PLANT BREEDING INVESTIGATIONS.

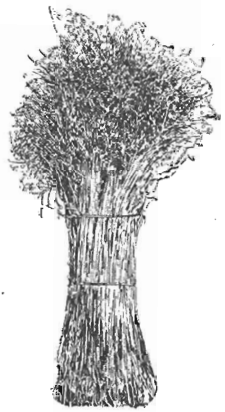
(5000)

BULLETIN NO. 54. MAY, 1898.

# OREGON AGRICULTURAL EXPERIMENT STATION.

AGRICULTURAL DEPARTMENT.





*I. Notes on Flax and Hemp.*
*II. Dairy Rations.*
*III. Fresh vs. Stripper Cow Butter.*
*IV. Feeding Pumpkins to Pigs.*
*V. Feeding Artichokes to Pigs.*

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
G. B. KEADY, PRINTER.
1898.

## BOARD OF REGENTS.

*J. T. APPERSON, President.....Oregon City*
*W. E. YATES, Secretary.....Corvallis*
*J. K. WEATHERFORD, Treasurer.....Albany*
*WM. P. LORD, Governor.....Salem*
*H. R. KINCAID, Secretary of State.....Salem*
*G. M. IRWIN, Supt. Public Instruction.....Salem*
*WM. M. HILLEARY, Master State Grange.....Turner*
*T. W. DAVENPORT.....Silverton*
*W. P. KEADY.....Portland*
*WALLIS NASH.....Nashville*
*BENTON KILLIN.....Portland*
*JONAS M. CHURCH.....La Grande*
*SAMUEL HUGHES.....Forest Grove*

---

## COMMITTEES.

### EXECUTIVE.

*SAMUEL HUGHES, Chairman, W. E. YATES, Secretary, J. T. APPERSON, WILLIAM M. HILLEARY, BENTON KILLIN.*

### FINANCE.

*BENTON KILLIN, WM. M. HILLEARY, J. M. CHURCH*

### AGRICULTURE AND CHEMISTRY.

*BENTON KILLIN, WILLIAM M. HILLEARY.*

### HORTICULTURE AND ENTOMOLOGY.

*SAMUEL HUGHES, J. K. WEATHERFORD.*

### MECHANICS AND HOUSEHOLD ECONOMY.

*J. K. WEATHERFORD, SAMUEL HUGHES, WALLIS NASH.*

### LITERARY DEPARTMENT AND LIBRARY.

*WALLIS NASH, T. W. DAVENPORT.*

### ADVERTISING AND PRINTING.

*W. P. KEADY, W. E. YATES.*

### BUILDINGS AND GROUNDS.

*W. E. YATES, J. M. CHURCH.*

### FARMERS' INSTITUTES.

*J. K. WEATHERFORD, W. E. YATES.*

## OFFICERS OF THE STATION.

*THOMAS M. GATCH, A. M., Ph. D.....President and Director*
*H. T. FRENCH, M. S.....Agriculturist*
*G. W. SHAW, Ph. D.....Chemist*
*A. B. CORDLEY, B. S.....Entomologist*
*MOSES CRAIG, M. S., M. Sc. Hort.....Botanist*
*GEORGE COOTE.....Horticulturist*
*E. F. PERNOT.....Bacteriologist*

# NOTES ON FLAX AND HEMP.

H. T. FRENCH.

IN Bulletin No. 43, published in February, 1897, mention is made of contemplated experiments in testing the growth of flax on the Station grounds at Corvallis.

Such experiments were carried out last season with the following results. We had expected to make a more detailed report including an account of the value of the fiber produced, as determined by the manufacturer, but this part of the report will be delayed on account of not getting returns from a portion of the straw sent through Foard and Strokes, of Astoria, to Robert Stewart & Sons, of Lisburn, Ireland. This firm kindly consented to prepare the fiber and test its value in the manufacture of salmon twine. This report is delayed on account of the flax not reaching the firm in time to work with last year's crop. The fiber will be prepared as soon as possible however, and the report made later.

## SEED.

Our experiments were made with seed purchased of Mr. Wm. M'Causland, Belfast, Ireland, and imported direct to us at Corvallis.

Four varieties were obtained as follows: Belgian, (Riga grown one year in Belgium), Pure Riga, Finest Dutch Sowing and White Blossom Dutch. The seed was of excellent quality and reached Corvallis in good condition. The germination in this seed was high, ranging from 85 to 95 per cent. The germinating qualities of flax seed are very important in flax grown for fiber. The quality of the fiber is very much affected by thick or thin seeding; for this condition will very largely determine the texture of the straw, and will modify the branching tendency of the plants. Plants which throw out lateral branches produce an inferior article of fiber. Two bushels of seed were sown per acre; but owing to the lack of moisture, as shown later in the report, only a portion of the seed germinated in time to make a crop.

## SOIL CONDITIONS.

The soil in which the flax was grown consisted of a clay loam, such as we find bordering on the white land, throughout the Willamette valley.

The plats were so laid out that a portion of each plat would cover ground where a crop of potatoes had been grown on clover sod the previous year, and the other portion would cover the clover sod plowed in the winter, without any crop having been taken off previous to the flax. The object of this was to determine the effect of growing flax after potatoes as compared with that grown on clover sod. No fertilizer was used. The plats were forty rods long and two rods wide making half an acre in each.

## PREPARING THE SOIL.

The soil was prepared by plowing deeply in the witner, and then again in the spring to the depths of six inches. The first plowing was ten inches. A portion of the ground was newly subsoiled; but no benificial results were observed from this work, owing to the fact the whole field had been subsoiled only two years previous, and that the soil was not in special need of this treatment.

After the second plowing the ground was thoroughly harrowed, April 20th. After this the soil was not disturbed again until just before seeding. In this way nearly all of the weed seeds gerinated, and were destroyed by subsequent harrowings. This is very important for it saves labor in hand-weeding the flax. Too much stress cannot be placed upon thorough preparation of the soil. The flax plant must be given a fine soil in which the plant food is readily available.

## SEEDING.

The seed was sown broadcast with a Thompson, wheelbarrow seeder. Two bushels of seed per acre was applied. The seed was covered with a light smoothing harrow, followed with the roller to firm the soil about the seed, and leave the ground smooth.

The seed was sown May 12th. This is too late for the average climatic conditions which prevail in this locality. We had expected to seed the last of April; but a rain storm placed the ground in a condition that it could not be worked. After this rain the surface soil dried out very rapidly, so much so that when the

flax was sown, on May 12th, there was not moisture enough to germinate all the seed.

## GERMINATION AND GROWTH.

Three fourths of the seed of the Belgian flax germinated, and was above ground, in five days after sowing. Of the other varieties about one-half the seed was above ground at this time. On May 25th, thirteen days from planting, all of the plants were above ground which made their appearance before the rain came on June 19th. When the rain came on this date, the balance of the seed germinated, so that there were two growths in the plats,—one two feet high or more, and the other just germinating. This second growth hindered the growth of the first crop, and did not reach maturity before the first crop was ready to harvest. This is one reason why a considerable portion of the plants on the plats sent out lateral branches. The plants were not close enough during the early growth.

## NOTES ON VARIETIES.

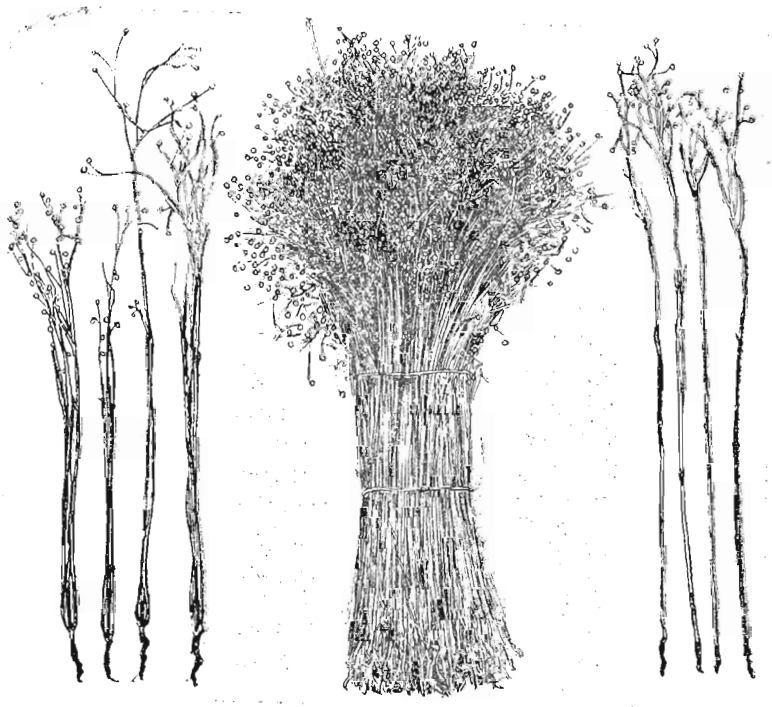
**Belgian.**—First appearance above ground May 17th. Second set of leaves May 25th. Flax began to bloom June 24th, forty three days from seeding. The flax at this time was 25 to 30 inches high on the clover sod, and 20 to 25 on the potato ground. Flax out of bloom and turning yellow at base of stalk July 19th. The flax was ready to pull at this date. This was sixty eight days from date of seeding. When compared with the time required for the plants to reach maturity, in other flax growing sections, this is very short indeed. Mention is made of this in another part of the report.

This variety was very little branched and made an average growth of forty inches. A great many of the plants on clover sod reached fifty inches in height. On the potato ground the flax did not exceed twenty-six to thirty inches, and was not considered worth harvesting.

The flax was pulled July 19th, and the straw tied into bundles six to eight inches in diameter. The bundles were set up in small shocks to dry. The flax remained in shocks until Aug. 11th, when it was weighed, yielding 3751 pounds per acre. A portion of the flax was weighed when pulled July 22nd, and again when dry August 11th. The flax shrunk sixty per cent. in weight during this time.

The Belgian variety made the best showing, as to yield and quality of straw, so far as could be determined from its appearance.

**Pure Riga.**—There was very little difference between this variety and the Belgian. The Belgian was more vigorous in its growth, and reached maturity a little earlier. The blooms came out five day earlier on the Belgian than on the Riga. The Riga began to bloom June 29th, forty eight days from seeding. The flax was ready to pull July 24th, seventy three days from time of seeding. The Riga was thinner on the ground than the Belgian on account of seed not germinating. This caused the plants to branch more than the Belgian, but not so badly however as in the Dutch varieties.



Worthless. FLAX. Good.

The flax was pulled July 24th, and treated the same as the Belgian. It was weighed on August 11th, showing a yield of 2140

pounds of dry straw per acre. Average length of straw thirty-six inches.

**Finest Dutch Sowing.**—This is a blue blossom Dutch variety resembling the Riga very much. It matured a little earlier than the Riga. It was ready to pull July 22nd, seventy-one days from time of seeding. The straw was the same height as the Riga. There were more lateral branches in this varitey, even where it had the same number of plants on the ground as the Riga. This variety yielded 2080 pounds of dry straw per acre.

**White Blossom Dutch.**—This variety was later in maturing than those named above. It was not ready to pull until August 3d, 83 days from date of seeding. The straw was coarser than from any other variety, and was more branched at the base. The average length of the straw was 33 inches. The yield was not as great as in the other varieties. As compared with the other kinds grown, it is not a disirable variety. One test is not conclusive however, and should count for what it is worth and no more.

## COST OF GROWING AND HARVESTING FLAX.

An accurate account was kept of labor expended in preparing the ground and sowing the seed, and of the time required in harvesting the flax. The following summaries are given. The relative cost of growing flax on a large scale would be somewhat less.

Plowing, harrowing and sowing seed $7.70 per acre. Wages of a man and team are reckoned at $2.50 per day. Pulling flax, and tying in bundles, with two bands made of binder twine, $5.70 per acre. Weeding plats by hand $1.75 per acre. Hand labor reckoned at $1.00 per day. Total cost $15.15 per acre. This is cost of labor only, and does not include interest on investment in tools, rent of land, etc.

## OBSERVATIONS.

While we could hardly expect conclusive results from a single years experience, and especially without a further test of the value of the fiber produced, yet so far as growth and quality are concerned, indicated by the appearance of the straw, the results were very flattering indeed. The yield was not much more than half a crop, owing to thin seeding, due to a lack of moisture in germinating the seed when first sown. In this particular the conditions were quite unfavorable.

The climate and soil seem to be well adapted to growing flax as shown in the rapid developement of the plants. The period of growth was not as long as that in many flax growing sections as the following would indicate:

Mr. Eugene Bosse says, in a report to the Department of Agriculture, regarding the growth of flax for fiber in Minnesota and Wisconsin, that "the flax in this part of the West should be ready to pull in from eighty-five to ninety-two days after sowing when sown between the 15th and 25th of April, and from seventy-five to eighty-five generally when sown from the 1st to the 15th of May; but the capsules must be just turned yellow, and the lower half of the plant free from leaves. The richer the land the earlier the flax may be sown, and the earlier the flax is sown the more seed it will take to have a good stand."

None of the varieties tested required the maximum time indicated here, and only one passed the minimum. The White Blossom Dutch required eighty three days.

The straw produced by the Belgian and pure Riga varietfes, was of uniform length and quality. It was pronounced excellent by parties who were familiar with the growth of flax in this country, and in the countries of Europe.

The weather conditions were not as favorable for a large growth of flax, as we might well expect in this locality.

The lack of moisture, during the early growth of the plants, hindered very materially in the greatest developement. There was only .19 of an inch of rain fall from time of seeding May 12th, to June 19th. Flax should make its greatest growth in the first forty days, but in this case the growth was hindered just at the critical time. This long continued drought would have proved fatal to the young plants in a less humid atmosphere.

The total precipitation at the college during the growth of the flax, is shown in the following table, taken from the State Weather Bureau report. Only dates on which rain fell are given.

| May | June | | | | | | | | | | July | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 13 | 14 | 19 | 20 | 21 | 22 | 25 | 26 | 29 | 38 | 1 | 5 | 7 | Inches. |
| .16 | .01 | .02 | .23 | .15 | .75 | .39 | .03 | .01 | .02 | .48 | .02 | .06 | .01 | 2.34 |

PLATE I. RETTING POND.

The flax on clover sod did much better than that after potatoes. In fact the flax grown on the potato ground was not considered worth pulling.

The cut in plate I shows a retting pond located at Salem Oregon. The cut was made from a photograph taken last season when the pond was in use by the Oregon, Womens' Flax Fiber Association. The cut shows the pond as it appeared when filled with flax straw in the process of retting.

The illustration on page 6 shows a sample of flax tied in a bundle as it came from the field. The flax on the side shows good and bad straw. The one showing the lateral branches is worthless in the production of high grade fiber, the others are ideal straws, being straight and free from branches.

The experiments with flax and other fiber plants are again in progress this season, and will furnish material for a more conclusive report in which we shall endeaver to give the final results of a test of the fiber produced. So far, the experiments indicate favorable soil and climatic conditions, for the productions of high grade flax fiber. If we can produce the raw material, economically, and of a high quality, we shall have added another important industry to our Agricultural resources.

The manufacturer is ready to take all the fiber we can produce, providing it is of high quality, and furnished in sufficient quantities to call the trade in this direction.

# HEMP.

H. T. FRENCH.

HEMP was grown last year for the first time in the history of our experimental work. A small quantity of Japanese hemp seed was procuredof Mr. Felix Fremerey, of Bakersfield, California. The seed was sown broadcast on May 18th, at the rate of 40 pounds per acre. The ground, which was a clay loam, was prepared by plowing deeply in the winter and again in the spring, and harrowing thoroughly until the surface was free from clods. The seed was covered with a light smoothing harrow followed by the roller to increase capillary moisture near the surface. A portion of the seed germinated very quickly while the remainder did not germinate until the rain came on June 19th. At this time the remainder of the seed germinated making two growths, the same as in the flax.

The first plants shot up very quickly making a strong and vigorous growth. The roots extended down into the moist soil beyond the reach of the hot sun. The warmer the weather the more rapidly the crop seemed to grow.

The plants continued to grow until September 17th, when the stalks began to turn yellow at the base and the lower leaves began to drop. Many of the stalks at this time measured 12 to 14 feet in height.

The quality of the hemp, in the production of fiber, was not tested as we had no means of preparing the fiber. The hemp was pronounced of excellent quality by those who are familiar with its growth in other States.

It is believed by experts that our soil and climate are well adapted to the growth of this most valuable fiber plant. A more extended experiment is in progress this season, in coöperation with several other experimenters, in testing the growth of hemp throughout the Willamette valley.

Capitalists are interested in the success of these experiments, and we are reliably informed that, if the plant can be grown successfully, large manufacturing establishments will be put up in our State, to handle the product.

We make this preliminary report hoping to interest others in multiplying, if possible, the number of industries which may be made remunerative to the farmers of the State.

Hemp is one of the best crops known, to rid land of noxious weeds, and is a crop easily handled, requiring less hand labor than many other crops which are being recommended. It is a crop which gives good returns for the labor expended, where it is now grown. Those who are best informed say there is no danger of over production. There are only comparatively few localities where it can be grown successfully. Hemp fiber is entering into many manufactured articles, such as blankets, clothing, and other every-day uses, besides the vast amount that is used in the manufacture of cordage. By growing our own hemp we shall keep a large amount of money at home which is now sent abroad for thepurchase of raw material.

The cut on this page shows the male and female plants. These were taken from our plats last season. The one on the right is the male plant which bears the pollen, and the one on the left is the female, or the one which bears the seed. The female plant is more branched than the male and is not as valuable for the production of fiber.

HEMP.

# DAIRY RATIONS.

F. L. KENT.

"WHAT is the best feed for a dairy cow," is a question asked nearly every time the matter of feeding is brought up at a Farmers' Institute. The "best feed" referred to would be that ration which would produce milk, or more properly, butter fat, at the least cost. In order to determine what would be the most economical ration made up of the various products of Oregon farms, the Station arranged a series of five rations which were fed to a portion of the Station herd during the winter of 1896–7, beginning in December, '96, and continuing into March, '97. Four cows which were giving about the same quantity of milk each, and which had about the same capacity for consuming food, were selected for the purpose. The cows had been in milk from two to three months, and had all been bred again before the experimental feeding began. The conditions of the experiment were as follows:

Each period was of fifteen days duration, five days preliminary, and ten days test.

Samples of the milk of each cow were taken daily and a composite test made at the end of the ten days. During the five days of preliminary feeding no samples were taken. During the ten days of the first feeding period samples were taken and tested every day, as well as a composite sample of the ten days milk. The average of the ten daily tests agreed so closely with the composite test that it was considered unnecessary to make the daily tests, and only the composite was used in the succeding periods. The milk was carefully weighed at each milking, for a computation of the amount of butter fat depends on the quantity of milk as well as upon the test.

The cows were weighed at the close of each period to determine whether there had been a gain or loss in live weight during that feeding period.

It was found that the cows would each eat practically the same quantity of feed, hence the ration fed consisted of the same amount for each cow.

The four cows used were: Bonnie, grade Jersey; Rose, Ayrshire; Sally, Shorthorn-Ayrshire; Topsy, Ayrshire.

Ration I consisted of corn silage, 25 lbs., clover hay, 10 lbs., bran, 6 lbs.

Ration II consisted of corn silage, 25 lbs., clover hay, 10 lbs., bran, 5 lbs., oat chop, 3 lbs.

Ration III consisted of corn silage, 40 lbs., clover hay, 5 lbs.

Ration IV consisted of clover hay, 15 lbs., bran, 5 lbs., oat chop, 2 lbs., carrots, 8 lbs.

Ration V consisted of clover hay, 15 lbs., bran, 5 lbs., oat chop, 3 lbs., shorts, 2 lbs.

The corn silage was prepared from Pride of The North corn which yielded about ten tons of green fodder per acre. The corn was properly matured for silage, and when fed to the cows was in first class condition.

The clover hay came from a field of twenty-eight acres which produced ninety-six tons of well cured hay.

In making the computations the following values were allowed for the different feeding stuffs: Clover hay, $6.00 per ton; bran, $10.00 per ton; corn silage, $1.50 per ton; oat chop, $18.00 per ton; carrots, $2.00 per ton; shorts, $16.00 per ton.

In all the rations except No. III the silage was all fed at noon, and the grain and hay equally divided between the night and morning feeds. In No. III twenty pounds of silage was fed at noon and the remainder fed with the hay night and morning.

**Table I. Age of cows and date of calving prior to experiment.**

| Cow. | Breed. | Age. | Date of calving. | Weight at beginning of experiment. |
|---|---|---|---|---|
| Bonnie | Grade Jersey | 3 years | October 15, 1896 | 795 pounds |
| Rose | Ayrshire | 7 years | November 13, 1896 | 980 pounds |
| Sally | Shorthorn-Ayrshire | 6 years | September 10, 1896 | 935 pounds |
| Topsy | Ayrshire | 5 years | September 29, 1896 | 830 pounds |

**Table II. Cost per pound of butter fat with Ration I.**

RATION.—25 pounds corn silage, 10 pounds clover hay, 6 pounds bran. Cost of feed for ten days 79 cents.

| Cow. | Pounds of milk. | Test. | Pounds of butter fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 177 | 3.8 % | 6.73 | 79 cents | 11.8 cents | Gain, 10 pounds |
| Rose | 261 | 3.7 | 9.66 | 79 cents | 8.2 cents | No gain or loss. |
| Sally | 208 | 3.4 | 7.07 | 79 cents | 11.2 cents | Gain, 5 pounds. |
| Topsy | 195 | 3.9 | 7.60 | 79 cents | 10.4 cents | Loss, 10 pounds. |
| Average | 210 | 3.7 % | 7.76 | ---------- | 10.4 cents | Gain, 1 pound. |

**Table III. Cost per pound of butter fat with Ration II.**

RATION.—25 pounds corn silage, 10 pounds clover hay, 5 pounds bran, 3 pounds oat chop. Cost of food for ten days 101 cents.

| Cow. | Pounds of milk. | Test. | Pounds of butter fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 186 | 4.0% | 7.44 | 101 cents | 13.6 cents | Loss, 5 pounds. |
| Rose | 276 | 3.4 | 9.38 | 101 cents | 10.8 cents | Loss, 10 pounds. |
| Sally | 215 | 3.2 | 6.88 | 101 cents | 14.7 cents | No gain or loss. |
| Topsy | 215 | 3.9 | 8.38 | 101 cents | 12.0 cents | Loss, 10 pounds. |
| Average. | 223 | 3.6% | 8.02 | ..... | 12.8 cents | Loss, 6 pounds. |

**Table IV. Cost per pound of butter fat with Ration III.**

RATION.—40 pounds corn silage, 5 pounds clover hay. Cost of feed for ten days, 45 cents.

| Cow. | Pounds of milk. | Test. | Pounds of butter fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 156 | 4.0% | 6.24 | 45 cents | 7.2 cents | Loss, 35 pounds. |
| Rose | 223 | 3.2 | 7.14 | 45 cents | 6.3 cents | Loss, 45 pounds. |
| Sally | 174 | 3.2 | 5.57 | 45 cents | 8.1 cents | Loss, 35 pounds. |
| Topsy | 185 | 3.8 | 7.03 | 45 cents | 6.4 cents | Loss, 30 pounds. |
| Average. | 184 | 3.55% | 6.49 | ..... | 7.0 cents | Loss, 36 pounds. |

**Table V. Cost per pound of butter fat with Ration IV.**

RATION.—15 pounds clover hay, 5 pounds bran, 2 pounds oat chops, 8 pounds carrots. Cost of feed for ten days, 96 cents.

| Cow. | Pounds of milk. | Test. | Pounds of butter fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 147 | 4.0% | 5.88 | 96 cents | 16.3 cents | Gain, 25 pounds. |
| Rose | 219 | 3.3 | 7.23 | 96 cents | 13.3 cents | No gain or loss. |
| Sally | 171 | 3.0 | 5.13 | 96 cents | 18.7 cents | Gain, 15 pounds. |
| Topsy | 163 | 3.6 | 5.87 | 96 cents | 16.3 cents | Loss, 15 pounds. |
| Average. | 175 | 3.5% | 6.03 | ..... | 16.1 cents | Gain, 16 pounds. |

**Table VI. Cost per pound of butter fat with Ration V.**

RATION.—15 pounds clover hay, 5 pounds bran, 3 pounds oat chop, 2 pounds shorts. Cost of feed for ten days, 113 cents.

| Cow. | Pounds of milk. | Test. | Pounds of butter fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 156 | 4.0% | 6.24 | 113 cents | 18.1 cents | Gain, 15 pounds. |
| Rose | 229 | 3.3 | 7.56 | 113 cents | 14.9 cents | Gain, 25 pounds. |
| Sally | 178 | 3.2 | 5.70 | 113 cents | 19.8 cents | Gain, 20 pounds. |
| Topsy | 175 | 3.8 | 6.65 | 113 cents | 17.0 cents | Gain, 25 pounds. |
| Average. | 184 | 3.6% | 6.54 | ..... | 17.4 cents | Gain, 21 pounds. |

A comparison of the foregoing tables shows that the cost of producing a pound of butter fat was as low as 6.3 cents with the cow Rose in feeding ration III, while with the same cow in ration

V the cost reached the sum of 14.6 cents per pound of butter fat. Taking the average of the four cows we find that butter fat was produced at a cost of 7.0 cents per pound when feeding ration III, and at a cost of 17.4 cents when ration V was fed. But this would hardly justify the statement that ration III was a better one than ration V, for in feeding the former the four cows showed a loss in live weight amounting to an average of 36 pounds each during the fifteen days, and in feeding the latter ration the cows made an average gain of 21 pounds each, in the same length of time.

It is desirable that a cow remain fairly stationary in weight during the milk giving period, hence the use of a ration like No. III is not desirable. Ration V in addition to its high cost has the disadvantage of causing the cows to lay on flesh too rapidly, but it is possible that this gain would not have been so rapid had there not been so great a loss in weight during the feeding of ration III.

Of the five rations fed, No. I, consisting of 25 lbs. corn silage, 10 lbs. clover hay, and 6 lbs. bran, is shown by the tables to be the most satisfactory. The cost of a pound of butter fat is low, only 10.2 cents at a time when butter was worth 25 cents per pound in the market. During the fifteen days the four cows gained in weight a total of only five pounds, or about one pound each, on an average.

Rations IV and V were arranged without corn silage as already shown, and the results are apparent from the tables. In rations I and II, where silage was fed in connection with grain and hay, butter fat was produced at a cost of 10.4 cents and 12.8 cents respectively. In rations IV and V, where the silage was omitted and larger quantities of hay and grain fed, the cost per pound of butter fat was 16.1 cents and 17.4 cents respectively.

The term butter fat is used because the butter fat can be determined with ease and exactness, and shows just what the cow is doing, while the amount of butter made from a given quantity of milk depends somewhat upon the operator. If a separator is used to do the skimming and care is exercised in the churning there should be an increase in the amount of butter made over the quantity of fat contained in the milk, amounting to not less than one eighth of the number of pounds of butter fat. That is, if 100 pounds of butter fat are present in a given quantity of

milk, there ought to be produced from it at least 112½ pounds of butter. Not unfrequently in creameries, the amount is as high as 115 to 118 pounds. Figuring on the basis of one eighth increase, we find that a pound of butter could have been produced with these rations, taking into consideration the cost of feed only, at the following rates:

Ration I, 9.2 cents. Ration II, 11.4 cents, Ration III, 6.2 cents. Ration IV, 14.3 cents. Ration V, 15.4 cents.

It is interesting in this connection to notice the cost of producing a pound of butter fat in other states.

The Minnesota Experiment Station, Bulletin 35, has a year's record of cost of butter fat production from which we take the following:

The ration fed during the winter consisted of 24 to 40 pounds silage, 3 to 5 pounds mixed hay, 6 to 10 pounds wheat bran, and 1 to 2 pounds linseed meal. Ten cows which calved between October 16th and November 30, 1892, produced butter fat during the first three months of the succeeding year at the following average cost per pound: January, 11.6 cents; February, 12.9 cents; March, 15.4 cents.

From Bulletin 52 of the Cornell University Experiment Station, N. Y., which reports results of a whole year's work in feeding we take the following:

The ration fed during the winter consisted of 40 to 55 pounds silage, 10 to 15 pounds hay, 10 pounds roots, and 8 pounds grain. Twelve cows which calved between September 1st and November 16th produced butter fat during the first three months of the succeeding year at the following average cost per pound: January, 20.7 cents; February, 21.8 cents; March, 22.1 cents.

# ROOT FEEDING.

F. L. KENT.

DURING the winter of 1897-8 some feeding was done for the purpose of studying the effect of a considerable quantity of various roots in a ration. Three kinds of roots were used viz: Sugar beets, carrots, and mangels. Three rations were made up as follows:

Ration I, Sugar beet ration: 8 pounds clover hay, 20 pounds corn silage, 3 pounds wheat and oat chop, 3 pounds bran, 23 pounds sugar beets.

Ration II, Carrot ration: 8 pounds clover hay, 20 pounds corn silage, 3 pounds wheat and oat chop, 3 pounds bran, 24 pounds carrots.

Ration III, Mangel ration: 8 pounds clover hay, 20 pounds corn silage, 3 pounds wheat and oat chop, 3 pounds bran, 24 pounds mangels.

The above rations were fed to three of the four cows in the experiment. The fourth cow, Corvallis Beauty, was fed the same ration except that she consumed about one pound less of hay per day. With the exception of the cow just mentioned the animals fed were the same ones used in the feeding of the previous winter.

Each ration was fed for a period of four weeks, one week preliminary and three weeks test. During the last week of each feeding period the cream from two days milk was churned and the quality of the butter noted.

Owing to the price of wheat being higher than during the preceeding winter the values allowed the grain portion of the ration are somewhat higher than in the previous table of feed values. Following are the feeds used and the value allowed per ton:

Clover hay, $6.00 per ton; wheat and oat chop, $20.00 per ton; corn silage, $1.50 per ton; bran, $11.00 per ton; beets, carrots, and mangles, $2.00 per ton.

The hay and silage were practically the same as used the preceeding winter. The wheat and oat chop consisted of about equal parts of wheat and oats which had grown thus mixed. The val-

ue placed upon the mixture was based upon the market price of the two grains at the time of feeding, plus the cost of chopping.

The rations were fed in three feeds, the silage being fed at noon, and the hay, grain, and roots equally divided between the morning and evening feeds.

**Table VII. Age of cows, breed, and date of calving prior to experiment.**

| Cow. | Breed. | Age. | Date of calving. |
|---|---|---|---|
| Bonnie | Grade Jersey | 4 years | August 17, 1897. |
| Corvallis Beauty | Reg. Jersey | 4 years | August 7, 1897. |
| Rose | Ayrshire | 8 years | October 12, 1897. |
| Topsy | Ayrshire | 6 years | September 8, 1897. |

**Table VIII. Cost per pound of butter fat with sugar beets.**

RATION.—8 pounds clover hay, 20 pounds silage, 3 pounds bran, 3 pounds wheat and oat chop, 23 pounds sugar beets.

| Cow. | Pounds of milk. | Test. | Pounds fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 385 | 3.6 % | 13.86 | $2.28 | 16.4 cents | Gain, 20 pounds |
| Corvallis Beauty | 282 | 4.8 | 13.54 | 2.24 | 16.5 cents | Loss, 5 pounds |
| Rose | 556 | 3.0 | 16.68 | 2.28 | 13.7 cents | Gain, 25 pounds |
| Topsy | 439 | 3.7 | 16.24 | 2.28 | 14.0 cents | Gain, 20 pounds |
| Average | 415 | 3.8 % | 15.08 | | 15.1 cents | Gain, 15 pounds |

**Table IX. Cost per pound of butter fat with carrots.**

RATION.—8 pounds clover hay, 20 pounds silage, 3 pounds bran, 3 pounds wheat and oat chop, 24 pounds carrots.

| Cow. | Pounds of milk. | Test. | Pounds fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 373 | 3.7 % | 13.80 | $2.30 | 16.7 cents | Gain, 15 pounds |
| Corvallis Beauty | 294 | 5.1 | 14.99 | 2.26 | 15.1 cents | No gain or loss |
| Rose | 526 | 3 1 | 16.29 | 2.30 | 14.1 cents | Gain, 20 pounds |
| Topsy | 445 | 3.8 | 16.91 | 2.30 | 13.6 cents | Gain, 10 pounds |
| Average | 409 | 3.9 % | 15.50 | | 14.9 cents | Gain, 11 pounds |

**Table X. Cost per pound of butter fat with mangels.**

RATION.—8 pounds clover hay, 20 pounds silage, 3 pounds bran, 3 pounds wheat and oat chop, 24 Pounds mangels.

| Cow. | Pounds of milk. | Test. | Pounds fat. | Value of feed. | Cost per pound of butter fat. | Gain or loss in weight. |
|---|---|---|---|---|---|---|
| Bonnie | 376 | 3.6 % | 13.54 | $2.30 | 16.9 cents | Gain, 15 pounds |
| Corvallis Beauty | 272 | 5.2 | 14 14 | 2.26 | 16.0 cents | Loss, 15 pounds |
| Rose | 535 | 3.0 | 16.05 | 2.30 | 14.3 cents | Loss, 10 pounds |
| Topsy | 442 | 3.8 | 16.80 | 2.30 | 13 7 cents | No gain or loss |
| Average | 406 | 3 9 % | 15.13 | | 15.2 cents | Loss, 2½ pounds |

Computing the cost of producing a pound of butter on the same basis as used with the previous set of rations we find that butter could have been prodnced at a cost for feed only at the following rates: With sugar beets, 13.4 cents per pound; with carrots, 13.2 cents per pound; with mangles, 13.5 cents per pound.

Very little difference was noticeable in the quality of the butter from the different rations, especially between the rations consisting largely of carrots and sugar beets. That from the ration consisting largely of mangels was not quite so high in flavor however as the butter from the other two rations. Flavor was the only point on which the butter was judged, the usual scale of 45 as perfection being taken as the basis. Following is the score on flavor: Sugar beets, 43; carrots, 43; mangels, 42.

# FRESH vs. STRIPPER COW BUTTER.

F. L. KENT.

IT is a well known fact that as the period of lactation advances the fat globules become smaller and the milk becomes more viscous. It would naturally be supposed that both churning and creaming would be more difficult with milk from cows well along in the period of lactation than from those comparatively fresh. It is also frequently claimed that the butter from fresh cows is of considerably better quality than that from cows well advanced in the period of lactation. To determine as much as possible in a short experiment, the effect due to an advanced period of lactation the following experiment was carried out, the points above mentioned being kept in view.

In this case a cow which had been in milk more than eight months was considered a stripper. The records indicated that there were four such cows in the college herd, the most advanced period being 308 days, and the average of the four cows being 283 days. Accordingly the milk from these four cows was kept by itself and considered "stripper" milk. The remainder of the herd, eleven in number, had been in milk less than six months, the average time for the eleven cows being 121 days. The milk from these was considered as "fresh" cows milk.

As soon as the milking was finished the milk was taken to the dairy building. The night's milk was allowed to stand until morning when the cream was removed by the centrifugal separator, and mixed with the cream from the morning's milk. The cream from the strippers milk was set aside in an ordinary "shot gun" can. After the fresh cows milk was separated the cream was well stirred and a quantity equal to the stripper cream placed in another shot gun can and set beside the can containing the stripper cream. This was done to get the same degree of ripeness in each lot of cream. The churning was done in a five gallon barrel churn.

The following table is a record of the work:

| Number of sample | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| Kind of milk | Fresh | Stripper | Fresh | Stripper | Fresh | Stripper |
| Temperature of separation | 80° | 80° | 80° | 80° | 80° | 80° |
| Per cent. fat in milk | 4.2 | 4.4 | 4.2 | 4.4 | 4.3 | 4.4 |
| Per cent. fat in skim milk | .1 | .2 | .15 | .2 | .1 | .15 |
| Amount of cream, pounds | 13 | 13 | 14 | 14 | 14 | 14 |
| Temp. of cream at churning | 59° | 59° | 59° | 59° | 57° | 57° |
| Time of churning, minutes | 30 | 25 | 22 | 29 | 38 | 33 |
| Per cent. fat in buttermilk | .4 | .4 | .25 | .25 | .2 | .2 |
| Date of churning | Mar. 23 | Mar. 23 | Mar. 25 | Mar. 25 | Mar. 27 | Mar. 27 |

The table shows that in each case there was slightly more butter fat left in the skim milk from the strippers than in the milk from the fresh cows. Possibly if the cream had been raised by the gravity system the difference would have been considerably greater.

The time required for churning was a surprise to the writer. It was expected that the cream from the fresh cows would churn somewhat quicker than that from the strippers, but the record shows that such was not the case. In two out of the three comparisons it will be seen that the stripper butter churned the quicker of the two, the difference in time being five minutes. In the other case the fresh cow butter churned in seven minutes less time than the stripper.

The butter was molded into two pound rolls and a roll from each lot set aside for ten days from the date of the first churning, when the whole was examined for flavor and grain. The examination was made by Mr. Geo. Harding who had been in the butter business as a commission man for fifteen years. In making the report Mr. Harding said: "I can't say that I see any difference in the grain of the several samples. In Nos. I, III, and V, however, the flavor is slightly better than in the others, but the difference is so slight that it would make no difference in the selling price, not even to the amount of one eighth of a cent per pound."

## CONCLUSION.

So far as this short experiment goes it shows that the milk from comparatively fresh cows gives up its cream more readily even with a separator, than does milk from cows well along in the period of lactation.

It also shows that butter made from the milk of cows which have been in milk for a considerable period of time is slightly inferior to that made from the milk of cows which are comparatively fresh.

# FEEDING PUMPKINS TO PIGS.

H. T. FRENCH.

THE following experimental feeding was carried out last winter to determine the value of pumpkins when fed to pigs. Several inquiries have come to the Station asking for information on this subject. The notes in detail, regarding the work, are here given.

Six Berkshire pigs were selected from two litters raised on the College farm. Four were taken from one litter, and two from another.

The pigs were eight months old when the feeding began. For six weeks previous to the experimental feeding, the pigs ran in a stubble field. A preliminary period of seven days was passed before the recorded weights were made.

The pigs were weighed on October 23d, and marked with ear tags so that subsequent weights might be made without any possibility of error. The pigs were weighed every fourteen days during the entire period.

## PREPARATION OF FOOD AND FEEDING.

The pumpkins were prepared by cutting up, removing the seed, and placing in a large kettle where they were cooked or steamed. The kettle used is called the Profit farm boiler, manufactured at Batavia, Ill. It consists of a large kettle mounted in a stove frame, and so arranged that the heat is all driven around the kettle. This is one of the most satisfactory boilers we have ever seen. Mention is made of this as a matter of information which is often called for by our correspondents.

The pumpkins were weighed before cooking. Enough were cooked each day for two feeds. When thoroughly cooked the pumpkins were dumped into a vat, and mixed with the day's ration of shorts. Enough salt was added to the mixture to render the food more palatable. Pigs enjoy salt as much as other animals when fed to them regularly.

The pigs were fed at eight o'clock in the morning, and at four o'clock in the afternoon.

The weights at the beginning, the gains, and amount of food consumed, are given in the following tables:

TABLE I.

| Period. | Ear tag | Weight Oct. 30. lbs. | We ght Nov. 13 lbs. | Gain. lbs. | Amt. of food per pound of gain. lbs. | Total food consumed. lbs. |
|---|---|---|---|---|---|---|
| First period 14 days... | 34 | 210 | 214 | 4 | 15.45 pumpkins 2.15 shorts | Pumpkins, 1210 Shorts, 168 |
| First period 14 days... | 35 | 206 | 228 | 22 | | |
| First period 14 days... | 36 | 123 | 132 | 9 | | |
| First period 14 days... | 37 | 176 | 185 | 9 | | |
| First period 14 days ... | 38 | 173 | 190 | 17 | | |
| First period 14 days... | 39 | 141 | 158 | 17 | | |
| Total gain..... | ..... | 1029 | 1107 | 78 | ..... | ..... |

TABLE II.

| Period. | Ear tag | Weight Nov. 13 lbs. | We ght Nov. 27 lbs. | Gain. lbs. | Amt. of food for pound of gain. lbs. | Total food consumed. lbs. |
|---|---|---|---|---|---|---|
| Second period 14 days | 34 | 214 | 237 | 23 | 14.95 pumpkins 1.3 shorts | Punpkins, 1975 Shorts, 168 |
| Second period 14 days | 35 | 228 | 244 | 16 | | |
| Second period 14 days | 36 | 132 | 157 | 25 | | |
| Second period 14 days | 37 | 185 | 206 | 21 | | |
| Second period 14 days | 38 | 190 | 217 | 27 | | |
| Second period 14 days | 59 | 158 | 176 | 18 | | |
| Total gain..... | ..... | 1107 | 1237 | 130 | ..... | ..... |

TABLE III.

| Period. | Ear tag | Weight Nov. 27 lbs. | Weight Dec. 11. lbs. | Gain. lbs. | Amt. of food for pound of gain. lbs. | Total food consumed. lbs. |
|---|---|---|---|---|---|---|
| Third period 14 days.. | 34 | 237 | 257 | 20 | 15.39 pumpkins 1.79 shorts | Pumpkins, 2170 Shorts, 252 |
| Third period 14 days.. | 35 | 244 | 272 | 28 | | |
| Third period 14 days.. | 36 | 157 | 174 | 17 | | |
| Third period 14 days.. | 37 | 206 | 235 | 29 | | |
| Third period 14 days.. | 38 | 217 | 233 | 16 | | |
| Third period 14 days.. | 39 | 176 | 207 | 31 | | |
| Total gain..... | ..... | 1237 | 1378 | 141 | ..... | ..... |

TABLE IV.

| Period. | Ear tag | Weight Dec. 11. lbs. | Weight Dec. 25. lbs. | Gain. lbs. | Amt. of food for pound of gain. lbs. | Total food consumed. lbs. |
|---|---|---|---|---|---|---|
| Fourth period 14 days. | 34 | 257 | 287 | 25 | 14.46 pumpkins 2.54 shorts | Pumpkins, 2170 Shorts, 336 |
| Fourth period 14 days. | 35 | 272 | 296 | 24 | | |
| Fourth period 14 days. | 36 | 174 | 196 | 22 | | |
| Fourth period 14 days. | 37 | 235 | 253 | 18 | | |
| Fourth period 14 days. | 38 | 233 | 263 | 30 | | |
| Fourth period 14 days. | 39 | 207 | 238 | 31 | | |
| Total gain..... | ..... | 1378 | 1528 | 150 | ..... | ..... |

TABLE V.—SUMMARY.

| | Total weight Oct. 30th. | Total weight Nov. 13th. | Total weight Nov. 27th. | Total weight Dec. 11th. | Total weight Dec. 25th. | Total gain. |
|---|---|---|---|---|---|---|
| | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. |
| Weight by periods | 1029 | 1107 | 1237 | 1378 | 1528 | 499 |
| Total pumpkins consumed | | 1210 | 1975 | 2170 | 2170 | 7523 |
| Total shorts consumed | | 168 | 168 | 252 | 336 | 924 |
| Average cost per lb. gain | | | *2.9 cents. | | | |

* Pumpkins reckoned at $2.50 per ton. Shorts reckoned at $12.00 per ton.

## RESULTS.

Reckoning the pumpkins at $2.50 per ton, and the shorts at $12.00, the cost would be as follows: Pumpkins, $9.40; shorts, $5.54, or a total cost of $14.94.

The total gain in live weight during the entire period was 499 pounds. This makes the cost of food for one hundred pounds gain, live weight, $2.00. This is much cheaper than pork can be produced from grain rations, when reckoned at present prices.

The profit in feeding pigs is not wholly governed by the cost per pound of gain, during the fattening period. The growth up to this time may have been made at a much less cost; but is not marketable. Hence a little more can be profitably expended during the finishing period, and yet not represent a net loss.

On the whole the results were quite satisfactory when compared with previous work in feeding grain rations alone. The pigs seemed to relish the food and were very contented. It was somewhat surprising that such a large amount of pumpkins could be consumed by each pig. It will be observed, by consulting Tables III and IV that, during the last two periods, the pigs consumed an average of twenty-six pounds of pumpkins apiece each day. At first it required a small ration of shorts to satisfy the pigs; but toward the end of the feeding period the shorts had to be increased. The effort was made to induce the pigs to eat as large an amount of pumpkins as possible, and then make up with shorts to a complete ration, or one that would satisfy the needs of the pigs.

The average daily gain during the whole period, from Oct. 30th to Dec. 25th, was 1½ pounds. The largest daily gain, during any one period, was from Dec. 11th, to Dec. 25th, when the pigs gained

1.78 pounds. The daily gain compares favorably with that made from grain rations.

The variety of pumpkins used in the feeding experiment is known and sold as the common yellow field pumpkin.

The meat product from these pigs was pronounced by experienced butchers the best they ever saw. The bacon was not over fat and was firm in texture. The pigs were healthy throughout the experiment. They were not *off* their feed at any time during the feeding period.

While the food does not have everything to do with the quality of the product, yet much of the superior flavor and texture of the bacon and hams produced in Oregon, is due to the feed. There is a broad field for the farmers of Oregon, to occupy in producing a superior article of bacon and other pork products. Our climatic and feed conditions are the very best that can be found for producing a grade of pork which cannot be excelled in the world. There is not a day in the year, in Western Oregon, when pigs can not have some form of green and succulent feed. Pastures of clover, grasses and annual plants can be provided that will furnish a large amount of food, which, supplemented with a small grain ration, will produce a superior article of meat product. The foreign, as well as the domestic market, demands a better pork product, especially in the hams and bacon. These demands can be supplied on the farms of Oregon, if enough forethought is put into the work to insure a good supply of food. Good blood in the herd is the first essential, and then a proper food supply, and the results will be wholly satisfactory. Clover, vetch, peas, rape, cabbage, artichokes, pumpkins, grasses, and many of the grains, such as rye and wheat, furnish good pasture for pigs. When we add to these the vast stubble fields, and a ration of shorts, chopped oats and barley to finish the product, and we have an array of food materials which can not be excelled in any State or country.

# FEEDING ARTICHOKES TO PIGS.

MUCH has been written on the subject of feeding artichokes; but very little has been done to determine just what proportion of a ration can be profitably made up of these tubers. Artichokes have been recommended for all kinds of stock, not as a fat producing substance, but to keep animals healthy and vigorous. Our experiments were confined to pigs.

Six Berkshire pigs were weighed and marked with ear tags October 22d, preparatory to the feeding operations.

The pigs had been running on wheat stubble prior to the feeding test. They were in a thrifty growing condition, but not fleshy.

An effort was made at the outset, to compel the pigs to subsist on a diet of artichokes alone; but after a few days we determined to supplement the artichokes with a small ration of chopped wheat and oats, in equal parts.

In the absence of grain there was very little gain, and the pigs were not contented. They were vigorous in their demands for something more substantial.

The artichokes were grown near the pens, so that the pigs could have access to them whenever they desired. The tubers were left in the ground for the pigs to root out as they were needed.

A portion of the plat was measured, and the artichokes dug to determine the yield, which was found to be 740 bushels per acre. This is a very satisfactory yield, although larger yields have been reported. The Jerusalem artichoke was the variety under experiment.

## METHOD OF PLANTING.

The artichokes were planted the last of April, on ground plowed deeply, and prepared as we would prepare ground for potatoes.

The tubers were planted in furrows which were three feet a part. The seed was dropped eighteen inched apart in the row. The seed was covered with a hoe; but an easier method would be to turn a furrow over the seed; and then in a few days harrow the furrow down, making the ground smooth, and keeping the surface loose at the same time.

The plants were cultivated a few times; but after the tops were two feet high no further cultivation was necessary. The tops grew seven feet high before the end of the season.

Some men who have grown artichokes recommend the tops very highly, as a fodder for horses and cattle.

One writer, who has grown artichokes in an eastern state for several years, says, "that one acre of artichokes will produce more good fodder than five acres of corn." This is a very strong statement; but coming from one who has had experience, it is worthy of consideration.

We made no use of the tops, as there was no other stock in the yards, and the pigs would not eat them. The artichokes were not matured until October 1st.

## RESULTS.

The pigs were weighed every fourteen days, and the results are here given in tabular form.

TABLE SHOWING WEIGHT OF PIGS BY PERIODS AND TOTAL GAIN.

| Ear Tag. | Weight Oct. 22 lbs | Weight Oct. 30 lbs. | Weight Nov. 13 lbs. | Weight Nov. 27 lbs. | Weight Dec. 11 lbs. | Total gain. lbs. |
|---|---|---|---|---|---|---|
| No. ear tag 28 | 133 | 137 | 148 | 165 | 172 | 39 |
| No. ear tag 29 | 119 | 121 | 134 | 146 | 155 | 36 |
| No. ear tag 30 | 117 | 119 | 123 | 129 | 139 | 22 |
| No. ear tag 31 | 192 | 205 | 214 | 231 | 233 | 41 |
| No. ear tag 32 | 200 | 209 | 219 | 238 | 248 | 48 |
| No. ear tag 33 | 215 | 224 | 235 | 255 | 273 | 58 |
| Total weight and gain | 976 | 1015 | 1073 | 1164 | 1220 | 244 |

The total gain is 244 pounds, or an average daily gain of .81 pounds for each pig. This gain would not be large for pigs fed on grain ration exclusively; but for stock hogs the increase is very good indeed.

The pigs consumed 756 pounds of grain during the whole period. This is 3.1 pounds of grain for each pound of gain in live weight. In other experiments we have found that it takes about 5 pounds of mixed grain to produce a pound of gain, hence on this basis, the artichokes consumed, would represent two pounds of grain in producing each pound of gain in live weight.

The pigs consumed the artichokes grown on $\frac{1}{8}$ of an acre. Only a few roots were left in the ground when the feeding ceased. The pigs were healthy and vigorous during the feeding period.

It does not cost much to raise a small area of artichokes, and there is little danger of the farmer having too great a variety for his stock. A small acreage might be profitably employed by any farmer who expects to make his own bacon, or supply the market with a superior grade of pork products.

Artichokes do best in rich, loose soil, where there is an abundance of humus and decayed vegetable matter.

I hereby wish to acknowledge the valuable assistance rendered by Mr. S. B. Smith, farm foreman, in keeping the notes which have entered into this publication.

H. T. FRENCH.