

Legumes as a Factor in Beef Production.

by

George W. Loomis.

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In recent years beef production has become more of an art than ever before. Those who now feed on the old plan of one-half bushel of corn and a little of any kind of roughage per steer daily, are generally unsuccessful and soon go out of business. On the other hand, however, those who make a study of the various feeds, and make a wise choice in the feeds which they use, are receiving profitable returns.

I am sure that the problem of successful steer-feeding cannot be solved except by the use of the legumes, in the feeding ration; for they form the cheapest source of the costly and necessary nutrient ^{protein}.

The data on the feeding of legumes in beef production, by the various experiment stations in the United States, is rather meager, but in this thesis I have gathered together what data I could find relating to this subject, and I hope that the data which I have gathered, and the suggestions herein, regarding the use of the various legumes crops will be of interest to those who are contemplating the growing of legumes for the purpose of feeding them to beef cattle.

I shall restrict this discussion

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to the four legumes; Alfalfa, Red clover, Soy-beans, and Cow peas. These are the principal legume crops grown in Kansas, and are the only ones which are of importance in beef-production in this state. I will treat them in the order of their relative importance in beef production in Kansas.

Alfalfa (Medicago sativa)

The native home of the alfalfa plant is generally thought to be France and Spain. It was introduced into Chili from Europe and from thence it was brought to the state of California in 1854.

Its importance as a food for stock is recognized wherever it is grown, and it easily holds first place, as the most valuable legume crop in those parts of the United States, where it can be successfully grown.

Alfalfa thrives in many places where the clover yields are uncertain, as in central and western Kansas and Colorado. Alfalfa can be grown on a variety of soils, but in Kansas it grows best on fertile, well-drained bottom-land, where the subsoil is a porous loam, but preferably not sand or gravel.

Land for alfalfa should be in the best tillth and should carry a large amount of moisture, without becoming saturated and moulded.

The young alfalfa plants grow slowly and are easily checked by unfavorable conditions of soil, weather, or culture.

Alfalfa is generally cut when one-tenth in bloom, as it has been shown, by experiments, that the hay cut at that stage gives the best results. The manner of putting up the hay is very important, as the leaves are shattered very easily. A ton of these leaves has as much protein as 2800 pounds of wheat bran, and hence we see that this part of the plant is very valuable.

The alfalfa is generally raked into windrows a few hours after cutting, and is then left to cure until it is in the right condition to stack.

The following table, giving the digestible nutrients in Alfalfa is taken from Henry's Feeds and Feeding.

Composition of Alfalfa

Form of food.	Dry matter in 100 lbs.	Digestible Nutrients in 100 lbs.		
		Protein	Carbohydrates	Fat.
Alfalfa hay	91.6	11.	39.6	1.2
Alfalfa silage	27.5	3.	8.5	1.9
Fresh Alfalfa	28.2	3.9	12.7	.5

The following experiments were carried out for the purpose of finding the feeding value of alfalfa.

Value of Alfalfa when Fed Alone.

The Utah station bulletin, number 29 describes an experiment carried on for the purpose of finding the value of alfalfa when fed alone compared with other kinds of hay. Three lots of steers were fed alfalfa, timothy, and wild hay respectively for five weeks. 1873 lbs of hay was fed to each lot. The results were as follows: the lot fed timothy hay lost 125 pounds; the lot fed wild hay lost 49 pounds; and the lot fed alfalfa gained 27 pounds.

Amount of Alfalfa for lb. of Gain. (Nev. Bul. 41)

An experiment was carried on at the Nevada experiment station to ascertain the amount of alfalfa needed to produce 1 pound of gain. The experiment commenced Dec. 11th, 1897 and closed May 9th, 1898. It was found that when alfalfa was fed alone, it required 15 to 23 pounds for every pound of gain.

Value of Cut and Uncut Alfalfa (Kans. Bul. 112)

The Kansas experiment station performed an experiment to find the benefit, if any, in grinding

corn and cutting alfalfa hay for steers. In many places in the west, it is almost impossible to keep hogs to follow the steers, because of hog cholera, and it was thought that by treating the food in this way, feeding, with out hogs, could be made profitable.

Eighty steers, part natives and part south-western cattle, of good quality, were used in the experiment.

The steers were divided into four lots of twenty each.

Lot No. 1 was fed shelled corn and whole hay

" " 2 " " " cut "
 " " 3 " " corn meal " whole "
 " " 4 " " " " cut "

In all cases the grain was placed on the hay, in boxes, and mixed.

The following is a statement of the results of the experiment.

Food for 100 lbs. Gain.

Kind of feed	Grain	Hay.
Shelled corn, whole hay	789	409
" " cut alfalfa	771	387
Corn meal whole "	756	401
" " cut "	680	345

Kind of feed	Gain per Steer	Daily gain.
Shelled corn, whole hay	262 lbs.	2.26 lbs.
" " , cut "	257 " "	2.21 "
Corn meal whole "	273 " "	2.35 "
" " cut "	293 " "	2.52 "

<u>Pounds Gain from 1 bushel grain & Hay fed per bushel.</u>		
<u>Feed</u>	<u>Gain per bu. (56 lbs)</u>	<u>Hay each bu.</u>
Shelled corn, whole hay	7.1	29.
" " cut "	7.3	28.
Corn meal whole "	7.4	29.7
" " cut "	8.2	28.4

Value of Alfalfa in Feeding Baby-Beef. (Kans Bul 113)

The Kansas station has made an experiment which shows the value of alfalfa with corn, in feeding baby-beef. 130 head of calves that had just been weaned, were fed 7 months, with the following results:

<u>Feed</u>	<u>Average gain per head</u>	<u>Grain per 100 lbs gain</u>	<u>Hay</u>
Alfalfa hay & corn.	407	470	544
" " " Kafir corn	379	524	626
" " & Corn (S.M. calves)	440	439	436
" " " " (Or milk ")	404	470	420

In the above table we see that alfalfa and corn make a ration that gives remarkable gains, for feed consumed.

Alfalfa in Balanced Rations (Calculated from Kans. Bul 115)

- (1) Growing beef cattle (wt. 750) { Alfalfa hay 10.98 lbs.
nutritive ratio 1 to 6.81 { Corn fodder (F.C.) 18.35
- (2) Growing beef cattle (wt. 950) { Corn fodder (F.C.) 19.19
nutritive ratio 1 to 7.17 { Alfalfa hay 9.79

(3) Fattening cattle first period } Corn --- 15.56
 Nutritive ratio 1 to 6.45 } Alfalfa hay - 17.2

(4) Fattening cattle 2nd period } Corn --- 14.12
 Nutritive ratio 1 to 5.36 } Alfalfa --- 20.68
 Oil meal (O.P.) --- 1.8

(5) Fattening cattle 3rd period } Corn --- 16.24
 Nutritive ratio 1 to 6.14 } Alfalfa --- 7.98
 Corn silage --- 21.47
 Oil meal (O.P.) --- 3.82

Red Clover (*Trifolium pratense*)

Red clover is a native biennial of Europe. It is an important crop in the eastern part of Kansas, but as far west as Manhattan it is an uncertain forage producer.

It is generally found that spring seeding is more successful than fall seeding, on account of winter-killing. In my experience in growing red clover, I have found that seeding with oats, as a nurse crop, is a very successful way of seeding. The seed is sown with a broadcast sower, as soon as the oats are sown; then the ground is lightly harrowed to cover the seed.

The oats keep the weeds down and the clover makes a fine growth after the oats are cut. The clover is usually about six inches high,

when the oats are cut; and during the late summer and fall it will furnish a large amount of good pasture. There will be a full crop of hay the next season.

We hardly ever cut more than one crop per year, but when ^{the} pastures get a little short, in Aug. and Sept., we turn the cattle, which we intend to fatten the following winter, into the meadow and let them gather the clover for themselves. When we do this we always get good results in gains in the cattle; and there is always enough seed ripens to seed the field again, so that the stand never dies out.

Proper time for Cutting Red clover.

The following facts concerning the time for cutting red clover are taken from W. A. Henry's book on "Seeds and Feeding".

If clover is cut before blooming, the amount of water is so great that the process of curing is very slow. The clover should not, however, be left until all the heads are brown, because experiments show that by that time the plants have lost much of their valuable nutrients. It has been found in testing the

cut at various stages, that the best time for cutting is when one third of the heads are turning brown.

Care must be taken in saving the leaves, as in handling alfalfa. The clover should finish curing in the windrow or small cocks.

The effect of rain on clover hay is shown in the following table:

(Ritt Hansen)

	Not rained upon, per cent	Rained upon, per cent.
Water	16.0	16.0
Protein	14.6	15.8
Crude fiber	25.3	37.4
N. free ether extract	36.1	23.4
Ash	8.0	7.5

The following table shows the composition of red clover, as compiled by W. A. Henry in his book, "Feeds & Feeding."

Form of feed.	Dry matter in 100 lbs.	Digestible nutrients in 100 lbs.		
		Protein	Carbohydrate	Ether extract
Fresh red clover	29.2	2.9	14.8	.7
Red clover hay	84.7	6.8	35.8	1.7
" " silage	28.	2.0	13.5	1.0

Cut vs. Vint Clover Hay (Ind. Bul. 32)

This experiment was a comparison between four yearling shorthorn steers fed cut clover, and four steers fed the whole hay. The grain ration and other food was the same for both lots, and there

was but ten pounds difference in the total amount of food consumed by the two lots. During the 100 days, that the experiment was carried on, the lot fed cut hay gained 607 lbs, and the lot fed uncut hay only 425 lbs, or nearly 50% in favor of the animals fed the cut clover.

Value of Clover for Steers (Tenn. Bul. 1, vol. 4.)

An experiment was made by the Tennessee experiment station, for the purpose of finding the value of the first and second crops of red clover for steer-feeding. Four grade Shorthorns, about 2 years of age, were divided into two equal lots, and fed rations containing either first or second cuttings of clover, with wheat-bran and corn meal, during 14 periods of 10 days each. The two lots were fed alternately on the two rations, while lot 1 received first crop clover, lot 2 received second crop clover and vice versa. The first crop clover was eaten all right by both lots, but the second crop hay was not eaten very well, and its use caused considerable salivation. The results of the experiment showed that the steers required 10 lbs. of the first crop ration, and 5-4.6 lbs of the second crop ration to produce one pound of gain, in the fattening years.

Red Clover Ensilage (Wis. Rep. '88)

An experiment was carried out by the Wisconsin experiment station to find if the clover plant could be used profitably as a silage crop.

Clover is very liable to lose value during the curing process, and is also likely to become musty and moldy in the barn or stack, thus if the nutrients can be saved better in the silo, this might be a desirable way of storing the crop.

The silo, used in the experiment, was filled with clover, and the top was covered with a layer of tarred paper and sawdust. When it was opened for feeding, only about six inches of the silage was dry and mouldy, and below that, the silage was in prime condition.

Result of Trial.

Clover put in	Ensilage taken out	Dry matter put in	Dry matter taken out
12 279 lbs.	9 283	4 458.6	3772.1 lbs.
Protein put in	Protein taken out	Loss in dry matter	Loss in protein
563.1 lbs.	490.9 lbs.	15.41 %	12.66 %

The results obtained by the Wisconsin station would seem to indicate that by siloing clover, we are able to preserve one of our best crops, with comparatively little labor, and with a reasonable certainty of keeping it in a condition most valuable for feeding.

Red Clover in Balanced Rations (Calculated from Kans. Bul. 115)

- (1) Growing beef cattle (wt 750 lbs) } Nutritive ratio 1 to 6.81 { Red clover hay - 19.83 lbs
Corn fodder (S.C.) - 8.58 "
- (2) Growing beef cattle (wt 950 lbs) } Nutritive ratio 1 to 7.17 { Red clover hay - 17.50 "
Corn fodder (S.C.) - 10.46 "
- (3) Fattening cattle 1st period } Nutritive ratio 1 to 6.45 { Red clover hay - 19.70 "
Wheat bran - 6.01 "
Corn - - - - 9.2 "
- (4) Fattening cattle 2nd period. } Nutritive ratio 1 to 5.36 { Red clover hay - 15.92 "
Cow pea - - - 2.56 "
Corn - - - - 9.00 "
Oats - - - - 6.95 "
Oil meal (O.P.) - 3.46 "
- (5) Fattening cattle 3rd period } Nutritive ratio 1 to 6.14 { Red clover hay - 17.69 "
Prairie - - - 1.20 "
Oil meal (O.P.) - 3.82 "
Corn - - - - 16.24 "
-

Soya-bean (*Glycine hispida*)

The soya (or soy)-bean is a native of Japan; and was introduced from that country into the United States, by the department of agriculture.

The soy-bean is successfully grown in Kansas and has become widely known during the last few years.

The seed, when sown thickly, produces a fair amount of nutritious hay, and when planted for the seed, it generally produces a fair yield of beans.

Test of Varieties of Soy-beans. (Kans. Rep. 1900)

The yields of soy-beans at the Kansas experiment station have generally ranged from 12.5 to 19 bushels per acre. In 1900 the Station carried on a comparative test of varieties, to see which were adapted to Kansas conditions. The year of 1900 was very unfavorable for growing soy-beans. June was very dry, and the rainfall in August was deficient, and, during the hot weather, the hot winds blew considerably.

In the following table it will be seen that the yields of all varieties were small, on account of the dry weather, and that several of the late maturing varieties failed to mature and thus they produced no seed.

It was found that the "Early Yellow Soy" produced more hay and more beans, than any other variety.

Variety of Soy-beans	Yield of beans	Yield of hay.
Early Yellow Soy	7.4 bu.	1.4 tons.
Early Soy	6.2 ..	.8 "
American Coffee	5.5 ..	.95 "
Medium Early Black	3.0 ..	.62 "
Extra Early Dwarf.	2.7 ..	.6
Late Soy.	Did not mature	.75
Medium Soy.	(" " ")	(No stand)
Dwarf Soy.	6.4 bu.	.86 "

Culture.

The ground should be put in good condition, the same as for corn.

Plant with a grain drill, stopping up enough holes, so as to place the rows about 30 inches apart. Cultivate the same as for corn. The beans may be cut with the bean harvester or with a mowing machine.

Composition of Soy-beans.

The following table was gathered from Henry's "Feeds and Feeding":

Form of feed.	Dry matter in 100 lbs.	Digestible nutrients in 100 lbs.	Protein	Carbohydrates	Other Ext.
Soy-bean silage	25.8	2.7	8.7	1.3	
Fresh soy-beans	24.9	3.2	11.0	.5	
Soy-bean hay	88.7	10.8	38.7	1.5	
Soy-bean seed.	89.2	29.6	22.3	14.4	

Soy-bean Meal for Baby Beef (Kans. Bul. 113)

The following data will give some idea of the importance of soy-bean meal as the means of furnishing the protein of the feeding ration.

The experiment began in Oct. 1900 and was carried on for 7 months. The gains made, by the animals in the experiment, show that soy-beans have a very important place in the list of protein feeds of Kansas.

Feeds in ration	Average gain per head.	Strain per 100 lbs. gain.	Hay per 100 lbs. gain.
Prairie hay } { corn $\frac{2}{3}$ { Soy-bean meal $\frac{1}{3}$	378.	520.	486.
Prairie hay } { Kafir corn $\frac{2}{3}$ { Soy-bean meal $\frac{1}{3}$	342.	594.	539.

Results from feeding Soy-bean Meal. (Kans. Bul. 112)

The Kansas experiment station was feeding 80 head of steers, a ration of alfalfa and corn, and at the beginning of the 12th week, of the feeding period, began feeding soy-bean meal, to put on a finish.

The soy-bean meal was scattered over the other grain, and the steers were given $\frac{1}{2}$ lb. per head the first day. This amount was increased until, in 100 days, the steers received four pounds per head daily. The steers showed excessive looseness, and the amount was lowered to 1 lb.

per day. After a while the amount was raised, but the steers began to scour badly and the soy-bean meal was dropped from the feeding ration.

I think that the scouring of the steers, in this experiment, was due to feeding the meal with alfalfa, which also has a loosening effect on the bowels. If the roughage part of the ration had been prairie hay or timothy hay, it is probable that the result would have been favorable to the feeding of the soy-bean meal. For authority for this statement I will cite the experiment described in Kansas bulletin number 113, with feeding soy-bean meal, prairie hay, and corn to baby beef.

In this experiment no bad results followed, although soy-bean meal constituted $\frac{1}{3}$ of the concentrates of the feeding ration.

Since soy-beans are very rich in fat and protein, which are so costly in cattle feeding, the meal should make an excellent concentrate to mix with other feeds less rich in protein and fat. It would be much cheaper to furnish protein in this form than in the costly concentrates on the market.

Soy-beans in Balanced Rations (Compiled from Kan Bul. 115.)

- | | |
|--|---|
| (1) Growing beef cattle (Wt. 750 lbs)
Nutritive ratio 1 to 6.81 | { Soy-bean hay 12.4 lbs
Corn stover -- 18.37 " |
| (2) Growing beef cattle (Wt. 950 lbs)
Nutritive ratio 1 to 7.17 | { Soy-bean hay 10.27 "
Corn fodder (D.C.) 19.94 " |
| (3) Fattening cattle 1st period.
Nutritive ratio 1 to 6.45 | { Soy-bean hay 18.9 "
Corn - - - - 16.8 "
Soy-bean hay 21.05 " |
| (4) Fattening cattle 2nd period
Nutritive ratio 1 to 5.36 | { Wheat bran 5.65 "
Corn - - - - 10.87 "
Soy-bean hay 9.36 " |
| (5) Fattening cattle 3rd period.
Nutritive ratio 1 to 6.14 | { Corn - - - - 16.24 "
Oil meal (O.P.) 3.82 "
Timothy hay 7.51 " |
| (6) Fattening cattle 3rd period
Nutritive ratio 1 to 6.14 | { Soy-bean meal 4.37 "
Prairie hay 13.24 "
Wheat bran 9.66 "
Corn 7.48 " |

Cowpea (Vigna Catjang)

The cowpea is probably of Asiatic origin, although the original wild type has never been identified.

The cowpea plant has been grown, for many years, in the Southern States, where it is prized very much as a forage crop. Its value as a forage plant, for Kansas is being recognized in the last few years. Although it cannot compete with good clover and alfalfa in amount of yield, or cost of production, the crop may be profitably grown in parts of the state, where alfalfa or clover cannot be grown to the best advantage, or where the forage supply is deficient to carry the stock throughout the year.

Culture.

(Ark. Bul 70)

The ground should be in good condition, prepared as for planting corn. If the crop is desired for hay, heavier seeding is practiced than when seed is wanted. The Arkansas station found that 12.5 lbs of seed per acre yielded greater returns than 18.75 lbs or more, in both hay and peas.

Heavy seeding produces a larger proportion of hay, and light seeding produces a larger proportion of seed.

Under Kansas conditions, if forage is wanted, heavier seeding than for Ark.

should be practiced.

Composition of Cowpeas.

The following data was collected from Henry's Feeds and Feeding:

Form of feed.	Dry matter in 100 lbs.	Digestible nutrients in 100 lbs.		
		Protein	Carbohydrate	Ether Ext.
Green Cowpeas	16.4	1.8	8.7	.2
Cowpea hay	89.3	10.8	38.6	1.1
Cowpea silage	20.7	1.5	8.6	.9
Cowpea seed.	85.2	18.3	54.2	1.1

Cowpea hay for Steers. (Ark. Bul. 27)

The Arkansas experiment station performed an experiment, in which cowpea hay and cotton-seed meal were fed to steers. A mixture of 20 lbs of cowpea hay and 13.6 lbs. of cotton-seed meal per 1000 lbs live weight was fed to two yearling steers, for 37 days; and to two three-year-old steers for 87 days. The yearlings weighed about 475 lbs at first, and the three-year-olds 946 lbs and 876 lbs respectively. The results were that the yearlings gained 2.6 lbs and 3. lbs per day respectively, and the three-year-olds 2.92 lbs and 3.14 lbs.

The gains made in the above experiment are very good, and show that cowpea hay is a very valuable feed to use with cotton-seed meal.

Cowpea hay for Steers. Tenn. Bul. 4 Vol. 10

The Tennessee experiment station fed 8 native steers, to test cowpea hay as a substitute for the nitrogen in cotton-seed meal.

It was found that cowpea hay made an excellent substitute for the cotton-seed meal. Since, however, it is not so rich in protein, it should be fed at the rate of 2 or 3 lbs of cowpea hay to 1 lb. of cotton-seed meal.

Feeding Cowpea Hay.

The Arkansas station fed two steers a ration of cowpea hay and cotton-seed, to find the value of such a combination for the production of beef, with the following results:

	Weight at first	Weight at end of 90 days	Gain per head	Amount of feed eaten
Black steers	876	1150	274	{ Cowpea hay - 1484 lb. Cotton seed - 973 "
Red steers	946	1216	270	{ Cowpea hay - 1554 lb. Cotton seed - 1047 "

The above results show that cowpea hay and cotton-seed may be fed to steers and get very good results, in gains. The value of cowpea hay, however, would be more noticeable if it was fed with a concentrate, which is poor in protein.

Cowpeas in Balanced Rations (Calculations from Kan. Bul. 115)

- | | |
|--|---|
| (1) Growing beef cattle (wt 750 lbs.)
Nutritive ratio, 1 to 6.81. | { Cowpea hay 12.4 lbs.
Corn stover - 18.37 " |
| (2) Growing beef cattle (wt 950 lbs.)
Nutritive ratio, 1 to 7.17. | { Cowpea hay 10.27 "
Corn fodder (D.C.) 19.94 " |
| (3) Fattening cattle 1st period
Nutritive ratio, 1 to 6.45. | { Cowpea hay 18.9 "
Corn - - - 16.8 " |
| (4) Fattening cattle 2nd period
Nutritive ratio, 1 to 5.96. | { Cowpea hay - 21.05 "
Wheat bran - 5.65 "
Corn - - - 10.87 " |
| (5) Fattening cattle 3rd period
Nutritive ratio, 1 to 6.14. | { Cowpea hay 9.36 "
Timothy " 7.51 "
Corn - - - 16.24 "
Oil meal (A.P.) 3.82 " |

Feeding value of Clover & Cowpeas & other Feeds

The Connecticut experiment station worked out the feeding value of the following feeds:

Feed	Feeding value
Cowpeas.....	\$12.60
Red clover.....	11.20
Timothy.....	10.48
Corn.....	17.72
Oats.....	16.72
Wheat bran.....	13.76

Digestible nutrients of Legumes & other Feeds

The following data was collected from Henry's Feeds & Feeding:

Kind of feed	Protein	Carbohydrates	Ether ext.
Corn.....	7.9	66.7	4.3
Wheat bran.....	12.2	39.2	2.7
Oats.....	9.2	47.3	4.2
Fooder's Corn (F.C.).....	2.5	34.6	1.2
Timothy hay.....	2.8	43.4	1.4
Soy-bean hay.....	10.8	38.7	1.5
Red Clover hay.....	6.8	35.8	1.7
Alfalfa hay.....	11.0	39.6	1.2
Cowpea hay.....	10.8	38.6	1.1
Soy-bean meal.....	29.6	22.3	14.4
Lin seed meal.....	29.3	32.7	7.0

By the preceding table we see that alfalfa, soy-bean hay and cowpea hay have high nutritive values and compare very favorably with corn, wheat bran and oats in

feeding value. We also see that soy bean meal has a larger percent of protein, and over twice as much fat as old process linseed meal.

Every feeder should realize the value of legumes, as a source of protein, in steer feeding, and he should attempt to supply this valuable nutrient in this form, rather than in the costly concentrates, as linseed meal, cottonseed meal, ect.

Year by year many Kansas farmers, realizing the value of legumes as a feed, and the benefit to their land from growing them, are increasing their legume acreage, and thus are producing their own protein feeds, and stopping the deadly drain on their land, which continual cropping with wheat or corn requires.

The great value of the legumes was fully demonstrated in the feeding experiments, and I would say, in conclusion, that no person, who intends to take up the feeding of cattle, for beef production, can afford to leave the legumes out of his feeding rations.

Finis.