART IV

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1926-1927
Group B



week to the fourth week was 5.57% while in the case of the corn silage periods, it was 2.75%. These figures indicate that there was a tendency for a greater decline in production when kale was fed than when the cows received corn silage.

Tables III and IV in the Appendix, give the individual, average and total milk and butter-fat production and feed consumption, and net gain or loss in weight of the animals in Groups A and B respectively. They show that during the kale periods the average production per cow was 553.32 pounds of milk in contrast to 542.5 pounds of milk produced on corn silage. The average production of butter-fat on kale was 26.23 pounds against 26.44 pounds on corn silage.

Tables XXIII, XXIV, XXV, and XXVI in the Appendix, give the mean production, standard deviation, probable error of the mean production, and the true mean production of milk and butter-fat for all of the periods of the 1926-1927 trial. The true mean of the milk production during the kale periods was found to be 553.32# ± 29.95# and during the corn silage periods 542.62# ± 33.25#. The true mean of the butter-fat production on kale was 26.23# ± 1.17# and on corn silage 26.44# ± 1.16#. These tables were worked out to check the results and prove that they were significant.

Summary of the experiment--

The results of this trial showed that it required two pounds of kale to produce as much milk or butter-fat as one pound of corn silage. Kale was fed at the rate of two and one-third pounds to each pound of corn silage. The feeding of large amounts of kale may have had considerable to do in bringing about the results of this trial, inasmuch as later results indicated that it may be uneconomical to feed large amounts of kale. It would have been interesting to know just what would have been the effect of feeding at the rate of one pound of kale for every one pound of corn silage. This point was investigated in later trials.

Experiment III--1927-1928

Object of experiment--

The object of the third experimental trial comparing kale and corn silage was to check as closely as possible for the third consecutive year the values of the two feeds.

Aside from this primary object which was merely a continuation of that set up by Jones and Brandt in their two previous year's work, the author decided to compare the result of feeding kale and corn silage on the pound for pound basis.

Plan of experiment--

Twelve cows were selected and divided into two groups as closely as possible on the basis of age, breed, stage of lactation and gestation, and milk and butter-fat production.

Both groups of cows received oat and vetch hay and grain according to the amount of milk produced and the weights of the individual animals. The grain mixture consisted of : 200# wheat bran, 50# soy-bean meal, 50# cotton-seed meal, and 300# oat and vetch screenings (80% oats and 20% vetch, approximately.)

The amounts of hay and grain fed remained constant throughout the trial.

Group A started the trial on kale. During a preliminary period of one week, this group of cows were given as large amounts of kale as would be readily consumed and similar amounts were fed for a period of four weeks. This constituted the first period for this group. This group was fed corn silage for four weeks after a transition period of one week. The change was made on the dry matter basis. This second period was followed by a transition period of one week, after which the group was changed back to the original kale rations.

Following a preliminary period of one week, the cows in Group B were fed normal amounts of corn silage for four weeks. After a transition period of one week, the group was then fed kale at the rate of one pound for each pound of corn silage fed during the preceeding period. A transition period of one week followed, after which the cows of Group B were returned to their original corn silage rations.

Accurate records of milk and butter-fat produced, feed given and consumed, weights at start and completion of the experimental periods, and butter-fat tests were kept throughout the trial.

Daily observations were made to note any

abnormal conditions appearing in any of the cows.

Discussion of data--

In Table IX is shown the average amount of succulence consumed, dry matter consumed, and milk and butter-fat produced by each group by periods.

Table IX (Cont.) shows the average number of pounds of the two feeds required to produce one pound of milk, pounds of milk produced for every pound of dry matter consumed, pounds of feed required to produce one pound of butter-fat, pounds of butter-fat produced for every pound of dry matter consumed, and the net gain or loss in weight per group per period.

As Table IX indicates, Group B was fed normal amounts of kale and corn silage on the pound for pound basis; while Group A received kale and corn silage on the dry matter basis--more than two pounds of kale being fed to each pound of corn silage.

In the case of Group B, the dry matter consumption was almost twice as great during the corn silage periods as during the kale periods. A greater production of milk occurred when kale was fed. However, corn silage produced the larger amount of butter-fat. It will be noted from Table IX (Cont.) that there was little difference between the two feeds in regard to

Table IX

Feed	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
Group A				
Kale---------Per.1	7835.5	1019.97	4841.8	202.77
Corn Silage--Per.2	4423.3	1097.29	4444.2	196.02
Kale---------Per.3	7829.2	1020.14	4338.6	183.83
Ave. Periods 1 & 3	7832.3	1020.05	4590.2	193.30
Group B				
Corn Silage--Per.1	5590.5	1365.08	3934.8	152.42
Kale---------Per.2	5530.0	720.56	3468.4	133.74
Corn Silage--Per.3	5544.0	1352.74	2962.1	119.09
Ave. Periods 1 & 3	5567.2	1358.41	3449.4	135.75

Table IX (Cont.)

Feed	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	#B.F. to 1# D. M.	Weight Change
Group A					
Kale---------Per.1	1.61	4.74	38.64	.198	26
Corn Silage--Per.2	0.995	4.11	22.56	.181	198
Kale---------Per.3	1.80	4.25	42.59	.180	33
Ave. Periods 1 & 3	1.70	4.495	40.61	.189	29
Group B					
Corn Silage--Per.1	1.42	2.88	36.67	.111	132
Kale---------Per.2	1.59	4.81	41.35	.185	208
Corn Silage--Per.3	1.87	2.19	46.55	.088	173
Ave. Periods 1 & 3	1.65	2.535	41.61	.0995	152

the number of pounds required to produce one pound of milk. Kale produced larger amounts of milk per pound of dry matter consumed. The pounds of feed required to produce one pound of butter-fat was almost identical. The pounds of butter-fat produced per pound of dry matter consumed was greater during the kale periods, since the total amount of dry matter consumed in the form of kale was approximately one-half the amount consumed in the form of corn silage. Kale feeding resulted in greater gains in body weight.

Taking Group A into consideration, one finds that when two pounds of kale was fed to one pound of corn silage, the dry matter consumption was greater on corn silage, although the production of milk was about 150 pounds greater during the kale periods. The butter-fat production was a few pounds greater on corn silage. Feeding very nearly twice the amount of kale as of corn silage did not seem to result in proportional increases in production when compared to the production of the group fed kale or corn silage on the pound for pound basis. It required 0.7 pounds more of kale to produce one pound of milk than it did of corn silage. The pounds of milk produced per pound of dry matter consumed favored kale. It was necessary to feed almost twice as much kale as corn silage to produce one pound of butter-

fat. The pounds butter-fat produced per pound of dry matter consumed was nearly the same. A gain in weight per group per period was 198 pounds on corn silage and 29 pounds on kale.

Tables V and VI in the Appendix, give the individual, average and total milk and butter-fat production and feed consumption, and net gain or loss in weight. They show that during the kale periods, the average production per cow was 702.71 pounds of milk and 28.91 pounds of butter-fat, in contrast to a production of 629.45 pounds of milk and 25.96 pounds of butter-fat on corn silage.

Charts V and VI, derived from Tables XIV and XV in the Appendix, give the plotted average weekly milk production of all animals included in the experiment and show the trend of production throughout the entire trial, including the production during the preliminary periods. In the case of the kale groups, the average decline in milk production from the first week to the fourth week of the periods was 4.523%. In the case of the corn silage group, the decline was 0.614%. These figures indicate that the group on kale declined somewhat faster than those on corn silage.

Tables XXVII, XXVIII, XXIX, and XXX in the Appendix, give the mean production, standard deviation,

CHART V

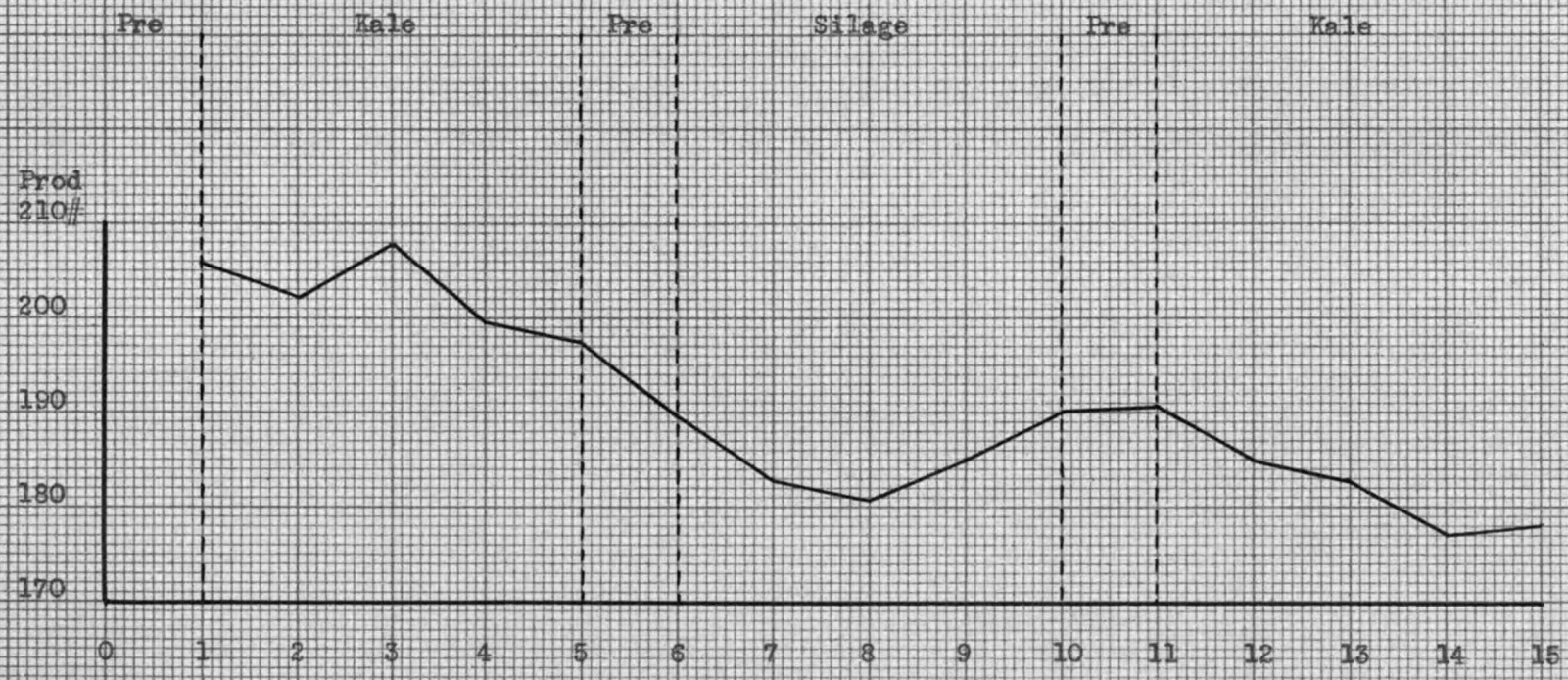
CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1927-1928
Group B

CHART VI

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1927-1928
Group A



probable error of mean, and the true mean production of milk and butter-fat for all periods of the 1927-1928 trial. The true mean of the milk production on kale was 702.71# ± 39.21# in contrast to 629.45# ± 37.70# on corn silage. The true mean of the butter-fat production was 28.91# ± 1.31# on kale and 25.96# ± 1.34# in the case of corn silage.

Summary of experiment--

The results of the 1927-1928 trial indicate that one pound of kale produced practically the same amount of milk as one pound of corn silage. A greater gain in weight followed the feeding of kale.

Increasing the plane of kale feeding to two pounds for every pound of corn silage fed did not prove economical. Increasing the amount of kale fed also had a tendency to keep the gain in weight of the animals relatively low in comparison with gains made when fed corn silage.

Experiment IV--1928-1929

Object of experiment--

The object of the fourth year's experiment was primarily that of testing the two feeds as to comparative feeding values. This involved both milk and butter-fat production and gain or loss in body weight. Three secondary objects were also kept in mind during this year's work. An attempt was made to determine the most economical amount of kale to feed. It was considered advisable to compare the feeds alone and in combination as to value for milk and butter-fat production and as to ability to maintain body weight. It was considered desirable to determine the relative effect on the quality of the milk and butter of feeding varying amounts of kale to cows before and after milking.

The results of the 1927-1928 trials seemed to indicate that there might be a basis for the statement that kale in limited quantities was equal to corn silage, pound for pound. From the results of the 1927-1928 trial, it was indicated that 25 pounds to 35 pounds of kale per day gave the best results.

The findings of the 1927-1928 test merited confirmation, and consequently the 1928-1929 experiment was planned in order to find what would follow the feed-

ing of kale pound for pound in contrast to corn silage. Also what would be the result of feeding a ration in which half the succulence was provided in the form of kale and half in the form of corn silage. This latter idea has been stressed by practical dairymen for the past few years.

Plan of experiment--

Twenty-one cows were selected and divided into three groups as equally as possible on the basis of age, breed, stage of lactation and gestation, and milk and butter-fat production.

All three groups of cows received oat and vetch hay and concentrates as determined by the amount of milk produced and their body weights. The grain mixture used in this experiment consisted of the following: 800 pounds oat and pea screenings, 400 pounds of bran, 33 1/3 pounds of soy-bean meal, 33 1/3 pounds of cotton seed meal, and 33 1/3 pounds of linseed oil meal. The amounts of hay and grain feed remained constant throughout the trial.

After a one week preliminary period, the cows in Group A were fed kale for a period of 28 days. Following a transition period of a week, they were given kale and corn silage in combination for four

weeks. For the third period, Group A received corn silage for another 28 days following a seven day transition period.

The cows in Group A were first fed kale and silage for four weeks, after allowing 7 days as a preliminary period. Following a transition period of a week, the cows were changed to corn silage for 28 days, and then given kale for a third transition period and the last four weeks of the trial.

Group C, after a preliminary period of 7 days, continued on the silage ration for 4 weeks. Following this, the cows were changed to kale over a one week period, and were then fed this succulence for 28 days. After another transition period of a week, Group C was fed the combination of kale and corn silage for the final four weeks of the trial. In this way all three groups were given an opportunity to produce on all three rations.

Accurate records of milk and butter-fat produced, feed given and consumed, weights at the beginning and the completion of the experimental period, and data secured from tests of the effect of the feeds on the flavor and odor of the milk and butter were kept during the trial.

Daily observations were made of the

experimental animals and any abnormal conditions noted.

Discussion of data--

The following summary table (Table X) shows the average amounts of succulence consumed, dry matter consumed, and milk and butter-fat produced by each group by periods.

Table X (Cont.) shows the average number of pounds of the three feeds required to produce one pound of milk, pounds of milk produced for every pound of dry matter consumed, pounds of feed required to produce one pound of butter-fat, pounds of butter-fat produced for each pound of dry matter consumed and the net gain or loss in weight per group per period.

Table X indicates that kale and silage were fed alone on the pound for pound basis to two groups and that in the case of the third group the succulence of the ration was made up of equal parts of kale and corn silage. As was expected, the dry matter comsumption was greatest when corn silage was fed, and least when kale was fed. The combination of kale and corn silage gave the greatest milk and butter-fat production, followed by kale and then by corn silage. It is to be noted that the spread in production of both milk and and butter-fat was relatively small between kale and

Table X

Feed	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
Group A				
Kale----------Per.1	6260.00	731.79	5,464.4	214.35
Kale & Silage-Per.2	K3055.5 S3031.0	K357.19 S696.83	5,323.1	213.47
Corn Silage---Per.3	5372.5	1235.14	4,250.3	170.40
Group B				
Kale & Silage-Per.1	K2447.0 S2419.0	K286.05 S556.13	3,123.5	140.67
Corn Silage---Per.2	4231.0	972.71	2,785.2	123.02
Kale----------Per.3	4928.0	576.08	2,575.8	119.13
Group C				
Corn Silage---Per.1	6300.5	1448.48	5,177.2	219.85
Kale----------Per.2	6384.0	746.29	4,689.8	210.43
Kale & Silage-Per.3	K3184.0 S3145.5	K372.21 S723.15	4,349.1	193.70
Ave. Kale Periods	5857.0	684.72	4,243.3	181.30
Ave. K.& S.Periods	5761.0	997.19	4,265.2	182.61
Ave. Silage Periods	5301.3	1218.78	4,070.9	171.09

Table X

(Cont.)

Feed	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	#B.F. to 1# D. M.	Weight Change
Group A					
Kale----------Per.1	1.14	7.47	29.20	.288	62
Kale & Silage-Per.2	1.14	5.05	28.51	.203	317
Corn Silage---Per.3	1.26	3.44	31.52	.137	96
Group B					
Kale & Silage-Per.1	1.55	3.71	34.58	.167	178
Corn Silage---Per.2	1.52	2.86	34.39	.126	151
Kale----------Per.3	1.91	4.47	41.36	.206	104
Group C					
Corn Silage---Per.1	1.22	3.57	28.65	.151	42
Kale----------Per.2	1.36	6.28	30.33	.281	8
Kale & Corn Silage3	1.45	3.97	32.67	.176	98
Ave. Kale Periods	1.47	6.07	33.63	.258	58
Ave. K.& S.Periods	1.38	4.24	31.92	.182	198
Ave. Silage Periods	1.33	3.29	31.52	.138	96

corn silage in combination and kale fed separately.

Tables VII, VIII, and IX in the Appendix, indicate that during the four weeks on kale the average production per cow was 670.0 pounds of milk in contrast to 673.5 pounds of milk on kale and corn silage and 678.4 pounds of milk on corn silage. The average production of butter-fat on kale was 28.62 pounds in contrast to 28.55 pounds on corn silage and 28.83 pounds of butter-fat on kale and corn silage.

Table X (Cont.) shows that it required almost the same amount of the three feeds to produce one pound of milk. The figures indicate that it was necessary to feed slightly more kale than either corn silage or a combination of kale and corn silage to produce a similar amount of milk. It required less corn silage to produce a pound of milk than either of the other two feeds by a small margin. More pounds of milk were produced per pound of dry matter consumed on kale, followed next by kale and corn silage, and finally by silage. The three feed ranked relatively close in the pounds of feed required to produce one pound of butter-fat. However, somewhat more silage was needed to produce one pound of butter-fat than either of the other two feeds. Kale produced the greatest number of pounds of butter-fat per pound of dry matter consumed, and the smallest

production of butter-fat per pound of dry matter consumed was obtained on corn silage. The greatest gain in weight was made on kale and corn silage, followed next by silage and then by kale. It is of special interest to note that the gain made per group per period while on a combination of kale and corn silage was practically three and one-half times the gain made while fed kale separately.

Charts VII, VIII, and IX, derived from Tables XVI, XVII, and XVIII in the Appendix, give the plotted average weekly milk production of all animals included in the experiment and show the trend of production throughout the entire trial, including the production during the preliminary periods. In the case of the kale groups, the average decline in milk production from the first week to the fourth week of the period was 6.03%. In the case of kale and corn silage groups, the average decline was 4.95%. The decline on corn silage for a similar period was 7.71%. Thus the most rapid decline in milk production occurred when corn silage was fed alone.

Tables XXXI, XXXII, XXXIII, XXXIV, XXXV, and XXXVI in the Appendix, give the mean production, standard deviation, probable error of the mean, and the true mean production of milk and butter-fat for

CHART VII

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1928-1929
Group C

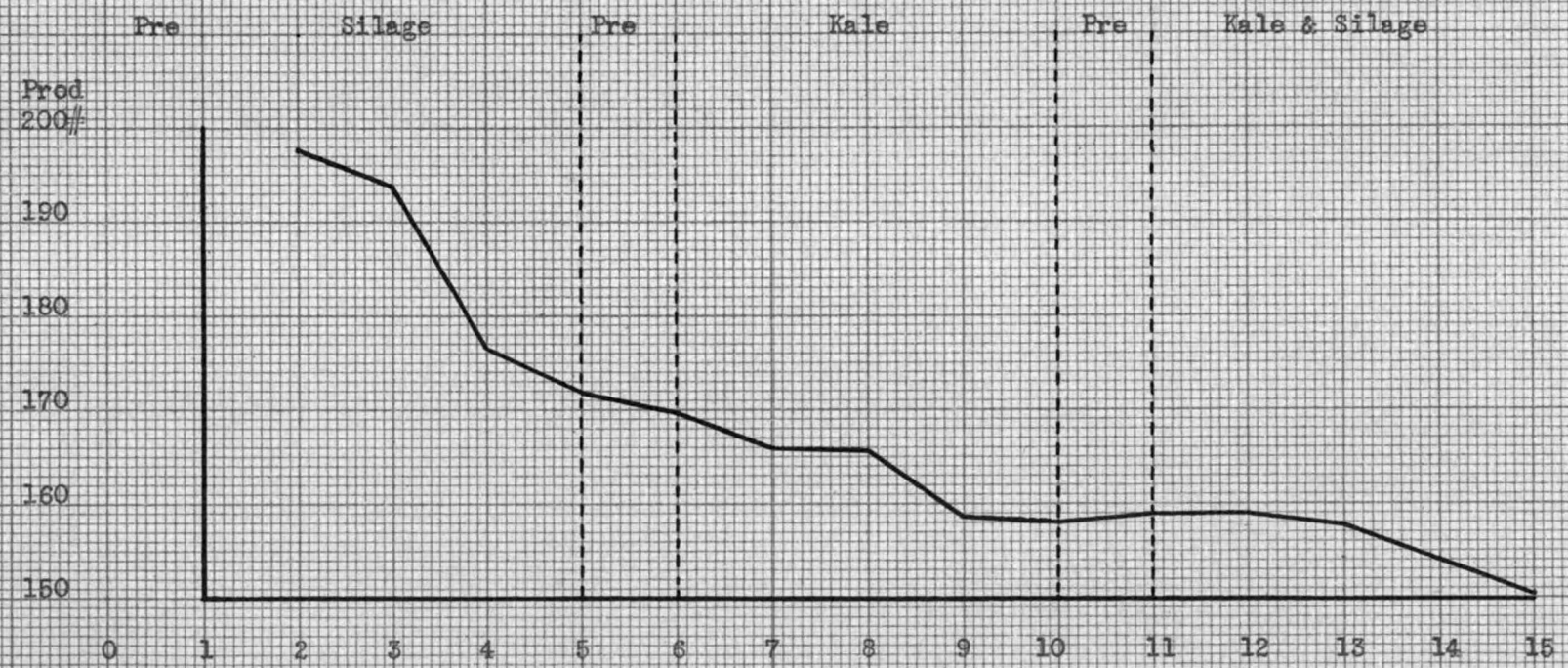


CHART VIII

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Yearr1928-1929
Group B

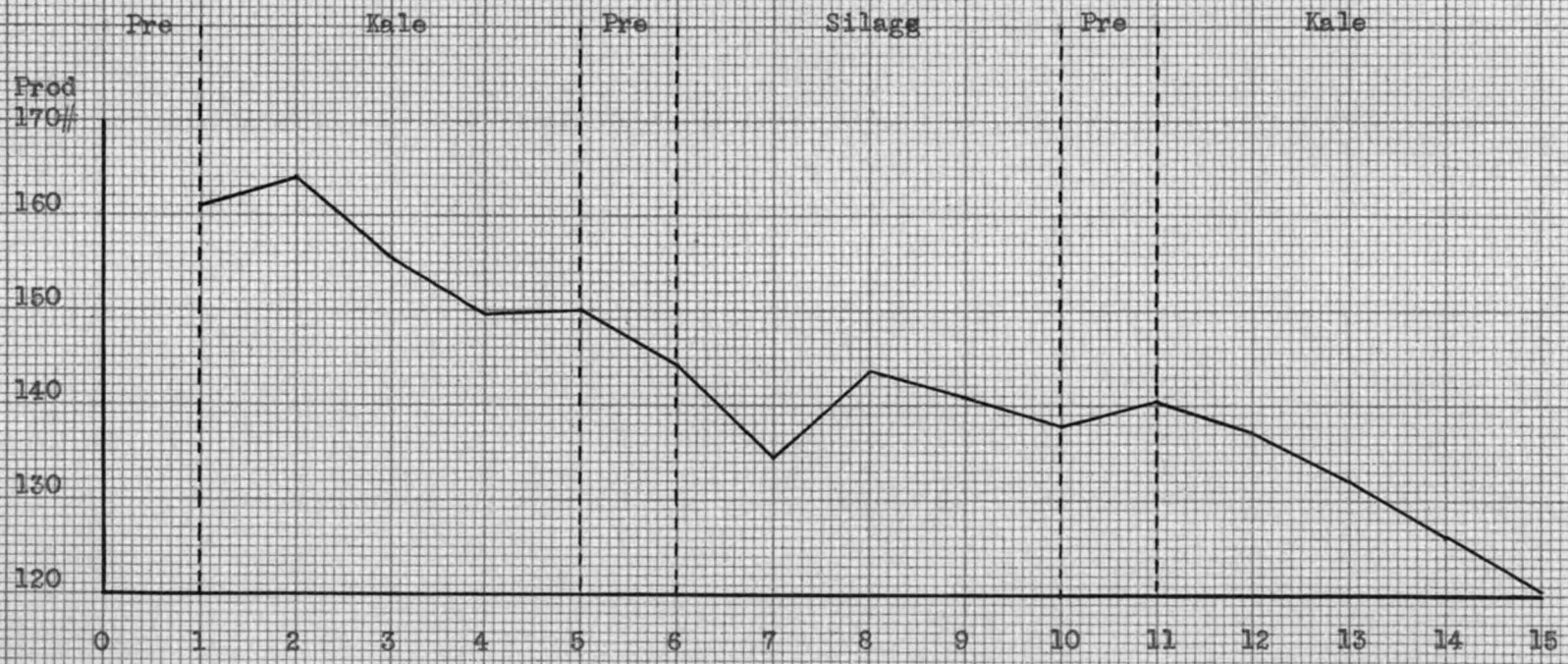
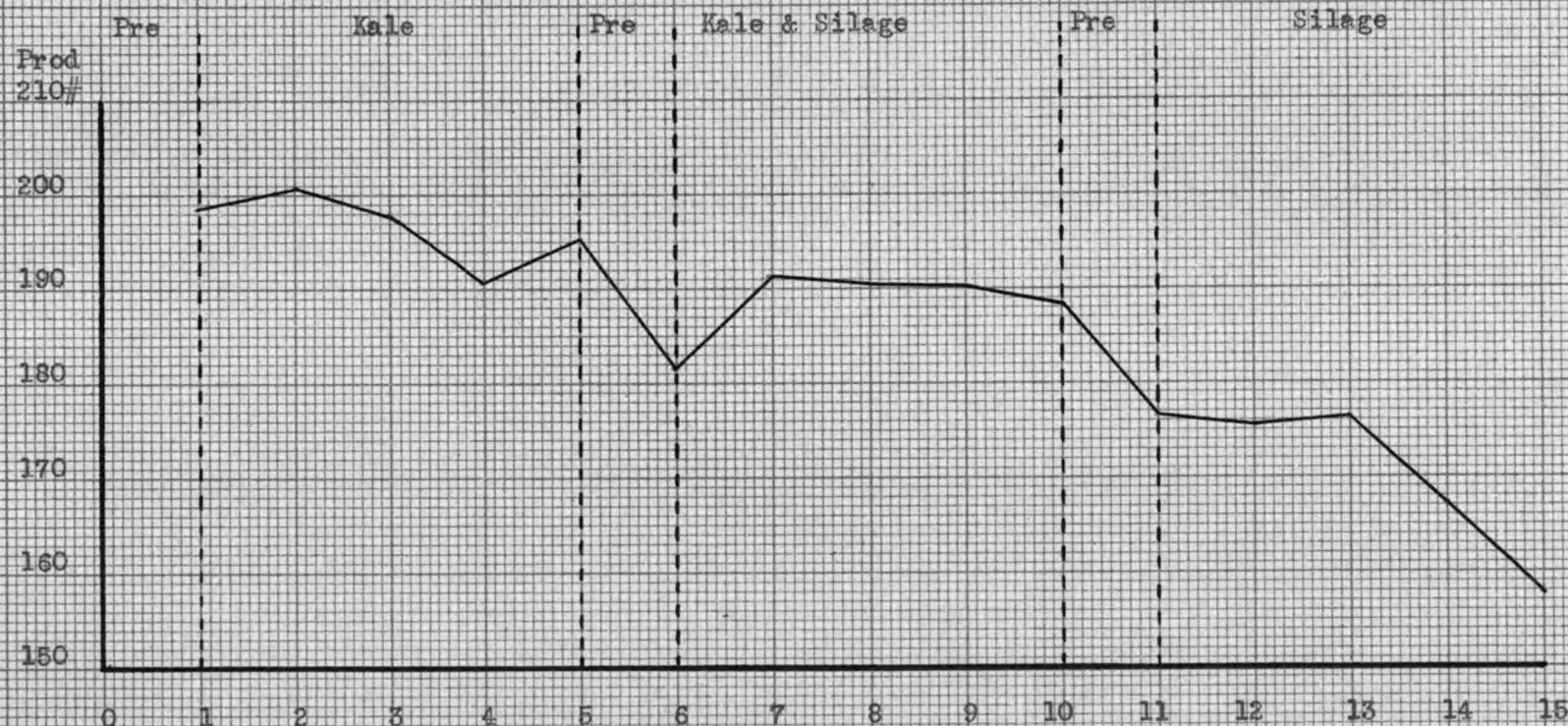


Chart IX

CURVE OF AVERAGE WEEKLY MILK PRODUCTION

Year 1928-1929
Group A



periods of the 1928-1929 trial. The mean production of milk on kale was 670.00# ± 41.27# in contrast to 673.5# ± 36.77# on kale and corn silage and 678.42# ± 39.94# on corn silage alone. The mean of the butter-fat production on kale was 28.62# ± 1.56# and 28.83# ± 1.69# on kale and corn silage in contrast to 28.55# ± 1.62# on corn silage.

Summary of experiment--

The results of the 1928-1929 trial indicate that there is very little difference between kale and corn silage for milk and butter-fat production, when fed on a pound for pound basis. A combination of the two feeds resulted in a slightly higher production of milk and butter-fat than that following the feeding of kale alone. Corn silage fed alone and kale and silage in combination gave results indicating that the two feeds were practically identical in feeding value as far as the production of milk and butter-fat was concerned. However, the feeding of kale and corn silage in combination resulted in a gain that was approximately three and a half times that made on kale and three times that made on corn silage. This latter point is not to be over-looked when the relative feeding values of the three feeds are under consideration.

EXPERIMENTAL WORK ON EFFECT OF KALE FEEDING on MILK AND BUTTER

1928-1929

Object of the experiment--

Kale has been rather widely used throughout the Willamette Valley section of Oregon to furnish succulence in dairy cattle rations. It has been a common contention on the part of dairy products manufacturers, creamerymen, and consumers in general that this feed, like garlic, may impart a very characteristic and undesirable flavor and odor to milk and the products made from it.

An experiment was planned and carried out to determine definitely whether kale actually did have a deleterious effect on the flavor and odor of milk, and if so, how it might be fed without injury to the product.

Plan of experiment--

Six cows were selected on the basis of the apparently normal flavor and odor of their milk. Two

Jerseys, two Guernseys, and two Holsteins made up the experimental animals. All of these cows were fed a basal ration of corn silage, oat and vetch hay, and a grain mixture, consisting of 800 pounds oat and pea screenings, 400 pounds bran, 33.3 pounds soy-bean meal, 33.3 pounds cotton-seed meal, and 33.3 pounds of linseed-oil meal. About 25 pounds to 30 pounds of corn silage were fed per cow per day. This was fed two hours previous to milking.

The ration of each cow was completed by feeding as much oat and vetch hay as she would consume. Careful records were kept of all feed refused during these experimental periods.

The stage of lactation varied from cows just recently freshened to cows fairly well along in their lactation periods.

After the normal period of one week when all cows received the basal ration in order to check the flavor and odor of the milk from each individual cow and to obtain cream for the making of normal check samples of butter, the cows were divided into three groups and varying amounts of kale fed.

The animals in Group A, consisting of one Jersey and one Guernsey, were given 15 pounds of kale twice daily one hour before milking; Group B, consisting

of the other Jersey and the other Guernsey, received 15 pounds of kale twice daily one hour after milking; Group C, consisting of the two Holsteins, because of their size and digestive capacity, were fed 30 pounds of kale twice daily one hour after milking.

After the cows had been on this ration for a period of 8 days, it was assumed that true samples of milk could be taken. Accordingly samples were taken and enough milk separated from each group's production to insure, after milking, a large enough butter sample. The rations of the groups were then interchanged--Group B to 15 pounds of kale one hour prior to milking, Group A to 15 pounds of kale one hour after milking, and Group C to 30 pounds of kale one hour before milking.

Samples of milk were warmed to body temperature and judged by men in the department, members of the dairy products judging team, and students in the department. Samples were considered either normal or off in flavor or odor.

The cream from the various periods and groups was churned by means of a hand churn and the butter samples each divided into halves. One half was salted and the other left unsalted. All butter samples were judged as to flavor and odor at time of putting into the cold room for storage and then sampled once

after being kept in storage for several weeks.

Discussion of data--

Milk--Table XI gives a brief summary of the results secured in determining the effect on the milk of feeding various amounts of kale to cows either one hour previous to milking or one hour after milking. This data is the result of opinions on a total of 75 samples of milk taken at intervals of one week.

Table XI

Effect of Kale on Flavor of Milk

Check Samples	15#before	15#after	30#before	30#after
98.6%Normal	58.4% N	98.2%N	24.8% N	96.0%N
1.4% Off	41.6% O	1.8%O	75.2% O	4.0%O

Table XI

Effect of Kale on Odor of Milk

Check Samples	15#Before	15#After	30#Before	30#After
98.6%Normal	54.3% N	98.2%N	20.4% N	96.2%N
1.4% Off	45.6% O	1.8%O	79.6% O	3.8%O

The consumption of 15 pounds of kale one hour prior to milking resulted in an undesirable feed flavor being produced in the milk. When the amount of kale consumed was increased to 28.8 pounds out of 30 pounds fed one hour before milking a very objectionable flavor and odor was produced in the samples. Consumption of 15 pounds of kale one hour after milking apparently had little affect on either the flavor or odor of the milk. When the amount consumed one hour after milking was 29.4 pounds out of 30 pounds fed, the affect was very slight.

Butter--Judges of the butter samples were able to distinguish quite easily between the butter from the groups fed kale prior to milking and the groups fed kale after milking and the check samples.

In the case of the samples from the groups fed 15 pounds one hour before milking, there was a noticeable feed flavor and odor present. The samples of butter from the animals receiving 30 pounds of kale one hour before milking had a characteristic strong kale flavor and odor. In both cases, it was thought that the samples of butter from cows fed kale one hour before milking would have been objected to by the consumer.

Very little kale flavor or odor was noticeable in the butter samples from the groups fed 15 pounds of kale one hour after milking and 30 pounds of kale when fed one hour after milking. The butter from the group fed 15 pounds one hour after milking was almost identical in flavor and odor with the normal check samples.

Summary of the experiment--

Milk and butter samples were affected in a deleterious manner both as to flavor or odor when feeding of kale took place one hour prior to milking. The dairyman should feed his cows grain prior to milking and then feed his hay and kale after milking in order to avoid objectionable feed flavors in the product--whether it be milk, cream, or butter.

Final Summary of Experiments

Table XIII shows the average amounts of kale consumed, dry matter consumed, and milk and butter-fat produced by each group by periods for the four years, 1925-1926, 1926-1927, 1927-1928, and 1928-1929. Table XII (Cont.) shows the average number of pounds of kale required to produce one pound of milk, pounds of milk produced for every pound of dry matter consumed, pounds of kale required to produce one pound of butter-fat, pounds of butter-fat produced for each pound of dry matter consumed, and the net gain or loss in weight per group per period for the four years.

Similar figures for corn silage appears in Tables XIII and XIII (Cont.). A final summary of the results of feeding a combination if kale and corn silage appears in Tables XIV and XIV (Cont.)

A glance at Tables XII, XIII, and XIV shows that when an average of 5,760.6 pounds of a combination of kale and corn silage were fed over a period of 28 days, an production of 4265.2 pounds milk and 182.61 pounds of butter-fat resulted, in contrast to an average production of 4051.81 pounds of milk and 175.70 pounds of butter-fat when an average of 7189.4 pounds of kale

SUMMARY TABLES

Table XII

Kale

Year	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
1925-1926				
Group A-Period 2	3750.0	441.76	3,724.5	158.48
Group B-Ave.1 & 3	9135.0	1071.08	4,206.6	184.76
1926-1927				
Group A-Period 1	10029.2	1432.17	4,214.4	197.07
Group B-Period 2	10856.0	1550.24	3,532.2	170.06
1927-1928				
Group A-Ave.1 & 3	7832.3	1020.05	4,590.2	193.30
Group B-Period 2	5530.0	720.56	3,468.4	133.74
1928-1929				
Group A-Period 1	6260.0	731.79	5,464.4	214.35
Group B-Period 2	4928.0	576.08	2,575.8	119.13
Group C-Period 3	6384.0	746.29	4,689.8	210.43
Total	64704.50	8290.02	36,466.3	1581.32
Average	7189.40	921.11	4,051.8	175.70

Table XII (Cont.)

Kale

Year	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	B.F. to1# D.M.	Weight Change
1925-1926					
Group A-Period 2	1.000	8.431	23.02	.358	+ 96
Group B-Ave.1 & 3	2.195	3.929	49.64	.172	- 26½
1926-1927					
Group A-Period 1	2.37	2.93	50.89	.137	+ 59
Group B-Period 2	3.05	2.15	63.83	.109	+ 89
1927-1928					
Group A-Ave.1 & 3	1.70	4.495	40.61	.189	+ 29
Group B-Period 2	1.59	4.81	41.35	.185	+ 208
1928-1929					
Group A-Period 1	1.14	7.47	29.20	.288	+ 62
Group B-Period 2	1.91	4.47	41.36	.206	+ 104
Group C-Period 3	1.36	6.28	30.33	.281	+ 8
Total	16.315	44.965	370.23	1.925	+ 648½
Average	1.812	4.996	41.13	.214	+ 72

Table XIII

Corn Silage

Year	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
1925-1926				
Group A-Ave.1 & 3	3389.0	674.71	3,666.4	149.22
Group B-Period 2	7864.0	1722.68	3,964.1	177.54
1926-1927				
Group A-Period 2	5007.0	1457.04	3,836.2	200.60
Group B-Period 1	5463.8	1589.97	3,760.5	169.58
1927-1928				
Group A-Period 2	4423.3	1079.29	4,444.2	196.02
Group B-Ave.1 & 3	5567.2	1358.41	3,449.4	137.75
1928-1929				
Group A-Period 3	5372.5	1235.14	4,250.3	170.40
Group B-Period 2	4231.0	972.71	2,575.8	119.13
Group C-Period 1	6300.5	1448.48	5,177.2	219.85
Total	47618.3	11538.43	35,124.1	1540.09
Average	5290.9	1282.04	3,902.6	171.12

Table XIII (Cont.)

Corn Silage

Year	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	#B.F. to 1# D. M.	Weight Change
1925-1926					
Group A-Ave.1 & 3	0.926	5.637	22.91	0.2265	-22½
Group B-Period 2	1.984	2.301	44.29	0.103	+106
1926-1927					
Group A-Period 2	1.31	2.63	24.96	0.137	+55
Group B-Period 1	1.45	2.36	32.31	0.107	+100
1927-1928					
Group A-Period 2	0.995	4.11	22.56	0.181	+198
Group B-Ave.1 & 3	1.65	2.535	41.61	0.0995	+152
1928-1929					
Group A-Period 3	1.26	3.44	31.52	0.137	+96
Group B-Period 2	1.52	2.86	34.37	0.126	+151
Group C-Period 1	1.22	3.57	28.65	0.151	+42
Total	12.315	29.443	283.18	1.268	+877½
Average	1.368	3.271	31.46	0.140	+97½

Table XIV

Kale and Corn Silage

Year	#Feed Cons.	#D.M. Cons.	#Milk Prod.	#B.F. Prod.
1928-1929				
Group A-Period 2	K3055.5 S3031.0	K357.19 S697.83	5,323.1	213.47
Group B-Period 1	K2447.0 S2419.0	K286.05 S556.13	3,123.5	140.67
Group C-Period 3	K3184.0 S3145.5	K372.21 S723.15	4,349.1	193.70
Total	K8686.5 S8595.5	K1015.45 S1976.11	12,795.7	547.84

Table XIV (Cont.)

Kale and Corn Silage

Year	#Feed to 1# Milk	#Milk to 1# D. M.	#Feed to 1# B. F.	#B.F. to 1# D.M.	Weight Change
1928-1929					
Group A-Period 2	1.14	5.05	28.51	.203	+317
Group B-Period 1	1.55	3.71	34.58	.167	+178
Group C-Period 3	1.45	3.97	32.67	.176	+98
Total	4.14	12.73	95.76	.546	+593
Average	1.38	4.24	31.92	.182	+198

was fed. A production of 3902.6 pounds of milk and 171.12 pounds of butter-fat followed the feeding of 5290.9 pounds of corn silage. These figures indicate that a combination of kale and corn silage gave the greatest production of both milk and butter-fat. On the other hand, when the kale and the corn silage were not fed in combination, a greater production resulted when approximately one and one-half pounds of kale were fed in place of one pound of corn silage.

It will be noted from Tables XII (Cont.), XIII (Cont.) and XIV (Cont.) that an average of 1.368 pounds of corn silage, 1.380 pounds of a combination of kale and corn silage, and 1.812 pounds of kale were required to produce one pound of milk. Corn silage seemed to have a slightly higher feeding value pound for pound, although the margin of difference was very slight between corn silage and a combination of kale and corn silage. Somewhat greater amounts of kale were required to produce one pound of milk.

Greater returns of butter-fat per pound of feed consumed were obtained when corn silage was fed, while the smallest returns were obtained following kale feeding. The following amounts of the three feeds were required to produce one pound of butter-fat: 31.46 pounds of corn silage, 31.92 pounds of a combina-

tion of kale and corn silage, and 41.13 pounds of kale.

As might easily be expected from the comparative dry matter contents of kale and corn silage, a greater production of milk and butter-fat per pound of dry matter consumed was obtained when kale, or a combination of kale and corn silage was fed. An average of 4.996 pounds of milk and 0.214 pounds of butter-fat were produced per pound of dry matter consumed in the form of kale. These figures are in direct contrast to those of 4.24 pounds of milk and 0.182 pounds of butter-fat obtained from feeding a combination of kale and corn silage, and 3.271 pounds of milk and 0.14 pounds of butter-fat produced on corn silage.

Feeding a combination of kale and corn silage resulted in a gain in body weight that was approximately three times the gain made on kale, and twice that made when corn silage was fed. A gain of 198 pounds followed the feeding of a combination of kale and corn silage. This figure was in sharp contrast to gains of 97.5 pounds made on corn silage and 72.0 pounds made while kale was fed. However, it must be noted that the results of only one year's trial were obtained on feeding a combination of kale and corn silage. The data on the gains made while kale and corn silage were being fed separately were obtained as a result of four year's

trials. Had the combination of kale and corn silage been fed during a number of trials there might not have been such a great divergence in gains.

Using a figure of $2.50 per hundred-weight for the milk produced, values of $12.00 and $35.00 per ton for hay and grain consumed, and using the figures of Selby (17) of $3.78 and $7.40 per ton for kale and corn silage, a summary table has been compiled in order to show the returns obtained above feed cost per cow per day as a result of feeding kale, corn silage, and a combination of kale and corn silage:

Table XV

Feed	Tons of Succulence Cons.	Tons of Grain Cons.	Tons of Hay Cons.	Total Cost of Feed
Kale	40.69	9.64	11.89	$633.98
Corn Silage	28.57	9.18	11.75	$673.56
Kale & Silage	8.64	3.16	3.53	$201.35

Table XV (Cont.)

Feed	Lbs. Milk Prod.	Value of Milk	Total Returns above Feed Cost	Returns above Feed Cost PerCowDay
Kale	45,263.4	$1131.59	$497.51	$0.263
Corn Silage	42,434.9	$1060.87	$387.51	$0.206
Kale & Silage	12,795.7	$ 318.89	$117.54	$0.209

The table just given shows conclusively that kale gave greater returns above feed cost per cow day than either corn silage or a combination of kale and corn silage. Using a hypothetical case, the saving that would have been made by feeding kale in preference to corn silage to a herd of 10 cows over a period of six months would have amounted to $102.60. A saving of $97.20 would have resulted from feeding a similar herd for the same period of time on kale instead of a combination of kale and corn silage. A saving of $0.57 a day would have resulted in the first instance and a saving of $0.54 a day would have resulted in the second case. These results appear to be very significant--in that they bring out the relative returns that may be expected from feeding these three forms of succulence--kale, corn silage, and a combination of kale and corn silage.

CONCLUSIONS

1. Corn silage has a slightly greater feeding value pound for pound than a combination of kale and corn silage or kale alone.

2. On the pound for pound basis a combination of kale and corn silage was 99.13% as efficient for milk production as corn silage fed alone while kale was found to be 75.49% as efficient as corn silage.

3. On the pound for pound basis a combination of kale and corn silage was 98.5% as efficient for butter-fat production as corn silage fed alone while kale was 76.4% as efficient as corn silage in this respect.

4. An average decline in milk production of 5.39% occurred between the first and the fourth weeks of the kale periods, in contrast to declines of 4.95% and 4.31% on a combination of kale and corn silage and on corn silage alone.

5. A combination of kale and corn silage gave by far the greatest gains in body weight--the gain on this combination being approximately three times that made on kale and twice that made when corn silage was fed.

6. A saving of 21.67% was made when kale was fed in place of corn silage. A saving of 20.53% resulted when kale was fed in preference to a combination of kale and corn silage.

7. The feeding of 25 to 35 pounds of kale per day seems to be the most economical amount to feed under ordinary conditions. However, heavier feeding is warranted where a large amount of this succulent is available at a low initial cost per ton. Such heavy feeding seems to result in low gains in body weight.

8. Milk and butter assumed a characteristic undesirable feed flavor and odor when kale was fed one hour prior to milking. Dairymen should feed kale to their cows after milking, in order to avoid objectionable feed flavors and odors in the product--whether it be milk, cream, or butter.

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APPENDIX

Table I

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale Periods--1925-1926

Group B--Periods 1 & 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
221	-27	364	360	1644	870.8	3.40	29.61
221	+30	340	356	1652	623.9	3.75	23.50
233	-83	392	333	1727	1060.4	3.70	39.23
233	+11	392	316	1736	956.9	3.65	34.93
41	-18	252	301	1573	635.4	5.15	32.72
41	+ 8	252	285	1596	561.0	5.95	33.38
42	-37	280	301	1424	797.1	5.35	42.64
42	+ 5	280	308	1456	566.0	6.10	34.53
468	- 5	224	231	1377	561.5	4.05	22.74
468	+55	224	259	1428	399.3	4.85	19.37
473	- 8	280	269	1313	715.2	3.95	28.25
475	+18	278	287	1344	665.7	4.30	28.63
Total	-51	3658	3644	18270	8413.2	54.20	369.53
Period Ave.	-25.5	1829	1822	9135	4206.6	27.10	184.76

Group A--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
219	+26	392	392	840	801.4	3.97	31.79
232	-12	345	354	756	1102.2	3.70	41.46
26	+24	364	280	756	859.9	5.00	43.00
31	+28	224	252	728	396.3	5.37	21.27
479	+30	193	245	670	564.7	3.80	20.96
Period Ave.	+96	1518	1523	3750	3724.5	21.84	158.48
Grand Total	+45	5176	5167	22020	12137.0	76.04	528.01
Grand Ave.	+15	1725	1722	7340	4045.8	25.35	176.01
Ave. Per Cow	+2.64	304.4	301.7	1295.3	713.9	4.47	31.06

Table II

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Silage Periods--1925-1926

Group A--Periods 1 & 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
219	- 15	390	389	756	816.8	3.75	30.63
219	+ 18	394	395	756	819.9	3.90	31.98
232	- 39	308	336	660	810.9	3.05	24.73
232	+24	386	372	720	1358.4	3.50	47.54
26	- 23	364	280	667	806.6	4.60	37.10
26	- 5	364	280	672	776.0	5.50	42.68
31	- 8	224	252	644	416.8	4.85	20.21
31	+ 1	224	252	644	359.0	5.55	19.92
479	- 4	196	249	616	616.0	3.50	21.56
479	+ 6	190	241	644	552.5	4.00	22.10
Total Period	-45	3040	3046	6779	7332.9	42.20	298.45
Ave.	-22.5	1520	1523	3389.5	3666.4	21.10	149.22

Group B--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
221	+ 25	352	358	1454	733.6	3.90	28.61
233	+ 27	392	326	1511	904.1	3.83	34.65
41	+ 16	252	299	1203	547.5	5.20	28.47
42	- 11	280	304	1260	635.4	5.93	37.70
468	+ 39	224	245	1260	474.8	4.50	21.37
473	+ 10	279	279	1176	668.5	4.30	26.74
Period Ave.	+106	1779	1811	7864	3963.5	27.66	177.54
Grand Total	+ 61	4819	4857	14642	11296.4	69.86	475.99
Grand Ave.	+20.3	1606.3	1619	4881	3765.6	23.28	158.66
Ave.Per Cow	+ 3.8	311.8	304	915.1	706.0	4.36	29.75

Table III

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale Periods--1926-1927

Group A--Period 1

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
26	- 7	308	280.0	1601.0	747.2	5.13	38.33
41	+13	168	280.0	1363.0	453.5	4.40	22.22
52	+10	224	280.0	1352.0	525.1	5.60	29.41
54	+36	168	276.0	1347.3	434.0	5.20	22.59
233	-11	336	392.0	1643.0	1002.2	3.95	39.59
479	- 1	197	280.0	1374.3	596.3	4.13	24.65
638	+19	168	276.2	1348.6	456.1	4.45	20.30
Period Ave.	+59	1568	2064.2	10029.2	4214.4	32.86	197.09

Group B--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
31	+ 3	252	280.0	1408.5	559.5	5.39	30.16
45	+11	168	280.0	1671.0	365.6	5.13	18.76
57	+14	112	280.0	1395.5	362.3	6.34	22.97
60	+15	140	278.0	1381.5	435.9	5.44	23.71
221	+ 5	252	391.0	1679.0	782.7	4.14	32.40
248	+26	140	336.0	1653.0	426.1	4.38	18.66
641	+15	168	280.0	1667.5	600.1	3.90	23.40
Period Ave.	+89	1232	2125.0	10856.0	3532.2	34.72	170.06
Grand Total	+148	2800	4189.2	20885.2	7747.6	67.58	367.15
Grand Ave.	+74	1400	2094.6	10442.6	3873.3	33.79	183.57
Ave.Per Cow	+10.5	200	299.2	1493.7	553.32	4.83	26.23

Table IV

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Silage Periods--1926-1927

Group B--Period 1

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
31	+ 6	252	280.0	840.0	632.6	5.23	33.08
45	+37	168	280.0	814.8	397.5	5.23	20.79
57	- 3	112	280.0	697.0	373.0	6.00	22.38
60	+30	140	279.0	598.0	428.6	4.95	21.22
221	- 9	252	392.0	837.0	808.5	3.55	28.70
248	+31	140	336.0	838.0	500.5	4.03	20.17
641	+ 8	168	280.0	839.0	619.8	3.75	23.24
Period Ave.	+100	1232	2127.0	5436.8	3760.5	32.74	169.58

Group A--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
26	+ 2	308	280.0	831.0	694.6	5.89	40.91
41	+18	168	280.0	700.0	430.9	5.68	24.48
52	- 4	224	276.5	700.0	478.7	6.19	29.63
54	+15	168	276.0	626.0	407.2	5.89	23.98
233	- 6	336	392.0	840.0	912.4	4.15	37.86
479	+12	196	280.0	700.0	506.9	4.68	23.72
638	+18	168	276.0	610.0	405.5	4.94	20.02
Period Ave.	+ 55	1568	2060.5	5007.0	3836.2	37.42	200.60
Grand Total	+155	2800	4187.5	10470.8	7596.7	70.16	370.18
Grand Ave.	+ 77	1400	2093.7	5235.4	3798.3	35.08	185.09
Ave. Per Cow	+ 11	200	299.1	747.9	542.6	5.01	26.44

Table V

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale Periods--1927-1928

Group A--Periods 1 & 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat.
26	-11	336	448.0	1278.7	936.3	4.05	37.92
26	- 2	336	446.2	1222.6	842.8	4.40	37.08
221	+17	308	445.0	1396.5	889.9	3.28	29.14
221	+52	308	448.0	1344.0	529.8	3.75	19.87
240	- 9	308	446.5	1501.3	1154.2	4.10	47.32
240	+12	308	448.0	1456.0	1118.2	3.30	36.90
483	+ 9	280	391.0	1284.5	773.0	3.94	30.46
483	-46	280	392.0	1232.0	819.9	4.05	33.21
57	+ 1	168	333.0	1095.5	411.1	5.26	22.30
57	+24	168	336.0	1062.6	369.7	5.88	21.72
639	+19	336	392.0	1279.0	677.3	5.26	35.63
639	- 7	336	392.0	1232.0	658.2	5.33	35.05
Total	+59	3472	4917.7	15384.7	9180.4	52.60	386.60
Period Ave.	+24.5	1736	2458.8	7692.3	4590.2	26.30	193.30

Group B--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
245	+48	280	392.0	840.0	740.0	3.52	26.05
244	+39	280	448.0	1120.0	563.6	3.82	21.53
246	+28	336	448.0	1118.1	958.3	3.17	30.38
423	+50	168	448.0	1008.0	361.0	4.22	15.23
55	+18	224	334.2	719.1	455.8	4.62	21.06
638	+25	224	392.0	724.8	389.7	5.00	19.49
Period Ave.	+208	1512	2462.2	5530.0	3468.4	24.35	133.74
Grand Total	+267	4984	7379.9	20914.7	12648.8	76.95	520.34
Grand Ave.	+89	1661	2459.9	6971.6	4216.3	23.65	173.45
Ave.Per Cow	+14.8	277	410.0	1161.9	702.7	4.28	28.91

Table VI

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Silage Periods--1927-1928

Group A--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
26	-8	336	446.6	728.0	871.2	4.38	38.16
221	+68	308	447.5	784.0	682.2	3.45	23.54
240	+49	308	446.5	1501.3	1154.2	4.00	47.32
483	+46	280	391.7	727.3	730.0	4.13	30.17
57	+28	168	335.7	616.0	372.1	5.95	22.14
639	+15	336	390.9	728.0	623.5	5.52	34.39
Period Ave.	+198	1736	2458.9	5084.6	4433.2	27.43	195.72

Group B--Periods 1 & 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
245	+18	280	392.0	840.0	778.3	3.08	23.93
245	+56	280	392.0	840.0	708.5	3.50	24.80
244	+17	280	448.0	1120.0	601.0	3.87	23.26
244	+16	280	448.0	1120.0	490.9	4.15	20.37
246	+30	336	447.1	1117.6	1072.0	3.45	36.98
246	+17	336	448.0	1120.0	753.7	3.40	25.63
423	+26	168	448.0	1001.1	465.2	4.25	19.77
423	+27	168	448.0	1008.0	248.8	4.03	10.01
55	+13	224	334.7	717.5	538.1	4.40	23.68
55	+44	224	336.0	728.0	460.5	4.75	21.87
638	+28	224	392.0	728.0	480.2	5.17	24.80
638	+10	224	392.0	728.0	299.7	5.48	16.41
Total	+305	3024	4925.8	11068.2	6896.9	49.53	271.51
Period Ave.	+152	1512	2462.9	5534.1	3448.4	24.76	135.75
Grand Total	+503	4760	7384.7	16152.8	11330.1	76.96	467.23
Grand Ave.	+168	1587	2461.6	5384.3	3776.7	25.65	155.74
Ave.Per Cow	+27.4	264	410.3	897.3	629.5	3.16	25.96

Table VII

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale Periods--1928-1929

Group A--Period 1

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
26	-25	336	327.0	840.0	963.0	4448	43.14
56	+20	280	323.5	772.0	404.2	5.40	21.83
60	+ 1	336	380.5	728.0	620.9	5.21	32.35
641	+12	448	437.5	840.0	1226.9	3.30	40.49
477	+36	448	437.0	840.0	1055.3	4.04	42.63
258	+24	252	433.5	1120.0	478.9	2.60	12.45
229	- 6	280	445.0	1120.0	715.2	3.00	21.46
Period Ave.	+62	2380	2784.0	6260.0	5464.4	28.03	214.35

Group B--Period 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
52	+ 11	336	321.5	840.0	640.7	6.37	40.81
55	+ 16	280	322.0	728.0	403.1	4.85	19.55
222	+ 25	392	445.0	1120.0	837.3	3.27	27.38
244	+ 31	252	382.0	1120.0	422.7	3.95	16.70
638	+ 21	280	370.5	1120.0	272.0	5.40	14.69
Period Ave.	+104	1540	1841.0	4928.0	2575.8	23.84	119.13

Table VII (Cont.)

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale Periods--1928-1929

Group C--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Milk	% Fat	Lbs. Fat
42	+13	392	325.5	840.0	505.7	6.42	32.37
54	- 8	280	327.0	728.0	595.9	5.99	35.69
246	- 6	448	375.5	1120.0	1036.1	3.40	35.22
255	- 3	280	388.5	1120.0	740.4	3.57	26.43
469	+ 4	392	331.5	1008.0	948.4	4.39	41.63
445	+13	336	333.0	728.0	496.1	3.74	18.55
629	- 5	280	328.0	840.0	367.2	5.59	20.53
Period Ave.	+ 8	2408	2409.0	6384.0	4689.8	33.10	210.43
Grand Total	+174	6328	7037.0	17572.0	12730.0	84.97	543.91
Grand Ave.	+ 58	2109	2346.0	5857.0	4243.0	28.32	181.30
Ave.Per Cow	+ 9.1	333	359.8	924.8	670.0	4.47	28.62

Table VIII

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Silage Periods--1928-1929

Group A--Period 3

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
56	+32	280	336.0	772.0	388.5	5.45	21.17
641	-21	448	441.5	832.5	989.4	3.78	37.40
60	- 2	336	386.5	721.5	594.6	4.28	25.45
477	+27	448	436.0	831.5	992.4	3.94	39.10
258	+39	252	437.0	1109.0	385.3	3.16	12.18
229	+21	280	445.5	1106.0	900.1	3.90	35.10
Period Ave.	+96	2044	2482.5	5372.5	4250.3	24.51	170.40

Group B--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
52	+48	336	328.5	200.5	759.2	5.66	42.97
55	+33	280	325.5	712.5	444.3	4.70	20.88
222	+ 8	392	438.0	1105.5	798.9	3.40	27.16
244	+25	252	388.5	1104.0	477.6	3.36	16.05
638	+37	280	377.5	1108.5	305.2	5.23	15.96
Period Ave.	+151	1540	1858.0	4231.0	2785.2	22.35	123.80

Table VIII (Cont.)

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Group C--Period 1

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Silage	Lbs. Milk	% Fat	Lbs. Fat
42	8	392	328.5	828.0	629.8	5.67	35.71
54	26	280	331.0	715.5	664.4	6.25	41.53
246	24	448	385.5	1106.5	1098.3	2.95	32.40
255	11	280	386.5	1109.5	658.1	3.26	21.45
469	26	392	336.0	999.5	1111.5	4.06	45.29
445	41	336	329.5	715.5	635.1	3.75	23.82
628	26	280	326.0	826.0	380.0	5.17	19.65
Period Ave.	42	2408	2723.0	6300.5	5177.2	31.11	219.85
Grand Total	289	5992	7063.5	15904.0	12211.7	77.97	514.05
Grand Ave.	96	1997	2454.5	5301.3	4070.5	25.99	257.02
Ave.Per Cow	16	333	392.4	883.5	678.4	4.32	28.55

Table IX

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Kale & Silage Periods--1928-1929

Group A--Period 2

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Silage	Lbs. Milk	Lbs. Fat
26	+36	336	330.0	417.5	414.5	891.1	42.33
56	+68	280	319.5	333.0	328.5	391.5	22.55
60	+53	336	384.5	360.5	361.0	634.3	29.18
641	+48	448	441.5	414.5	414.0	1122.6	39.74
477	+32	448	441.5	414.0	417.0	1081.0	40.65
258	+38	252	435.5	560.0	553.0	454.6	12.55
229	+42	280	448.0	556.0	543.0	748.0	26.47
Period Ave.	+317	2380	2800.5	3055.5	3031.0	5323.1	213.47

Group B--Period 1

Cow No.	Wt. Change	Lbs. Grain	Lbs. Hay	Lbs. Kale	Lbs. Silage	Lbs. Milk	Lbs. Fat
52	- 5	336	329.0	420.0	410.0	888.8	54.13
55	+43	280	330.0	364.0	364.0	498.9	22.20
222	+55	392	440.0	554.0	553.0	902.5	27.08
244	+54	252	384.5	556.0	553.0	465.6	16.30
638	+31	280	376.0	553.0	539.0	367.7	20.96
Period Ave.	+178	1540	1859.5	2447.0	2419.0	3123.5	140.67

Table IX (Cont.)

MILK AND BUTTER-FAT PRODUCTION
FEED CONSUMPTION
NET GAIN OR LOSS IN WEIGHT

Group C--Period 3

Cow No.	Wt. Change	Lbs Grain	Lbs. Hay	Lbs. Kale	Lbs. Silage	Lbs. Milk	Lbs. Fat
42	+28	392	329.0	420.0	414.5	452.6	29.50
54	+13	280	328.0	364.0	360.0	583.8	37.89
246	+ 9	448	380.0	556.0	549.0	989.0	31.25
255	+ 4	280	389.0	556.0	552.0	596.5	20.10
469	- 5	392	331.5	504.0	493.0	967.9	40.75
445	+30	336	326.5	364.0	361.0	372.6	13.41
629	+19	280	324.5	420.0	416.0	386.7	20.80
Period Ave.	+98	2408	2408.5	3184.0	3145.5	4349.1	193.70
Grand Total	+593	6328	7068.5	8686.5	8595.5	12795.7	547.84
Grand Ave.	+198	2109	2356.2	2895.5	2865.2	4265.2	182.61
Ave.Per Cow	+31.2	333	372.0	457.2	452.4	673.5	28.83

Table X

MILK PRODUCTION BY WEEKS

Kale--Silage--Kale Group
Year 1925-1926

Wk	221	233	41	42	468	473	Total	Ave.
1:	228.3:	273.4:	165.6:	174.9:	138.3:	162.6:	1,143.1:	190.5
2:	231.7:	265.3:	173.9:	207.7:	137.8:	179.1:	1,195.5:	199.2
3:	219.0:	277.6:	162.3:	202.1:	143.3:	184.6:	1,188.9:	198.1
4:	212.4:	245.1:	151.5:	196.6:	142.0:	176.1:	1,023.7:	170.6
5:	207.7:	262.4:	147.7:	190.7:	138.4:	175.4:	1,122.3:	187.6
6:	201.6:	242.2:	126.7:	182.5:	131.2:	164.4:	1,048.6:	174.8
7:	183.7:	225.7:	136.4:	172.9:	124.5:	161.2:	1,004.4:	167.4
8:	187.9:	229.8:	139.5:	159.4:	124.1:	169.9:	1,010.6:	168.4
9:	186.2:	222.4:	135.3:	153.0:	114.7:	166.8:	978.4:	163.1
10:	175.8:	226.2:	136.3:	150.1:	111.5:	170.6:	970.5:	161.7
11:	174.8:	235.7:	141.4:	146.3:	112.3:	177.1:	987.6:	164.6
12:	171.8:	239.0:	144.3:	143.0:	108.5:	176.4:	983.0:	164.0
13:	166.5:	238.6:	142.8:	145.7:	106.3:	166.8:	966.7:	161.1
14:	150.0:	245.0:	139.6:	141.3:	101.3:	162.4:	940.1:	156.7
15:	135.1:	234.3:	134.4:	136.0:	83.2:	160.1:	833.0:	147.2

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XI

MILK PRODUCTION BY WEEKS

Silage--Kale--Silage Group
Year 1925-1926

Cow	219	232	26	31	479	Total	Ave.
Wk							
1	247.7	236.4	232.6	123.2	161.6	1,001.5	200.1
2	206.6	216.0	215.7	114.8	160.2	913.3	182.6
3	215.9	206.5	209.4	110.7	161.1	903.6	180.7
4	200.2	196.5	189.9	95.4	148.5	830.5	166.1
5	194.1	191.9	191.7	95.9	146.2	819.8	163.9
6	210.5	202.7	211.3	105.9	158.3	888.7	177.7
7	195.7	184.5	214.7	100.9	139.9	837.5	167.5
8	202.0	195.8	212.4	100.4	140.3	850.9	170.2
9	205.2	356.1	213.1	98.5	145.3	1,018.2	203.6
10	196.7	365.8	219.7	96.5	139.2	1,017.9	203.6
11	207.8	382.5	220.4	99.8	139.7	1,050.2	210.0
12	202.6	357.6	201.3	92.7	134.1	988.3	197.6
13	197.2	350.7	193.9	91.2	136.3	969.3	193.8
14	210.2	335.6	191.8	89.7	139.9	967.2	193.4
15	209.9	314.5	189.0	85.4	142.2	941.0	188.2

Note--Cow No. 232 was removed from experiment at the end of the 8th week and Cow 218 replaced her

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XII

MILK PRODUCTION BY WEEKS

Kale--Silage Group
Year 1926-1927

Cow	26	41	52	54	233	479	638	Total	Ave.
Wk									
1	214.7	172.8	133.8	105.3	254.1	155.2	113.6	1,149.5	164.2
2	193.5	120.2	135.0	110.7	255.8	153.0	117.5	1,085.7	155.1
3	181.0	109.3	136.8	109.8	256.9	150.8	114.5	1,059.1	151.3
4	184.0	112.4	129.4	110.2	245.7	150.4	112.5	1,044.6	149.2
5	188.7	111.6	123.9	103.3	243.8	142.7	111.6	1,025.6	146.5
6	187.5	92.9	125.2	106.3	233.1	133.7	111.0	989.7	141.4
7	180.6	106.9	118.7	101.7	227.5	125.6	101.8	962.8	137.5
8	176.5	108.8	116.7	96.4	235.6	124.9	101.2	960.1	137.1
9	167.8	106.2	120.1	104.8	229.0	124.7	99.8	952.4	136.0
10	169.7	109.0	123.2	104.3	220.3	131.7	102.5	960.7	137.2

Note--Weeks 1 and 6 are Preliminary Periods

Table XIII

MILK PRODUCTION BY WEEKS

Silage--Kale Group
Year 1926-1927

Cow	31	45	57	60	221	248	641	Total	Ave.
Wk									
1	162.0	104.6	103.4	119.4	221.9	134.4	158.2	1,003.9	143.4
2	163.5	100.5	94.1	111.5	209.3	132.0	157.3	968.2	138.3
3	160.0	100.0	94.8	106.0	203.7	129.0	160.3	953.8	137.0
4	152.7	99.1	93.4	108.5	197.5	123.2	153.4	927.8	132.5
5	156.4	97.9	90.7	102.6	198.0	132.3	148.8	926.7	131.0
6	157.1	102.6	96.7	115.8	192.8	118.5	153.8	937.3	133.9
7	136.4	86.8	94.8	117.2	198.3	109.8	156.5	899.8	128.5
8	150.1	93.9	92.9	110.9	194.3	113.9	156.0	912.0	130.0
9	138.9	85.2	87.1	104.1	197.5	103.6	141.8	858.2	122.6
10	134.1	85.0	87.5	103.7	194.6	98.8	145.8	849.5	121.3

Note--Weeks 1 and 6 are Preliminary Periods

Table XIV

MILK PRODUCTION BY WEEKS

Silage--Kale--Silage
Year 1927-1928

Cow	245	244	246	423	55	638	Total	Ave.
Wk								
1	199.2	146.0	306.0	151.3	158.2	122.8	1,083.5	180.6
2	194.7	164.2	277.3	117.4	145.7	116.8	1,016.1	169.3
3	199.2	143.7	271.7	123.7	140.0	125.3	1,003.6	167.3
4	192.3	130.7	272.3	125.7	134.5	120.1	975.6	162.6
5	192.1	162.4	251.0	98.4	117.9	118.0	939.8	156.6
6	194.7	170.6	256.5	96.0	119.0	107.9	944.7	157.4
7	185.6	139.9	264.5	105.4	112.5	107.4	915.3	152.5
8	185.5	127.8	248.5	82.5	111.2	96.7	852.2	142.0
9	186.0	157.5	234.1	84.9	116.1	94.7	873.3	145.5
10	182.9	138.4	221.2	88.2	116.0	90.9	837.6	139.6
11a	168.7	118.2	189.7	79.0	117.2	83.1	755.9	126.0
12	170.7	109.1	187.7	68.9	110.2	73.7	720.3	120.0
13	171.1	143.1	191.1	73.8	113.5	78.7	771.3	128.5
14	178.4	125.0	186.5	54.0	116.4	73.9	734.2	122.2
15	188.3	113.7	187.7	52.1	120.4	73.4	735.6	122.6

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XV

MILK PRODUCTION BY WEEKS

Kale--Silage--Kale
Year 1927-1928

Cow	26	221	240	483	57	639	Total	Ave.
Wk								
1	237.0	221.4	318.7	192.2	108.9	155.9	1,234.1	205.7
2	242.2	214.9	307.7	181.1	107.1	160.4	1,213.4	202.2
3	234.2	228.7	306.9	200.7	106.6	170.0	1,247.1	207.8
4	227.7	226.6	273.9	197.7	99.2	172.0	1,197.1	199.5
5	232.2	219.7	265.7	193.5	98.2	174.9	1,184.2	197.4
6	221.9	196.2	294.1	177.3	93.3	154.7	1,137.5	189.6
7	218.9	182.8	281.2	166.1	94.9	152.6	1,096.5	182.8
8	217.5	171.9	291.8	159.6	91.6	153.2	1,085.6	180.9
9	215.0	164.9	295.3	185.9	92.1	156.8	1,110.0	185.0
10	219.8	162.6	284.9	218.4	93.5	160.9	1,140.1	190.0
11	221.2	148.1	290.7	222.3	95.5	165.1	1,142.9	190.5
12	211.5	141.0	283.4	216.6	96.0	159.8	1,108.3	184.7
13	215.5	137.1	272.9	215.6	94.3	162.6	1,098.0	183.0
14	214.1	126.9	279.4	188.2	87.9	165.8	1,062.3	177.0
15	201.7	125.8	282.5	199.5	91.5	170.0	1,071.0	178.0

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XVI

MILK PRODUCTION BY WEEKS

Silage--Kale--Kale & Silage
Year 1928-1929

Cow / Wk	42	54	246	255	469	445	629	Total	Ave.
1	178.4	174.7	288.4	171.3	272.3	159.9	97.8	1,342.8	191.8
2	171.9	181.9	288.6	178.1	290.5	175.2	96.0	1,382.2	197.4
3	169.3	170.3	283.7	174.2	295.6	167.7	95.8	1,356.6	193.8
4	146.7	163.2	270.8	154.7	252.6	152.3	96.1	1,236.4	176.6
5	141.9	149.0	255.2	151.1	272.8	139.9	92.1	1,202.0	171.7
6	138.1	140.3	268.7	157.8	258.4	131.7	94.7	1,189.1	169.8
7	139.6	148.1	252.2	154.0	238.2	139.3	90.6	1,162.0	166.0
8	128.9	151.5	262.6	153.9	243.2	122.9	96.0	1,159.0	165.6
9	117.8	142.5	261.5	146.9	233.8	117.5	89.7	1,109.7	158.5
10	119.0	153.7	258.8	127.8	239.2	116.4	91.9	1,107.2	158.1
11	110.0	139.4	261.7	151.7	244.0	111.6	94.0	1,112.4	158.9
12	112.0	139.9	262.3	150.3	249.7	100.8	97.9	1,112.9	159.0
13	120.0	137.5	262.0	249.6	250.3	90.6	94.7	1,104.7	157.8
14	110.7	152.7	242.1	152.1	229.4	92.5	99.2	1,178.7	154.1
15	109.9	153.7	222.6	144.6	238.5	88.7	94.9	1,152.9	150.4

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XVII

MILK PRODUCTION BY WEEKS

Kale & Silage--Silage--Kale
Year 1928-1929

Cow Wk	52	59	55	222	244	638	Total	Ave.
1	234.8	151.4	132.0	219.4	125.7	103.7	967.0	161.1
2	247.4	150.5	137.3	228.3	123.6	96.9	984.0	164.0
3	235.1	154.0	122.7	215.4	111.0	94.8	933.0	155.5
4	206.3	148.2	120.7	223.9	110.0	88.8	897.9	149.6
5	198.2	140.7	118.2	234.9	121.0	87.2	900.2	150.0
6	196.2	133.9	115.1	229.2	118.9	70.7	864.0	144.0
7	197.2	138.0	113.6	165.6	117.6	75.4	807.4	134.6
8	191.6	139.8	112.1	214.4	122.5	80.7	861.1	143.5
9	187.6		111.6	210.1	120.3	75.2	704.8	140.9
10	182.8		107.0	208.8	117.2	73.9	689.7	137.9
11	176.8		101.4	228.3	118.6	77.3	702.4	140.5
12	167.6		100.3	228.6	116.8	73.0	686.3	137.3
13	150.8		102.0	216.3	113.5	77.3	659.9	132.0
14	160.1		102.3	198.9	102.5	66.5	630.3	126.0
15	163.2		98.5	194.1	89.9	56.2	601.9	120.4

Note--Cow 59 went off experiment end of 8th week

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XVIII

MILK PRODUCTION BY WEEKS

Kale--Kale & Silage--Silage
Year 1928-1929

Cow	26	56	60	641	477	258	229	Total	Ave.
Wk									
1	244.8	98.6	157.5	291.7	280.8	147.1	169.6	1,390.6	198.6
2	249.0	99.6	157.2	318.3	277.8	129.7	174.3	1,405.9	200.8
3	242.0	96.9	157.6	330.4	267.3	114.1	176.9	1,385.2	198.9
4	237.6	97.2	149.4	288.2	263.3	114.4	185.2	1,335.3	190.8
5	234.3	110.5	156.7	290.0	274.8	120.7	179.4	1,366.4	195.2
6	218.1	94.6	151.7	276.2	225.0	119.4	185.7	1,270.7	181.5
7	229.5	95.9	154.7	290.3	267.1	112.9	188.5	1,338.9	191.3
8	221.9	95.4	158.2	278.1	277.7	115.0	186.9	1,333.2	190.4
9	214.9	103.8	161.0	277.5	271.8	116.4	186.8	1,332.2	190.3
10	224.8	96.3	160.4	277.6	264.4	110.3	185.8	1,319.6	188.5
11		92.9	155.8	260.8	264.5	104.9	182.3	1,061.2	176.9
12		98.8	154.5	257.2	254.3	103.8	186.0	1,054.6	175.7
13		105.7	151.2	256.5	262.3	96.4	185.4	1,057.5	176.2
14		93.4	147.1	241.8	251.0	95.2	175.8	1,004.3	167.4
15		90.6	141.8	233.9	224.8	89.9	170.6	951.6	158.0

Note--Cow 26 went off experiment end of 10th week

Note--Weeks 1, 6, and 11 are Preliminary Periods

Table XIX

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1925-26

Milk

Cow	X	x	x
221	870.8	156.83	24,595.65
221	623.9	90.07	8,112.60
233	1,060.4	346.43	120,013.74
233	956.9	242.93	59,014.98
41	635.4	78.56	6,173.24
41	561.0	152.97	23,399.82
42	797.1	83.13	6,910.60
42	566.0	147.97	21,989.12
468	561.5	152.47	23,247.10
468	399.3	314.67	99,037.21
473	715.2	1.23	1.51
473	665.7	48.27	2,329.99
219	801.4	87.43	7,644.00
232	1,102.2	388.23	150,722.53
26	859.9	145.93	21,295.56
31	396.3	317.67	100,914.23
479	564.7	149.27	22,291.53
			697,693.41

Arithmetic Mean----------713.97#
Total Deviation Squared----------697,693.41
Standard Deviation----------202.50
Probable Error of Mean---------- 33.12#
True Mean---------- 713.97 - 33.12#

Table XX

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1925-26

Butterfat

Cow			
221	29.61	1.45	2.10
221	23.50	7.56	57.15
233	39.23	8.17	66.75
233	34.93	3.87	14.98
41	32.72	1,66	2.76
41	33.38	2.32	5.38
42	42.64	11.58	134.09
42	34.53	3.47	12.04
468	22.74	8.32	69.22
468	19.37	11.69	136.66
473	28.25	2.81	7.90
473	28.63	2.43	5.90
219	31.79	0.73	0.53
232	41.46	10.40	108.16
26	43.00	11.94	142.56
31	21.27	9.79	109.59
479	20.96	10.10	102.01
			977.78

Arithmetic Mean----------31.06#
Total Deviation Squared----------977.78
Standard Deviation---------- 7.58
Probable Error of Mean---------- 1.24#
True Mean----------31.06 - 1.24#

Table XXI

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1925-26

Milk

Cow	X	x	x
219	816.8	110.8	12,276.64
219	819.9	113.9	12,976.21
232	810.9	104.9	11,004.01
232	1358.4	652.4	425,625.76
26	806.6	100.6	10,120.36
26	776.0	70.0	4,900.00
31	416.8	289.2	83,636.64
31	359.0	347.0	120,409.00
479	616.0	90.0	8,100.00
479	552.5	153.5	23,562.25
221	733.6	27.6	761.76
233	904.1	198.1	39,243.61
41	547.5	158.5	25,122.25
42	635.4	70.6	4,984.36
468	474.8	231.2	53,453.44
473	668.5	37.5	1,406.25
			837,579.54

Arithmetic Mean----------706.01#
Total Deviation Squared-------837,579.54
Standard Deviation----------228.79
Probable Error of Mean---------- 38.58#
True Mean----------706.01 - 38.58#

Table XXII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1925-26

Butterfat

Cow	X	x	x
219	30.63	0.88	.77
219	31.98	2.23	4.97
232	24.73	5.02	25.20
232	47.54	17.79	316.48
26	37.10	7.35	54.02
26	42.68	12.93	167.18
31	20.21	9.54	91.01
31	19.92	9.83	96.63
479	21.56	8.19	67.08
479	22.10	7.65	58.52
221	28.61	1,14	1.30
233	34.65	4.90	24.01
41	28.47	1.28	1.64
42	37.70	7.95	63.20
468	21.37	8.38	70.22
473	26.74	3.01	9.06
			1,051.29

Arithmetic Mean----------29.75#
Total Deviation Squared----------1051.29
Standard Deviation---------- 8.10
Probable Error of Mean---------- 1.38#
Tue Mean----------29.75 - 1.38#

Table XXIII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods--1926-27

Milk

Cow	X	x	x
26	747.2	193.88	37,589.45
41	453.5	99.82	9,964.03
52	525.1	28.22	796.37
54	434.0	119.32	14,237.26
233	1,002.2	448.88	201,493.25
479	596.3	42.98	1,847.28
638	456.1	97.22	9,451.73
31	559.5	6.18	38.19
45	365.6	187.72	35,238.79
57	362.3	191.02	3,648.86
60	435.9	117.42	1,378.74
221	782.7	229.38	52,615.18
248	426.1	127.22	16,184.93
641	600.1	46.78	2,188.37
			386,672.43

Arithmetic Mean----------553.32#
Total Deviation Squared----------386,672.43
Standard Deviation----------166.10
Probable Error of Mean---------- 29.95#
True Mean----------553.3 - 29.95#

Table XXIV

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1926-27

Butterfat

Cow	X	x	x
26	38.33	12.10	146.41
41	22.22	4.01	16.08
52	29.41	3.18	10.11
54	22.59	3.64	13.25
233	39.59	13.36	178.49
479	24.65	1.58	2.50
638	20.30	5.93	35.16
31	30.16	3.93	15.44
45	18.76	7.47	55.80
57	22.97	3.26	10.63
60	23.71	2.52	6.35
221	32.40	6.17	38.07
248	18.66	7.57	57.30
641	23.40	2.83	8.00
			593.59

Arithmetic Mean----------26.23#
Total Deviation Squared----------593.59
Standard Deviation---------- 6.51
Probable Error of Mean---------- 1.17#
True Mean----------26.23 - 1.17#

Table XXV

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1926-27

Milk

Cow	X	x	x
31	623.6	89.98	8,096.40
45	397.5	145.12	21,059.80
57	373.0	169.62	28,770.90
60	428.6	114.02	13,000.56
221	808.5	265.88	70,692.17
248	500.5	42.12	1,774.09
641	619.8	77.18	5,956.75
26	694.6	151.98	23,097.92
41	430.9	111.72	12,481.35
52	478.7	63.92	4,085.76
54	407.2	135.42	18,338.57
233	912.4	369.78	136,737.25
479	506.9	35.72	1,275.92
638	405.5	137.12	18,801.89
			364,169.33

Arithmetic Mean----------542.62#
Total Deviation Squared----------364,169.33
Standard Deviation----------184.40
Probable Error of Mean---------- 33.25#
True Mean----------542.62 - 33.25

Table XXVI

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1926-27

Butterfat

Cow	X	x	x
31	33.08	6.64	44.09
45	20.79	5.65	31.92
57	22.38	4.06	16.48
60	21.22	5.22	27.24
221	28.70	2.26	5.11
248	20.17	6.27	39.31
641	23.24	3.20	10.24
26	40.91	14.47	209.38
41	24.48	1.96	3.84
52	29.63	3.19	10.18
54	23.98	2.46	6.05
233	37.86	11.42	130.42
479	23.72	2.72	7.40
638	20.02	6.42	41.22
			582.88

Arithmetic Mean----------26.44#
Total Deviation Squared----------582.88
Standard Deviation---------- 6.45
Probable Error of Mean---------- 1.16#
True Mean----------26.44 - 1.16#

Table XXVII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1927-28

	Milk		
Cow	X	x	x
26	936.3	233.6	54,568.96
26	842.8	140.1	19,628.01
221	889.9	187.2	35,043.84
221	529.8	172.9	29,894.41
240	1154.2	451.5	203,852.25
240	1118.2	415.5	172,640.25
483	773.0	70.3	4,942.09
483	819.9	117.2	13,735.84
57	411.1	291.6	85,030.56
57	369.7	333.0	110,889.00
639	677.3	25.4	645.16
639	658.2	44.5	1,980.25
245	740.0	37.3	1,391.29
244	563.6	139.1	19,348.81
246	958.3	255.6	65,331.36
423	361.0	341.7	116,758.89
55	455.8	246.9	60,959.61
638	389.7	313.0	97,969.00
			1,094,609.58

Arithmetic Mean----------702.71#
Total Deviation Squared--1,094,609.58
Standard Deviation----------246.50
Probable Error of Mean--------- 39.21#
True Mean----------702.71 - 39.21#

Table XXVIII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1927-28

	Butterfat		
Cow	X	x	x
26	37.92	9.02	81.36
26	37.08	8.18	66.91
221	29.14	0.24	0.58
221	19.87	9.04	81.72
240	47.32	18.41	338.93
240	36.90	8.00	64.00
483	30.46	1.56	2.43
483	33.21	4.30	18.49
57	22.30	6.61	43.69
57	21.72	7.19	51.70
639	35.63	6.72	45.16
639	35.05	6.15	37.82
245	26.05	1.85	3.42
244	21.53	7.37	54.52
246	30.38	1.48	2.19
423	15.23	13.67	186.87
55	21.06	7.84	61.47
638	19.49	9.41	88.55
			1,229.61

Arithmetic Mean----------28.91#
Total Deviation Squared---1,229.61
Standard Deviation---------- 8.26
Probable Error of Mean------- 1.31#
True Mean----------28.91 - 1.31#

Table XXIX

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1927-28

	Milk		
Cow	X	x	x
26	871.2	241.75	58,443.06
221	682.2	52.75	2,782.56
240	1154.2	524.75	275,362.56
483	730.0	100.55	10,110.30
57	372.1	257.35	66,229.02
639	623.5	5.95	35.40
245	778.3	148.85	22,156.32
245	708.5	79.05	6,248.90
244	601.0	28.45	809.40
244	490.9	138.55	19,196.10
246	1072.0	442.5	195,850.50
246	753.7	124.25	15,438.06
423	465.2	164.25	26,978.06
55	538.1	91.35	8,344.82
423	248.8	380.65	144,894.42
55	460.5	168.95	28,544.10
638	480.2	149.45	22,275.56
638	299.7	329.75	108,735.06
			1,012,434.20

Arithmetic Mean----------629.45#
Total Deviation Squared-1,012,434.20
Standard Deviation----------237.10
Probable Error---------- 37.70#
True Mean----------629.45 - 37.70#

Table XXX

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1927-28

Butterfat

Cow	X	x	x
26	38.16	12.20	148.84
221	23.54	2.42	5.86
240	47.32	21.36	456.25
483	30.17	4.21	17.72
57	22.14	3.82	14.59
639	34.39	8.43	71.06
245	23.93	2.03	4.12
245	24.80	1.16	1.35
244	23.26	2.70	7.29
244	20.37	4.59	21.07
246	36.98	11.02	121.44
246	25.63	0.43	0.11
423	19.77	6.19	38.32
423	10.01	15.95	254.40
55	23.68	2.28	5.20
55	21.87	4.09	16.73
638	24.80	1.16	1.35
638	16.41	9.55	91.20
			1,276.90

Arithmetic Mean----------25.96#
Total Deviation Squared------1,276.90
Standard Deviation---------- 8.42
Probable Errorof Mean---------- 1.34#
True Mean----------25.96 - 1.34#

Table XXXI

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1928-29

Milk

Cow	X	x	x
26	963.0	293.0	85,849.00
56	404.2	265.8	70,651.64
60	620.9	49.1	2,410.81
641	226.9	556.89	310,137.61
477	1055.3	385.3	148,456.09
258	478.9	191.1	36,519.21
229	715.2	45.2	2,043.04
52	640.7	29.3	858.49
55	403.1	266.9	71,235.61
222	837.2	167.3	27,989.29
244	422.7	247.3	61,157.29
638	272.0	398.0	158,504.00
42	505.7	164.3	26,994.49
54	595.9	74.1	5,490.81
246	1036.1	366.1	134,029.21
255	740.4	70.4	4,956.16
469	948.4	278.4	77,206.56
445	496.1	173.9	30,241.21
629	367.2	302.8	91,687.84
			1,346,418.36

Arithmetic Mean----------670.00#
Total Deviation Squared-1,346,418.36
Standard Deviation----------266.20
Probable Error of Mean-------- 41.27#
True Mean----------670.00 - 41.27#

Table XXXII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale Periods 1928-29

Butterfat

Cow	X	x	x
26	43.14	14.52	210.83
56	21.83	6.79	46.10
60	32.35	3.73	13.91
641	40.49	11.87	140.90
477	42.63	14.01	196.28
258	12.45	16.17	261.47
229	21.46	7.16	50.27
52	40.81	12.19	148.60
55	19.55	9.07	82.26
222	27.38	1.24	1.54
244	16.70	11.92	142.09
638	14.69	13.92	193.77
42	32.37	3.75	14.06
54	35.69	7.07	49.98
246	35.23	6.61	43.69
255	26.43	2.19	4.80
469	41.63	13.01	169.26
445	18.55	10.07	101.40
629	20.53	8.09	65.45
			1,936.66

Arithmetic Mean----------28.62#
Total Deviation Squared---------1,936.66
Standard Deviation----------10.09
Probable Error of Mean---------- 1.56#
True Mean----------28.62 - 1.56#

Table XXXIII

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1928-29

	Milk		
Cow	X	x	x
56	388.5	289.92	84,053.61
60	594.6	83.82	7,025.79
641	989.4	310.98	96,708.56
477	992.4	313.98	98,583.44
258	385.3	293.12	85,919.33
229	900.1	221.68	49,142.02
52	759.2	80.78	6,525.41
55	444.3	234.12	54,817.17
222	798.9	120.48	14,515.43
244	477.6	200.82	40,328.67
638	305.2	373.22	139,293.17
42	629.8	48.62	2,523.90
54	664.4	14.02	196.56
246	1098.3	419.88	176,301.41
255	658.1	20.32	412.90
469	1111.5	433.08	187,558.29
445	635.1	43.32	1,876.62
629	380.0	298.42	89,053.50
			1,134,835.78

Arithmetic Mean----------678.42#
Total Deviation Squared--1,134,835.78
Standard Deviation----------251.09
Probable Error of Mean--------- 39.94#
True Mean----------678.42 - 39.94#

Table XXXIV

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Silage Periods 1928-29

Butterfat

Cow	X	x	x
56	21.17	8.88	78.85
60	25.45	4.60	21.16
641	37.40	7.35	54.02
477	39.10	9.05	81.90
258	12.18	17.87	319.34
229	35.10	5.05	25.50
52	42.97	12.92	166.93
55	20.88	9.17	84.09
222	27.16	2.89	8.35
244	16.05	14.00	196.00
638	15.96	14.09	198.53
42	35.71	5.66	32.04
54	41.53	11.48	131.79
246	32.40	2.35	5.52
255	21.45	8.60	73.96
469	45.29	15.24	232.26
445	23.82	6.23	38.81
629	19.65	10.40	108.16
			1857.21

Arithmetic Mean----------30.05
Total Deviation Squared----------1857.21
Standard Deviation----------10.17
Probable Error of Mean---------- 1.62
True Mean----------30.05 - 1.62

Table XXXV

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale & Silage 1928-29

Milk

Cow	X	x	x
26	891.1	217.65	47,371.52
56	391.5	281.95	79,495.80
60	634.3	39.15	1,532.72
641	1122.6	449.15	201,733.72
477	1081.0	409.55	166,097.00
258	545.6	218.85	47,895.32
229	748.0	74.55	5,557.70
52	888.8	215.35	46,375.62
55	498.9	174.55	30,467.69
222	902.5	229.05	52,463.90
244	465.6	207.85	43,201.62
638	367.7	305.75	93,483.06
42	452.6	220.85	48,774.72
54	583.8	89.65	8,037.12
246	989.0	315.55	11,217.80
255	596.5	76.95	5,921.30
469	967.9	294.45	86,700.80
445	372.6	300.85	10,510.72
629	386.7	286.75	82,225.56
			1,069,063.69

Arithmetic Mean----------673.45#
Total Deviation Squared-1,069,063.69
Standard Deviation----------237.20
Probable Error of Mean-------- 36.77#
True Mean----------673.45 - 36.77#

Table XXXVI

MEAN PRODUCTION
STANDARD DEVIATION
PROBABLE ERROR OF MEAN

Kale & Silage 1928-1929

Cow	Butterfat X	x	x
26	42.33	13.50	182.25
56	22.55	6.28	39.44
60	29.18	0.35	0.18
641	39.74	10.91	119.03
477	40.65	11.82	139.71
258	12.55	16.28	265.04
229	26.47	2.36	5.57
52	54.13	25.30	640.09
55	22.20	6.63	43.96
222	27.08	1.75	3.08
244	16.30	12.53	157.00
638	20.96	7.87	61.94
42	29.50	0.67	0.45
54	37.89	9.06	82.08
246	31.25	2.42	5.86
255	20.10	8.73	76.21
469	40.75	11.92	142.09
445	13.41	15.42	237.78
629	20.80	8.03	64.48
			2,266.24

Arithmetic Mean----------28.83#
Total Deviation Squared-----2,266.24
Standard Deviation----------10.92
Probable Error of Mean--------- 1.69#
True Mean----------28.83 - 1.69#