EXPERIMENT STATION

OF THE

KANSAS STATE AGRICULTURAL COLLEGE,

MANHATTAN.

BULLETIN NO. 32 — DECEMBER, 1891.

DEPARTMENTS OF CHEMISTRY AND AGRICULTURE.

CHEMICAL DEPARTMENT.

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COMPOSITION OF SOME FEEDING STUFFS.

One of the lines of chemical work pursued by the Station is the analysis of feeding stuffs. This work deserves place, although many of our common feeding stuffs have been frequently analyzed; thus, the American analyses of maize grain on record number over 200. These analyses are of the product of widely separated regions, and may be accepted as giving us a fair knowledge of the composition of this article. The same may be said, in general, of wheat and oats; but differences in the composition of different varieties, and in the same variety when grown under different conditions of soil and climate, may well receive further attention. The products of our newer States, especially, deserve study. Furthermore, methods of analysis have received great attention in recent years, and have been somewhat improved. Greater value, therefore, attaches to recent analyses than to those made some years since.

There are many articles that are used more or less as stock feed that have received little attention from chemists, such as sweet potatoes, artichokes, and kohl-rabi. Below will be found a table giving the results of our analyses of some of such feeds grown and fed on the College farm, and, in addition, some of the more common feeds. These represent our work on this subject since that published in our annual report for 1889. In these analyses the usual determinations to decide food value were made. The explanation of terms used, and the purposes served in the animal economy by the several constituents of foods, have been given in previous publications of the Station. (See Second Annual Report, 1889.) They will not be repeated in detail here. It may be remarked, however, that the water in foods has no value in itself; succulent foods are frequently more palatable and digestible, and exercise a beneficial effect upon the general tone of the system. Water must be considered as one of the elements of the weight of a food in comparing one food with another. Thus, a sample of sweet potatoes contained seven-tenths of their weight of water and three-tenths of solid matter; stock melons, one-twentieth of solid matter and nineteen-twentieths of their weight water; shorts, less than one-tenth water and over nine-tenths solid matter. It is obvious that any comparison of these must involve a consideration of the water content.

The digestible protein, or albuminoids, is that portion which goes to build up and to repair waste of muscular tissue. A portion of the nitrogen of grains and vegetables exists in albumen-like compounds, and a portion exists in other states of combination. The former are referred to in what has just been said; the latter are generally grouped under the name non-albuminoids. These are believed to be less valuable than the true albuminoids, and this from the fact that they are not used in making flesh growth, but in reducing the consumption or waste of albuminoids. They are more abundant in root crops, sprouted grains and immature plants than in ripe plants and grains.

The "nitrogen-free extract" comprises those organic constituents, exclusive of fatty and nitrogenous matters, that dissolve by treatment with dilute acid and alkali. It includes starch, sugar, gums, digestible cellulose, and other similar substances. It gives rise to heat and supplies power, and is converted into fat in the animal body. The fat serves the same purpose in animal nutrition, but is worth about 2½ times as much, pound for pound, as starch.

Without going further into details, these are believed to be the primary functions of these elements of food materials. It may be added that a feeding stuff rich in albuminoid or nitrogenous matters is of greatest value, because these are so important and are the scarcest of the several classes. Oily foods come next in value. An admixture of these concentrated foods with those that are coarse and of poor quality makes a good ration of the whole. By this means an article that alone would be nearly valueless may be fed with profit.

Foods that are largely water may be very nutritious, if the solid matter they contain is of good character, and they be fed in large quantities. The excessive amount of water may be regarded as a refined method of watering the stock.

These facts and principles should be borne in mind in comparing the miscellaneous feeding stuffs whose composition is given on the following page.

TABLE SHOWING THE COMPOSITION OF CERTAIN FEEDING STUFFS.

KINDS OF FEEDING STUFFS.	IN THE AIR-DRY SUBSTANCE.											IN THE DRY SUBSTANCE.								
	Water	Dry matter.					Total dry matter	Total nitrogen	Albuminoid nitrogen	Non-albuminoid nitrogen	Pure albuminoids	Ash	Crude protein	Crude fiber	Nitrogen-free extract	Crude fat	Total nitrogen	Albuminoid nitrogen	Non-albuminoid nitrogen	Pure albuminoids
		Ash	Crude protein	Crude fiber	Nitrogen-free extract	Crude fat														
Stock melons	95.22	.35	.45	1.01	2.93	.04	4.78	.07	.03	.04	.18	7.40	9.38	21.15	61 26	.81	1.50	.59	.91	3.69
Sugar beets (roots)	84.04	.77	1.76	.95	12.45	.03	15.96	.28	.10	.18	.63	4.84	11.03	5.93	78.01	.19	1.77	.63	1.14	3.95
Leaves of sugar beets	87.89	1.97	2.36	1.07	6.47	.24	12.11	.38	.22	.16	1.35	16.23	19.52	8.83	58.41	2.01	3.12	1.78	1.34	11.14
Sweet potatoes, So. Queen	69.77	1.09	1.78	.86	26.22	.28	30.28	.28	.21	.07	1.32	3.60	5.88	2.86	86.73	.93	.94	.70	.24	4.36
Sweet potatoes, R. Bermuda,	71.32	1.11	1.88	.74	24.75	.20	28.68	.30	.22	.08	1.37	3.87	6.58	2.57	86 30	.68	1.05	.77	.28	4.79
Artichokes (fresh)	81.50	.99	2.23	.63	14.54	.11	18.50	.36	.20	.16	1.23	5.33	12.08	3.43	78.56	.60	1.93	1.07	.86	6.67
Linseed meal	9.03	5.22	36.84	6.84	33.35	8.72	90.97	5.89	5.47	.42	34.20	5.74	40.50	7.52	36.62	9.62	6.48	6.01	.47	37.56
Linseed meal (old process)	9.17	5.80	34.66	7.21	35.72	7.41	90.83	5.55	(*)	...	...	6.38	38.15	7.96	39.34	8.16	6.10	(*)	...	...
Bran	8.80	6.99	16.31	8.81	54.70	4.39	91.20	2.61	2.34	.27	14.63	7.66	17.88	9.66	59.99	4.81	2.86	2.57	.29	16.03
Shorts	10.50	4.09	17.25	5.82	57.35	4.99	89.50	2.76	2.33	.43	14.56	4.57	19.27	6.50	64 10	5.56	3.08	2.60	.48	16.27
Middlings	11.75	.75	11.18	.70	74.10	1.57	88.25	1.78	1.43	.35	8.93	.84	12.61	.79	83.98	1.78	2.02	1.62	.40	10.11
Sorghum seed	14 43	1.95	8.89	1.79	69.82	3.12	85.57	1.42	1.41	.01	8.81	2.27	10.36	2.09	81.63	3.65	1.66	1.65	.01	10.29
Shorts	9.30	3.91	17.78	5.15	59.84	4.02	90.70	2.85	2.41	.44	15.06	4.31	19.60	5.67	65.99	4.43	3.11	2.66	.48	16.63
Millet hay	7.96	8.20	8.53	30.13	43.71	1.47	92.04	1.37	1.04	.33	6.49	8.91	9.27	32.73	47 49	1.60	1.48	1.13	.35	7 06
Prairie hay (upland)	8.60	8.16	4.79	28.05	47.93	2.47	91.40	.766	.712	.05+	4.45	8.93	5.24	30.69	52.43	2.71	.84	.78	.06	4.87

COMPOSITION OF CERTAIN PLANTS AT DIFFERENT STAGES OF GROWTH.

A further study of the composition of plants, at different stages of growth, has been made. In the annual report of 1889, some analyses of corn cut at different dates are given. We now report upon Kaffir corn, oats, and wheat.

KAFFIR CORN.

The white variety was used. Ten average stalks were cut at each date given hereafter. Each sample was weighed green, weighed again after thorough curing, and the seed was shelled out and weighed. The fodder and the seed were then sampled and analyzed.

OATS.

The oats were cut at three different dates. When the first sample was taken, the contents of the oats grains were in a soft, milky condition; the second sample was taken when the seeds were doughy; the third sample was secured when the crop was harvested. After curing, the grain was shelled out; the straw and grain weighed separately, to determine the relation of grain to straw in each sample. Taken as they came, 1,000 grains of each sample were weighed. This gives the relative weight of the grains at the several dates and conditions of development. The grain was analyzed.

WHEAT.

Two samples of wheat were taken — one when the grain was harvested; the other one week before, when the grain was in the dough. This was treated in every respect as was the oats, giving us similar data. The tables following present the facts obtained by these observations arid analyses.

TABLE SHOWING DATA ON PLANTS CUT AT DIFFERENT PERIODS OF GROWTH.

	WHITE KAFFIR CORN.					OATS.			WHEAT.	
DATE OF CUTTING.	August 27....	September 4..	September 4..	September 17.	October 3....	June 27........	July 6..........	July 12........	June 11.......	June 18.......
CONDITION OF GRAIN.	*In soft milk...*	*In soft dough..*	*Hard dough...*	*Hard, easily split.........*	*Hard, nearly dry............*	*In milk.........*	*Dough..........*	*Ripe............*	*Dough..........*	*Ripe............*
Per cent. of loss in curing.	77.3	71 4	70.2	65.9	40 9	....	....	......	....	....
Per cent. of grain in cured plant.	20 0	30.4	36.0	40.9	40 7	36 8	39.3	41.3	27.2	36.0
Weight of 1,000 grains, grams	....	....	....	....	....	8.5	18.5	20.2	25.4	31.4

In the figures giving the loss in curing the Kaffir corn, a remarkable showing is made. The plants first cut were 77.3 per cent. water, and 22.7 per cent. solid matter. Those last cut were 40.9 per cent. water and 59.1 per cent. solid matter. The proportion of solid matter to the water was about five times as great in plants when mature, but still entirely green and fresh, as when the seed had just formed. The progressive increase in the weight of the seed was to have been expected. The last remark applies, also, to the oats and to the wheat. The weight of the grain compared to that of the whole plant increased appreciably, and of course the difference is still greater when we compare the grain and the straw. One thousand grains of wheat dipped from a pile that had been thoroughly mixed weighed nearly 25 per cent. more when harvested than a similar number did taken one week before.

TABLE SHOWING COMPOSITION OF PLANTS CUT AT DIFFERENT PERIODS OF GROWTH.

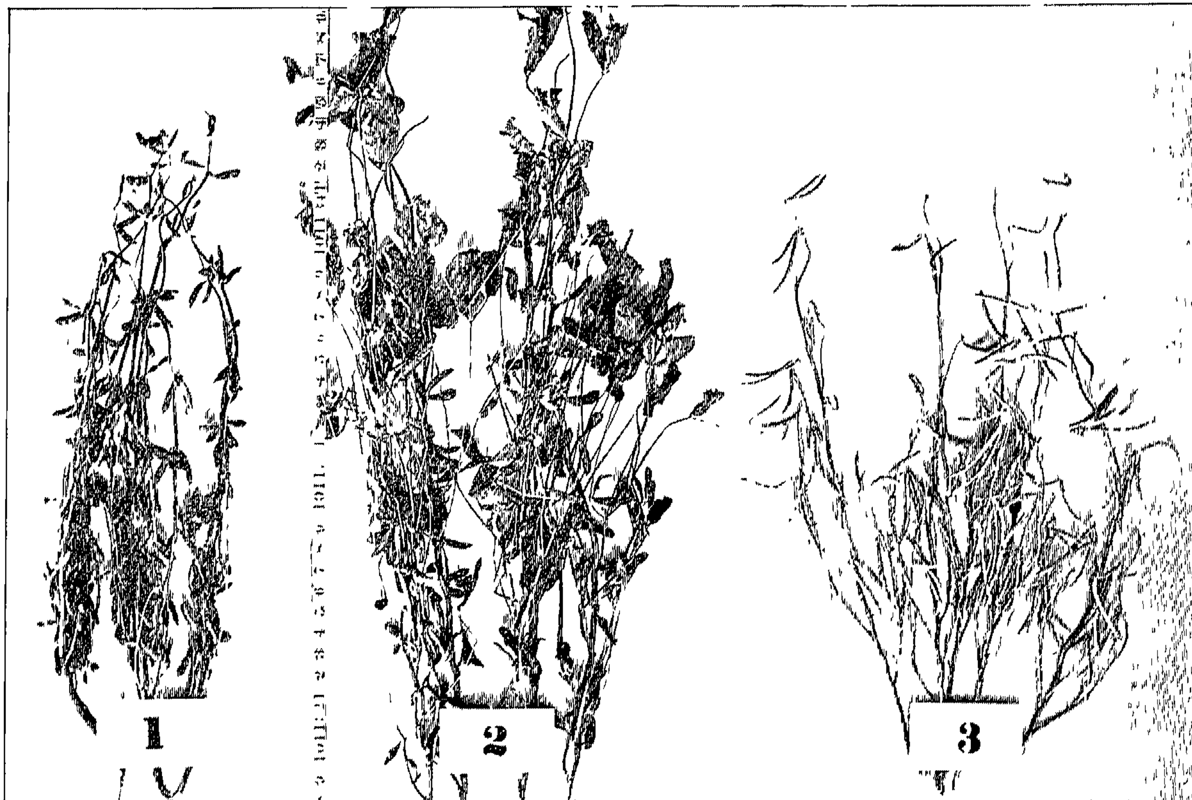
KIND AND CONDITION OF PLANT.	IN THE AIR-DRY SUBSTANCE.											IN THE DRY SUBSTANCE.								
		Dry matter.																		
	Water	Ash	Crude protein	Crude fiber	Nitrogen-free extract	Crude fat	Total dry matter	Total nitrogen	Albuminoid nitrogen	Non-albuminoid nitrogen	Pure albuminoids	Ash	Crude protein	Crude fiber	Nitrogen-free extract	Crude fat	Total nitrogen	Albuminoid nitrogen	Non-albuminoid nitrogen	Pure albuminoids
KAFFIR CORN, FODDER:																				
Seed in soft milk	7.37	9.08	7.99	31.41	41.96	2.19	92.63	1.28	.95	.33	5.97	9.80	8.63	33.91	45.30	2.36	1.38	1.08	.35	6.44
Seed in soft dough	6.08	8.41	6.84	32.77	44.28	1.62	93.92	1.10	.84	.26	5.23	8.95	7.28	34.89	47.16	1.72	1.17	.89	.28	5.57
Seed in hard dough	9.75	9.13	6.83	30.17	42.04	2.08	90.25	1.09	.85	.24	5.31	10.12	7.56	33.43	46.59	2.30	1.21	.94	.27	5.89
Seed hard, easily split	7.13	8.93	6.08	31.55	44.56	1.75	92.87	.97	.85	.12	5.31	9.61	6.55	33.97	47.99	1.88	1.05	.91	.14	5.71
Seed hard, nearly dry	8.67	7.82	5.35	30.68	45.80	1.68	91.33	.86	.70	.16	4.38	8.56	5.86	33.59	50.15	1.84	.94	.77	.17	4.82
KAFFIR CORN, GRAIN:																				
Seed in soft milk	10.02	2.06	13.72	2.72	68.91	2.57	89.98	2.19	2.15	.04	13.44	2.29	15.24	3.02	76.58	2.87	2.44	2.39	.05	14.93
Seed in soft dough	9.37	1.77	11.22	2.00	72.64	3.00	90.63	1.80	1.81	....	11.31	1.95	12.38	2.21	80.14	3.32	1.98	1.99	....	12.48
Seed in hard dough	9.89	1.73	11.19	1.65	72.94	2.60	90.11	1.79	1.76	.03	11.02	1.91	12.42	1.83	80.95	2.89	1.99	1.96	.03	12.23
Seed hard, easily split	9.70	1.59	10.78	1.54	73.14	3.25	90.30	1.78	1.70	.08	10.60	1.77	11.94	1.71	80.98	3.60	1.91	1.88	.08	11.74
Seed hard, nearly dry	9.31	1.69	10.91	1.49	73.30	3.27	90.69	1.75	1.73	.02	10.81	1.86	12.06	1.64	80.83	3.61	1.93	1.91	.02	11.92
OATS, GRAIN:																				
Seed in milk	10.51	4.40	12.93	16.52	51.08	4.56	89.49	2.07	1.73	.34	10.79	4.91	14.45	18.45	57.10	5.09	2.31	1.93	.38	12.06
Seed in dough	10.56	3.93	10.89	9.28	59.56	5.78	89.44	1.74	1.58	.16	9.86	4.39	12.17	10.38	66.60	6.46	1.95	1.76	.19	11.02
Seed ripe	9.70	4.02	11.25	8.68	60.75	5.60	90.30	1.80	1.68	.12	10.47	4.45	12.46	9.61	67.28	6.20	1.99	1.85	.14	11.59
WHEAT, GRAIN:																				
Seed in soft dough	12.48	1.78	14.85	2.41	66.87	1.61	87.52	2.38	1.90	.48	11.90	2.03	16.98	2.75	76.40	1.84	2.72	2.18	.54	13.60
Seed ripe	11.82	1.59	14.06	2.24	68.80	1.49	88.18	2.25	1.72	.53	10.76	1.80	15.94	2.54	78.03	1.69	2.55	1.95	.60	12.19

There are not such changes in the composition of the Kaffir corn during growth as to attract great attention, and yet several interesting things are shown. We are not able to give the relative yield per acre, although the 10 stalks constituting each sample were weighed. A careful examination of the seed was made, in order to secure samples of proper development; but no attempt was made to be exact as to size of sample stalks. None but fair-sized stalks were taken; and a rough comparison as to yield may be made by comparing the weights of the samples. The cured samples, in the order of cutting, weighed as follows, in pounds: 3.2, 3.6, 4.0, 4.3, and 4.6; the cured grain: .64, 1.09, 1.46, 1.77, and 1.88, respectively. Thus, between the time that the Kaffir corn seed was in the soft, milky condition and the ripening period, there was a very considerable increase in the quantity of fodder and a great increase in the quantity of grain; so that there can be no question that the crop was worth more in the later stages of growth than when the seed was just forming, although, in some respects, the crop is not so nutritious.

The table shows that both the fodder and the grain of the Kaffir corn decreased in albuminoids rapidly between the first and second stages, and slowly thereafter. In the fodder the fiber was nearly constant, but it decreased in the grain. The nitrogen-free extract, sometimes called carbohydrates, increased in both parts of the plant. The non-albuminoid nitrogen is more abundant in the growing plant than in the mature one. All of these changes are percentage changes. They are in the main the result of greater increase of some constituents than of others. Thus, although there is a percentage decrease in the albuminoids, there is a greater total weight in the grain when ripe than at any previous time, being more than twice as much at the last cutting as at the first. In the fodder there was a slight decrease in the whole amount of protein.

The conclusion must be, that it is more profitable to harvest the crop when ripe, or nearly so, than at any earlier time. This is true when fodder is an important consideration, as well as when the grain is most important. It is true that this sorghum (Kaffir corn) does not make quite so good fodder, neglecting the tops, if allowed to get dead ripe; but the tops are worth more. There is little difference in its value for some little time, covering the ripening period. With corn, the character of the ripening process is somewhat different. In the latter, the stalks and blades do not remain green and turgid, but early become dry and woody. The quality of corn fodder may vary more with age than that of the sorghums.

What has been said upon the variations of the composition of Kaffir corn grain applies with little modification to the oats and the wheat. The first cuttings of Kaffir corn were made at an earlier stage of development. This may account for the greater variations of Kaffir corn than is observed in the other grains.



YELLOW SOY BEAN. YAMAGATA CHA-DAIDZU. WHITE PODDED ADZUKI.

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TEST OF SOME JAPANESE BEANS.

Two species of Japanese beans have been grown here at the Station for two years past. These are the soy bean *(Glycine hispida),* and the adzuki — the mungo, of India *(Phaseolus radiatus).* Both of them have given promise of much usefulness in this country. They have been subjected to severe tests concerning their endurance of this climate, and have come out triumphantly. Having seen these beans grown in Japan, and noted the very important part they take in the diet of the Japanese, the writer became anxious to try them here, which has been done with gratifying success.

THE SOY BEAN *(Glycine hispida).*

It is true the soy bean has been grown in this country before, and cannot in any sense be called a novelty, as far as knowledge of its characters are concerned. The United States Department of Agriculture made an effort to introduce it years ago, and several enterprising seedsmen have from time to time made attempts in the same direction; but with the result that it has been generally successful only in the South, because the varieties introduced were too late to mature in the latitude of the Northern States. Knowing this, pains were taken to procure some of the earliest varieties grown in Japan. A few dozen beans of each of several kinds arrived in the spring of 1890. They were planted in the latter part of May and matured seed before frost, in a little over three months' time. The amount planted being so small, no attempt was made to estimate the yield, but they appeared to be very productive. One thing in their favor was proved that first season — their ability to withstand drouth. This was especially noticeable when compared with varieties of the common garden beans. Part of the seed was placed with the Horticultural Department, and it was there noticed that they stood the long, trying period of dry weather to a degree surpassing all others on trial. (See Bulletin 19, December, 1890.) This alone is a very strong point in their favor; but, as we shall soon see, it is by no means their only recommendation. The seed thus raised was planted in the latter part of May, in 1891, and harvested early in September, with yields ranging for the several varieties from 12½ to nearly 19 bushels of beans per acre. These yields would under more favorable conditions have been considerably larger. Owing to the unsettled weather at the time of harvest, a portion of the pods burst open and the beans wasted before the crop could be secured.

The bean takes its common name, “Soy” from a sauce manufactured from it, which in commerce goes by the name of “Soy,” though the Japanese name for this sauce is "Shoyu." The beans are boiled and mixed with certain proportions of rice and salt, and the compound is then allowed to undergo a process of fermentation, which results in the delicious brown sauce so common in Japan, and which forms the basis of the best sauces in this country. The term "soja," often applied to this bean, is misleading, inasmuch as the species named by Siebold and Zuccarini *Glycine soja* is not cultivated there, or at least rarely cultivated, though it is wild in the south; and later this species was confounded with the cultivated species, *G. hispida* Mœnch, whence the origin of the term “soja,” as applied to the cultivated bean. The soy bean is a native of Japan, and it has been cultivated there from a very remote period, as is testified by the numerous and strongly-differentiated varieties which have been developed. The Japanese cultivate it extensively, and it is to them an important article of food. It takes to a very large degree the place of meat in their diet, and it is altogether too costly and precious an article to be fed to live stock, except when it on rare occasions is grown as a hay crop. They use the beans ripe, and, properly cooked, they make a palatable and highly-nutritious dish. Sometimes they are eaten green when nearly full grown; they are then boiled in the pods and shelled at the meal.

In this country they will likely be of most value as a fodder plant, though they compare favorably with navy beans for table use; they are, however, more glutinous and less starchy than navy beans, and on this account may not suit the taste of all persons. But there can be no doubt of their value as a stock food, whether we consider the ripe seed ground and fed as a meal or the whole plant cured as hay, or even the ripe straw after the beans have been threshed out.

The following figures on the composition and digestibility of the soy bean in the various stages named are from the laboratory of the agricultural college at Tokio, Japan:

SOY BEAN.	COMPOSITION IN PER CENT.						DIGESTIBLE NUTRIENTS.			Nutritive ratio......
	Water.........	Ash...........	Crude protein...	Crude fiber....	Nitrogen free extract......	Crude fat.....	Crude protein...	Carbohydrates.......	Fat..........	
Hay, end of blossom......................	16.0	5.8	14.2	35.5	26.3	2.2	9.1	36.5	.4	4.1
Hay, still later..................................	16.0	5.9	16.9	35.9	23.1	2.2	10.8	31.5	.3	3.4
Straw..	15.0	10.2	6.7	27.0	38.6	2.5	3.4	35.6	1.5	11.5
Dry pods (husks).............................	14.0	8.1	5.1	29.0	42.5	1.3	2.2	45.8	.8	21.7
Ripe seed	10.0	5.0	33.4	4.8	29.2	17.6	30.1	30.7	15.8	2.3
Soy bean cake..................................	13.4	5.2	40.3	5.5	28.1	7.5	36.3	29.4	6.8	1.3

It will be seen from this that all parts of the plant are highly nutritious. None of our ordinary fodder plants can at all compare with it, and it would seem that wherever it can be grown it must take a high rank among our fodders. It has been tried on a small scale at several experiment stations, and, so far as the writer has ascertained, their judgment is unanimously in its favor. Before its usefulness can be fully determined, however, it should be fed, on a fairly large scale, in comparison with some standard fodder plant, and the results noted. This we have, so far, been unable to do, for want of sufficient material. It is hoped that we can test it in this respect the coming season. Cattle, on pasture, which were offered a few handfuls of the green plant did not seem to relish it; but they showed no marked objection to the hay made from it.

All varieties are stocky bush beans, and should be grown in the following manner: Do not plant before the ground is warm; in Kansas, from the middle to the end of May. Plant in rows 30 inches (or, on low, rich ground, three feet) apart, and drop the beans with a drill about two inches apart in the row. Keep them free of weeds, and give shallow culture whenever the ground begins to form a crust after a rain; but do not work them while the leaves are wet, whether from dew or rain. Cut the plants with a scythe or mower when the beans begin to ripen; let them cure in small, high piles, and thresh when dry. If allowed to get too ripe before they are harvested, or if left long in the field after they are cut, exposed to alternating showers and sunshine, the pods will burst open and the beans waste. The plants grow, with varying conditions, to heights of from two to four, or sometimes five feet. They send their roots deep into the soil. They are upright in growth, stiff, branching. The leaves are composed of three large, pinnate leaflets, on long petioles. Flowers vary with the variety, from white, through pink and purple, to violet; small, in short, axillary racemes. Pods always short, containing from two to four beans, according to variety, suspended in clusters of two or three, on very short peduncles, and so thick on the plant that in some instances the stems can scarcely be seen for pods. It is a characteristic of the species that the whole plant — stem, pod, and leaf— is densely covered with short, rough hair, though some varieties are more hairy than others.

The following four kinds are early enough to be depended upon to mature seed in this latitude every year; several others have been tried, but rejected because too late in maturing:

Eda-mamé. Seeded May 23, 1891; ripe September 2. Plants two to three feet high, erect, stocky, strong growers, dark green; leaflets two to three inches long; was in bloom July 15, blossoms small, white, in axillary racemes; pods short, each containing but two, rarely three, beans, but crowded densely on the stalk; beans greenish-yellow, oval, almost round, the size of large peas; yield, 12.6 bushels beans (at 60 pounds per bushel) per acre. In 1890 this variety stood the drouth better than any other bean grown at the Station. The whole plant is thickly covered with short, coarse hair.

Yellow Soy Bean. Seeded May 23; ripe September 1. Plant three to four feet high, erect, branches upright, in a close bunch. Figure 1 in the accompanying illustration shows three stalks with their pods after the leaves have fallen. Pods very thick on the plant, each containing two or three seeds; whole plant, and especially the pods, thickly covered with short brown hair; beans yellow, slightly oval, the size of peas; yield, 14.57 bushels per acre.

Yamagata Cha-daidzu (tea-colored bean from Yamagata). Seeded May 23; ripe September 29. Plant four feet tall, a very rank grower, producing an abundance of foliage; leaves larger and coarser than any of the others, and stems more straggling and longer between the nodes. Figure 2 in the illustration shows some dry specimens, with the pods and a portion of the foliage still adhering. Blossoms in latter half of July, flowers deep violet; pods two to two and a half inches long and three-fourths inch broad, containing two or often three beans; whole plant very hairy. The beans are oval in shape, deep greenish-brown, the color of newly-manufactured tea, and larger than any of the others here named; yield, 18.8 bushels per acre.

Kiyusuké Daidzu (Kiyusuké is the name of a person). Seeded May 23; ripe September 9. Plant two and a half to three and a half feet high, a rank grower, with much dark green foliage; leaflets wrinkled or folded along the midrib, and narrower and more pointed than the others; flowers white, in short racemes; pods smaller than the last, containing two or sometimes three beans; the latter oval or nearly round, yellow; whole plant hairy; yield, 18.23 bushels per acre.

As has been stated, all of these yields would have been larger it the weather had permitted the saving of the crop in better shape. They were threshed on the machine, and it was found that a large portion of the beans were cracked and broken by the cylinder.

THE ADZUKI *(Phaseolus radiatus).*

Adzuki is the Japanese name for beans belonging to the above-named species. There are many varieties, which differ in color, size, and other characteristics. Two of the more common kinds were imported in 1890, along with the soy beans, and have since been grown here very successfully. So far as the writer has learned, they have not been tried elsewhere in this country, but will be subjected to tests over a large area this year, as we have freely distributed a large portion of last year's crop. It can, of course, be used for stock feed, but it is more particularly a table bean. Authorities on the subject concede that it is the best flavored bean in existence. It is a bush bean, about two feet tall, branching, and not so stocky and erect as the soy bean. The stalks are somewhat hairy, but the pods are smooth. Flowers rather large, yellow, borne on the ends of little branches, in clusters, and followed by a cluster of pods usually arranged in pairs. The pods are cylindrical, four to five inches long, and, according to length, containing from a few up to a dozen beans. These features are common to all varieties. The two kinds grown here differ from each other only in the color of the pods, and they are designated by the English equivalent of their Japanese names.

White-Podded Adzuki conforms to the above general description, and when ripe has white pods. Beans small, dull red, or reddish-brown, truncated at the ends, hilum white, long, and narrow. Figure 3 in the plate shows a couple of stalks of this variety with the leaves removed. It was planted May 23; ripe, August 22, and yielded 16.3 bushels (60 pounds per bushel) to the acre.

Black-Podded Adzuki resembles the preceding, except that on ripening the pods turn a dark gray — not strictly black. No difference can be seen in the beans. They matured with the others but yielded only 8.7 bushels to the acre, but part of them grew in an unfavorable position.

These beans have been submitted to several housekeepers for trial, who all, with two exceptions, give them most favorable recommendations. By the courtesy of Mrs. Nellie S. Kedzie, Professor of Household Economy, the writer is enabled to give her estimate of their value for cooking purposes to the readers of this Bulletin. A report so favorable from so high authority, taken in connection with their earliness, easy culture, and sure producing qualities, would indicate that this bean may some day rival, if not excel, the navy bean in usefulness and popularity. Mrs. Kedzie writes as follows:

Professor Georgeson: The small brown bean (the adzuki) sent to my department by you proves a very good bean for cooking purposes. In baking the old-fashioned way, *i. e.,* soaking 12 hours, parboiling, then baking at least 10 hours, the bean keeps its shape, is of good flavor, and is desirable in every way. It is sweeter than the ordinary white bean; so less sugar or molasses is needed in baking.

I found this bean especially nice for making bean soup. Soaking 12 hours, then simmering slowly most of the forenoon, adding a bit of butter and flour mixed for a little thickening, and seasoning well, the bean soup is nutritious and palatable. The addition of a little cream to this soup is as great an addition as it is to any bean soup. NELLIE S. KEDZIE.

They should be grown in rows three feet apart, and the beans dropped about an inch apart in the row and covered one inch deep. They should be cut before they are dead ripe, cured in small bunches, and housed as soon as possible. Careful handling is necessary to avoid waste. It was found that the beans are too brittle to be threshed on the machine, nearly all being broken; but they are very easily beaten out with sticks.

PLASTER AND OIL MEAL (CASTOR POMACE) AS FERTILIZERS FOR MILLET.

This experiment was carried out in a field belonging to Mr. Davies, a neighboring farmer. The field was new prairie, broken early in 1891. The inverted sod was worked several times with a weighted disc barrow, and was seeded to millet on the 13th of May. Fifteen plats, each one-tenth acre, were then laid out, to five of which plaster was applied at the rate of 400 pounds per acre, to five oil meal (castor pomace) in same amount, and five alternating with these received no fertilizer.

The following is the yield of hay:

No. of plat.	*Treatment.*	*Yield of hay, lbs.*
1....	Plaster	225
2....	Oil meal	290
3....	Nothing	220
4....	Plaster	225
5....	Oil meal	265
6....	Nothing	155
7....	Plaster	155
8....	Oil meal	235
9....	Nothing	190
10....	Plaster	195
11....	Oil meal	235
12....	Nothing	200
13....	Plaster	295
14....	Oil meal	315
15....	Nothing	260

Average per plat and yield per acre in tons:

Oil meal, yield per plat, 266 pounds; rate per acre, 1.33 tons.
Plaster, yield per plat, 219 pounds; rate per acre, 1.045 tons.
Nothing, yield per plat, 205 pounds; rate per acre, 1.025 tons.

In this instance it appears that the oil meal had the effect of increasing the yield some 600 pounds per acre, which, however, is but a small return for the expenditure of 400 pounds of fertilizer.

PLASTER ON PRAIRIE GRASS.

Ten plats of one-tenth acre each were measured off on the prairie pasture of the upper farm, and every alternate plat plastered at the rate of 400 pounds per acre, while the remaining plats received nothing. The plaster was applied April 14, when the grass was beginning to show signs of life. On September 21 all plats were cut, and when dry, two days later, they were raked and weighed, with the following result:

No. of plat.	*Treatment.*	*Hay produced, lbs.*
1	Nothing	234
2	Plastered	227
3	Nothing	250
4	Plastered	250
5	Nothing	215
6	Plastered	210
7	Nothing..	262
8	Plastered	259
9	Nothing	285
10	Plastered	310

Average of plastered plats, 251.2 pounds = 1.256 tons per acre.
Average of nothing plats, 249.6 pounds = 1.248 tons per acre.

The result is practically the same for both; and the inevitable conclusion is, that on this soil plaster has no effect on the growth of prairie grass.

PLASTER ON TAME GRASS.

A portion of field No. 3 was sown to plaster April 14, 1891. The field was sown to orchard grass and clover mixed in the spring of 1889, and a good stand secured. Owing to the drouth of 1890 the yield was light in that year. Ten plats were measured off, each one-fourth acre in extent. Of these five were plastered, two at the rate of 400 pounds per acre, and three at the rate of 800 pounds per acre; the remaining five plats received nothing.

Two cuttings were made, the first June 15 and the second August 19, with the following results:

No. of plat.	Treatment.	First cutting, hay, lbs.	Second cutting, hay, lbs.	Total yield of hay, one-fourth acre, lbs.
1	Plaster, 800 pounds per acre..................	1,110	760	1,870
2	Nothing....................................	940	705	1,645
3	Plaster, 400 pounds per acre..................	965	680	1,645
4	Nothing....................................	965	675	1,640
5	Plaster, 800 pounds per acre..................	1,070	670	1,740
6	Nothing....................................	1,020	700	1,720
7	Plaster, 400 pounds per acre..................	1,060	700	1,760
8	Nothing....................................	990	690	1,680
9	Plaster, 800 pounds per acre..................	1,050	590	1,640
10	Nothing....................................	1,125	680	1,805

AVERAGES.

Treatment.	First cutting, pounds.	Second cutting, pounds.	Total yield per acre, tons.
Plaster—800 pounds per acre.................	1,076⅔	676⅔	3.506
Plaster—400 pounds per acre.................	1,012½	690	3.404
Nothing....................................	1,008	690	3.396

There is here a slight gain on the plastered plats in the first cutting, but no gain at all in the second cutting. The actual yield of hay from the 1¼ acres that were plastered was 8,655 pounds, and of the 1¼ acres not plastered 8,490 pounds, giving 165 pounds hay on 1¼ acres in favor of the plaster. It is, however, extremely doubtful if this small increase should be credited to the plaster, as it might well be due to variations in the soil. But even if credited to the plaster, it is a poor investment. The five plats were sown with 800 pounds of plaster, which cost $4.50 per ton, laid down at the College (cost at Blue Rapids, $2; freight,, $2; hauling from depot, 50 cents), or $1.80 for the amount applied— a high price for 165 pounds of hay.

We conclude that plaster cannot be profitably applied to orchard grass and clover on this soil.