THESIS

Forage Plants

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T H E S I S.

F O R A G E P L A N T S.

By

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Results of this thesis are based on one year's trial made during the year 1900.

The immense production of meat in this country makes the question of feeds and forage plants one of vital importance, and our Experiment Stations quickly seize upon every new forage plant of any promise whatever and try all kinds of experiments to determine its requirements as to soil, temperature, moisture, treatment, and its effects on the soils, its yield, food value, etc., but few, if any, experiments have been tried in which the fodder plants of well established value and the newer, less known fodder plants have been compared under like conditions of soil, temperature, and moisture.

This fact led to the following experiment:

1. It was planned to compare a number of fodder plants that investigators at present think are or may become of value under such conditions as are ordinarily met with in this section of the country.

The plants and the combinations of plants which were selected can be found in the diagram. The seeds were obtained from various sources.

2. A plot of soil was selected for the experiment-

(a) that would represent as nearly as possible the average fertility and texture of our southern Michigan soils.

(b) that would be as nearly uniform as possible in fertility, texture, and slope, and

(c) that would be high enough to ensure safety of the plants from drowning out in case of a wet season or to test their drouth resisting power in case of a very dry season.

3. The land was divided into forty plots, each twenty by twenty feet, separated by two foot paths, and the whole area surrounded by a five foot path. The plots were arranged in four rows of ten plots each running east and west. Two plots of each plant were sown and the plots so arranged that the distance between the two plots of each plant was the same in every case. It was believed that this arrangement would make the probability of variation between the two plots of each plant the same. The following diagram will show the arrangement of plots. For convenience in recording notes the two rows of plants are numbered from 1 to 20, and the south rows from 1" to 20", 1" being a duplicate of 1, 2" a duplicate of 2, etc.

1 Peas and Oats	" 2 "Vetches " and "Oats "	" 3 "Vetches " " "	" 4 "Rape " (One " cut)	" 5 "Evergreen "Sweet "Corn	" 6 "Common "Millet	" 7 "Bromus "iner- "mis	" 8 "Spelt " "	" 9 "Dwarf "Vic- "toria" "Rape	" 10 "Kaffir "Corn
11 German Millet	" 12 "Hungar- "ian "Millet	" 13 "Japan- "ese "Millet	" 14 "Amber "Cane "	" 15 "Rowe Co. "Dent "Corn	" 16 "Hog "Millet	" 17 "Spur- "ry	" 18 "Soy "Bean "	" 19 "Rape "(Cut twice"	" 20 "Jeru- "salem "Corn
6" Common Millet	7" "Bromus "iner- "mis	8" "Spelt " "	9" "Dwarf "Vic- "toria "Rape	10" "Kaffir "Corn "	1" "Peas "and "Oats	2" "Vetch- "es "and "Oats	3" "Vetch- "es "	4" "Rape "(Cut "once)	5" "Ever- "green "Corn
16" Hog Millet	17" "Spurry " "	18" "Soy "Bean "	19" "Rape "(Cut "twice)	20" "Jerusalem "Corn "	11" "Ger- "man "Mil- "let	12" "Hun- "gar- "ian "Mil- "let	13" "Japan- "ese "Mil- "let	14" "Amber "Cane "	15" "Rowe "Co. "Dent "Corn

4. For the time and method of planting, quantity of seed used, care of growing crops, and time of harvesting, various bulletins and other works were resorted to and the methods supported by the best authorities were followed as nearly as circumstances would permit, there being no attempt in this case to determine anything along these lines.

5. A brief history of, and conditions required by each plant is given under the separate treatment of the plant.

6. The ultimate data to be derived from the experiment is to consist of,

(a) Estimated total yield of green fodder per acre in each case, the yield of the whole plant without trimming the edges being taken as a basis.

(b)Estimated total yield of dry forage per acre for each plot, to be reckoned by oven drying, an average sample of the plant grown taken from near the center of the plant and multiplying the total estimated green yield per acre by the per cent of dry matter in this sample.

(c) Estimated digestible nutrients per acre of each fodder obtained by multiplying the total dry yield per acre by the ratio of digestible nutrients to total dry matter per 100 pounds given in the table of digestible nutrients (Table III Appendix) given in Henry's Foods and Feeding.

(d) Digestible protein,carbohydrates, and ether extract computed from same table as preceding.

(e) Accompanying notes with each fodder plants regarding its characteristics of growth, noting any circumstances or conditions that would influence results, with full notes as to the management the plant received.

General Conditions.

1. The soil selected was a sandy loam on a slight elevation with a very gentle slope to the south-east. While apparently uniform in fertility, the growing plants soon showed that the north-east part of the piece, including plots 10 and 20, most of plots 9 and 19, and shading gradually into the adjoining plots south was decidedly poorer than the rest of the piece. The previous year timothy sod and a dressing of coarse stable manure had been turned and the field planted to corn.

2. The preparation of the piece was the same for all plots. Before plowing, the corn stubble was cleared off to eliminate as much as possible all cause of variations. The piece was plowed in connection withthe rest of the field the latter part of April, about six to seven inches deep, worked twice with a spring-tooth harrow, and once with a spike-tooth drag to smooth the surface. The peas and oats, vetches and oats, vetches, bromus inermis, and spelt were sown without any further working; the rest of the ground was cultivated thoroughly the latter part of May, and just before planting the various corns on June 16, the

remaining unplanted plots were cultivated thoroughly. In planting cultivated ground the surface was always worked over with a rake before planting to make the ground smooth.

3. The season was as nearly uniform as could possibly be expected. The soil was sufficiently moist until almost the close of the experiment, whenthe corn and rape were the only crops still growing, but was not really too wet at any time. It was in a mellow moist condition in every case whenthe crops were planted. The temperature was quite normal although the season was a trifle cold the middle and latter half of May. These uniform conditions were very essential to the success of the experiment, as the earliest crops were nearly ready to harvest before the latest ones were sown and only under uniform conditions of temperature and moisture could a fair comparison of the crops be made.

The following is a detailed account of the several plots.

Peas and Oats,- Plots 1 and 1".

The field pea is one of the oldest forage plants, and yet it has not been brought to the attention of American farmers so largely as it deserves. In Canada the acreage is large and the success of Canadian farmers in fattening stock is said to be due to the use of pea and oat hay and pea meal.

The field pea is adapted to cultivation in this State. It requires a long, cool season, with gradual increasing heat toward the time of maturity.

The peas and oats were sown April 27 in drills seven inches apart, 35 drills per plot, at the rate of 1 bu. 24 lbs. 11 oz. oats and 2 bu. 20 lbs. peas per acre. The drills were opened with a hoe sufficiently deep to bury the peas 2 ½ to 3 inches deep, the peas sown in the drills by hand, partially covered, then the oats sown in the partially filled drill, and finally all covered by raking the surface level with a garden rake, giving the oats a depth of about 1½ inches. Both peas and oats began to come up in seven days and continued to grow nicely until mature. The seed was good, as a first class even stand was secured. June 16

they were a good knee high, and June 26 about hip high and beginning to lodge some. By July 7 they were badly flattened. Some of the peas were big enough to cook. The two plots looked very even and practically alike throughout the season, though the weights showed quite a difference in yield. They were cut July 23. Both seemed to have been considerably injured by a cut worm. Chopped heads and stems of oats were seen about the ground in many places.

The estimate yields in pounds per acre were as follows:

			Digestible.			
	Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 1 -	14618-	5321-	3027	599	2362	66
" 1"-	20807-	7324-	4167	824	3251	92
Average-	17712-	6322-	3597	711	2807	70

The figures show quite a marked difference in yield between the two plots in favor of plot 1". The soil in plot 1" and a few adjoining plots seemed a trifle heavier than the rest of the experimental ground though there did not appear to be as much difference in productive power as the figures indicate. In the yield of vetches and oats, plots 2 and 2", and vetches, plots 3 and 3"

the difference favors plot 2" and 3" which are near plot 1" of the peas and oats but the difference is not as marked as in case of the peas and oats.

Vetches and Oats,- Plots 2 and 2".

Vicia villosa is an annual leguminous plant, a native of western Asia. It has been cultivated for fifty years in Europe, and was introduced into this country in 1847. Its cultivation was neglected until its reintroduction about twelve years ago. Hairy vetches withstand winter cold and summer drought, but they do not do well where there is an excess of rain fall. While it gives a fair crop on poor soil it is most profitable as a forage plant on rich and well-tilled land. It needs considerable moisture during the first six weeks of its growth, but when once fairly established withstands drought and extremes of temperature.

The vetches and oats were sown April 28, at the rate of 1 bu. 24 lbs. 11 oz. oats and 61 lbs. 11 oz. vetches per acre in drills seven inches apart and covered 1½ to 2 inches deep. The oats were nearly all pricking through in seven days, while only an occasional vetch was seen in eleven days, and only a small per cent of the seed came up finally.

A germination test gave only 53% of good seed, and most of those germinated very slowly.

At first the vetches sown with the oats seemed to grow about as well as those sown alone but by the time the oats were nearly knee high the vetches had practically stopped growing except at the edge of the plots. After the whole crop had been cut off July 26, the vetches began to grow again nicely and by September first had formed quite a thick mat and were beginning to blossom. The failure of the vetches to grow successfully with the oats may have been due to the poor seed and consequent slow start, or perhaps if sown a few days ahead of the oats so that the vetches and oats would appear above ground at the same time they would have done better. If not, this experiment would indicate that the vetches and oats could not be grown together to produce a mixed fodder for the vetches were certainly not held back by insufficient moisture. The product of these 2 plots will practically represent oats sown alone for fodder, but will not be a fair test as the oats were sown too thin for a fodder crop.

The estimated yields in pounds per acre were as follows:

	Green.	Dry.	Digestible. Nutrients.	Protein.	Carbo-hydrates.	Ether Extract.
Plot 2-	15472-	6452-	3840	444	3315	171
Plot 2"-	17606-	7095-	4223	488	3547	188
Average-	16539-	6773-	4031	466	3386	179

The amounts of digestible nutrients were calculated from the digestibility for oats as given inthe table of digestibility, ignoring the few vetches present. The land had to be plowed for wheat, otherwise the yield for the season might have been greatly increased by cutting the vetches later in the season.

Vetches,- Plots 3 and 3".

The vetches were sown April 29, at the rate of 61 lbs. 11 oz. per acre, in the same way as the vetches and oats. Theycame up very slowly, a few showing in eleven days and the ultimate stand very thin. Their slow germination may have been partly due to the freezing weather during the first week they were in the ground but could not be entirely due to this cause as the germination was slow in the class room. After once getting started, they grew quite rapidly and thickened up remarkably well,

but the weeds took advantage of their slow start and secured an equally good stand. The vetches are very spreading in growth and when sown alone lie too flat on the ground. July 17 they laid about knee high, and were beginning to blossom. They do not have a definite period of fruiting but continue to blossom in growing weather as long as allowed to stand. They were harvested July 17. A second crop might have been cut nearly as heavy as the first if the ground had not been plowed for wheat.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Nutrients	Digestible. Protein	Carbo-hydrates	Ether-Extract.
Plot 3-	15472-	3435-	1989	444	1489	47
Plot 3"	16751-	4138-	2386	535	1794	57
Aver-age.	16111-	3786-	2183	489	1642	52

Bromus inermis,- Plots 7 and 7".

Bromus inermis is a native brome grass of Europe which is hardly to be distinguished from a native (Bromus pumpellionus) of Montana, Colorado, and Wyoming. Its introduction to this country has

done much to improve the stock interests of the country. It is well worth more attention than has been given it.

The seed was sown April 24, at the rate of 36 lbs. 11 oz. per acre, in drills seven inches apart and covered about one inch deep. It was well through the ground in nine days but was so fine one could hardly see it. June 16 it was very thick and four or five inches high, with so many weeds in it that the Bromus was nearly hidden. It commenced to head about the middle of July but seemed to head very slowly and unevenly as timothy does when it gets to heading the same year it is sown. The plant with the head stood about knee high. At the time the ground was plowed, about the middle of September, the plots were complete masses of leafy grass about 1 ft. high hidden by weeds. On account of the great amount of weeds in the plots and the immature condition of the Bromus it was not harvested, so there are no figures for comparison. Considering the fact that it is a perennial and that it is deemed advisable to sow it only where it will stand three or four years, it would seem unfair to compare its yield within five months after sowing with our annual fodder plants. At the time of plowing, the ground was quite dry but the Bromus was as fresh

and luxuriant as if abundantly supplied with moisture. Judging from the short trial with it this summer it seems very worthy of further trial.

Spelt,- Plot 8 and 8".

The Spelt was sown April 28,at the rate of 130 lbs. 1 oz. per acre, in drills seven inches apart and covered about two inches deep. It was about all up in ten days but was a thin stand. In its early growththe spelt looked more spindling than wheat or oats. It made a thin,scraggly growth and was nearly run out by weeds. June 26 it stood about knee high. It became quite rust and was altogether a sorry looking crop to cut for hay. It was cut July 15, but the sample that was taken was burned up in drying so no data can be given.Altogether it seemed a very unpromising crop.

Spurry,- Plot 17 and 17".

Spergula arvensis.

Spurry is a new plant in Michigan as well as in the United States, but it is an old plant in sections of the world. Its name being found in certain books published in 1829. Spurry is sometimes called a weed and is grown in some countries as a forage crop. It is a quick and rapid growing crop, which returns early and does best on sandy soils.

The spurry was sown June 21, very thickly in drills seven inches apart and covered about one inch deep. It came up in five days and grew very rapidly at first, but was soon affected with some disease and died out. Enough was seen of it, however, to conclude that it is probably of no use here under ordinary conditions.

Rape.

This is a succulent forage plant, which is much like the Swedish turnip or rutabaga in appearance, but the root is more like that of cabbage. The leaves are large, glaucous, smooth, spreading, and variously notched and divided. Rape is a native of northern Europe, ranging eastward into Siberia. It has received little attention in this country until within recent years.

Rape is best adapted to rather cool, moist climates, such as prevail in Canada and the northern United States. It requires a rich, moist, and loamy soil.

As to the feeding value, their is little difference between the two varieties used, yet the Dwarf Victoria rape gives usually a better result.

Dwarf Essex Rape (One cutting)Plot 4 and 4".

The rape was sown June 16, at the rate of 8 lbs. 11 oz. per acre in drills 2½ feet apart, and was covered about 1½ inches deep. The seed came up very quickly and evenly and made a splendid stand, appearing, if anything, rather thick. It grew very rapidly and showed more variation in different parts of the plots during the early stages of growth than any other plant. It is evidently the most susceptible to variation in fertility. July 10 the rape was cultivated about three inches deep and the weeds were carefully cleaned from the rows. Before cutting the rape September 5 the cabbage worm and the plant louse began to work but had not at that time greatly damaged the crop. Most of the stalks had from 5 to 18 big fres leaves besides the few lower ones that had turned yellow and were dropping off. Joining each plot of rape on the south was a plot of amber cane about nine feet high, whose shade seemed to favor the growth of the rape nearest it, keeping it ranker and fresher. The same affect was observed in both plots. At time of cutting it stood on an average about 2½ feet high and covered the ground.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 4	-34821	-3796-	2657	407	2196	54
Plot 4"	36756	-4411-	3088	473	2552	63
Aver-age.	35788	-4103-	2872	440	2374	58

Dwarf Essex Rape,-(Cut twice)Plot 19 and 19".

Operations and conditions of these plots appeared the same up to the time of the first cutting as in the preceding two plots. July 26 both plots were cut, after which the rape sprang up again quickly and made a good growth with practically as thick stand as before. The rape was about knee high when cut the second time, September 5, and had smaller and less woody stalks than rape of plot cut once.

The estimated yields in pounds per acre for the two cuttings were as follows:

	Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 19-						
First Cutting-	15949	1340	938	143	775	20
Second Cutting-	11896	1154	808	123	668	17
Total-	27355	2494	1746	266	1443	37
Plot 19"-						
First Cutting-	19811	1690	1183	181	976	26
Second Cutting-	15488	1670	1169	179	966	24
Total-	35277	3360	2352	360	1942	50
Average of two plots-	32577	2927	2049	313	1693	43

It will be noticed that plot 19" gave considerably better yield than plot 19. As before stated, the northern part of the experimental ground was decidedly poorest and as plot 19 is near the northeast corner, the lighter yield is accounted for by the poorer soil. The figures also show that the second cutting contained a greater per cent of dry matter than the first cutting in each plot.

Dwarf Victoria Rape,-Plots 9 and 9".

This variety was sown to compare with the Dwarf Essex. In the treatment received and in its appearance this variety did not differ from the Dwarf Essex.

The estimated yields in pounds per acre were as follows:

			Digestible.			
	Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 9-	36303-3869		2709	415	2238	56
Plot 9"-	37723-4678		3274	501	2706	67
Average-	37289-4273		2992	458	2473	61

These figures show a slightly better yield than of the Dwarf Essex, (one cut) but the difference might reasonably be attributed to difference in fertility of the plots as they were not adjacent. This experiment cannot be said to prove any superiority of one variety over the other.

Soy Bean-Plots.18 and 18".

(Glycine hispido).

The soy bean is a leguminous plant, native to southeastern Asia and has been cultivated in China and Japan before the time of Confucius. This crop received little attention in this country until within the last fifteen years.

The bean is an erect, annual plant, with branching, hairy stems, trifoliate, more or less hairy leaves, rather inconspicuous pole lilca or violet colored flowers, two to five seeded pods. It is found to thrive best on soils of medium texture that are well supplied with potash, phosphoric acid, and lime. It requires the same temperature as corn.

The seed of the desired variety of this forage plant was not secured, so it was necessary to take some old seed on hand at the Station of some early, dwarf variety. On this account the experiment cannot be considered a fair test of the yield of forage from soy bean. They were sown June 21 in drills fourteen inches apart, making eighteen drills per plot. The beans were sown six to eight per foot, placed by hand one at a time, and covered about two inches deep. This sowing is equivalent to 136 pounds 2 oz. per acre. The seed proved remarkably good, almost every bean growing, and the plants breaking the ground almost simultaneously in six days. July 17 they stood very even, and three to four inches high and were beginning to branch. July 11 they were hoed and weeded thoroughly, then were left untended until harvested September 12.

At time of cutting they stood about 2½ feet high. They were slightly rusty and slightly over-ripe to make the best fodder. Some insects had been cutting off a few leaves but had done very little damage. In any great numbers the insect would spoil the crop as it cuts off every leaf where it works but does not eat any of them.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 18-	17629-	4407-	2600	566	1945	89
Plot 18"-	17214-	4562-	2691	586	2014	91
Average-	17421-	4484-	2645	576	1979	90

Millets.

Only those millets were selected that are pretty well established as distinct varieties and that are quite commonly grown or seem to give promise of superiority. The following varieties were selected: German millet, Common millet, Hungarian millet, Japanese millet, and hog millet. The hog millet proved to be common millet a mixture of common and German millets with a predominance of German. They were all sown at practically the same time,- June 16 and 18, with no special weather

conditions to give that sown one day an advantage over that sown the other day. The varieties were all sown at the rate of 50 lbs. per acre, in drills seven inches apart, thirty-five drills per plot, and were covered about one to one and a half inches deep. The millets all grew so rapidly and covered the ground so completely that the weeds were entirely subdued.

In the early stages of their growth the German and common millets could not be distinguished, but were ranker growing than the Hungarian and thicker on the ground. Compared to the Japanese millet they were thicker on the ground and broader leaved. The German and Japanese millets made the heaviest growth, and stood up nicely at time of cutting while the common and Hungarian millets were badly lodged. At the edge of the plots the stalks were much the coarsest and tallest, and the heads much the largest or fartherest advanced, the difference being most noticeable with the German and Japanese millets.

At the rate sown, the millets were all of fine quality for hay in the interior of the plots, except perhaps the Japanese which should be sown a little more thickly. The German and Japanese millets were practically free from rust, while the common and Hungarian were quite rusty.

The German and Japanese millets matured about the same time, and both about ten days to two weeks later than the Hungarian, and two to three weeks later than the common. A comparison of the green yields of the various plots will be entirely unsatisfactory as they were not all cut at the same stage of maturity, some plots having a majority of the heads out of bloom while some were so ripe as to be almost dry enough for hay when cut. The following tables with notes show the yields of the various plots and the condition of the forage when cut.

German Millet,-Plot 11 and 11".

(Setaria Italica).

The origin of this variety and the date of its introduction into the United States has not been determined, but it evidently of recent introduction. East India is supposed to have been its source. It changes its character very materially the further north it is grown. The yield of German millet is greater in southern latitudes and therefore it does not do well in this State. It is a late variety.

German millet has a robust stem, usually single, unbranched, often reaching four to five feet in height, leaves large, subdivisions crowded, drawn fine at the ends; beards conspicuous, usually

with a purplish tinge.

Plots even, about 3½ feet high. Plot 11, cut September 3, 2/3 of heads out of bloom; plot 11", cut September 11, heads practically all well filled, no heads quite ripe.

The estimate yields in pounds per acre were as follows:

			Digestible.			
	Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 11 -	30303-					
Plot 11"-	19740-7475-		4784	374	4301	109

Japanese Millet,- Plots 13 and 13".

Native of Japan. Gives large yields of forage under favorable conditions, but with little ability to withstand drought, succumbing quicker than any of the commonly grown sorts. The millet is flat stemmed and tinged with red at the tips of the leaves.

This is evidently one of the barnyard millets. Thinner and coarser than German millet, about 3½ feet high, leaves three to five inches long free from awns. Plot 13, cut September 3, plot 13", cut September 11, at about same stage of maturity as plots of German millet cut the same dates. The east six drills of Plot 13" were sown to Hungarian millet making 29/55 of a full plot sown to Japanese

millet. Only the Japanese millet was considered in reckoning yields.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 13	-30301-					
Plot 13"	-19316-6972-		4462	349	4011	102

Common Millet,- Plot 6 and 6".

(Letaria Italica).

The time of its introduction is unknown, though it is the first millet to have been generally grown in the United States. Its average hight is about 3½ feet, b ing shorter than the Hungarian. This millet is often used for German millet. It is most widely cultivated of the foxtail millets in this country. It gives the better returns on poor soils, is hardier, and endures drought better than any other variety.

Plot 6 was cut September 3, with the German millet adulteration about same stage of maturity as in the plot of German millet cut the same date, while the common millet was ripe. The common millet was about a foot shorter than the German millet and the heads were not more than half as large. Plot 6" was cut September 11, although [illegible] ripe

for good hay, the common millet shelling badly and the leaves mostly dried up.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 6 -12139-						
Plot 6"-12804-5995-		3581		280	3220	31

Hog Millet,- Plot 16 and 16".

(Panicum Miliaceum).

This seed was sent by W. Atlee Burpu upon request for hog millet and was labelled Panicum Miliaceum but proved by its growth to be common millet (Setaria Italica). This millet grew about 2½ feet tall, with heads about two inches long, was flat on the ground when cut, rusty, and over ripe. Plot 16", cut September 11, being almost dry enough for hay.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 16 -11524-						
Plot 16"- 8536-4839		3097		239	2785	73

Hungarian Millet,- Plot 12 and 12".

Setaria Italica var. Germanicum.

This plant has long been known in Europe and is possibly a native of that continent. It has been cultivated in this country since 1830. This grass found a congenial home in the new prairie soil of the west. It will not withstand drought as well as common millet, and will live through the winter under certain conditions.

This millet has rather a slender stem, clustered, branching, 3 to 4 feet high; leaves abundant, beards prominent, usually purplish or brownish.

About equal in size of straw and head to common, but not quite as ripe when cut. Plot 12, cut September 3, plot 13", cut September 11, both cuttings too mature, first cutting even containing many dead ripe heads.

The estimated yields in pounds per acre were as follows:

		Digestible.		
Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 12 -15151-					
Plot 12"-11737-6021-	3858		302	3464	87

Corn.

The Stowell's Evergreen Sweet-corn, Iowa

County Dent Corn, Kaffir corn, and Jerusalem corn were planted May 26 in drills 3½ feet apart. In planting, three kernels (two kernels in case of dent) were placed together every one foot in drills and were covered one to two inches deep. All the plots were cultivated June 16 and July 10 about three inches deep. The weeds were cleaned from the rows thoroughly.

Powe County Dent Corn, Plots 15 and 15".

This corn, a variety of dent, came up quickly and evenly, and grew very rapidly. Standing about hip high July 7. The stalks were coarse and tall with practically no suckers and comparatively few leaves. At time of cutting, September 11, the north half of plot 15 was larger and fresher than the south half, which bordered on a little patch of clay. The stalks were eight to ten feet high, and badly down. There were very few ears and none near maturity. Plot 15 stood up somewhat better and was eared better than plot 15". The corn although adapted to the conditions in this State is not a promising looking fodder corn.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 15	-34052-	9057-	5688	371	5139	178
Plot 15"	-33553-	8992-	4421	289	3994	138
Average-	33805-	9024-	5054	330	4566	158

Stowell's Evergreen Sweet-corn,-Plot 5 and 5".

A native of this country. Did not come up well but a fair stand was secured. The corn did well all the fore part of the season, but later it did not seem to do as well as this variety usually does. When cut, September 11, the stalks were only six to seven feet high, and looked rather dried up and unthrifty. The ears were few and small.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo hydrates	Ether Extract
Plot 5	-58129-	8273-	5957	467	5373	117
Plot 5"	-23705-	5879-	4233	332	3818	83
Average-	25917-	7076-	5095	399	4596	100

Jerusalem Corn,- Plots 20 and 20".

The recently introduced Jerusalem corn, a non-saccharine variety of sorghum, is much grown in Kansas and other states where dry weather is liable

to interfere with the raising of Indian corn. The growing of this crop is spreading rapidly. It is not regarded to be equal to corn for ensilage.

The Jerusalem corn came up and grew for a time very slowly. Scarcely more than half the seed came up, making a rather poor stand. Unfortunately, both plots were poorly located, plot 20 being in the poor north-east corner, while plot 20" was the lowest spot on the experimental plot and was rather wet, cold, and hard the fore part of the season. July 11, the corn average scant knee high. After getting well established it grew finely, and when cut, September 11, was about six feet high with the heads well formed and seeds full grown, utnot many out of the milk. The stalks were tender and juicy clear to the ground and the leaves were very fresh and nice, even the lower ones. Of the plants (sample) taken from plot 20, the green weight of the heads was 27% of the whole green weight and the dry weight of the heads was 42% of the total dry weight. The stalks dried to 26%, and the heads dried to 51% of their green weight. Of the samples taken from plot 20", the green weight of the heads was 35% of the total green weight, and the dry weight of the heads was [illegible] total dry weight. The stalks dried to

88%, and the heads dried to 58% of their green weight.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Nutrients	Digestible. Protein	Carbo-hydrates	Ether Extract
Plot 20	-14813-	4619-	2914	131	2695	88
Plot 20"	-17174-	6509-	4107	137	3796	124
Average-	15693-	5564-	3510	159	3245	106

Kaffir Corn,- Plots 10 and 10".

Kaffir corn is also a recently introduced non-saccharine variety of sorghum. It is a native of Africa, and is adapted to dry climates. In experiments it has been found to give a larger total yield on very dry sandy soil than Indian corn. The seed rarely matures in this State. It cannot take the place of Indian corn, except possibly on light sandy soils, though our seasons are too short for it to reach full maturity.

In the experiment, the Kaffir corn also came up very slowly and took a long time to get a good start. The stand was about the same as the stand of Jerusalem corn and poorest in plot 10. Plot 10 was the poorest soil of the forty plots. July 11 the corn in plot 10" was knee high, while the corn in plot 10 was no more than six or eight inches high. [illegible] of cutting, Sept. 11,

the corn in plot 10" was about 5½ feet high with the heads all well formed and many well toward maturity, while very few heads had developed in plot 10. The corn was well suckered in both plots, but more so in plot 10", some main stalks having three or four suckers as big as the stalk itself and having as good a head. The corn was very leafy, and both stalks and leaves seemed to be fresh and tender clear to the ground. Of the sample plants taken from plot 10", the green weight of the heads was 11.5% of the total green weight, and the dry weight of the heads was 15.6% of the total dry weight. The stalks dried to 24% and the heads dried to 35% of the green weight.

The estimated yields in pounds per acre were as follows:

			Digestible.		
	Green	Dry	Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 10	-16779-	4228-	2667	121	2465	81
Plot 10"	-30943-	7736-	4831	284	4499	158
Average-	23861-	5982-	3774	172	3483	119

Amber Cane,-Plots 14 and 14".

Amber cane is a native of this country. It does well on sandy soil, which led to numerous experiments in this State during the year 1894. Upon sandy soil under favorable conditions it will [illegible] Indian corn, but its [illegible]

more susceptible to cold makes it a less favorable crop.

The Amber cane was sown June 18 in drills 2½ feet apart, dropping a kernel every three to six inches in the drill. The kernels were covered just deep enough to put them into moist dirt. In eight days it was up very well all over both plots sufficient to make a good stand. The plots were cultivated July 10, and the rows weeded thoroughly, then left untouched till harvest. The plants were very fine and spindling at first and grew very slowly. July 13 they were only three to four inches high. After getting well started it began to grow remarkably fast and reached a height of eight to ten feet at time of cutting, September 11. Both stalks and leaves were much finer than either Kaffir or Jerusalem corn, but had the same tendency to be fresh and tender clear to the ground. Some of the heads were just in blossom and none were very well matured. Where the stand was thick the stalks did not sucker much, but where a stalk had plenty of room it threw out two or three suckers that became one-half or two-thirds as large as the stalk itself. Of the samples taken from plot 14, the green weight of heads was 6.6% of the total weight, and the dry weight of heads was 9.2% of the total dry weight.

[illegible] to

32.4% of their green weight.

The estimated yields in pounds per acre were as follows:

	Green	Dry	Digestible. Nutrients	Protein	Carbo-hydrates	Ether Extract
Plot 14	-37240-	8677-	5476	249	5061	166
Plot 14"	-36853-	7606-	4836	219	4471	146
Average-	37046-	8171-	5156	234	4766	156

Table Showing the Average Yields in Pounds Per Acre of the Duplicate Plots.

Name of Plant	" Green " Weight	" Dry "Weight	"Digest-ible nutri-ents	"Digest-ible pro-tein	Digest-ible carbo-hydrates	"Digest-ible "Ether Extract
Amber cane	" 37046	"8171	"5156	"234	"4766	"156
Rowe Co.,Dent Corn	" 33805	"6024	"5054	"330	"4586	"158
German Millet	" 19740	"7475	"4784	"374	"4301	"109
Stowell's Evergreen Sweet-corn	"25917	"7076	"5095	"390	"4506	"100
Japanese Millet	" 19316	"6972	"4462	"349	"4011	"102
Vetches and oats	" 16539	"6773	"4031	"466	"3386	"179
Peas and oats	" 17712	"6322	"3597	"711	"2807	" 79
Hungarian millet	" 11737	"6021	"3853	"302	"3464	" 87
Kaffir corn	" 23861	"5982	"3774	"172	"3483	"119
Common millet	" 12804	"5595	"3581	"280	"3220	" 81
Jerusalem corn	" 15693	"5564	"3510	"159	"3245	"106
Hog Millet	" 8536	"4839	"3097	"239	"2765	" 73
Soy Beans	" 17421	"4484	"2645	"576	"1979	" 90
Dwarf VictoriaRape	"37287	"4273	"2992	"458	"2473	" 61
Dwarf Essex Rape, (1 cut)	" 35788	"4103	"2872	"440	"2374	" 58
Vetches	" 16111	"3786	"2183	"439	"1642	" 52
Dwarf Essex Rape, (2 cuts)	" 32577	"2927	"2049	"313	"1693	" 43

In compiling the preceding table the various crops were arranged in order of the greatest production of dry matter per acre. The amount of digestible matter was computed from the dry matter by use of the table of digestible nutrients in Henry's Feeds and Feeding, assuming the crops to have been harvested at the proper time and to be in an average condition of digestibility.

In computing the digestible matter for Amber cane, Jerusalem corn, and kaffir corn, the proportions of digestible nutrients given for sorghum under "fresh grass" were used; in computing for Stowell's Evergreen Sweet-corn and vetches the digestible nutrients were computed from the tables of Average Composition, on average digestibility; for dent corn, the table for fodder corn (field cured); for all the millets, the table for Hungarian hay; for soy beans, the table for soy beans under "fresh legumes"; for all the rapes, the table for rape under "miscellaneous;" and for peas and oats, the table for peas and oats under "fresh grass." The figures given are the average of the two plots for each forage except in case of the millets, for which the figures represent only the last plot cut.

In drawing conclusions from the table the following points should be taken into consideration.

1. As to the accuracy of the figures in representing the fodder producing capacity of the different plants; the yield of vetches might have been nearly doubled by making a second cutting; the soy beans used were a dwarf variety and not intended for the production of a great bulk of forage; the figures for the several millets are from single plots, hence may have been affected greatly by slight variations in the soil.

2. The green weights given mean nothing as to the comparative yields of the various forage plants, as some were very green and sappy when cut, while others were quite dry.

3. With the exception of dent corn, German millet, peas and oats, and soy beans the plants stand in the same order in the production of total digestible nutrients as in thedry yield per acre.

4. The yield of dry matter or digestible nutrients does not alone determine the desirability of the forage, but is simply one factor in the problem, and is the one that this experiment aimed to show. Other factors equally important are: purpose to which grown, its season of growth, its effect upon the land, cost of production, and special circumstances, but it is not the aim of this investigation to consider these factors.

From the foregoing tables, together with

observations of the growing crops, the following conclusions were reached:

1. In dry weather or dry soils the sorghum (Amber cane, Jerusalem corn, and Kaffir corn) will give the best returns for fall or early winter feeding.

2. Under ordinary conditions fodder corn will give the best returns is a great amount of winter fodder is desired.

3. Peas and oats will give the most satisfactory results if the fodder is fed largely without supplementary feed. They have a good effect on the land, and make the best balanced ration of any of the fodders grown.

4. The millets are a good catch crop. The German millet will give best results with a fairly long and moist period of growth.

5. The rapes make a good succulent summer forage but are greatly excelled in production by other plants. There is no practical difference between Dwarf Essex and Dwarf Victoria rape. The rapes have a relatively higher amount of protein.

6. That vetches and soy beans should be given a fair trial before anything be said about them.

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