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FARM DEPARTMENT.

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Crop Experiments in 1903.

THE Station farm and the rented lands which were used in making the crop experiments in 1903 are located on the foot-hills just west of Manhattan, and bordering the valley of the Kansas river. The fields are in general sloping and inclined to wash. The soil is rather a fine-grained, compact, light-colored loam, not very fertile and not very uniform. Last season, as a rule, the experiments were not carried on in duplicate, but the plots were arranged in parallel series, usually extending with the slope of the field, so that the soil and conditions were as nearly alike for each series of plots as it was possible to have them. In a large series of plots, as in the trial of corn varieties, the same variety was planted in two different portions of the field, as a check.

The fall of 1902 was unusually wet, and the winter proved to be more or less open. A good rain (0.75 of an inch), February 27, was all absorbed by the soil, showing that little frost remained, but the ground continued too wet to work until March 13, when a plow was started on Kafir-corn ground, in preparing for the early seeding of grasses, and a field of unplowed soy-bean ground was disked, in preparation for the seeding of early grains. Some varieties of grasses were sown as early as March 18, on fall-plowed land, which was prepared by harrowing; but the weather remaining cold and wet, no

grain was sown until March 30, when the varieties of spring wheat, barley and oats were planted. The soil and weather conditions remained favorable for seeding and planting during the whole of April, but during May excessive rains and floods occurred, and little work was done in the fields between the dates of May 5 and June 8. All crops had been planted in their season, however, before the rains began, and on June 8 only those crops which are usually planted late, such as Kafir-corn, sorghum, soy beans, and cowpeas, remained to be planted. Because of the peculiar character of the season, it was considered essential to undertake some experiments in the late planting of corn and forage crops.

All together, some 240 acres, divided into 360 separate plots, ranging from one-tenth acre to five acres in area, were devoted to the various lines of experimental work in crop-production last season, In spite of the unfavorable spring weather, nearly all crops produced well and the experiments were fairly successful. A condensed weather and crop report, giving the tri-monthly averages of temperature, rainfall, etc., together with the soil and crop conditions, is given in table I.

VARIETIES OF SPRING WHEAT.

Since the professor in charge of the Farm Department did not begin work until December 1, 1902, no trial of fall-wheat varieties was undertaken. Eleven varieties of spring wheat, including the several different types, fife, blue stem, bearded, and macaroni, were planted March 30, on land which had grown soy beans in 1902 and cowpeas in 1901. The land had been well cultivated the year previous and proved to be exceptionally free from weeds. The land was not plowed for wheat, but was disked March 13 and 14 and Acme-harrowed March 30, just before the wheat was sown. The Acme harrow left the soil in excellent condition for seeding.

The wheat was sown with a McSherry single disk-drill, in drill rows eight inches apart. A plot consisted of one drill width, six feet and eight inches wide, extending the entire length of the field, 647 feet, giving an area of a little less than one-tenth acre. Alleys sixteen inches wide were left between the drill widths. These served as a division between the plots, so that the varieties were easily kept separate in harvesting. The seed was sown at the rate of one and one-half bushels per acre, and no cultivation was given after sowing.

On April 11 it was observed that the wheat was up well and showed a good stand on all plots. The early growth of the grain was very satisfactory. The wheat was not injured by chinch-bugs, but all of the varieties rusted some, and all except the macaroni wheat were badly injured by Hessian fly. It was noted that the macaroni wheat

TABLE I.—Trimonthly and monthly weather and crop report, March 1 to November 1, 1903.

Month—Days, 1903.	Average temperature.			Weather.*				Rainfall, in inches.	Condition of soil.	Progress of the work and condition of crops.
	Maximum.	Minimum.	Mean.	Clear days.	Part cloudy.	Cloudy	Prevailing winds.			
March 1-10	50.0	29.0	39.5	4	2	4	S. W. and N. W.	.30	Wet	Cold and wet; soil not workable.
" 11-20	64.0	36.0	50.0	1	6	3	N. W. and S. E.	.50	Favorable.	Began plowing and other spring work.
" 21-31	61.0	29.0	45.0	7	4	0	S. W. and N. E.	.50	"	Sowed varieties of early grain.
Monthly totals and aver.	58.4	31.2	44.8	12	12	7	S. W. and N. W.	1.30	"	[of month. Spring bkwd., but favorable for sowing at close
April 1-10	74.0	41.0	57.5	6	3	1	S. W. and N. W.	.75	Favorable.	Plowing for corn.
" 11-20	79.0	44.0	61.5	4	5	1	N. W. and S. E.	1.10	"	Plowing for corn; preparing seed-bed.
" 21-30	72.0	42.0	57.0	6	1	3	N. and S.	1.20	"	Commenced planting corn.
Monthly totals and aver.	75.0	42.3	58.6	16	9	5	N. W. and S. W.	3.05	"	Early crops growing well.
May 1-10	82.0	45.0	63.5	4	5	1	S. E. and S. W.	.85	Favorable.	Finished planting early corn.
" 11-20	78.0	56.0	67.0	3	2	5	S. and S. W.	2.75	Wet & fav.	Harrowed corn; soil mostly too wet to work.
" 21-31	83.0	60.0	71.5	1	2	8	S. and S. W.	9.37	Wet	Too wet to cultivate; crops backward, weedy.
Monthly totals and aver.	81.0	53.8	67.6	8	9	14	S. and S. W.	12.97	"	Crops inj. by floods, excess. moist. Soil comp'ct.
June 1-10	77.0	55.0	66.0	6	2	2	N. W. and N.	.39	Wet & fav.	Corn cultivated.
" 11-20	55.0	54.0	69.5	6	4	0	N., S., W.	.02	Favorable.	Late crops planted.
" 21-30	88.0	60.0	74.0	7	3	0	S. W. and N. W.	1.10	"	All crops cultivated; small grains ripening.
Monthly totals and aver.	73.8	56.4	69.9	19	9	2	N. W. and N.	1.51	"	Cultiv. crops grow'g well; grain crop pr m'g.
July 1-10	95.0	67.0	81.0	5	4	1	S. W. and S. E.	.65	Favorable.	Harvested varieties of small grain.
" 11-20	94.0	67.0	80.5	3	4	3	N. E. and E.	1.67	"	Cultivated late crops.
" 21-31	92.0	66.0	79.0	5	5	1	S. and E.	1.48	Dry.	Thrashed varieties of grain.
Monthly totals and aver.	93.6	66.6	80.1	13	13	5	S., S. E., S. W.	3.80	Favorable.	Late crops growing well; corn promising crop.
August 1-10	91.0	66.0	78.5	4	6	0	S. and S. W.	3.72	Favorable.	Plowing for fall seeding; cultivating.
" 11-20	87.0	62.0	74.5	7	3	0	E. and S. E.	2.45	Wet & fav.	Plowing for fall seeding; cultivating.
" 21-31	82.0	64.0	73.0	9	2	0	S. W. and N.	.00	Favorable.	Hauled manure; pulled and cut weeds.
Monthly totals and aver.	86.5	64.0	74.9	20	11	0	S. W., S., S. E.	6.17	"	Crops look well; weeds made great growth.
September 1-10	89.0	60.0	74.5	5	4	1	S.	.96	Dry.	Harvested silage corn; too dry to plow.
" 11-20	78.0	52.0	65.0	6	3	1	N. and S. W.	.97	Favorable.	Harvested corn and soy beans.
" 21-30	80.0	53.0	66.5	5	4	1	S. W. and N.	1.05	Dry.	Harvested cane and Kafir-corn.
Monthly totals and aver.	82.3	55.0	68.6	16	11	3	N., S. W., S.	2.98	"	Good yld. forage crops; corn cut and in shock.
October 1-10	77.0	51.0	64.0	7	3	0	N.	.05	Favorable.	Sowed varieties of winter wheat.
" 11-20	67.0	37.0	52.0	5	2	3	N. and N. E.	2.25	Wet	Harvested cowpeas, late corn, etc.
" 21-31	69.0	39.0	54.0	9	0	2	S. W.	1.60	Favorable.	Thrashed soy beans.
Monthly totals and aver.	70.9	42.0	56.5	21	5	5	N. and S. W.	3.90	"	Harvest finished.
Totals and averages for season	77.7	53.1	65.1	125	79	41		35.68		A favorable season, except in May, and good average crops.

*Light frost, April 22 and May 3, September 17, 24, 28, and October 8; killing frost, April 30, May 1 and 2, October 15, 16, 18, 23, and 24.

was beginning to head April 12, and that it was well headed April 20. The other varieties were "just heading" on June 26, except the Preston, which was "fully headed" at that date.

The macaroni wheat headed well and made a fine appearance. The other varieties did not develop good heads and all varieties failed to fill well, so that the grain was shrunken and light. The macaroni wheat filled best, producing the heaviest grain and the largest yield. The failure to mature a good crop was probably due largely to the hot weather during the first part of July and to the hot winds July 7, 8, and 9, which, although they did not damage corn and cultivated crops, were yet severe enough to blight wheat and injure other immature grains. The macaroni and Preston wheats were ripe and harvested July 14. The other varieties were harvested July 18. The grain was thrashed from the shock July 24. Table II gives some of the data secured.

Under "Type," in table 11, A=awnless; B=bearded or with awns; S=smooth chaff; and V=velvet chaff. The "Weight per bushel" and the "Grade" were taken after the wheat was cleaned with the fanning-mill. The yield was determined by weighing the grain from each plot as it came from the separator. The straw was not weighed, but the "Average height at maturity," as given in the table, will allow some comparison of the growth and yield of straw by the several varieties. The results of the trial favor the macaroni varieties, but even this wheat failed to produce a profitable crop. It appears from the experiments at this Station, and it is the experience of farmers, that the common spring wheats cannot usually be grown successfully in this state. Doubtless, as a few trials have shown, macaroni wheat may succeed well in the western and northwestern counties of the state. (A good crop was produced at the Fort Hays Branch Station in 1903.) In Oklahoma and Texas, macaroni wheat has been grown to some extent as a fall wheat, and a few trials in fall seeding have been made in this state; as a rule, however, the wheat has winter-killed when planted in the fall. In order to test it as a winter wheat, and also with the purpose of developing a hardy winter variety, several varieties of macaroni wheat were seeded last fall at this Station. At the present time there are no real winter varieties of macaroni wheat.

VARIETIES OF BARLEY.

Twelve varieties of barley were planted in the field trial of 1903. These included one or more varieties of each of the common types, and the seed was secured from different states and climates. The seed secured from F. Barteldes & Co. was Kansas-grown. The Farmer Seed Company is located at Faribault, Minn.; the Ham-

TABLE II.—Varieties of spring wheat.

Bulletin No.	Name.	Type.	Where from.	Days to mature.	Stools, average No. per plant.	Average height at maturity.	Rust resistance.	Smut resistance.	Weight per bushel.	Grade.	Hard wheat.	Yield of grain per acre.
						inches.	*per cent.*	*per cent.*	*pounds.*		*per cent.*	*bushels.*
1.....	Minnesota 163.....	A. S...	Minnesota Exp. Sta.....	110	6.5	42	88	89	56.0	No. 2 N	90	9.6
2.....	Minnesota 183.....	A. S...	" "	109	4.5	42	89	99	59.5	"	90	8.1
3	Minnesota 285.....	A. S...	North Dakota Exp. Sta...	112	4.0	42	90	99	57.5	"	85	9.6
4.....	Pillsbury Fife.....	A. S...	F. Barteldes & Co.....	110	4.5	42	89	99	58.0	"	85	8.1
5.....	Defiance	A. S...	North Dakota Exp. Sta...	112	3.0	40	90	97	56.0	Rejected.	50	4.0
6.....	Velvet Chaff	A. V...	F. Barteldes & Co.....	110	4.0	41	88	96	53.0	No. 3 N.	85	6.6
7.....	Haynes's Blue-stem.....	A. V...	North Dakota Exp. Sta ...	112	4.0	40	89	95	55.0	"	80	7.0
8	Grant	B. S...	F. Barteldes & Co.....	110	4.5	40	90	94	60.0	No. 2 N.	70	6.2
9.....	Preston.....	B. S...	North Dakota Exp. Sta...	106	3.0	42	90	99	57.5	No. 3 N.	85	7.0
10.....	Gharnovka (macaroni)..	B. S...	" " ...	106	4.0	50	90	99	62.0	No. 2.	90	13.3
11	Velvet Don (macaroni)..	B. V...	" " ...	106	4.0	50	90	99	62.0	"	85	12.0

mond Seed Company, at Bay City, Mich.; and the North Dakota Experiment Station, at Fargo, N. Dak.

The varieties of barley were planted in the same field and adjoining the spring wheat. The seed-bed was prepared and the seed sown in the same manner as already described for wheat, Varieties Nos. 6, 9, and 12, as given in table III, were sown April 7; the others were seeded March 30, the same date the wheat was sown. The grain was seeded at the rate of seven pecks per acre. The first barley sown was coming up on April 11, and on April 15 this grain stood three inches high, varying slightly on the different plots, while the barley sown April 7 was just coming up. The grain made a rapid growth. On June 12 the following varieties were well headed: Nos. 1, 2, 3, 5, 7, 8, 9, 10, and 11; No. 6 was partly headed; No. 12 was just beginning to head, and No. 4 showed no sign of heading. The last-named variety was headed June 20. Little or no damage occurred from rust. Most of the varieties were ripe and harvested before the hot winds of July 8 and 9, and the varieties not harvested at that date seemed to be sufficiently mature so that the grain received little injury, and barley proved to be a good crop. Harvest was begun June 30 and completed July 12. The grain was thrashed from the shock July 24. The results of the trial are given in table III.

Under "Type," in table III, B=bearded; A=awnless or without beards; and H=hull-less. It will be observed that the Common, Bonanza, Mandscheuri and Success Beardless varieties were the best producing sorts. The six-rowed bearded barleys easily ranked first in yield and quality of grain, the Success Beardless giving a lighter grain, of poorer quality, while the hull-less varieties in every case were comparatively poor yielders. All yields were calculated at forty-eight pounds per bushel, so that the yields given are comparable, although, as the results show, the hull-less varieties weighed much heavier per measured bushel than the common type.

From the above trial, it would appear that the locality or climate from which the original seed came was not a deciding factor in production. While the seed of the Common barley was Kansas-grown, that of the best producing Mandscheuri came from North Dakota, the Bonanza came from Michigan, and the Success Beardless from Minnesota. The six-rowed bearded varieties are very much alike in appearance. Doubtless they are all closely related to the Mandscheuri or the Mansury barley, which is the standard six-rowed barley of the Northern and Northwestern states. There is no reason why barley may not be profitably grown throughout the greater portion of Kansas, Usually the early maturing strains are to be preferred, and home-grown seed is likely preferable to imported seed when a good quality of seed of the right variety can be obtained.

TABLE III.—Varieties of barley.

Bulletin No....	Name.	Type.	Where from.	Days to mature.	Stools, average number per plant.	Average height at maturity.	Rust resistance.	Smut resistance.	Color of grain.	Weight per bushel.	Grade.	Yield of grain per acre.
						inches.	*per ct.*	*per ct.*		*pounds.*		*bus.*
1	Mansury	B. 6-rowed ...	F. Barteldes & Co..	96	5.5	46	98	96	White, colored a little,	47.0	Good	29.5
2	Mandscheuri,	" ...	N. D. Exp. Sta.....	97	6.5	50	98	99	" "	46.5	"	32.0
3	"	" ...	Farmer Seed Co ...	100	5.5	48	97	100	White	46.5	"	31.5
4	2-rowed Mandscheuri,	B. 2-rowed ...	N. D. Exp. Sta.....	104	5.5	40	97	100	Bright white.....	47.0	Very good,	28.0
5	Common	B. 6-rowed ...	F. Barteldes & Co..	102	6.5	34	96	100	Light bronze.....	45.5	Good	33.9
6	Bonanza.....	"	Hammond Seed Co.	90	4.0	40	95	98	White, slightly colored,	49.0	Very good,	33.0
7	Black.....	B. H. 6-rowed,	Farmer Seed Co ...	93	6.5	32	96	100	Purple	64.0	"	22.0
8	Success Beardless ..	A. 6-rowed ...	" " ...	96	4.0	46	95	100	Dark bronze	43.5	Medium...	31.0
9	Success Beardless ..	" ...	Hammond Seed Co.	84	4.0	28	90	95	"	48.0	Good	24.4
10	White Hull-less....	A. H. 6-rowed,	F. Barteldes & Co..	96	4.5	30	94	90	Light amber.....	59.5	"	17.9
11	McEwan's Hull-less....	B. H. 2-rowed,	N. D. Exp. Sta.....	98	4.5	28	95	97	"	61.5	Very good,	15.0
12	Hammond's Colossal....	A. H. 2-rowed,	Hammond Seed Co.	92	8.5	24	95	96	"	61.0	Good	13.0

VARIETIES OF OATS.

Twenty varieties of oats were planted in the comparative trial in 1903. The oats were planted next to the varieties of barley, and the description of the soil, preparation of seed-bed and method of seeding given under "Varieties of Spring Wheat" applies also to oats, as well as to barley and wheat. About two bushels of oats were seeded per acre. The first thirteen varieties, as given in table IV, were sown March 30; the remaining varieties were seeded April 6. All the oats were harrowed once after seeding, a few days before the grain came up. The oats germinated quickly and made a vigorous early growth. On June 12, varieties Nos. 1 and 8 were well headed, and Nos. 10, 11, 12, 13 and 14 were beginning to head. The later varieties, Nos. 3, 4, 5, and 20, were headed June 20, at which date it was observed that the oats were free from rust and in a healthy, growing condition. On June 26 the Sixty Day oats were beginning to ripen, while the Tartarian and Black Tartarian varieties were not yet fully headed. The first-named variety was ripe and harvested July 4, before the hot winds. The Kherson oats were cut July 6. All other varieties were later in maturing and were more or less injured by the hot weather. The latest-maturing sorts were severely damaged, resulting in very light oats and a greatly reduced yield. The grain was thrashed from the shock July 24. Table IV gives the results of the trial, with a brief description of each variety.

The result of the trial favors the Sixty Day oats as being easily ahead of all other varieties in yield, in smut- and rust-resistance, and in the quality of the grain produced. The Black Beauty variety yielded next to the Sixty Day oats, but the grain was light and inferior in quality. The Kherson oats ranked third in yield and second in quality of grain. The Red Texas oats produced better than most of the other varieties, No. 12 ranking fourth in yield. It will be observed that this type of oats rusted worse than the other varieties, although it has the reputation of being "rust-proof." The seed of the Sixty Day oats which yielded so well last season was secured from the North Dakota Experiment Station, as given in table IV, but the original seed of this variety came from Russia, and was introduced by M. A. Carleton, cerealist of the United States Department of Agriculture. It is a hardy variety, and has proved to be an excellent yielder in several of the Northwestern states. The Kherson oats were also originally imported from Russia, by Prof. N. S. Hansen, of the South Dakota Experiment Station. This variety is ranked as one of the best producers in South Dakota and Nebraska. One of the most valuable qualities of these two varieties of oats is their earliness, by

TABLE IV.—Varieties of oats.

Bulletin No.	Name.	Where from.	Days to mature.	Average height at maturity.	Length of heads.	Rust resistance.	Smut resistance.	Color of grain.	Shape of berry.	Size of berry.	Weight per bushel.	Grade.	Yield of grain per acre.
				in.	*in.*	*per ct.*	*per ct.*				*lbs.*		*bus.*
1	Sixty Day	N. Dak. Exp. Station	96	37	5.5	99	100.0	Light yellow	Medium	Small	32.0	Good	53.5
2	Archangel	" " "	101	42	7.0	89	90.0	White	Short	"	22.5	"	19.0
3	Minnesota 202	" " "	106	47	10.0	88	95.0	"	Medium	Medium	21.5	Medium	27.7
4	Siberian White	" " "	105	48	11.0	94	94.0	"	Long	Large	20.5	"	26.9
5	Tartarian	" " "	111	42	10.0	95	90.0	Greenish white	"	Medium	25.5	"	29.9
6	Black Beauty	" " "	101	42	11.0	88	75.0	Brown	Medium	Small	22.0	"	52.1
7	Calgary Gray	F. Barteldes & Co.	101	42	6.0	90	65.0	Gray or brown	Long	"	21.5	"	23.0
8	Kherson	Nebraska Exp. Station	97	43	6.0	90	99.5	White (tinged)	"	"	30.5	Good	46.7
9	Canadian Giant	Farmer Seed Company	100	45	8.5	88	96.0	White	Short	Large	21.0	Medium	20.3
10	Red Texas	F. Barteldes & Co.	101	40	9.0	85	96.0	Reddish tinge	Long	"	27.5	Good	37.9
11	"	Fielding & Sons	101	49	9.0	85	96.0	White	"	"	22.0	Medium	33.4
12	"	Trumbull & Co.	101	45	9.0	85	96.0	Reddish tinge	"	"	24.0	Good	43.0
13	"	"	101	43	9.25	90	97.0	Slight reddish tinge	"	"	23.0	Medium	31.5
14	Early Champion	Iowa Seed Company	94	42	7.0	96	99.0	White	Medium	Small	29.5	Good	32.2
15	Silvermine	" " "	94	48	11.0	99	100.0	"	Long	Large	22.5	Medium	28.0
16	Michigan Wonder	Hammond Seed Co.	99	46	12.5	92	91.0	"	"	Medium	23.5	"	24.8
17	English Wonder	" "	98	45	7.5	92	92.0	Bright white	"	Large	21.5	"	23.7
18	Morgan-Feller	" "	99	44	6.0	93	80.0	White	Short	"	21.5	"	23.2
19	Czar of Russia	" "	99	33	6.0	90	78.0	"	"	"	22.0	"	21.8
20	Black Tartarian	Iowa Seed Company	113	33	9.0	90	96.0	Brown	Medium	Medium	22.0	"	25.8

which they may escape the hot weather which is so apt to injure the later-maturing oats.

The source of the seed, so far as comparisons can be made in the above trial, does not seem to have had much effect on the yield or quality of the oats. It appears that early maturing varieties of oats are to be preferred to later-maturing sorts, and that early sowing is an important factor in making the crop safe. Varieties Nos. 14 and 15. required less "Days to mature," as noted in table IV, than No. 1, the Sixty Day oats; yet because they were planted six days later than No. 1, these oats failed to mature early enough to escape the unfavorable weather conditions. Oats are even more susceptible to injury from hot weather than barley or wheat; hence the crop should be seeded as early in spring as the soil is in fit condition; and in order to prepare an early seed-bed and have the soil well settled and in good tilth, the ground should be fall-plowed for oats.

EMMER.

Emmer, also called "speltz," was first introduced into the Northwestern states from Europe by German-Russian settlers. During the last few years also the United States Department of Agriculture has imported and distributed a large amount of the best seed of this new grain. Emmer has not been grown so extensively in Kansas as it has in the states farther north, but enough trial has been made to show that it may be grown successfully throughout the central and western portions of this state. The grain is better adapted for growing in a dry climate than barley or oats, and in the Dakotas, where it has been grown most extensively, it has proved to be a surer crop than barley or oats and a larger producer of grain.

Two samples of emmer were planted at this Station last season. No. 1 came from F. Barteldes & Co., and No. 2 from the North Dakota Experiment Station. These varieties were planted March 30, on land and under conditions previously described for the other grain crops. By an error, about two and one-half bushels of No. 1 was seeded per acre and only one bushel of No. 2. This made the trial unequal so far as a comparative test of varieties was concerned. (It is usual to sow about two bushels of emmer per acre. The drill should be set to sow about two and one-half bushels of barley per acre in order to sow the required amount of emmer.) The grain came up nicely and grew well throughout the season. The crop was later in maturing than oats or barley; heads were just beginning to show June 26, and the grain was not ready to harvest until July 18, requiring 110 days to mature. The crop was not attacked by rust or smut, but was doubtless injured by the hot weather early in July, which checked the growth of the grain, causing a lighter berry and a

less yield than might otherwise have been produced. The height at maturity averaged forty-four inches. The straw was clean and bright and stood up well. The heads were plump and well filled, averaging about three inches in length. The grain was thrashed from the shock July 24, and the yields were determined as follows: No. 1 yielded 1756 pounds per acre, which tested thirty-five pounds per measured bushel; No. 2, 1472 pounds per acre, which weighed thirty-three and one-half pounds per measured bushel. In South Dakota forty-five pounds has been adopted as the standard weight of emmer per bushel; thus emmer No. 1 yielded thirty-nine bushels per acre. The best yield of oats last season, as noted in table IV, was 53.7 bushels, or 1712 pounds, per acre, while the largest yield of barley (see table III) was 33.9 bushels, or 1627 pounds, per acre. Emmer gave forty-four pounds more grain per acre than oats, and 129 pounds more than barley, in a season not especially favorable to the production of emmer, nor yet unfavorable to the production of oats or barley.

In appearance, growing emmer resembles two-rowed barley, the heads being bearded and having two rows of grains. The grain also resembles barley, the hull being usually retained when the grain is thrashed. If the hull is removed, two hard, flinty kernels are found, which very much resemble rye or macaroni wheat. Emmer is botanically a species of wheat, and the chemical analysis of the hulled grain shows a composition much like that of wheat. The analysis of the natural grain in the hull, however, makes the grain more like barley in the relative amount of the food constituents which it contains. There is little feeding value in the hulls, which constitute about twenty per cent. by weight of the total unhulled grain, but the hulls serve to dilute the rich grain and add coarseness to the feed. Experiments at the South Dakota and other experiment stations have shown that emmer is not usually relished by stock when fed whole, and that the grain is not equal to barley, oats or corn as a flesh former, when fed alone. The grain is best fed ground and in combination with other grains. Emmer will hardly take the place of barley or oats as a feed, but the crop should be grown along with other grain crops, especially in those parts of the state where barley, oats or corn may fail to produce profitable crops on account of drought or hot winds.

FLAX.

Three varieties of flax were seeded April 17, in the same field in which the variety trials of grains were made. About three pecks of seed was sown per acre with the disk grain-drill, in drill rows eight inches apart. The flax came up nicely and made a very satisfactory growth, blooming freely and producing many bolls, which, however,

failed to produce perfect seed. The yield was small and the flax was very poor in quality.

No. 1, Common flax, from F. Barteldes & Co., required eighty-seven days to mature, stood twenty-seven inches high, and yielded 4.6 bushels per acre. No. 2, Russian flax, from the North Dakota Experiment Station, required ninety-seven days to mature, measured twenty-eight inches in height, and yielded 4.7 bushels per acre. No. 3, Rega Fiber flax, from the North Dakota Experiment Station, made a rank growth of straw and appeared to be matured ninety-three days after planting, when it was harvested, but on thrashing, the seed was so light that it could not be saved, and the whole crop went into the straw-stack. In another field a plot (one-half acre) of Common flax yielded 10.3 bushels per acre. This land had previously been in alfalfa for three years, and the field was bordered on the south by a grove, which doubtless reduced the injurious effect of the hot southwest winds. Apparently the flax crop was injured by the hot, dry weather early in July, although this was not so evident at harvest time as it was later, when the flax was thrashed.

Flax is grown quite extensively and with fair success in the southeastern part of this state. There the practice seems to be to sow early, and thus mature the crop before the hot, dry weather. Flax ought to grow successfully throughout the greater portion of this state. It is one of the most valuable crops of the Northwest, and experiments in North Dakota indicate that it is not a hard crop on the land, as was formerly supposed, provided it is grown properly, in rotation with other crops. Many experiments need to be macle in Kansas, in order to determine the best variety to grow, the relation of flax to other crops, the proper time to sow, and the best methods of culture.

MILLET.

Twenty-four varieties of millet were planted in 1903. Twenty of these were sown May 16. The millet was grown in the same field as has already been described in discussing the experiments with grain. The soil was wet when the millet was sown, and became wetter and very hard and compact after seeding. Much of the millet failed to get out of the ground, while many of the young plants were destroyed as soon as the weather changed and the hot sun began to dry and bake the ground. The only varieties which withstood the unfavorable weather and soil conditions, so that they were considered worthy of trial, were No. 1, Common; No. 2, Hungarian; No. 3, German; and No. 4, Siberian. These varieties were from Kansas-grown seed, as given in table V. Three other varieties, which were received from the United States Department of Agriculture and sown in small

quantities, also survived the unfavorable conditions, but are not reported in table V. The rest of the millet was practically destroyed or made so poor a stand that it was disked up June 12, preparatory to reseeding. The seed of several of the varieties which failed to grow was received from the United States Department of Agriculture. Other varieties were duplicates in name with Nos. 1, 2, 3, and 4, but the seed came from Northern or Eastern seedsmen.

Twenty-two varieties were seeded on June **12,** but many of them in small quantities, because of the lack of seed. Many of the small plots produced sufficient seed so that the test can be carried on next season, and it was thought advisable in this report to give the yields of only those varieties which were grown in plots of regular size (about one-tenth acre in area). Part of each variety was cut for hay, and part was allowed to mature and was harvested for seed. Table V gives the results of the trial.

The exact date of maturing was not recorded for each variety. It was observed that Nos. 1 and 2 matured in eighty-four days, while No. 3 required ninety-three days to fully ripen seed. The later-planted millet required a less number of days to mature than that planted earlier in the season. German millet gave the largest yield of fodder and seed in both the early and the late seedings. No. 7, the late-seeded German millet, gave the largest yield of fodder. Nos. 2 and 4, given in the table as sown May 16, were also sown in the second seeding, June 12, but yielded less hay and less seed than from the early seeding. In the production of seed, the Siberian millet ranked second and the Hungarian third. The Steel Trust millet is really a strain of the Siberian type. Compared with the Siberian, the Hungarian variety gave slightly the larger yield of hay. Japanese barn-yard millet made a very poor crop, while Nos. 9 and 10, the broom-corn millets, failed to make enough growth to be worth cutting, No. 10 was also sown May 16, and part of the plot was not disked up June 12, yet that variety made no better growth from the early seeding than from the late seeding. Last season was either unfavorable to the growing of broom-corn millet or else this type of millet is not adapted to this climate and soil. This experiment will be continued next season.

VARIETIES OF SOY BEANS.

The variety trial of soy beans was conducted in the same field as the variety trial of grains. The condition of soil, preparation for planting, etc., were the same as already described for wheat, except that after the wheat was sown, and previous to planting the beans, the soy-bean ground was harrowed twice with the smoothing-harrow, three times with the Acme harrow, and once with the disk-harrow,

TABLE V.—Varieties of millet.

Bulletin No.	Name.	Where from.	Type.	Date planted.	Height at maturity.	Yield per acre.		Weight per bushel.	Color of seed.
						Hay.	Seed.		
					inches.	*pounds.*	*bushels.*	*pounds.*	
1	Common	F. Barteldes & Co.	Foxtail	May 16	36	4,180	8.1	55.5	Light yellow.
2	Hungarian	" "	"	"	36	5,180	13.1	49.25	Green and black.
3	German	" "	"	"	40	5,800	25.2	55.5	Light yellow.
4	New Siberian	" "	"	"	34	4,720	15.0	50.0	Light red.
5	Steel Trust	Hammond Seed Co.	"	June 12	31	4,740	13.0	47.5	" "
*6	Siberian	Fielding & Son	"	"	36	4,180	11.3	49.0	" "
*7	German	" "	"	"	40	7,260	21.0	49.0	" yellow.
8	Japanese Barn-yard	Farmer Seed Co.	Cock's-foot	"	18	2,600	6.1	31.0	" brown.
9	Hog or Broom-corn	F. Barteldes & Co.	Broom-corn	"	6	Very poor; no yield taken.			
10	Orenburg Broom-corn	U. S. Dept. Agr.	"	"	6	" " "			

*These varieties were not planted May 16. The other varieties were planted at the early date, and Nos. 5 and 10 made a fair stand, but were disked up and reseeded June 12. The early seeding of Nos. 8 and 9 was a total failure.

lapping half. The soy beans were planted June 15, at which time the soil was in good condition, being free from weeds and finely pulverized at the surface.

The beans were planted with the disk-drill, in rows thirty-two inches apart, the size of the plots being 0.067 acre. The drill was set to sow one and one-half bushels of wheat per acre. The soil and weather conditions after planting were favorable, and most of the varieties made a satisfactory growth throughout the season. The crop was harvested either with the bean-harvester or by hand. The more important data secured in this trial are given in table VI.

As mill be noticed from the above table, the yield of beans varied from nothing (Nos. 24 and 25) to 15.8 bushels per acre (No. 20) while the average yield per acre for the twenty-six varieties was 8.45 bushels. The Ito San and Early Yellow varieties, which are the same or very closely related, made by far the highest yields, averaging 12.06 bushels per acre, as compared with 6.54 bushels per acre for the remainder of the varieties. The six best producers of these promising varieties made an average yield of 15.13 bushels per acre. The yield of beans, as given in table VI, does not indicate the actual amount of beans produced, but rather the amount thrashed. A few of the varieties shelled very badly, so that, although it was attempted to harvest the beans as soon as they were mature, some of the varieties lost a considerable per cent of the beans produced, either before harvest, or during harvesting time, or while curing in piles after harvest. The number of pods and the per cent. of non-dehiscence (dehiscence means the splitting of the pods to discharge the beans), given in table VI, show which varieties lost the most by shelling. For instance, Nos. 5, 8, 10, 12 and 14 are reported as growing a large number of pods, but as having a small per cent. of non-dehiscence and a small yield, indicating that these varieties would be fairly good producers if they could be bred or improved so as to retain the beans. The early maturing and the late varieties yielded about the same last season, but it is probable that the early varieties should generally be given the preference. It is at least desirable that the crop should mature sufficiently early to insure against injury by frost.

The yield of fodder was not determined, as most of the leaves had fallen by the time the beans were mature. The "Average height" (August 24) of the different varieties, as given in the table, is an indication of the relative amount of fodder produced by each.

VARIETIES OF COWPEAS.

The field in which the variety trial of cowpeas was conducted is a fairly uniform field with western slope, which was purchased by the College in the spring of 1903. Kafir-corn was grown on the field in

TABLE VI.—Varieties of soy beans.

Bulletin No.	Name.	Where from.	Days to mature.	Average height.	Number of pods.	Non-delis-cence.	Yield of beans per acre.
				inches.		*per cent.*	*bushels.*
1	Green	College farm	107	22	Large	80	10.20
2	Early Yellow	"	89	22½	"	95	14.80
3	Ito San	Evans Seed Company	89	21	"	95	14.56
4	Medium Green	"	107	25	Medium	20	3.60
5	Olive Medium	"	95	12	Large	25	7.06
6	Ogema	"	82	12	Medium	15	2.46
7	Early Brown	"	89	22½	Large	92	13.73
8	Medium Green	H. N. Hammond & Co.	107	25	"	12	4.50
9	Ito San	"	89	18	"	96	15.70
10	Extra Early Black	"	95	14	"	20	4.43
11	Ito San, U. S. No. 1313	U. S. Dept. of Agr.	107	18	"	88	14.80
12	Medium Green, U. S. No. 1312–1	" "	107	24	"	50	7.50
13	Yellow, U. S. No. 1308–1	" "	115	26	"	94	15.10
14	Medium Early Green, U. S. No. 1306–1	" "	107	24	"	30	7.10
15	Southern, U. S. No. 1307–1	" "	119	22	Medium	89	9.81
16	Early Black, U. S. No. 1304–1	" "	107	12	"	40	4.60
17	Early Black, U. S. No. 1303–1	" "	95	12	"	50	5.10
18	Green Samarow, U. S. No. 1302	" "	95	13	Large	95	14.50
19	Late Yellow, U. S. No. 1300	" "	119	22	Medium	50	5.87
20	Small Yellow, U. S. No. 1299–1	" "	115	23	Large	96	15.80
21	Large Yellow, U. S. No. 1296–1	" "	107	15	"	88	10.20
22	Yellow, U. S. No. 1294–1	" "	107	15	Small	60	1.70
23	Flat Black, U. S. 1293–1	" "	117	22	Large	90	9.00
24	Small Brown, U. S. No. 972–1	" "	*	17	Small	100	†
25	Small Black, U. S. No. 964–1	" "	*	18	"	100	†
26	Early Green, U. S. No. 912–1	" "	107	18	Medium	90	6.30

*Not mature at time of killing frost—October 16. †Not harvested; only a few pods matured.

1901 and 1902, an average crop being removed each year. The ground has been very foul for several years and was especially infested with cockle-burs. The field was plowed to a depth of about five inches April 21, 22. The ground was well plowed, although the vegetation, mostly weeds, bothered a little. As a further preparation of the seed-bed, the following treatment was given: April 22, packed with the Campbell subsurface-packer, with extra weight of 1000 pounds, and followed with the smoothing-harrow. May 1, harrowed again with smoothing-harrow. May 16, harrowed with the Acme harrow. At the last date the ground was very hard, and was covered with a thick growth of young cockle-burs, resulting from the foul condition of the ground and the excessive rains, which prevented the proper tilling of the field. May 20 and June 5 the ground was Acme-harrowed, and on June 10 and 11 it was double-disked, and harrowed with the smoothing-harrow. When the cowpeas were sown, June 13 to 15, the soil was in good condition. The heavy rains had settled the ground and furnished plenty of moisture for the rapid decomposition of the vegetation turned under, and had started vast numbers of weeds, which were destroyed by the frequent cultivation.

Twelve of the varieties were sown on plots about one-tenth acre in area, while the others, on account of not having more seed, were sown on plots one-half that size. The peas were drilled in rows thirty-two inches apart, as already described for soy beans, the drill being set to sow two bushels of wheat per acre, which planted the peas at the rate of nearly two pecks per acre. After planting, a good soil mulch was preserved by frequent cultivation and the crop was kept free from weeds. The growing season was apparently favorable for cowpeas and most of the varieties continued to make a thrifty growth throughort the season.

The cowpea is a Southern plant. It is slow in maturing and the pods do not all ripen at the same time. In this test most of the varieties at some time during the season had blossoms and at least a few ripe pods at the same date. This is a great disadvantage in growing the cowpea for seed-production, since some of the peas will always be immature at harvest and some of the riper ones will have been lost by shelling. The cowpeas in this trial were allowed to grow until frost, so that as many peas would mature as possible. The vines were slightly injured by light frosts October 8 and 11, and were killed by a more severe frost October 16. The notes on "Stage of maturity September 14" will give some indication as to the comparative earliness of these varieties. Eleven of the earliest sorts, viz., Nos. 5, 8, 10, 11, 12, 15, 20, 28, 30, 31, and 32, made an average yield per acre just

TABLE VII.—Varieties of cowpeas.

Bulletin No.	Name.	Where from.	Stage of maturity, September 14.	Average standing height.	Number of pods.	Vine growth.	Yield of straw per acre.	Yield of peas per acre.
							tons.	*bus.*
1	Whip-poor-will	F. Barteldes & Co	Leaves green, blossoms and pods	19½	Very small	Medium	1.38	6.23
2	Mount Olive	Alabama Exp. Sta	" " "	14½	Small	"	1.72	7.24
3	Red Ripper	" "	" " "	11½	Medium	Small	1.76	7.90
4	Wonderful	" "	" " "	25½	Very small	"	1.50	.50
5	White Giant	" "	Leaves turning yellow, blos. and pods, pods ½ ripe,	15½	Large	"	1.22	8.62
6	Yellow Sugar Crowder	" "	Leaves green, blossoms and pods	15½	Small	Large	1.66	1.18
7	Clay	" "	" " "	21½	"	Medium	1.88	2.36
8	New Era	" "	Leaves green, blossoms and pods, pods ⅓ ripe	19	Large	"	1.06	6.64
9	Taylor	" "	Leaves green, blossoms and pods	13½	Medium	"	1.52	4.54
10	Extra Early Black Eye	" "	Leaves turning yellow, blos. and pods, pods ⅓ ripe,	13½	Large	Small	1.26	9.86
11	Large Black Eye	" "	Leaves green, blossoms and pods, pods 1-5 ripe	16	Medium	"	1.21	8.58
12	Warren's Extra Early	" "	Leaves ⅓ yellow and falling off, pods ⅓ ripe	13	Large	"	1.32	9.40
13	Whip-poor-will	" "	Leaves green, blossoms and pods	19½	Medium	Large	1.62	7.74
14	Lady	Evans Seed Co	" " "	17	Very small	"	1.59	6.10
15	New Era	" "	" " "	24	Very large	Small	.86	11.07
16	Michigan Favorite	" "	" " "	10	Medium	"	1.16	7.62
17	Hammond's Black	Hammond Seed Co	" " "	16	Small	Large	1.84	6.10
18	Extra Early	" "	Leaves green, beginning to blossom	20	None	"	1.24	.51
19	Wonderful, or Unknown,	N. C. Exp. Sta	" " "	25½	"	"	1.64	.42
20	Black Eye	F. Barteldes & Co	Leaves green, blossoms and pods, pods ¼ ripe	15½	Medium	"	1.66	8.00
21	Clay	" "	Leaves green, beginning to blossom	16½	None	Very large	1.97	1.09
22	Iron	U. S. Dept. of Agr.	" " "	23½	"	Large	1.62	2.53
23	Black	F. Barteldes & Co	" " "	18	Practically none	"	1.54	.34
24	Red Unknown	S. C. Exp. Sta	" " "	18½	None	"	1.60	.84
25	New Era	" "	Leaves green, blossoms and pods	25	Large	Medium	1.58	3.20
26	Clay	" "	" " "	18½	Very small	Very large	2.37	2.86
27	Black	" "	" " "	17½	"	Large	1.96	9.18
28	Old Man's	" "	Leaves green, blossoms and pods, pods ½ ripe	14	Medium	Small	1.82	9.10
29	Gray Goose, or Taylor	" "	Leaves green, blossoms and pods	14½	Very small	Large	2.12	2.74
30	California Black Eye	" "	Leaves green, blossoms and pods, pods ½ ripe	14	Medium	"	1.77	4.13
31	Warren's Extra Early	" "	Leaves green, blossoms and pods, pods 1-6 ripe	17	"	"	1.41	4.21
32	Warren's New Hybrid	" "	Leaves green, blossoms and pods, pods ¼ ripe	14½	"	"	1.78	6.56
33	Common Black Eye	" "	Leaves green, blossoms and pods	13	Large	"		6.18
34	Whip-poor-will	" "	" " "	18	Medium	Medium		2.72

twice that of the remaining varieties, which fact very strongly emphasizes the importance of breeding earlier-maturing varieties.

In Kansas the cowpea is grown for forage rather than for grain, but whether it be used as a forage or a grain crop, the yield of peas should undoubtedly be given more attention and be increased by selection and breeding. The yields of peas, as given in the above table, are small as compared with the yields secured in some of the Southern states, due to the fact, doubtless, that only a few of the varieties fully matured, In this test the New Era, No. 15, proved superior to any of the other varieties, especially as a grain-producer. Other promising varieties were the Black Eye, Warren's Extra Early, and Old Man's.

The yields of dry straw, after the peas were thrashed, are given in table VII, but these figures must not be accepted as showing the relative value of these varieties for forage. Neither is this relative forage value shown by the total weight before thrashing, for the later-maturing varieties retained a much larger per cent. of their leaves than the earlier varieties. Some comparison of the forage value of the several varieties may be made by observing the yield of grain and the average standing height of the peas. Considering the quality of fodder with the yield, the following were among the more promising forage varieties: New Era, Black, Black Eye, Warren's Extra Early, Old Man's, Whip-poor-will, and Lady. The "Vine growth," as given in table VII, indicates the tendency to creep or twine, but does not indicate the vine growth in length or the amount of forage.

VARIETIES OF SACCHARINE AND NON-SACCHARINE SORGHUM.

This test of varieties was conducted in the same field as the variety trial of cowpeas, and the notes on the condition of the soil and the preparation of the seed-bed are the same as given for cowpeas in another part of this bulletin. The sorghum was planted June 10 and 11, with a disk grain-drill, in rows forty inches apart, the drill being set to sow one bushel of wheat per acre. The plots were one-fourth of an acre in area, except Nos. 12 and 13, which were one-fourth that size. Varieties Nos. 2, 3, 7, and 9, as given in table VIII, were up in ten days, while the others were two and a half days later in germinating. Varieties Nos. 12 and 13 did not make a good stand, which accounts in part for their low yield. The remaining varieties germinated well, and made a very satisfactory growth throughout the season. The soil was kept in good condition and free from weeds by frequent cultivation.

TABLE VIII.—Varieties of saccharine and non-saccharine sorghums.

Bulletin No.....	Name.	Where from.	Days to mature.	Average height.	Per cent. of leafiness.	Weight, per bushel.	Grade of grain.	Stover, yield per acre.*	Grain, yield per acre.	Moisture in headed fodder.	Dry matter in headed fodder, yield per acre.
				ft.-in.			*per cent.*	*tons.*	*bushels.*	*per cent.*	*tons.*
1	Coleman cane	F. Barteldes & Co.,	110	9-6	Medium	65½	95	7.41	40.5	58.41	3.08
2	Kavanaugh cane	" "	131	9-0	"	57	85	6.82	33.7	52.82	3.22
3	Early Amber cane	" "	105	9-0	Small	59	98	7.28	22.8	48.63	3.74
4	Kansas Orange cane	" "	110	9-6	Medium	53	93	7.46	28.1	52.09	3.57
5	Folger cane	" "	107	9-6	Small	58	95	5.73	29.6	51.85	2.76
6	Fodder cane	" "	106	9-0	"	56	96	6.08	29.2	46.42	3.27
7	Yellow milo maize	" "	138	10-0	Very large	44	83	5.27	20.6	58.51	2.19
8	Red Kafir-corn	" "	107	6-4	Medium	59	88	4.42	57.3	56.75	1.91
9	Black-hulled White Kafir-corn,	College farm	110	7-0	Large	58	93	4.80	39.8	47.30	2.53
10	Black-hulled White Kafir-corn,	F. Barteldes & Co.,	115	5-6	"	58	85	4.07	59.1	60.04	1.63
11	Large African millet	" "	110	8-2	"	57½	80	5.33	37.3	.....	.....
12	Brown Donrrha corn	" "	110	5-0	Medium	54	78	1.16	19.5	40.57	.69
13	Jerusalem corn	" "	110	5-0	"						

*By "stover" is here meant the total weight of crop less the weight of the grain. The weights were taken December 22, when the "stover" was stacked.

All of the varieties except the Kavanaugh cane and the Yellow milo maize were ripe, and harvested September 28–30. The Kavanaugh cane was harvested October 19, and the milo maize October 26, but the latter did not fully mature seed. The crop was cut with the corn-binder and shocked in the field. During December the varieties of sorghum were headed in the field; the heads were hauled to the separator and thrashed, and the weight and yield of seed were determined. The stover (headed fodder) vas hauled from the field and stacked December 22, and the yields given in table VIII were determined from the weights as taken at that date. The yields also include the chaff, which was separated from the seed in thrashing the heads. At the time the stover was stacked, sample bundles were saved, from which the percentage of moisture present in the headed fodder was determined. It will be observed (as shown in table VIII) that the stover still contained a large percentage of water, although it was apparently fairly well cured. Eight out of the thirteen varieties contained over fifty per cent. of water in the headed fodder when stacked, more than fifty days after cutting. (Nos. 2 and 7 had been cut only about thirty days, but these varieties were badly frosted before cutting, which doubtless hastened their drying.)

The "Dry matter" in the headed fodder, as given in table VIII, was determined by subtracting the total moisture from the air-dry weight. No. 1, Coleman cane, gave the highest yields of grain and fodder of any of the saccharine sorghums. The difference between the yields of the remaining varieties was not so marked, though No. 2, Kavanaugh cane, would probably rank second.

Of the non-saccharine sorghums, No. 7, Yellow milo maize, and No. 11, Large African millet, made the largest yields of fodder, but comparatively low yields of grain. These are very large growing varieties, and would seem profitable to grow, if forage is the main object sought. Considering both the grain and fodder yields, No. 8, Red Kafir-corn, and No. 7, Black-hulled White Kafir-corn, were of about equal merit, and were easily ahead of the other varieties. The yields of grain of these varieties were very satisfactory.

LATE-PLANTED SORGHUM.

Several of the varieties of sorghum mentioned above were planted June 19, with the lister, in shallow furrows about four inches deep, in the same field and adjoining the late-planted corn. The crop was given similar cultivation to that described for corn. (See "Late-planted Corn.") None of the varieties matured fully. The Early Amber cane and the Red Kafir corn were nearest mature when the crop was

harvested, October 8. The varieties grown, with their yields of grain and headed fodder, are given below :

Bulletin No.	Name.	Yield per acre.	
		Grain.	Stover.
		bushels.	*tons.*
3	Early Amber cane	19.87	4.55
5	Folger cane	14.59	2.65
7	Yellow milo maize	11.01	2.96
8	Red Kafir-corn	17.98	2.30
9	Black-hulled White Kafir-corn	22.57	3.43

The lister did not plant the seed so thick as did the grain-drill used in the regular variety trial, and the stand in the above trial was rather thin, which accounts in part for the small yields. Moisture determinations made from samples of headed fodder when it was hauled gave 59.68 per cent. of moisture in the Amber cane, and 56.75 per cent in the Red Kafir-corn, thus showing that the fodder had cured about as well as that of the earlier-planted crop. (See table VIII.)

VARIETIES OF BROOM-CORN.

In this trial four varieties were planted, June 11, adjacent to and in a similar manner as already described for varieties of sorghum. The plots were each one-fourth acre in area.

TABLE IX.—Varieties of broom-corn.

Bulletin No.	Name.	Where from.	Days to maturé	Average height	Average length of heads	Freedom from center stalk	Uniformity in size of fiber	Yield per acre, fodder,	Yield, per acre, grain
				feet.	*inch's.*	*per ct.*	*per ct.*	*tons.*	*bush.*
1	Genuine Dwarf	F. Barteldes, Lawrence, Kan.	110	6.0	15.0	35.0	87	3.10	28.7
2	California Golden		110	11.0	18.5	25.0	78	5.86	18.3
3	Improved Evergreen		110	10.5	16.0	29.5	79	1.67	20.0
4	Extra Early Japanese		110	10.0	17.0	37.5	85	2.66	29.9

As the value of broom-corn lies chiefly in its broom-making qualities, the average length of head, the freedom from central stalk and uniformity in size of the fiber are important characters to study. None of the varieties tested in this trial showed much breeding in

this respect, being especially poor in the last two characters mentioned. The percentages given under "Freedom from central stalk" indicate the number of heads out of 100 which were free from the central stalk. By observing the data in Table IX, it will be seen that No. 4, the Extra Early Japanese broom-corn, was apparently the best variety for the manufacture of brooms, while No. 1, the Genuine Dwarf, ranked second. The "Days to mature," as given above, are the number of days required fully to mature the seed. About eighty-five days were required to mature the broom-corn sufficiently for the manufacture of brooms. Broom-corn fodder has little feeding value, especially when the grain has been allowed to mature. The grain itself, when ground, is worth about two-thirds as much as cane-seed for feeding purposes. In the production of grain, the Extra Early Japanese variety ranked first and the Genuine Dwarf second, while the California Golden variety gave the largest yield of fodder.

TEOSISTE AND PENCILLARIA, OR PEARL MILLET.

Some seedsmen make a distinction between pencillaria and pearl millet, selling the pencillaria at one dollar or more per pound and the pearl millet at ten cents per pound. Samples of seed sold under one or the other of these names were secured from several seedsmen last season and planted side by side. The product proved to be the same plant in each case, viz., the old "cat-tail" or pearl millet *(Pennisetum spicatum).* The same conclusion was reached in experiments conducted by the United States Department of Agriculture. (See Farmers' Bulletin No. 168.)

The pearl millet was planted June 11, in rows forty inches apart, in the same field as the sorghum varieties, and given much the same culture. The yields from the separate plots were not determined, but the average yield of the fully matured crop was 4.95 tons of fodder and 594 pounds of seed per acre. The seed was not fully ripe on all the heads when the crop was harvested, October 1. A part of each of the plots was cut twice during the season — once in the summer, August 17, and the second time, October 1. The total yield secured in this way was not greater than that secured from one cutting, but the quality of fodder and its value for feeding purposes was greater when the crop was not allowed to mature. When pearl millet is allowed to mature, the stalks are stiff and woody, and have less feeding value than mature cane or Kafir-corn. Much has been said or written of the great yielding qualities of pencillaria as a forage plant. In the above trial, which was made on the ordinary upland soil of the Station farm, the crop did not produce as well as cane or Kafir-corn. Pearl millet is a southern plant, and does not grow at its best as far north as Kansas. Doubtless, on fertile, moist land, especially in the South-

ern states, very large yields may be secured, as has been reported by several of the experiment stations. But on average soil in Kansas the sorghums are greatly to be preferred, as being a surer crop, more productive, and more valuable for forage. The analysis of pearl-millet fodder, compared with that of cane-fodder and corn-stover (see Farmers' Bulletin No. 168, United States Department of Agriculture) shows that its feeding value is less than that of either of the other fodders.

A sample of teosinte planted beside the pearl millet was given similar culture and harvested at the same date as the pearl millet, but no record of the yield was taken. This plant is less adapted to growing in this climate than pearl millet. It made a rank growth of leaves and a thick growth of stalks, stooling abundantly, and reached a height of about four feet. The production of fodder, however, was much less than that from cane or Kafir-corn, and after it was cured it seemed to have little weight or substance and had a low feeding value, although the fodder was well eaten by the cattle. Teosinte is a native of Mexico, and is thought by some botanists to be the origin of our native Indian corn. It does not produce an ear, as does corn, but produces seed in the leaf axils on slender spikes. The plant does not mature seed when grown in the United States, except in southern Florida or on the Gulf coast. It is considered a valuable forage crop in the Southern states, and under favorable conditions produces immense crops of fodder. On rich bottom land, which is supplied with abundance of moisture, doubtless teosinte may be profitably grown for fodder, but for ordinary soils and Kansas climatic conditions, it is not to be compared with corn, Kafir-corn or cane as a forage crop.

EXPERIMENTS WITH CORN.

Seventy-four varieties of corn were planted in the regular field trial in 1903. Nine of these were duplicates in name, but the seed came from different sources; the remaining sixty-five varieties were different in name, although some of them were very similar in type. Fifteen of these varieties were secured directly from Kansas farmers, and may be considered native sorts, or at least varieties which are fully acclimated, many of them having been grown in Kansas twenty years or more. The remaining varieties came from the several seed companies and corn-breeders, and included all of the "standard" sorts of corn as well as many new or less-known varieties.

The varieties were planted side by side in a continuous series. Each plot consisted of four rows 228 feet in length. No attempt was made to keep the corn from crossing, except that the several types, as yellow dent, white dent, calico, etc., were grown together, in order to prevent the mixing of colors as far as possible. The land used for

for the trial grew a crop of sowed cane in 1901 and in 1902, which was pastured both seasons by cattle. Field was heavily manured during the winter of 1902–'03, mostly with cattle manure, put on with the manure-spreader. The ground was disked April 7 and plowed April 16–18. The disking mixed the manure with the soil, leaving a broken, mellow surface favorable to reestablishing a good capillary connection with the subsoil when the furrow was inverted. The plow was followed at once with the subsurface-packer, and this by the smoothing-harrow. On May 8 the smoothing-harrow was used again and the planting of corn was begun.

The corn was planted with the John Deere drill planter, in rows three and one-half feet apart, the kernels being dropped fourteen to fifteen inches apart in the row. The rows extended north and south. The soil was in good condition at planting, but became wet almost immediately, and remained wet for nearly a month, with only an occasional day when it was possible to go onto the ground with a team. This was accomplished on May 16, when the field was harrowed, and on May 22, when it was cultivated with a weeder. At this date the corn stood two to two and one-half inches high, and had made a good stand on nearly all plots. The number of stalks harvested, given in table X, indicates the comparative stand of the varieties. A perfect stand required 732 hills on the plot. The heavy rains, the washing of the soil, a hail-storm and unfavorable conditions for growth caused considerable injury to the stand and made the corn backward in growth. At the close of the wet weather the corn was spindling in growth and yellow in color. It needed cultivation badly, in order to loosen and warm the ground and supply the roots with air. The field was cultivated June 6–8 with Tower's surface cultivator. The rains had left the ground very compact, and a hard crust formed very rapidly at the surface. It was found necessary to cultivate at once in order to do good work. By the afternoon of June 8 the surface crust became so thick and hard that the cultivator knives were often forced out of the ground and scraped over the surface. The surface cultivator was found to be an excellent tool for the first cultivation. It broke the crust one and one-half to two inches deep, leaving a loose, mellow mulch. The soil was sticky and wet just below the crust, and if a shovel cultivator had been used at this time, the soil would have been turned up in clods, instead of leaving a surface of mellow soil.

The Corn received its second cultivation June 19, 20, with the John Deere disk cultivator. This cultivator did not work satisfactorily. It left an exposed, open furrow between the rows and it was found impracticable to use the levelers or scrapers which attach behind

the disks, because it was not possible to adjust them and make them hold their place in passing over rough ground, The same was true also of the disks themselves, since they were very hard to adjust and hold to their proper place. A third cultivation was given the corn June 29, 30, with the John Deere six-shovel cultivator. This cultivator did good work and was much superior to the disk cultivator. The corn was cultivated again, with the six-shovel cultivator, July 8, 9, and on July 20, 21, the crop received its final cultivation, with a five-shovel, single-horse cultivator, It was found necessary, also, to use the hoe in the latter part of the season, to keep the weeds down in the row. The corn made a good growth in spite of the unfavorable spring conditions. The date of tasseling, days maturing and other data are given in table X. The corn was harvested with the Osborne corn-binder, between the dates of August 30 and September 10, and shocked in the field. Some of the varieties were "dead" ripe when harvested and none of the varieties were cut before the ears were matured.

The corn was husked by hand November 16–19. The ears from each plot were weighed and counted and the fodder was hauled to the barn and weighed. Eighty ears of each variety of corn were reserved as a sample, from which the corn was graded and the per cent. of shelled corn and moisture in the sample was determined. To determine the per cent. of shelled corn, the whole eighty ears were weighed and shelled. To determine the moisture, the cobs were ground and sampled and the shelled corn was sampled. These samples were dried at a temperature of 110 deg. C., in a large oven used for drying soil samples. The percentage of moisture was determined for each sample, and also calculated for the original weight of the ears as husked. The per cent. of shelled corn, as given in table X, was determined by dividing the weight of the dry corn by the total weight of the dry ears. The percentage of shelled corn was also determined (not given in the table) when the sample was shelled, before drying. This per cent. was uniformly lower than that given in the table, showing that the cobs when the corn was husked contained relatively more moisture than the shelled corn, and this was verified by the moisture determinations.

The amount of moisture in the shelled corn varied from thirteen to twenty-two per cent.; that in the cobs from twelve to thirty-one one per cent. In the corn that was very ripe, as the flint varieties, the per cent. of moisture in the cobs was usually slightly less than that found in the shelled corn, but, with most of the varieties, the per cent. of moisture in the cobs was greater than that found in the shelled corn. As an average for all the samples, the shelled corn contained 17 per cent. of moisture, the cobs 17.31 per cent, and

the ears as husked 18.5 per cent. (There was some loss of moisture from the original sample before the shelled corn and cobs were sampled separately.)

The yield of stover given in the table was determined by taking the weight of the stalks as they were hauled from the field, soon after husking. Two samples of fodder taken for moisture determinations gave an average of 33.1 per cent. of moisture. All the fodder seemed to be well cured and thoroughly air-dry when stacked. The yield of the shelled corn has been reduced to the same comparative air-dry basis. The "Weight of air-dry shelled corn" given in the table contains fifteen per cent. of moisture, which was assumed to be the percentage of moisture in ripe, air-dry corn at husking-time.

A careful study of the data contained in table X shows some interesting results; one of the most remarkable of which is the great difference in the yield of corn produced by the different varieties. Disregarding the yields of several of the early maturing varieties which made a poor stand, the yields of "standard" varieties of corn varied from thirty to eighty-nine bushels per acre. Forty-five out of the seventy-nine varieties tested in the regular trial yielded less, while thirty-four varieties yielded more than sixty bushels of shelled corn per acre. The difference in yield must have been due almost entirely to the difference in varieties, since the conditions of soil, planting and culture were alike for all varieties. If the difference in the variety of corn causes a difference in crop of thirty to fifty bushels per acre, the adaptation of different varieties to different soils and climates is certainly a problem worthy of careful investigation. The figures given in the columns marked "Number of stalks," "Number of ears husked," "Weight of ears per plot," and ''Moisture in ear corn as husked," allow a comparison of varieties, by which the per cent. of "barren" stalks, the average weight of the ear and the actual amount of dry corn produced by each variety may be readily determined; also the condition of the corn for storing is indicated by the percentage of moisture present in the "Ears as husked." The "Total score," the per cent. of shelled corn, and the other data describing the stalk and ear are important also in presenting some of the breed characteristics of the different varieties and allowing a comparison of the quality of the corn produced.

The several varieties of corn marked with an asterisk in the table (Nos. 76–51) were grown in another field in larger plots (one-fourth acre in area), This land was not manured; otherwise the soil was similar and the crop received similar cultivation; but the corn produced a very much smaller yield in this field than was produced in the regular test, as will be observed by comparing the yields of No. 9,

TABLE X.—Varieties of corn.

Bulletin No.	Name.	Type.	Where from.	Date of tasseling.	Days to mature.	Suckers on stalks.	Number of stalks per plot.
						per cent.	
1	Golden Beauty	Yellow dent	F. Barteldes & Co.	July 23	130	24	460
2	"	"	Trumbull & Co.	July 21	128	32	640
3	Leaming	"	F. Barteldes & Co.	July 15	120	31	698
4	"	"	Iowa Seed Co	July 12	117	23	610
5	Kansas Sunflower	"	F. Barteldes & Co.	July 21	130	45	766
6	"	"	John Moody, Eudora, Kan	July 21	128	31	652
7	Golden Beauty	"	Iowa Seed Co	July 16	124	34	582
8	Bicker's Choice	"	J. H. Bicker, Council Grove, Kan.	July 23	128	28	694
9	Rumold	"	Henry Rumold, Dillon, Kan.	July 17	126	86	624
10	McAuley's Yellow	"	W. S. McAuley, Americus, Kan.	July 17	127	86	570
11	Hildreth	"	C. E. Hildreth, Altamont, Kan.	July 24	132	45	640
12	Ramsey	"	Wm. Ramsey, Solomon, Kan.	July 23	132	40	638
13	Sedgwick	"	Sedgwick & Co., Halstead, Kan.	July 22	128	49	704
14	Dahlsten	"	Emil Dahlsten, Marquette, Kan	July 18	128	38	708
15	Blaine	"	J. W. Blaine, Manhattan, Kan.	July 22	128	50	676
16	Mammoth Golden Yellow	"	Nebraska Experiment Station	July 19	124	50	576
17	Early Mastodon	White-cap'd y.d.,	Iowa Seed Co	July 17	120	19	562
18	"	" "	F. Barteldes & Co.	July 15	118	21	542
19	Yellow Elephant	Yellow dent	Farmers' Seed Co	July 10	110	10	437
20	Golden Row	"	Nebraska Experiment Station	July 16	118	52	630
21	Farmers' Reliance	"	Iowa Seed Co	July 8	116	25	658
22	Iowa Gold-mine	"	F. Barteldes & Co.	July 10	118	50	650
23	Profit	"	Iowa Seed Co	July 15	117	32	656
24	World's Fair	"	"	July 16	117	22	656
25	Hogue's Yellow Dent	"	Nebraska Experiment Station	July 18	119	49	650
26	Abundance	"	Farmers' Seed Co	July 17	117	32	752
27	Klondyke	"	F. Barteldes & Co.	July 17	118	21	698
28	Reid's Yellow Dent	"	College farm.	July 17	118	20	696
29	Pride of the North	"	F. Barteldes & Co.	July 12	115	29	664
30	" " "	"	Northrup, King & Co	July 9	106	15	464
31	King of the Earliest	"	F. Barteldes & Co.	July 8	114	41	658
32	American Pride	"	H. Hammond Seed Co.	July 6	110	28	658
33	Minnesota No. 13	"	Northrup, King & Co	July 4	102	6	666
34	Golden Cap	"	Nebraska Experiment Station	July 8	116	33	674
35	Early Cattle King	"	" "	July 10	114	26	652
36	Race Horse	"	H. Hammond Seed Co.	July 9	112	22	614
37	Funk's Ninety Day	"	Funk Bros.	July 11	116	20	616
38	Grove's Yellow Dent	"	"	July 13	117	20	652
39	Minnesota Ideal	"	Farmers' Seed Co.	July 12	116	30	668
40	Reid's Yellow Dent	"	U. S. Department of Agriculture	July 19	116	20	670
41	Riley's Favorite	"	" " "	July 17	115	14	648
42	Leaming	"	" " "	July 17	114	19	688
43	Henderson's Eureka	"	" " "	July 19	128	8	576

44	Hickory King	White dent	U. S. Department of Agriculture	July 17	126	21	646
45	Iowa Silver-mine	"	" " "	July 17	115	27	578
46	Boone County White	"	" " "	July 17	124	29	552
47	" "	"	" " "	July 21	122	20	612
48	Sanders's Improved	"	" " "	July 23	136	20	672
49	Mosby's Prolific	"	" " "	July 28	135	54	776
50	U. S. P. B. Selection No. 77	"	" " "	July 17	118	31	650
51	Cocke Prolific	"	" " "	July 24	128	20	628
52	Early Rustler	"	Northrup, King & Co	June 29	102	4	68
53	Snow Flake	"	F. Barteldes & Co	July 21	117	19	712
54	Snow White Dent	"	Iowa Seed Co	July 17	115	27	670
55	Hammett	"	P. A. Hammett, Marysville, Kan	July 17	117	39	698
56	Stevens	"	J. Stevens, Eureka, Kan	July 22	132	21	544
57	Kansas Pearl	"	B. G. Shelton, Hiawatha, Kan	July 17	115	28	6.6
58	Forsythe's Favorite	"	F. Barteldes & Co	July 28	130	42	662
59	Boone County White	"	" "	July 10	119	24	592
60	Nebraska White Prize	"	Nebraska Experiment Station	July 10	114	26	568
61	White Kansas King	"	F. Barteldes & Co	July 17	122	41	618
62	Mammoth White Dent	"	G. T. Fielding & Son	July 19	124	44	736
63	Champion White Pearl	"	F. Barteldes & Co	July 17	117	37	660
64	Giant Fodder	"	Farmers' Seed Co	July 8	110	30	688
65	Red Cob Fodder	"	" "	July 17	116	20	554
66	Red Cob Ensilage	"	Iowa Seed Co	July 13	117	11	658
67	Brazilian Flour	White	F. Barteldes & Co	July 24	128	70	724
68	" "	"	G. T. Fielding & Son	July 23	124	70	728
Check 11	Hildreth	Yellow dent	C. E. Hildreth	July 23	132	37	782
69	Calico	Calico dent	Funk Bros	July 14	122	35	752
70	Webster	"	H. R. Webster, Woodson county, Kansas	July 19	124	30	764
71	Griffing	"	W. J. Griffing, Manhattan, Kan	July 17	126	35	766
72	Northwestern Dent	Red dent	Northrup, King & Co	June 29	101	23	468
73	Triumph Flint	Yellow flint	" "	June 30	103	50	684
74	N. Dak. White Flint	White flint	" "	July 1	103	45	6.4
*75	Farmers' Interest	White dent	F. Barteldes & Co		136		
*76	Golden Eagle	Yellow dent	Funk Bros		119		
*77	Legal Tender	"	Iowa Seed Co		135		
*78	Leaming	"	Funk Bros		134		
*79	Golden West	"	Iowa Seed Co		127		
Check *9	Rumold	"	Henry Rumold				

*Trial in another field, plots 0.28 of an acre in area.

TABLE X—*Continued.*—Varieties of corn.

Bulletin No.	Number of ears per plot.	Average height of stalks.	Average height of ears on stalks.	Leafiness.	Average length of ears.	Average circumference of ears.	Total score.	Dry shelled corn on ear.	Yield per plot, ear corn as husked.	Moisture, ear corn as husked.	Yield per acre of stover.	Yield per acre, air-dry shelled corn.
		inches.	*inches.*	*per cent.*	*inches.*	*inches.*	*per cent.*	*per cent.*	*pounds.*	*per cent.*	*pounds.*	*bushels.*
1	303	98	48	90	9.50	6.75	78.5	78.34	184	24.18	2,740	31.45
2	451	94	48	90	9.50	6.25	77.5	71.06	255	16.93	3,767	42.25
3	545	94	42	85	8.50	6.50	77.5	81.42	273	15.96	3,603	54.33
4	415	91	42	87	8.50	6.75	73.2	81.22	209	18.83	1,781	39.64
5	690	91	50	89	9.00	7.00	77.5	82.42	372	19.51	5,920	70.09
6	612	98	47	90	9.00	7.00	78.9	82.29	376	20.33	5,480	70.95
7	383	94	49	90	9.00	6.25	73.5	80.02	196	14.81	2,329	38.28
8	557	100	41	91	9.50	7.25	78.5	83.03	398	21.58	5,068	74.53
9	508	96	46	92	8.50	6.75	78.5	81.85	315	18.27	3,767	60.60
10	470	100	44	95	9.75	6.75	79.2	83.10	292	20.23	4,315	56.99
11	581	110	52	88	10.00	7.75	82.8	83.83	472	23.80	5,616	86.79
12	482	98	46	95	8.50	7.50	82.5	80.78	295	24.59	4,384	53.53
13	578	90	43	90	8.75	7.00	82.5	82.27	377	18.41	4,384	72.83
14	546	79	40	88	8.50	6.75	77.2	85.62	280	23.55	3,973	52.45
15	570	90	43	90	9.00	7.50	77.1	79.42	350	22.18	4,589	62.47
16	449	88	45	90	9.50	7.75	79.1	83.36	257	17.24	3,493	51.00
17	488	74	34	85	8.75	7.00	81.1	81.89	274	18.23	2,192	52.76
18	454	72	32	87	8.00	7.25	77.7	81.25	217	16.19	2,329	42.50
19	296	68	30	85	7.25	7.00	78.2	79.61	118	15.31	1,370	14.41
20	480	88	31	86	9.50	7.50	81.0	82.38	313	17.00	3,247	61.59
21	458	90	40	90	8.00	7.25	78.2	84.90	259	15.74	3,014	53.32
22	481	91	33	90	8.00	6.75	80.3	64.03	249	13.11	2,945	39.41
23	582	90	35	85	8.00	7.25	77.8	82.97	320	17.49	3,562	63.08
24	582	91	40	90	8.50	6.75	83.2	83.63	369	19.69	3,630	71.24
25	602	94	41	93	8.75	7.00	83.2	84.83	355	17.41	3,699	72.58
26	536	94	44	90	8.50	7.50	80.7	84.88	272	20.30	2,877	52.96
27	666	95	48	95	9.00	7.00	80.0	83.57	389	19.09	3,425	75.70
28	432	93	42	90	9.00	7.25	81.8	84.19	284	17.24	3,493	56.95
29	544	93	42	90	9.00	6.50	81.4	82 54	307	17.50	3,699	61.57
30	283	66	28	88	6.50	5.50	77.8	84.12	107	15.34	1,781	21.93
31	674	88	32	89	7.50	6.25	76.7	84.96	308	19.26	3,699	60.82
32	829	84	31	80	8.00	6.00	78.2	87.88	316	23.32	3,563	61.30
33	229	56	20	85	7.00	6.25	77.8	81.33	81	19.00	1,027	15.35
34	673	80	32	90	8.25	6.75	77.8	81.55	334	17.18	2,877	64.90
35	533	91	34	90	8.25	6.50	78.9	82.27	302	21.62	3,493	56.20
36	387	90	36	90	7.75	6.50	75.0	86.92	187	17.83	2,603	38.44
37	559	90	34	90	8.50	6.75	85.0	83.23	313	18.33	3,151	61.21
38	522	92	36	92	9.50	7.00	82.5	83.00	320	18.89	3,699	62.00
39	429	70	31	90	7.00	6.50	73.8	80.79	202	16.69	2,534	39.13
40	422	89	36	90	9.00	7.00	82.5	81.26	256	21.88	3,904	46.77
41	453	88	48	93	8.00	6.75	81.3	86.59	236	16.11	2,671	49.30
42	577	91	38	90	8.00	7.00	73.9	80.77	315	16.60	3,836	61.06
43	356	[illegible]	[illegible]	90	9.00	7.75	69.6	76.39	236	20.03	3,219	41.50

44	491	80	50	90	7.50	6.25	77.1	87.92	227	20.04	4,452	45.93
45	355	78	29	80	8.00	6.75	79.6	82.90	170	16.52	3,288	33.86
46	477	94	48	92	8.50	7.50	83.7	81.41	274	17.02	3,219	53.25
47	479	94	50	90	9.00	7.50	82.8	81.14	270	20.48	3,151	50.13
48	750	94	58	95	8.00	7.25	85.7	85.09	356	19.77	4,795	69.94
49	610	90	62	97	8.00	6.50	80.3	88.56	267	25.37	5,480	50.79
50	642	97	50	85	8.50	6.75	82.3	80.91	326	19.10	3,973	61.44
51	826	99	50	90	8.75	6.50	79.3	84.05	379	17.41	4,521	75.70
52	81	48	15	75	7.00	6.00	74.6	78.79	22	13.95	274	4.29
53	550	88	38	90	9.25	7.00	81.1	81.71	336	19.84	3,836	62.91
54	543	89	38	85	9.50	7.25	80.0	83.93	284	15.91	3,014	57.66
55	640	90	50	95	8.50	7.25	83.2	79.41	419	17.45	4,110	79.04
56	473	97	46	90	9.75	7.75	80.0	77.85	332	24.13	4,795	56.43
57	453	89	48	95	9.00	7.00	83.9	81.48	322	19.65	4,384	60.68
58	567	99	58	90	9.50	8.00	88.4	78.47	428	24.94	5,068	72.55
59	435	96	36	90	8.50	7.50	84.6	82.07	279	16.85	3,014	54.79
60	404	93	39	95	9.75	7.25	87.1	82.63	249	15.16	2,945	50.23
61	692	93	58	95	7.50	6.00	79.6	85.32	323	17.14	5,411	65.71
62	813	90	57	95	8.50	8.00	84.6	74.43	479	24.83	5,205	77.12
63	551	106	42	85	8.50	7.25	84.8	82.26	327	16.59	4,384	54.85
64	568	80	35	96	8.75	6.75	81.1	83.08	304	18.74	3,425	59.07
65	427	83	40	95	8.00	7.50	82.5	82.35	258	18.76	3,082	49.67
66	553	81	46	85	8.00	7.00	83.5	83.53	353	16.92	3,562	70.49
67	966	90	50	90	9.00	6.00	.....	83.53	433	18.93	5,822	84.37
68	1,041	90	50	90	9.00	6.00	.....	84.37	412	20.33	5,205	79 65
Check 11	595	110	55	94	10.00	7.50	79.3	84.43	491	23.53	5,548	91.24
69	492	94	48	92	9.00	7.00	81.1	83 21	307	18.14	3,904	60.19
70	495	107	47	93	9.00	7.75	77.5	83.77	375	27.71	6,370	65.36
71	564	91	48	92	9.50	7.50	87.7	81.15	412	20.34	5,753	76.64
72	316	48	18	70	7.50	5.25	73.5	78.15	77	17.08	685	14.36
73	482	54	18	70	8.25	5.50	77.3	74.21	126	12.97	1,644	23.38
74	437	60	17	70	10.00	5.00	72.3	77.33	110	15.89	2,000	20.58
*75	.....	93	45	70	9.00	7.50	80.3	82.73	655	15.83	2,226	33.85
*76	.....	78	36	75	7.25	6.75	77.1	86.04	449	17.79	1,211	25.56
*77	.....	90	45	75	9.75	6.50	82.4	82.22	798	17.78	2,779	39.77
*78	.....	96	51	65	8.50	6.50	78.9	83.58	694	14.98	2,164	39.40
*79	.....	75	38	80	.....	.....	75.0	82.02	730	17.71	2,314	37.08
Check *9	.....	81	45	80	.....	.....	.....	80.94	842	20.08	2,249	41.85

Rumold yellow dent, which was grown in each field. This variety yielded 18.75 bushels more in the regular trial than it did in the other field. Adding this amount to the given yield of each of the varieties marked with the asterisk will raise their yields so that they will be comparable to the yields of the varieties given in the regular trial.

Varieties giving largest yields. – In table XI the varieties which produced more than sixty bushels per acre are given, in the order of their yields. Hildreth yellow dent easily ranked first as the best producing variety, giving an average yield from two plots of eighty-nine bushels per acre. This is a rank-growing, large-eared, late-maturing corn which has been grown in Labette county for a number of years, until it may be called a "native" variety. Mr. C. E. Hildreth, Altamont, Kan., from whom the seed was secured, says that it withstands drought better than other varieties, which he attributes to the large stalks and large cobs, which are characteristic of the variety. The cobs, although rather large, were covered with eighteen to twenty rows of medium-deep kernels, giving a large amount, as well as a large per cent., of shelled corn per ear. This is a promising variety of corn, but may be too late in maturing for growing in the northern part of the state.

Brazilian Flour corn is preeminently a fodder corn, but it appears to be a good producer of grain also, ranking second in yield (88.01 bushels per acre) in this trial. The corn, however, is soft and starchy, and has less feeding value than dent corn, and no regular market value except for seed. As a fodder corn this variety ranks high, making a large, leafy growth, suckering freely and bearing many ears, which increase the richness of the fodder.

Hammett white dent, which ranked third in yield (79.01 bushels per acre), is another "native" Kansas corn, which has been grown in the vicinity of Marysville, Kan., for the last twenty years. Mr. Hammett exhibited a sample of this corn at the World's Fair in 1883, taking a medal and diploma. This variety matured medium early. It made a good growth of stalks, and almost every stalk bore an ear. The ears are rather short, and the cobs are medium large, with a fair depth of kernel, but the per cent. of corn to cob was rather low. This variety was grown on the unmanured land mentioned above, and gave an inferior yield of 33.45 bushels per acre. Mr. Hammett says the corn is best adapted for growing on bottom land and on fertile soil.

Next to Hammett came Mammoth White Dent, with a yield of 77.12 bushels per acre. This corn is also "native" stock, having been grown in the vicinity of Manhattan for several years by G. T. Fielding, who describes it as the best corn he ever raised. From the

TABLE XI.—Varieties of corn tested in 1903 which yielded over sixty bushels per acre, arranged in the order of their yields.

Bulletin No.	Name.	Type.	Seed from.	Days to mature.	Barren stalks.	Moisture in ear corn as husked.	Total score.	Dry shelled corn.	Yield per acre, stover.	Yield per acre, air-dry shelled corn.
					per cent.	*per cent.*	*per cent.*	*per cent.*	*pounds.*	*bushels.*
11	Hildreth	Yellow dent	Kansas	132	16	23.67	81.1	84.13	5,582	89.02
67 & 68	Brazilian Four	Soft white	The South	126	*32	19.63	.....	83.92	5,514	82.01
55	Hammett	White dent	Kansas	117	9	17.45	83.2	79.41	4,110	79.04
62	Mammoth	"	"	124	*10	24.83	84.6	74.43	5,205	77.12
71	Griffing	Calico dent	"	126	35	20.34	87.7	81.15	5,753	76.64
27	Klondyke	Yellow dent	"	118	4	19.09	80.0	83.57	3,425	75.70
51	Cocke Prolific	White dent	Tennessee	128	*30	17.41	79.3	84.05	4,521	75.70
8	Bicker's Choice	Yellow dent	Kansas	128	20	21.58	78.5	83.03	5,086	74.53
13	Sedgwick	"	"	128	18	18.41	82.5	82.27	4,384	72.83
25	Hogue's Yellow Dent	"	Nebraska	119	8	17.41	83.2	84.83	3,699	72.58
58	Forsythe's Favorite	White dent	Kansas	130	15	24.94	88.4	78.47	5,068	72.55
24	World's Fair	Yellow dent	Iowa	117	12	19.69	83.2	83.63	3,630	71.24
6	Moody's Kansas Sunflower	"	Kansas	128	6	20.33	78.9	82.29	5,480	70.95
66	Red Cob Ensilage	White dent	Iowa	117	16	16.92	83.5	83.53	3,562	70.49
5	Kansas Sunflower	Yellow dent	Kansas	130	10	19.51	77.5	82.42	5,920	70.09
48	Sanders's Improved	White dent	Georgia	136	*10	19.77	85.7	85.09	4,795	69.94
61	White Kansas King	"	Kansas	122	*11	17.14	79.6	85.32	5,411	65.71
70	Webster	Calico dent	"	124	36	27.71	77.5	83.77	6,370	65.36
34	Golden Cap	Yellow dent	Nebraska	116	.....	17.18	77.8	18.51	3,877	64.90
23	Profit	"	Iowa	117	12	17.49	78.8	82.97	3,562	63.08
53	Snow Flake	White dent	Kansas	117	.....	19.84	81.1	81.71	3,836	62.91
15	Blaine	Yellow dent	"	128	16	22.18	77.1	79.42	4,589	62.47
38	Grove's Yellow Dent	"	Illinois	117	12	18.89	82.5	83.00	3,699	62.00
20	Yellow Elephant	"	Nebraska	118	24	17.00	81.0	82.38	3,247	61.59
29	Pride of the North	"	Kansas	115	11	17.50	81.4	82.54	3,699	61.57
50	U. S. P. B. Selection No. 77	White dent	Ohio	118	1	19.10	89.3	80.91	3,973	61.44
32	American Pride	Yellow dent	Michigan	110	*26	23.32	78.2	87.88	3,562	61.24
37	Funk's Ninety Day	"	Illinois	116	.....	18.33	85.0	83.23	3,751	61.21
42	Leaming	"	Ohio	114	16	16.60	73.9	80.77	3,836	61.06
31	King of the Earliest	"	Kansas	114	*2	19.26	76.7	84.96	3,699	60.82
57	Kansas Pearl	White dent	"	115	27	19.65	83.9	81.48	4,384	60.68
9	Rumold	Yellow dent	"	126	19	18.27	78.5	81.85	3,767	60.60
69	Calico	Calico dent	Illinois	122	35	18.14	81.1	83.21	3,904	60.19

*The number of ears produced by these varieties was greater than the number of stalks, by the per cent. given.

record last season, this variety produced ten per cent. more ears than there were stalks. There were many large suckers, some of which bore ears. The corn matured medium late, and was a vigorous grower, being a good producer both of ears and fodder.

Griffing calico corn stood well up among the best producing varieties, holding fifth place, with a yield of 76.64 bushels per acre. This variety has been grown for many years by W. J. Griffing, on his farm near Manhattan. In some respects, calico corn seems to be hardier and a better producer than many of the "standard" varieties of white and yellow dent. This variety, as well as the others of its class, made a rank growth of stalks, producing a large yield of stover as well as a good crop of ears.

Klondyke, the second best yielding yellow dent variety, is another medium-early maturing variety, which proved to be among the best yielders (75.7 bushels per acre). The seed of this corn was purchased from F. Barteldes & Co., Lawrence, Kan.

Cocke Prolific appears to be more of a fodder corn than most of the others, but seems to have produced many ears also, giving thirty per cent. more ears than there were stalks, which can only be explained by the fact that some stalks bore two ears. The ears were small.

Bicker's Choice, which ranked third in yield as one of the best producing yellow dent varieties, is a Kansas corn of rather late maturing season and is a promising variety. It has been grown for several years by J. H. Bicker, Council Grove; Morris county. He describes it as a "strong grower on 'good' soil, but it does not produce well on 'thin' land."

Forsythe's Favorite, holding fourth place in yield among the white dent varieties, deserves special mention. Besides being a thrifty grower and a good yielder, the corn scored high in quality and the ears were large, but the per cent. of corn was rather low, due partly to the large cob. It appears as a rule that the best producing "native" varieties grow large stalks and large cobs. These characters seem to go with hardiness and productiveness. There is no objection to a large cob, provided it is covered with many rows of deep-set kernels.

Another variety which deserves special mention is the Kansas Sunflower. This corn is a well-established Kansas variety, and has been grown and bred by Mr. John Moody, Eudora, Kan., for fifteen years. It is a good fodder corn as well as one of the best producers of ears. The ears are large, with medium large, fairly deep-set kernels, averaging fourteen to sixteen rows per ear. It matures medium late.

Perhaps other varieties given in tables X and XI may be equal to

those mentioned as giving highest yields last season. A trial of several seasons is necessary before any one variety can be named as being superior to others. It is a fact worth noting, however that the largest yields, both of shelled corn and stover, wereproduced by "native" Kansas varieties, and during a season, also, which was more favorable to the imported varieties than the average Kansas season.

Barring the Brazilian Flour corn, the five highest yielding varieties vere "native" Kansas corns; at least, the seed has been grown in Kansas for many years These five varieties gave an average yield of 79.5 bushels per acre, while the five best producing imported varieties yielded 72 bushels per acre. Of the thirty-three best producing varieties, eighteen were Kansas seed, three were from Nebraska three from Iowa, three from Illinois, two from Ohio, one from Michigan, and three from Southern states.

Other good producing varieties.—Besides the best yielding varieties named in table XI, other good producing varieties were as follows:

Bulletin No. and Name.	Bushels per acre.
64. Giant Fodder	59.07
54. Snow White Dent	57.66
28. Reid's Yellow Dent	56.95
56. Stevens	56.43
35. Early Cattle King	56.20
63. Champion White Pearl	54.85
59. Boone County White	54.79
3. Leaming	54.33
21. Farmers' Reliance	53.32
46. Boone County White	53.25
26 Abundance	52.96
17. Early Mastodon	52.76
14. Dahlsten	52.45
16. Mammoth Golden Yellow	51.00
49. Mosby's Prolific	50.79
60. Nebraska White Prize	50.23
47. Boone County White	50.13

Of the varieties grown on the unmanured land, No. 77, Legal Tender, deserves special notice for its yield and other good qualities. No. 78, the Leaming variety, from Funk Brothers, also produced well. The seed of many of the varieties named above came from other states, as noted in table X. Doubtless the imported varieties will produce better as they become better accustomed to Kansas conditions. It would appear, however, that the best producing sorts which have been grown in Kansas for a number of years, so that they have become thoroughly acclimated, are safest to grow, and offer the best foundation for selection and breeding in order to establish pure types or breeds of corn.

Yields compared according to type, maturing season, and origin of seed.—Comparing the types of corn: Out of the thirty-three best producing varieties, nineteen were yellow dent (average yield, 67.2 bushels per acre); ten were white dent (average yield, 69.6 bushels per acre); and three were calico corn (average yield, 67.4 bushels per acre). The ten best producing yellow dent varieties gave an average yield of 72.5 bushels per acre.

The early maturing varieties, northern-grown seed, gave the poorest yields. The very low yields given in table X for some of these varieties was partially due to a poor stand, as will be observed by noting the column marked "Number of stalks." However, such standard northern-grown varieties as Pride of the North, Minnesota No. 13, and Northwestern Dent, which made a fair stand, gave very inferior yields of fifteen to twenty bushels per acre. For late planting these varieties proved to be better yielders (see "Late-planted Corn"); yet even for late planting they are not to be compared to early Kansas sorts.

Of the thirty-three varieties giving highest yields, sixteen were late or medium late-maturing varieties, and gave an average yield of 71.6 bushels per acre, while seventeen matured medium early, and the average yield was 65.4 bushels per acre. The results thus favor the late-maturing sorts as being the best producers of corn; also in the production of stover the late varieties greatly outyielded the medium early sorts. Of the varieties mentioned above, the late sorts gave an average yield of 5084 pounds of stover per acre, while the medium early varieties yielded on the average 3732 pounds per acre, a difference of 1314 pounds in favor of the late-maturing corn. The early corn contained a little less moisture in the ears as husked than the late corn. The average for the seventeen samples of early corn was 18.51 per cent.; for the late corn, 22.12 per cent.

Varieties which scored highest.—Some of the varieties which were not included among the best yielders graded or scored high. The ten varieties scoring highest were as follows: Forsythe's Favorite, 88.4 per cent.; Griffing calico, 87.7 per cent.; Nebraska White Prize, 87.1 per cent.; Sander's Improved, 85.7 per cent.; Funk's Ninety Day, 85 per cent,; Champion White Pearl, 84.8 per cent.; Boone County White, 84.6 per cent,; Mammoth White Dent, 84.6 per cent.; Kansas Pearl, 83.9 per cent.; and Red Cob Ensilage, 83.5 per cent.

As a rule, the per cent. of shelled corn, as related to the total weight of ears, does not seem to have had any direct relation to the total yield of shelled corn. The varieties having over eighty-four per cent. of shelled corn were as follows: Mosby's Prolific, 88.56 per cent.;

Hickory King, 87.92 per cent.; American Pride, 87.88 per cent.; Race Horse, 86.92 per cent.; Riley's Favorite, 86.59 per cent.; Golden Eagle, 86.04 per cent.; Dahlsten, 85.62 per cent.; Sanders's Improved, 85.09 per cent; King of the Earliest, 84.96 per cent.; Farmers' Reliance, 84.9 per cent.; Abundance, 84.85 per cent.; Hogue's Yellow Dent, 84.83 per cent.; and Hildreth, 84.23 per cent.

Varieties giving highest yields of stover.—The varieties yielding two and one-half tons of stover per acre were as follows: Webster calico, 6370 pounds; Griffing calico, 5753 pounds; Kansas Sunflower, 5700 pounds; Hildreth, 5582 pounds; Brazilian Flour, 5514 pounds; Mosby's Prolific, 5480 pounds; White Kansas King, 5411 pounds; Mammoth White Dent, 5205 pounds; Forsythe's Favorite, 5068 pounds. All these were late-maturing varieties, and all but two were Kansas-grown seed, while the two exceptions were seed brought from a Southern state. The best producing "native" varieties are characterized by large stalks and large ears, with medium large kernels, which contain large germs. These characters indicate a hardy corn and a vigorous grower, and have been produced by climatic conditions. and may be necessary in order that the corn may resist drought and hot winds.

Average weight of ears-barren stalks.—The average weight of the ears (found by dividing the weight of the ears as husked by the number of ears harvested) varied from less than one-half pound to more than three-fourths of a pound, in some of the large-eared varieties. The difference between the number of ears harvested and the number of stalks on each plot divided by the number of stalks gives the percentage of "barren" stalks, viz., stalks bearing no ears, or ears not worth husking. This per cent. varied from nothing to forty, while with a few varieties, as Nos. 48, 51, 61, 62, and 68, the ears outnumbered the stalks. In counting the stalks, suckers were not included. Some varieties produced many suckers, as noted in table X, and these suckers sometimes produced ears; also, with some varieties, two ears were frequently borne on one stalk. A more careful study will be made on this point again next season.

LATE-PLANTED CORN.

On account of the excessive wet weather during May many farmers did not get their corn planted at the regular planting season; also a large part of the crop on the river-valley lands was destroyed by the extensive floods. This necessitated late planting of much corn, and it was considered an opportune season to test the several varieties of corn as to their relative adaptation for late planting. Twenty-nine varieties, selected mainly for earliness, were planted June 16 and 17

with the lister, in rows three and one-half feet apart and kernels about twelve inches apart in the row. The seed planted was the same as that planted in the variety trial, as reported in table X. The field used was rented land, and had been listed to corn early in May, and the above planting was made by splitting the ridges between the listed farrows. Thus the ground was double-listed. The field sloped quite uniformly towards the east, with a fall of about one foot in a hundred feet. The plots were arranged in two series of parallel plots extending with the slope. Each plot consisted of four rows 436 feet long, giving an area of 0.14 of an acre. The ground received no manure and was of average fertility.

This corn was harrowed several times and was well cultivated, All of the varieties made a rank growth of stalks. Notes were taken on the maturity of the corn September 24. At that date Triumph flint corn was fully ripe, and University No. 13 was nearly ripe, and all other varieties were in the dough or milk stage. The corn was cut and shocked October 10, before killing frost. The stage of maturity is given in table XII. None except the two varieties named above matured fully. These were northern-grown seed and mature in a short season, but do not give sufficient yield to compare favorably with the southern-grown corn. Other varieties which yielded well and which nearly matured, or matured sufficiently to make good corn, are named below in the order of their maturity (as per notes taken October 8): Early Longfellow Dent, Funk's Ninety Day, Learning, Boone County White, Early Mastodon, Early Cattle King, Pride of the North, King of the Earliest, Nebraska White Prize, Farmers' Reliance, Golden Row, Hogue's Yellow Dent, Stevens's White Dent, and Reid's Yellow Dent. The yields of shelled corn, as given in the table, were calculated on the air dry basis, as described in the discussion of the regular trial of varieties, so that the yields of corn are exactly comparable. The yields of stover were calculated by taking the weight of the stalks as they were hauled from the field soon after the corn was husked. No determination of the moisture in the stover was made, but the stalks were well cured and seemed to be air-dry. The weight of the ears when harvested, the percentage of shelled corn and the percentage of moisture in the corn when it was husked are given along with other data in table XII.

The varieties which ripened enough to make good corn, giving highest yields in this trial, were as follows: Early Mastodon, 54.4 bushels; Pride of the North, 51.95 bushels; Learning, 50.9 bushels; Reid's Yellow Dent, 50.8 bushels; Early Cattle King, 50 bushels; Golden Row, 49.2 bushels; Farmers' Reliance, 48.5 bushels. Of these varieties, Reid's Yellow Dent gave the largest yield of stover (2929

TABLE XII.—Late-planted corn.

Bulletin No.	Name of variety.	Type.	Stage of maturity October 8.	Height of stalk.	Leafiness.	Yield per plot, ear corn as husked.	Moisture in ear corn as husked.	Shelled corn.	Yield per acre, cured fodder.	Yield per acre, air-dry shelled corn.
				inches.	*per cent.*	*pounds.*	*per cent.*	*per cent.*	*pounds.*	*bushels.*
1	Golden Beauty	Yellow dent	Soft dough	114	95	559	30.78	80.36	4,321	46.7
5	Kansas Sunflower	"	Dough and milk	106	80	522	30.41	79.65	4,071	43.4
12	Ramsey	"	Soft dough and milk	106	92	289	34.32	79.34	1,607	22.6
13	Sedgwick	"	Soft dough to hard	102	90	529	41.85	77.54	3,557	35.8
14	Dahlsten	"	¾ dough, ¼ ripe	102	90	465	29.86	86.45	2,821	42.2
16	Mammoth Golden Yellow	"	"	108	97	437	24.56	78.87	3,000	39.0
17	Early Mastodon	White-capped yel. dent	Nearly ripe	114	85	657	31.43	80.47	2,321	54.4
20	Golden Row	Yellow dent	⅓ dough, ⅔ ripe	96	80	542	27.55	83.45	2,571	49.2
21	Farmers' Reliance	"	¼ dough, ¾ ripe	90	85	500	24.20	83.60	1,929	48.8
23	Profit	"	Tough dough	114	90	311	30.58	81.73	2,107	26.4
25	Hogue's Yellow Dent	"	½ dough, ½ ripe	102	90	.....	25.54	.....	1,393	.....
29	Pride of the North	"	Mostly ripe	102	90	556	23.51	81.03	.....	51.9
31	King of the Earliest	"	"	96	85	415	25.36	85.58	2,179	39.8
33	University No. 13	"	Ripe	72	60	182	17.69	82.24	1,000	37.0
35	Early Cattle King	"	Mostly ripe	114	88	517	22.71	83.39	2,357	50.0
37	Funk's Ninety Day	"	"	96	75	420	30.06	84.44	2,179	37.2
40	Reid's Yellow Dent	"	⅔ dough, ⅓ ripe	114	95	566	30.01	85.41	2,929	50.8
42	Leaming	"	Mostly ripe	96	80	512	22.16	83.52	2,000	50.9
44	Hickory King	White dent	Dough	108	88	498	29.25	82.97	3,607	43.9
46	Boone County White	"	Mostly ripe	120	88	505	30.79	80.19	3,000	42.1
56	Stevens	"	½ dough, ½ ripe	102	90	.....	25.54	.....	1,393	.....
58	Forsythe's Favorite	"	Dough	114	90	565	33.80	78.29	3,750	44.0
59	Boone County White	"	⅓ soft dough, ⅔ ripe	114	85	465	24.15	82.75	2,393	43.7
60	Nebraska White Prize	"	⅔ ripe	108	80	478	25 10	83.30	2,500	44.7
70	Webster	Calico dent	Soft dough	120	96	486	28.83	78.92	3,357	41.0
73	Triumph	Yellow flint	Ripe	72	70	150	18.23	79.07	1,000	28.4
75	Farmers' Interest	White dent	Milk and dough	118	89	717	28.44	79.07	3,429	60.9
80	Early Longfellow Dent	Yellow dent	Mostly ripe	102	80	435	23.78	80 80	2,000	40.2
81	Mammoth White Pearl	White dent	Dough and milk	102	90	474	33.66	78.81	2,643	37.2

pounds per acre). Larger yields of fodder and ears were produced by some of the varieties which did not mature, as Farmers' Interest, Golden Beauty, Kansas Sunflower, and Hickory King. The stalks seemed to grow taller with the late than with the early planted corn, yet the yield of cured stover was usually less with the late-planted corn.

LATE FORAGE CROPS.

Besides the planting of forage crops in the regular trials of varieties, as noted above, experiments were made in the late planting of several crops, in order to compare the yields and relative value of the dry fodder. In this experiment, the crops were all seeded in close drills and given no cultivation after seeding. The field used for the trial slopes uniformly toward the east, and the plots extended east and west, and were 825 feet long and 61 feet wide, containing 1.24 acres. The land had been listed in corn earlier in the season, and the ground was prepared for the forage crops by splitting the ridges with the lister, which covered up the corn that had started, after which the field was double-disked, and then leveled by means of the float and harrow, which left the soil level, mellow, and in good condition to receive the seed. The crops were planted June 23 and 24, with the grain-drill. The finer seeds were sown with a shoe-drill, in drills six inches apart, while the coarser seeds were planted with the disk-drill, in drills eight inches apart. The rate of seeding is noted in table XIII. No remarks need be made regarding the early growth of these crops. The height of the fodder and the yields are noted in the table.

The millet was cut September 12, the soy beans and cowpeas September 21, and the other crops September 23 and 26. All crops were cut with the mower. The soy beans were allowed to become too nearly mature for fodder and were saved for seed. The mower was provided with a side-delivery attachment which laid the beans in windrows out of the way of the horses. The cowpeas were raked into windrows at once, while green, and hauled to the silo, a sample being kept in order to determine the loss of moisture and the dry weight of the fodder. The yield of green fodder was 7.87 tons per acre, which contained 86.73 per cent. of water, leaving only 1.05 tons of dry matter.

The other crops, after curing in the swath for several days, were raked into windrows, piled in large bunches by hand, and allowed to remain in the field until December, when the fodder was hauled and stacked in long, rather narrow stacks. The fodder had cured remarkably well, and was bright and sweet when stacked. The corn-fodder was dryest and had lost some by weathering, but the cane-fodder and

TABLE XIII.—Late forage crops.

Plot No.	Name of crop.	Variety.	Seed planted per acre.	Days to mature fodder.	Average height.	Cured fodder, yield per acre.	Moisture in cured or air-dry fodder.	Dry matter per acre.
			lbs.			*tons.*	*per cent.*	*tons.*
1	Soy beans...	Early yellow,	115	90 (ripe)	2 ft.	*a* 1.12		
2	Cowpeas..	Whip-poor-will.....	94	90	2 ft. 6 in.	*b* 1.26	*b* 16.78	1.05
3	Millet	Siberian.....	69	81	2 ft. 1 in.	1.59		
4	Cane	Orange.....	81	94	7 ft.	7.70	39.40	4.62
5	Corn.....	Calico.....	125	94	7 ft. 6 in.	3.93	27.01	2.87
6	Kafir-corn and cowpeas	Black-hulled White	56	94	4 ft. 6 in.	6.12	36.20	3.89
		Whip-poor-will.....	94		1 ft. 6 in.			
7	Cane and cowpeas	Orange.....	36	94	6 ft. 8 in.	7.85		
		Whip-poor-will.....	94		3 ft.			
8	Corn and cowpeas	Calico	79	94	8 ft. 6 in.	3.69	38.88	2.25
		Whip-poor-will.....	94		2 ft. 6 in.			

a. The soy beans were allowed to mature, and a yield of 7.4 bushels of beans per acre mas secured. The total weight of the crop was not taken, but the yield of fodder was estimated from the yield in an adjoining field.

b. This yield of fodder was calculated from the weight of green fodder, as given in table XV. A sample of cowpea fodder left in a dry-room until February 6, 1904, contained 16.78 per cent. of mater. Air dry fodder as stacked would contain a larger percentage of moisture.

Kafir-fodder were in excellent condition; the fine stem-growth and the favorable fall weather had allowed these crops to cure out better than is usually the case, and the fodder pitched and handled almost as nicely as hay. Samples were taken when the fodder was stacked, from which the percentage of moisture was determined and the actual yield of dry matter was calculated, as given in table XIII.

The cowpeas were cut when some of the pods were turning yellow, but most of the pods were green and filled with plump green peas. The vines were well covered with leaves and pods, and just about the right stage of maturity to make the best quality of silage or dry fodder. The peas may have been planted too thickly to make the greatest growth. By actual count, the plants averaged about six inches apart, in drills eight inches apart. Apparently this is a good method of growing cowpeas for fodder and silage production. Grown in this way the plants stand up well—do not vine so much as when cultivated in rows, and are readily cut with the mower. Possibly a ranker growing variety than the "Whip-poor-will" may be found preferable for growing in this way.

The leaves had all dropped from the plants before the soy beans

were cut. Because of this habit, and also because of their small yield, soy beans cannot be recommended as a practical fodder crop. Although the beans were seeded at the rate of nearly two bushels per acre, the stand was not too thick to allow a good development of the plants. The plants averaged five inches apart, in drills eight inches apart, or about six plants per square foot. In spite of the good stand of beans, this plot was quite weedy. The beans did not grow rapidly enough and rank enough to keep down the weeds. The weeds were not noticeable in any of the other plots.

The cane seeded alone was very thick, the plants averaging less than one inch apart, in drills six inches apart. The stalks were very small, but had a good supply of leaves, making a very dense growth and an immense crop of excellent fodder. There was a very small development of heads. The seed was in the milk stage when the cane was cut.

Cane and cowpeas planted together gave a slightly larger total yield than was obtained from the cane alone, but the fodder was not so fine in quality, because the cane was much thinner on this plot and grew coarser and taller than it did on the plot seeded with cane alone. The cane plants averaged two inches apart, in drills six inches apart. The cowpeas made a very dwarfed and spindling growth, and produced considerable foliage, but no pods; they added very little to the total weight of the crop.

In the Kafir-corn the cowpeas were even less in evidence than they were in the cane. The Kafir fodder was very thick, being noted as "twice as thick as cane seeded alone." The Kafir stalks were very fine and slender, and also very leafy, and made excellent hay. There was very little development of heads.

The cowpeas grew better with the corn than with any of the other crops, mainly because the corn was not nearly so thick, the stalks averaging twelve to eighteen inches apart, in drills eight inches apart. The peas made a fair growth of vines, but produced no pods. They were estimated to be about one-tenth of the crop. The corn-stalks, however, were too large to be handled easily with the pitch-fork, and the smaller yield of the combined crop, as compared with corn alone, shows that the thicker planting of corn alone produced the more profitable crop. There were a few nubbins on the corn, about in the dough stage, when the fodder was cut.

The corn alone gave a fine growth of leafy stalks and made good hay. The plants averaged six inches apart, in drills eight inches apart. Corn needs to be sown thick, as do also cane and Kafir-corn, in order to make the fodder easy to handle and of the best quality. In this trial the corn was none too thick, but the cane alone and the

Kafir-corn might have been planted a little thinner. The experiments show that it is not practicable to attempt to grow cowpeas with sowed Kafir-corn, cane, or corn. From the standpoint of yields, the results of this experiment place cane first, Kafir-corn second, corn third, and cowpeas fourth. Cane and Kafir-corn are certainly excellent crops to grow for fodder in this way.

LATE PASTURE CROPS.

An experiment, which was practically the duplicate of the one just described, except that soy beans were in part substituted for cowpeas, was planned, with the purpose of using the forage crops for pasture. The field used for the experiment grew a crop of millet in 1902, and was seeded to rye in the fall of 1902, which was pastured last spring until about June 1. The field was plowed June 16–26. During most of the plowing the ground was hard, and turned over in a rather cloddy condition. The field was double disked June 25, 26 soon after a rain, so that the ground was left fairly well pulverized, but still too dry to germinate the seed. On July 1 there was sufficient rain to moisten the surface, and the ground was immediately harrowed and planted.

The field slopes to the north, and the plots extended north and south and were 605 feet long by 103 feet wide, making an area of 1.86 acres in each plot. The crop, or combination of crops, planted and the rate of seeding are given in table XIV. There was a good rain July 3, 4, and on July 6 all the plots were harrowed crosswise. This broke the crust and left the soil in fine condition, yet the seed did

TABLE XIV.—Late pasture crops.

Plot No.	Name of crop.	Variety.	Seed planted per acre.	Remarks.
			pounds.	
1	Corn	Calico	97	Preferred by cattle to all other crops.
2	Cowpeas and corn	Whip-poor-will Calico	67 53	A good combination, furnishing more pasture than corn alone.
3	Soy beans and corn	Early Yellow Calico	59 50	A good combination, but corn should not be planted too thick.
4	Soy beans and Kafir-corn	Early Yellow Black-hulled White	59 48	Least preferred of any crop by cattle, and much wasted by tramping down.
5	Cane	Orange	78	Preferred after corn and soy beans, and much wasted by tramping down.
6	Soy beans and cane	Early Yellow Orange	70 48	Eaten better by cattle than cane alone.
7	Cowpeas	Whip-poor-will	100	Not eaten so well as when grown with the corn. Ranked third or fourth, as preferred by cattle.
8	Soy beans	Early Yellow	105	Preferred by cattle next after corn.
9	Millet	Siberian	43	Not pastured; matured too early; yielded 2.23 tons of hay per acre.

not sprout and grow as rapidly as in the other trial, and some of the crops in the last trial did not make nearly so thick a stand, although fully as much seed was planted. However, all crops made a good stand and a fair growth.

It was intended to pasture each of the plots separately, but this was found to be impracticable last season, and on August 21 a herd of twenty-five milch cows was turned into the field and allowed a full run of all the plots. At this date the millet had been cut for hay, and several of the crops were advanced in growth further than was necessary to furnish good pasture.

On August 20, notes were taken on the several crops, as follows:

"Soy beans.—Average height, sixteen inches; not very weedy, except in spots; light in color and beginning to blossom.

"Cowpeas.—Average height, eighteen inches; good, rank growth, but light in color in places; a more even stand than the soy beans.

"Cane and soy beans.—Cane varies from two to four feet in height; small stalks, light color, very spotted in growth. Soy beans average two feet in height; light color; much better growth where cane is thin.

"Cane alone.—Varies from two and one-half to four and one-half feet in height; uneven growth and too light in color.

"Kafir-corn and soy beans.—Average height of Kafir-corn, two and one-half feet; yellow color and uneven growth. Soy beans, seventeen inches high; spindling growth and yellow color.

"Corn and soy beans.—Average height of corn, three feet and eight inches; uneven growth; poor stand in places. Soy beans growing well; average height, two feet.

"Corn and cowpeas.—Average height of corn, three and one-half feet; fair stand, light color, fair crop. Cowpeas, two feet high; good color and good stand; best appearance of any legume in the field.

"Corn alone.—Average height, three feet; fairly good growth, but light color."

The pasturing of the crops was in charge of the Animal Husbandry Department. The following report was made by Mr. G. C. Wheeler, assistant in feeding:

"August 21, twenty-five cows were turned into the pasture and allowed to remain twenty minutes. As they passed over the plots the cows ate some of the soy beans and some of the cane, but did not seem to care for the cowpeas. They soon reached the corn on the farther side of the field, and fed mainly on plots 1, 2, and 3. (See table XIV.)

"August 22, the cows were left in the field forty-five minutes, with practically the same results as noted yesterday.

"August 23, the cows remained on the pasture one and one-fourth hours. They grazed principally upon corn and soy beans, taking only an occasional mouthful of cowpeas as they fed upon the corn.

"August 24, the cows were left two hours. They fed mostly on corn and soy beans, but ate some cane and cowpeas.

"August 25, the cows were left for two hours. They seemed to get all they wanted to eat in that time. They commenced feeding on soy beans as they entered the field; ate some cowpeas, cane and Kafir-corn as they passed along, but finally stopped on the corn, making that their main diet.

"August 26, the cows remained in the pasture three and one-half hours. They fed mainly on corn, but ate some soy beans and a little Kafir-corn.

"August 27, the cows were in the pasture for four hours, with practically the same results as noted on August 26.

"August 28, the cows were in the pasture four and one-half hours. They fed mainly on corn, but ate some cowpeas. One cow seemed to prefer cowpeas, while another apparently preferred cane.

"August 29, the cows were left in the pasture three and one-half hours. They fed on soy beans with evident relish for about ten minutes and then gradually moved over to the corn and made that their main diet, eating some of the soy beans and cowpeas that grew with the corn on plots 2 and 3.

"August 30, 31, were practically repetitions of the results given above. Up to this time corn and soy beans seemed to have been the two forage plants preferred by the cows, and corn had formed the larger part of their food.

"For the first part of September the cattle continued to feed much the same way, gradually beginning to graze more upon the other crops, possibly because the best part of the corn had been eaten off, and also doubtless they were learning to like the other fodder. The note was made September 6 that the cows fed about equally well from all plots, and that some seemed to favor the cane.

"On September 7, besides the cows, twenty head of young cattle were turned into the pasture and left one and one-half hours. They fed principally upon soy beans and corn. From this date until September 20 forty-five head of cattle were pastured each day upon these crops.

"September 8, the young stock ate some of nearly everything.

"September 9, the cattle feed freely from each crop. It was observed, however, that much of the cane and Kafir-corn was being wasted by the stock tramping it down.

"September 10, the cattle seemed to favor cane and passed over the soy beans without feeding much. This was partly due, no doubt, to the fact that the beans had been pretty well eaten off, and also that they were becoming matured.

"September 11, the cattle fed mostly on the cane and Kafir-corn. The corn was about gone, but the cattle still picked at the stubble. From this date until September 20, when the cattle were removed from the pasture, they fed mainly upon the cane and Kafir-corn, although they cleaned up the cowpeas and soy beans which were planted with the corn, but did not seem to eat these crops quite so well where they were planted alone.

"When the cattle were removed, September 20, the pasture had been practically exhausted, but fully one-half of the cane and Kafir-corn was tramped down and wasted."

The results of this trial show clearly that corn was relished best by the cattle, and doubtless furnished more pasture than any of the other crops. Next to corn, soy beans were preferred, especially in the early part of the trial, before the beans had become too mature. The third preference of the cattle was probably for cane, and the fourth for cowpeas, although the cowpeas in the corn were well eaten before the cane had received much attention. The suggestion is that several crops seeded together furnish more pasture, which is perhaps relished better by the cattle than any one crop planted alone. An average of thirty-three head of cattle, including twenty-five milch cows, were pastured as described for thirty-one days on these crops, which covered an area of fifteen acres. This was not a very large amount of pasturage. It is safe to say that if the whole field had been in corn and soy beans, or corn and cowpeas, it would have given twice or three times the amount of pasture which it did furnish.

SILAGE CROPS.

Several crops were planted in different fields and at different dates to be used for silage. The purpose was not especially to compare the yields of these different crops, but rather to compare their keeping qualities and their feeding value as silage. This part of the work is in charge of the Animal Husbandry Department of this Station, and has not yet been completed. The names of the crops grown and put in the silo, together with the yield of grain, fodder, and other data, are given in table XV.

Little description need here be given of the planting and culture of these crops. The early corn on plot 1 was planted with the planter in drill rows three and one-half feet apart, kernels ten to twelve inches apart in the row. The late corn was planted with the lister, about the same thickness as on plot 1. The Kafir-corn and cane were planted with the grain-drill, in drill rows forty inches apart, The drill was set to sow one bushel of wheat per acre. This produced a thick growth of fine, leafy fodder with a fair development of heads. At harvest-time, by actual count, the stalks of Kafir-corn averaged two inches apart and those of cane three inches apart in the drill row. Each of the above crops was given proper cultivation and harvested when in good silage condition.

The cowpea crop used for silage was the same as that mentioned in table XIII, and described under "Late Forage Crops."

Cowpeas with corn—The cowpeas with corn were planted with the lister at the same date as the late-planted corn, and in the same field. The ground was double-listed, the seed being planted in furrows about four inches deep. The pens and corn were mixed together in

TABLE XV.—Silage crops.

Plot No.	Name of crop.	Variety.	Date planted.	How planted.	Seed planted per acre.	Date cut.	Stage of maturity.	Average height.	Yield, green fodder per acre.	Moisture in green fodder.	Dry matter per acre.	Average cost of silage per ton.
					lbs.			*feet.*	*tons.*	*per cent.*	*tons.*	
1	Corn	Blaine's Yellow Dent	April 25	Planter, drill rows 3½ feet apart	10	Sept. 5	Hard dough	7½	7.77	.....	.....	$2 26
2	Corn	Leaming and Silver-mine	June 27	Lister, drill rows 3½ feet apart	10	Sept. 23	Milk and dough	8	8.12	75.49	1.99	2 20
3	Corn and cowpeas	Silver-mine Whip-poor-will	June 27	Lister, drill rows 3½ feet apart	7 7	Sept. 23	Milk and dough Green pods	8 4	7.27	77.76	1.66	2 39
4	Kafir-corn	Black-hulled White	June 12	Grain-drill, rows 3½ feet apart	15	Sept. 21	Hard dough	6½	11.03	76.74	2.57	1 95
5	Cane	Folger	June 12	Grain-drill, rows 3½ feet apart	15	Sept. 21	Nearly hard	8	11.16	.....	.....	1 95
6	Cowpeas	Whip-poor-will	June 23	Grain-drill, rows 8 inches apart	94	Sept. 21	Green pods	2½	7.87	86.73	1.05	2 31
7	Alfalfa	Common	Fall, 1902	Seeded broadcast	20	Sept. 23	Bloom	1¼	4.00	71.32	1.15	1 63

equal parts by weight. A rim-drop, sixteen-cell plate, in which the cells had been lengthened by filing out the ends, was used to drop the seed. By this means the seed was distributed, so that, by actual count, the corn-stalks averaged nearly two feet apart and the cowpea plants about six inches apart in the row. Planted at a late date, and in a warm, moist soil, the peas sprouted and grew as rapidly as the corn, so that they were not covered by the early cultivation. Later, the corn-stalks served as a support for the pea-vines, as is shown in plate IX, which was made from a photograph of the field taken September 10. The crop was readily harvested with a corn-binder, which gathered the pea-vines nicely, binding the fodder into neat bundles, which were easily handled and shocked.

In a sample of six average bundles, the pea-vines were separated from the corn-stalks and the weight of each determined, by which it was found that the pea plants represented twenty-one per cent. of the weight of the green fodder. When the crop was harvested the pea-vines were fairly well podded and the pods were filled with large green peas, the corn was in the milk and soft-dough stage, and both the peas and the corn were in just about the right stage of maturity to make the best quality of silage. This combination crop ought to have a higher feeding value for silage or dry forage than corn alone.

Note has already been made of the unsuccessful attempt to grow cowpeas with sowed corn in the forage-crop trial. In another experiment the cowpeas and corn were planted early in the season, about the usual time for planting corn. This method proved to be a failure because the cowpeas started slowly, many of the plants were destroyed by unfavorable weather, and most of the remainder were covered by the cultivator. Another trial was made in which the peas were planted in the corn rows after the corn was up. This did not prove successful, because it was found necessary to cover the young plants in cultivating in order to destroy the weeds in the corn. Thus the first plan described above, as given in table XV, plot 3, seems to be the only practical method of growing cowpeas and corn together for the production of silage or dry fodder. For the greatest yield of fodder the crop should be planted thicker than was the case in the above trial; corn twelve to eighteen inches apart and cowpea plants three to four inches apart in the drill row would not be too thick. Perhaps the most practical way to plant the crop would be to plow the land and prepare a good seed-bed and plant with the grain-drill, in rows the desired distance apart, by stopping up part of the feed-cups. By this method the amount of seed planted could be readily controlled. It would appear that in mixing the seed the combination

of half corn and half cowpeas was about right, This crop will make excellent dry forage as well as good silage.

Cost of silage.—In determining the cost of silage per ton, four dollars per acre was allowed for rent of land, Proper charges were made for preparing the seed-bed for the seed, for planting, for cultivating the crop, for harvesting, for hauling, and for cutting up and elevating tho crop into the silo. The last charge was estimated at twenty cents per ton. The other charges were for actual labor or material used. The following outline of the expense of growing and siloing the cane is given as an example, to show how the cost of production was determined:

Rent of land	$4 00
Plowing	1 25
Subsurface-packing	50
Harrowing (twice)	50
Planting	40
Seed, fifteen pounds	30
Harrowing after planting (twice)	50
Cultivating (four times)	2 50
Hoeing	67
Cutting	80
Twine, six pounds, at 13 cents	78
Hauling (11.16 tons, at 66 cents per ton)	7 36
Total cost per acre	$19 56
Average cost per ton delivered to feed-cutter	$1 75
Average cost per ton, cutting and elevating into silo,	20
Total average cost of silage per ton	$1 95

The average farmer will grow these crops cheaper than it is possible to grow them at this Station, because he will carry on the work in larger fields and on a larger scale, and perhaps with cheaper labor, In the above trial the cost was increased by a longer haul than would be usual on the well-regulated farm; also, the yields secured were not large. As the yield is increased the cost per ton of producing the silage is lessened. Thus, a small plot of Kafir-corn produced 15.25 tons of green fodder per acre, which was placed in the silo at a cost of $1.65 per ton.

The figures indicate that alfalfa can be more cheaply made into silage than any of the crops. The estimate on the cost of alfalfa silage is based upon an annual yield of twelve tons of green alfalfa per acre for a period of six years. Cane and Kafir-corn have given the largest yields and lowest cost per ton of any of the annual crops, while corn ranks second, and cowpeas third. It cost more to produce the cowpea-corn silage last year than it did to silo any other crop; but this was partly due to the low yield of the cowpeas and

corn. By thicker planting, larger yields may be produced, at a lower cost.

BALING ALFALFA.

Occasional reports have appeared in the agricultural press of the Middle states advocating the baling of clover hay while in a wilted or partially cured condition, claiming that the method was an economical practice, and that it made a better grade of hay than could be made in the ordinary way. These reports have led to considerable discussion among Western farmers and in the farm papers as to whether alfalfa could be profitably handled in the same way. In order to determine at what stage of curing alfalfa may safely be baled, and whether this method of handling the crop is a practical one, the Farm Department conducted the following experiment last season:

The baling was done July 16, with a 14x18 Lightning hay-press, manufactured by the Kansas City Hay-press Company, This press has a capacity of one ton or more of prairie hay per hour. The alfalfa used was the second cutting of a medium growth, from an old field, and was about one-fourth in bloom when cut. Fifteen bales were made from green alfalfa, which was raked and hauled to the baler immediately after being mowed. Six bales were made from alfalfa that was wilted, having been mowed in the morning and baled in the afternoon of the same day. Fourteen bales were made from alfalfa that was cut July 14 and put in cocks July 15. This alfalfa was in the "sweat" when baled, and did not differ much in moisture content from the wilted alfalfa. Nineteen bales were made from well-cured hay in proper condition to stack.

TABLE XVI.—Giving data on baled alfalfa.

Stage of curing when baled.	Average weight of bales at baling.	Average dry weight of bales October 12.	Loss of weight.
	pounds.	*pounds.*	*per cent.*
Green.....	164	57	65.2
Wilted.....	167	92	44.9
In sweat.....	171	96	43.9
Well cured.....	81	76	6.2

Baling the green alfalfa was hard work for the men and teams, and was also a strain on the press. The cured hay handled much easier and baled faster. It will be observed from table XVI that the average weight per bale of the cured alfalfa, when baled, was eighty-one pounds, while that of the green alfalfa was 164 pounds, and the wilted, 167 pounds. The wilted alfalfa was pressed tighter than the green

alfalfa. The men who did the baling were inexperienced in the work and were able to make about twenty three-foot bales in an hour from the green alfalfa. About one and one-fourth hours were required for making the same number of bales of the wilted alfalfa. The capacity of the baler was not tested in the dry alfalfa, but ten tons per day of ten hours mould represent about the average capacity of the press.

The bales of alfalfa were stored in an open shed and placed on edge in single vertical tiers, a space of six to ten inches being left between the tiers to allow a free circulation of air. The uncured alfalfa was examined at frequent intervals, and notes made on its condition of curing. It had developed considerable heat within twenty-four hours after baling, and the fermentation lasted about twenty-five days. The outsides of the bales which were exposed to the air were not at any time very warm, but the interior was very much heated. On October 12 the alfalfa bales were weighed and examined. All of the hay was found to be well dried. The bales from the green alfalfa were very light, and the wires were so loose that the bales could scarcely be handled. There was no good hay in any of these bales, and not much that would be eaten by stock. Much of the hay was covered by a white mold, and some of it seemed to be partially rotten. The hay which was baled when wilted and that baled from the cock was about of the same grade, and but little better in quality than the hay which was baled when green. The heavier and more closely pressed bales contained the best hay, but none of it was salable hay, and the best of it was inferior for feeding. The hay which was baled after being cured was seemingly as good a grade of hay as when baled, and just as good as if it had been stacked. It had a good color, and the leaves were well retained. It would grade No. 1.

It may be concluded from this experiment that it is not advisable to bale alfalfa except when it is well cured and dry enough to stack.

The question as to whether it will pay to bale cured alfalfa from the field depends upon the amount of hay that must be put up in a given time, the capacity of the press, the force or crew that can be kept at work, the facilities for handling and storing the baled hay, and the market price. If it is desired to ship the hay or sell it in the bale, it would seem advisable to bale it from the field, if the necessary help and machinery can be obtained, as in this way labor will be saved, and without doubt a larger percentage of the leaves is retained, giving a better quality of hay than would result as a rule by baling from the stack. The main question is, whether the baling can be done fast enough to take care of the crop at the proper time and as rapidly as the hay should be put in the stack. With a large power

press, having a capacity of fifteen to twenty tons per day, it will be practicable to put up alfalfa by baling it directly from the field.

To handle hay economically in this way with a press of the above capacity, without loss of time and with the least possible expense, will require five teams and nine men, besides the necessary equipment. This assumes that the hay will be hauled to the baler by means of sweep-rakes and that the bales will be piled in the field, to be removed later. Such an outfit should be able to put up eighty acres of alfalfa, averaging one and one-fourth tons of hay per acre, in from five to six days of good weather. The same outfit should handle the crop on 160 acres in from ten to twelve days. Thus, it would take about two weeks of actual work, if the weather was favorable, to take care of the crop on 160 acres, and with unfavorable weather interfering, the period might be extended a week or two longer. It does not seem advisable to extend the cutting of one crop of alfalfa over a period of more than two or three weeks. Therefore, if the acreage is doubled it would be necessary to double the equipment and the number of men and teams required to handle the crop properly. In case the hay is stacked it would require practically the same number of men and more teams, but the work might be done more rapidly and a larger acreage could be taken care of by stacking than by baling from the field,

GRASSES.

During the past season the Farm Department has been conducting two variety trials of grasses. The first included the seeding of one-fourth-acre plots of twenty-two varieties, and eight mixtures of various grasses and legumes. The second included six varieties of grasses and clovers, which were sown in seven mixtures, on four-acre plots, for pasturing. The first field was seeded March 18 to 23, and the second March 28 to April 6. The weather after seeding was exceptionally favorable for the germination of grass seed, and a very satisfactory stand was secured of nearly all of the grasses and legumes. Both these fields were mowed several times during the summer, but the growth was somewhat uneven and weedy in places, so that it was not attempted to determine the yields from the different varieties and combination of grasses. These experiments will be continued for two or more years, and the results will be published later.

ROTATION EXPERIMENTS.

Two rotation experiments were commenced by this department last season. The plan of these experiments may best be learned from a description of one of them — for instance, the corn-rotation experiment.

In this trial twenty-four plots, each one-fourth of an acre in area,

were laid out and planted to the following crops: Wheat, wheat followed by cowpeas as a catch-crop, oats, barley, emmer, flax, millet, cane (sown broadcast), Kafir-corn, corn, corn with cowpeas sown when corn was laid by, corn with rye sown when corn was laid by, soy beans, and potatoes. Although the field is fairly uniform, most of the rotations are being carried on in duplicate plots, the exceptions being the rotations with wheat, cowpeas, potatoes, corn with cowpeas, and corn with rye, which are on single plots. In the same field was laid out a second series of plots similar to those just described, all of which were planted to corn last season. In 1904 the plots in series I will be planted to corn, and the plots in series II will be planted to the various crops named above. This alternation will be kept up as long as the experiment is continued, so that each year the experiment will include corn growing after these various crops, and also these crops growing after corn.

By this arrangement a check is secured on the effect of the season, and it will be possible to study the effect of the different crops on corn, and *vice versa,* each year under different climatic and other conditions. After the data from several years' trials has been accumulated, it is hoped that the relation between corn and the other crop will be so well known that these crops may be grown in succession as an ideal rotation for corn. It is also planned to study the effect of the rotation with grasses and legumes, other than those mentioned above, upon corn and other crops.

The wheat-rotation experiment is planned much the same as that for corn, and includes the following crops, which will be studied in their relation to wheat: Wheat, oats, flax, millet, soy beans, cane, Kafir-corn, and corn.

The green-manuring crop rotation with wheat includes four plots. It is planned to grow wheat on each of these plots every year, and the ground will be given the following treatment after harvest: Plot I, disked, lapping half; plot II, disked, lapping half, and sowed to cowpeas; plot III, untreated; plot IV, disked, lapping half, and sowed to millet. The object of this trial is to test the value of cowpeas and millet as catch crops between continuous sowings of wheat. Plot I is disked and left unplanted, as a check upon plots II and IV, in order to learn the effect of the dust mulch produced directly after harvest.

SEED SELECTION AND BREEDING.

During the past season the Farm Department has made seed selections from several of the best producing varieties of the various crops, in order to secure improvement in the yield or other desirable qualities. The work with corn has included the careful grading and

selection of the seed-corn planted; the planting of the kernels of a single ear in separate rows, in order to select seed from the best producing ears and produce a purer type of corn; the careful selection of the seed-corn in the fall before hard frost, and the careful grading and storing of the corn. Seventeen varieties of corn secured from Kansas farmers, and fifty-six varieties secured from the various seedsmen, including the standard sorts, were grown on the College farm last season. Seven of the most promising farmers' corns and six of the other varieties were grown on isolated plots in different portions of the farm, and, it is believed, were kept practically pure. Several of these varieties have made very satisfactory yields, and are in many respects promising corn for this locality and will be planted in a larger way next season.

The breeding and cultivation trials included a twenty-acre field of Reid's Yellow Dent corn (see plate VII), which gave an average yield of 50 bushels per acre. There were fourteen plots in the field, and the yields varied from 41.9 to 56 bushels per acre. First-grade seed-corn, carefully selected from this field before the crop was harvested, was offered for sale at $2.50 per bushel.

Kafir-corn and cane have been selected to secure a uniform type and to increase the grain and fodder yields. In the Kafir-corn selection, special attention has been paid to the production of grain. In the selection of soy beans, it has been attempted to increase the yield of grain by choosing plants with a large number of pods and a large number of beans in a pod. It was observed that the number of good beans in a pod averaged about two, but that some pods, on well-podded plants, contained three or four good beans. At present the yield of soy beans is too low to make it a profitable grain crop to grow for stock feed. It is probable that, by the continued selection of seed from the best producing plants, the yield of beans may be materially increased and the soy bean made a profitable crop for feeding purposes. The selection of cowpeas is being conducted in much the same manner as that described for soy beans.

The selection of the small grains was made at maturity and just before harvesting. The various plots were carefully examined and notes taken on the stand, the average height, length of heads, filling of heads, rust and smut resistance, etc., and the best heads of the most promising varieties were chosen for securing seed for planting next season. The object of this careful selection of seed is to secure better producing strains of purer type than the original variety, with the ultimate purpose of increasing these varieties by propagation and distributing the improved seed among the farmers of this state. The methods followed are not strictly those of seed-breeding, by

which new varieties are produced, but rather those of careful farm seed selection, such as any progressive farmer may practice. The Botanical Department of this Station has charge of the regular plant-breeding work, in which the purpose is to originate new and improved varieties by cross-fertilization and individual plant selection. The Farm Department expects to cooperate with the Botanical Department in testing and improving these new varieties and in propagating them for distribution.

SUMMARY.

The soil of the Station farm is upland, a light-colored, rather compact loam, inclined to wash, not very fertile and not very uniform. Except for the excessively wet weather in May, which delayed planting, the season was favorable for the growth of crops; 35.68 inches of rain fell during the growing season (March 1 to October 31). Some 240 acres, divided into 360 separate plots, ranging from one-tenth of an acre to five acres in area, were devoted to the various experiments in crop production last season.

1. No experiments were made with winter wheat. In the trial of spring wheat varieties, the macaroni type gave the largest yield and heaviest wheat. Ordinary spring wheat was a poor crop.

2. The six-rowed bearded type of barley ranked first in yield and quality of grain. The best yielding varieties were Common barley, 33.9 bushels; Bonanza, 33 bushels; and Mandscheuri, 32 bushels per acre. Barley was not injured so badly by hot weather as was oats, and this crop may be grown successfully throughout the larger part of the state.

3. Among twenty varieties of oats tested, the Sixty Day oats, a new variety recently imported from Russia by the United States Department of Agriculture, gave the largest yield of grain — 53.9 bushels per acre. The three varieties giving the next largest yields were: Black Beauty, 52.1 bushels; Kherson, 46.7 bushels; and Red Texas, 43 bushels per acre. The Kherson oats is another Russian variety, The early maturing varieties yielded much better than the late varieties. Early sowing is desirable as well as earliness in maturing, in order that the crop may escape the hot weather, which is so apt to blight late oats.

4. Emmer yielded 1756 pounds of grain per acre, which was 44 pounds more than the largest yield of oats and 129 pounds above the yield of the best producing barley. This new grain is better adapted to growing in a dry climate than oats or barley, and it seems to resist diseases and unfavorable weather conditions better than the other

grains. It may not take the place of barley or oats as a feed, and is better fed ground and in combination with other grains,

5. Flax was planted rather late in the season and was a poor mop, the average yield being 6.5 bushels of seed per acre.

6. Millet was a fair crop. German millet ranked first both in the production of hay and seed, while Siberian millet ranked second. The largest yields were 3.6 tons of hay and 25.2 bushels of seed per acre. Japanese barn-yard millet was a poor crop, while hog or broom-corn millet made a total failure of crop. The foxtail varieties seem to be best adapted for growing at this Station.

7. The varieties of soy beans yielding more than thirteen bushels of seed per acre were as follows: Yellow, Small Yellow, Ito San, Early Yellow, Green Samarow, and Early Brown. The Ito San and Yellow varieties were by far the best yielders. The Early Yellow and Ito San are both very early in maturing and much the same in type. The first-named variety is a standard sort in Kansas.

8. Thirty-four varieties of cowpeas were planted in the field trial. The New Era variety gave the largest yield of grain — 11.07 bushels per acre. Only a few of the varieties matured seed, and as a grain producer the soy beans are to be preferred to cowpeas for growing in this state. Cowpeas make a ranker vine growth, and are usually to be preferred to soy beans for forage production; several of the better producing varieties yielding on an average 2.5 tons of dry fodder per acre. The Whip-poor-will cowpeas, a medium early variety, is well known and most extensively grown in this state.

9. Coleman cane yielded 40.5 bushels of seed and 7.41 tons of cane stover per acre. Other good producing varieties were Early Amber, Kansas Orange, and Kavanaugh. The Amber cane matured the earliest; the Kavanaugh was the latest maturing variety. When stacked, fifty days after harvesting, the cane stover still contained on the average 51.7 per cent. of water.

10. Yellow milo maize and Large African millet gave larger yields of fodder and much smaller yields of grain than the Kafir-corn. There was little difference in the yield of Red and White Kafir-corn. The average yield was 58.2 bushels of seed per acre and 4.25 tons of stover per acre. In the production of grain, Kafir-corn proved much superior to cane. The Kafir stover contained fully as much water when stacked as the cane stover.

11. In the trial of broom-corn varieties, the Extra Early Japanese appeared to be superior to the others for the manufacture of brooms,

while the Genuine Dwarf ranked second. The first variety named also gave the largest yield of seed—29.9 bushels per acre,

12. Pencillaria gave a total yield of 5.25 tons of fodder per acre, This plant is really the old "cat-tail" or pearl millet *(Pennisetum spicatum),* and in the average Kansas soils the sorghums are greatly to be preferred, as being a surer crop, more productive, and more valable for forage.

13. The yield of teosinte fodder was much less than that secured from sorghum, and as a forage crop in Kansas it is not to be compared to corn, Kafir-corn, or cane.

14. Eighty-one varieties or strains of corn were grown in the comparative test last season. It is a remarkable fact that, in the same field and, under the same conditions of culture, the yields of "standard" varieties of corn varied from thirty-one to eighty-nine bushels per acre, which indicates that the adaptation of the different varieties to different soils and climates is a subject worthy of careful study. The varieties giving yields of shelled corn above seventy-four bushels per acre were: Hildreth yellow dent, 89.02 bushels; Brazilian Flour, 82.01 bushels; Hammett white dent, 79.01 bushels; Mammoth white dent, 77.12 bushels; Griffing Calico, 76.64 bushels; Klondyke yellow dent, 75.7 bushels; Cocke Prolific white dent, 75.7 bushels; and Bicker's Choice yellow dent, 74.53 bushels.

All of these were native Kansas-grown seed except Cocke Prolific and Brazilian Flour, the seed of which was southern-grown. The five best native varieties gave an average yield of 79.5 bushels per acre; the five best imported sorts, 72 bushels per acre. Of the thirty-three varieties yielding over sixty bushels per acre, eighteen were Kansas-grown seed. Nineteen out of the thirty-three were yellow dent, ten were white dent, and three were the calico type of corn. The best producing native varieties are characterized by large stalks, large ears, and medium large kernels, containing large germs. These characters seem to go with hardiness and productiveness.

The early maturing varieties (northern-grown seed) gave the lowest yields. The late-maturing sorts were the best producers of both grain and stover. Sixteen out of the thirty-three best producers were late or medium late varieties (average yield, 71.6 bushels of corn and 5084 pounds of stover per acre), while seventeen varieties matured medium early (average yield, 65.4 bushels of corn and 3732 pounds of stover per acre). The varieties scoring highest (above 85 per cent.) in points other than yield were: Forsythe's Favorite, 88.4 per cent.; Griffing Calico, 87.7 per cent.; Nebraska White Prize, 87.1 per cent.;

Sanders's Improved, 85.7 per cent.;and Funk's Ninety Day, 85 per cent.

The field in which the trial was made was heavily manured. Several of the varieties grown in an adjacent field which received no manure gave eighteen to twenty-five bushels per acre less yield than was secured in the regular trial. Soil fertility is a very important factor in producing large yields.

In order to test their adaptation for late planting, twenty-nine varieties were planted June 16. Those varieties which matured sufficiently to make good corn, also giving largest yields, were as follows: Early Mastodon, 54.4 bushels; Pride of the North, 51.95 bushels; Early Cattle King, 50 bushels; Golden Row, 49.2 bushels; Farmers' Reliance, 48.8 bushels; and Reid's yellow dent, 50.8 bushels.

15. In a trial of late forage crops, sown broadcast June 24, cane yielded 7.7 tons, Kafir-corn, 6.12 tons, and corn, 3.93 tons of cured fodder per acre. The fodder, cut in September, was well cured when stacked, in December. Moisture determinations were made from samples of the fodder taken December 25, which gave the following results: Moisture in cane, 39.4 per cent.; Kafir-corn, 36.2 per cent,; corn, 27.01 per cent. Cane and Kafir-corn, sown broadcast, are excellent forage crops, giving large yields of fodder of good quality.

16. As late pasture crops (sown broadcast), corn and soy beans and corn and cowpeas were preferred by the cattle to the sorghums, and furnished more grazing. Much of the cane and Kafir-corn was trampled down and wasted, while soy beans and cowpeas, planted alone, were not eaten so well by the stock as when these plants were grown in combination with corn. Soy beans seemed to be preferred to cowpeas by the cattle, especially in the early part of the season, before the soy beans began to mature.

17. As silage crops, alfalfa was put in the silo at less cost per ton than any other crop. Cane and Kafir-corn gave the largest yields of any of the annual crops, and the cost per ton of siloing these crops was less than the cost of siloing corn. Corn ranked second in yield of silage and cowpeas third. Corn and cowpeas grown together in drill rows and cultivated made good silage, and this combination will also make excellent dry forage.

18. The experiments in baling alfalfa hay from the field have shown that it is not safe to bale the hay until it is well cured and ready to stack. The alfalfa which was baled in this condition made a good quality of hay, retaining the leaves better than is usually the case when alfalfa is baled from the stack.

19. Two series of rotation experiments have been begun with the object of studying the effect of the different crops on corn and wheat and *vice versa,* when several crops are grown in rotation, with the ultimate purpose of learning what combination of crops may be grown in succession so as to give an ideal rotation of the several crops. The rotation systems also include methods of green manuring.

20. The Farm Department is making a careful selection of seed of the best producing varieties of the various crops. Those varieties which prove superior to others in points of yield and quality will be propagated in a larger way, with the purpose of distributing seed among the farmers of the state.

ACKNOWLEDGEMENTS.

V. M. Shoesmith, assistant in the Farm Department, whose name appears as one of the authors of this bulletin, has had special charge of the field experiments, and is responsible for much of the detailed work necessary in preparing this bulletin. The photographs from which the cuts were made were taken by Dr. S. C. Orr, who has made a reputation as a view photographer,

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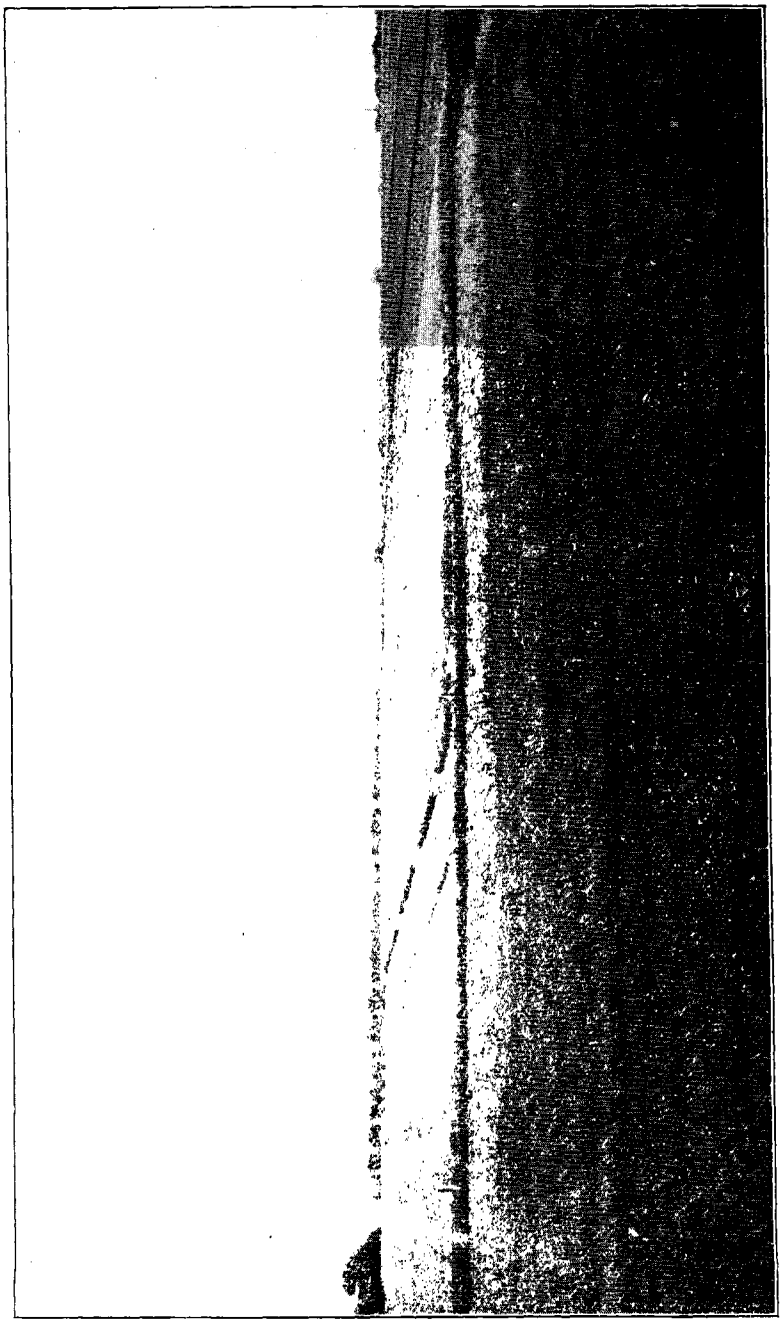

Plate I.—Field trial of varieties of grain.

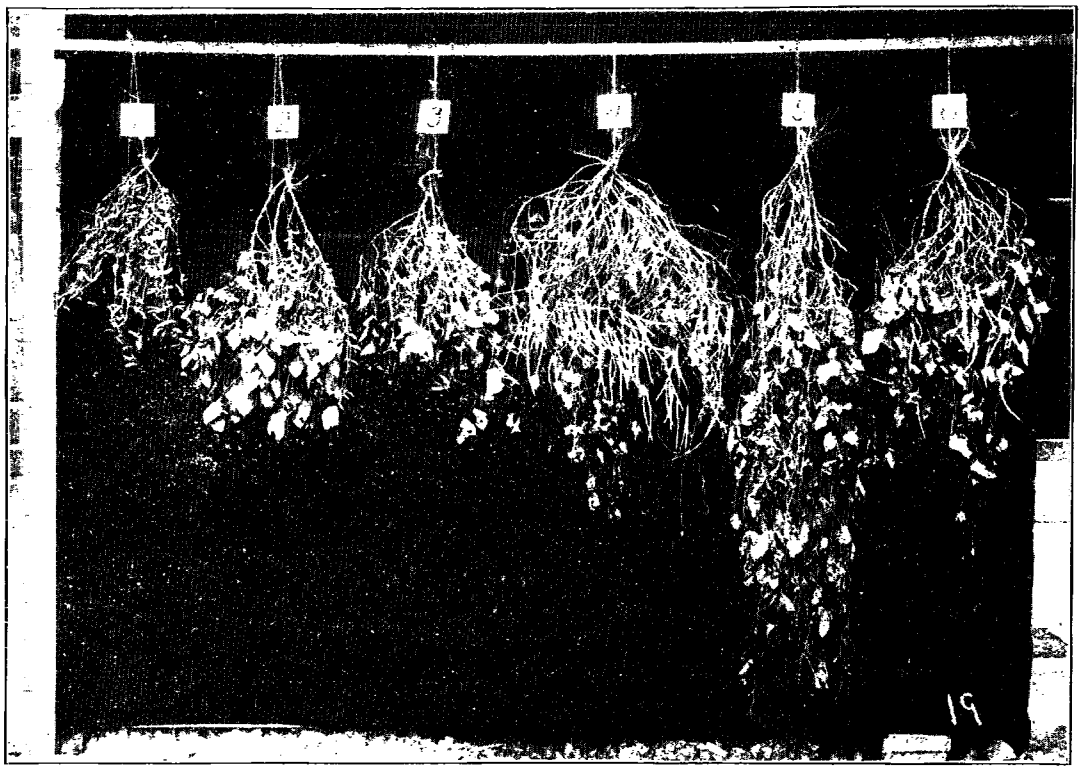

Plate II.—No. 1, Early Yellow soy beans; No. 2, Southern soy beans; No. 3, Flat Black soy beans; No. 4, New Era cowpeas; No. 5, Clay cowpeas; No. 6, Whip-poor-will cowpeas.

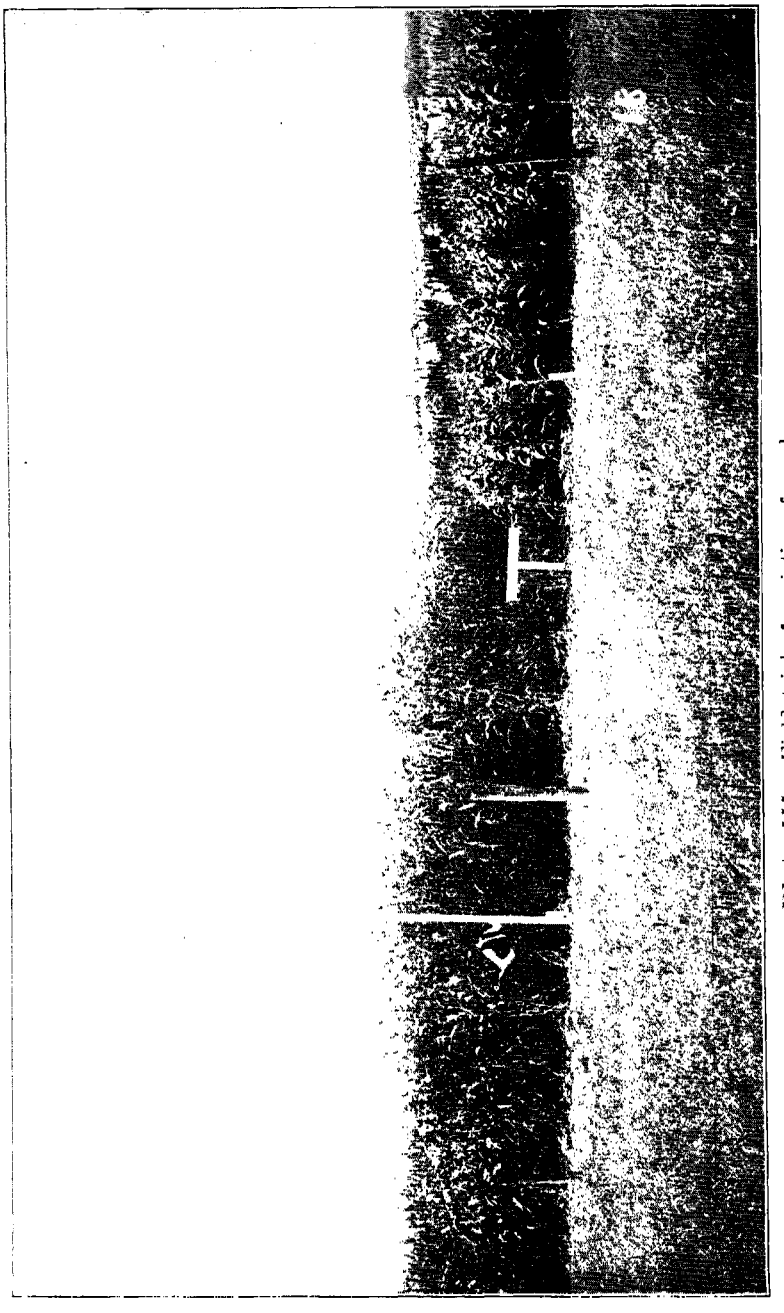

Plate III.—Field trial of varieties of sorghum.

Plate IV.—No. 1, Brown Dounha; No. 2, Black-hulled White Kafir corn; No. 3, Red Kafir-corn; No. 4, Kavanaugh cane; No. 5, Yellow milo maize; No. 6, Large African millet.

Plate V.—No. 1, Black-hulled White Kafir-corn; No. Kansas Orange cane; No. 3, Early Amber cane; No. 4, Kavanaugh cane; No. 5, Folger cane; No. 6, pencillaria; No. 7, teosinte.

Plate VI.—No. 1, Red Kafir-corn; No. 2, Kavanaugh cane; No. 3, Yellow milo maize; No. 4, Hildreth corn; No. 5, Forsythe's Favorite corn; No. 6, Brazilian Flour corn.

Plate VII.—Twenty-acre field of Reid's Yellow Dent corn. (Yield, 50 bushels per acre.)

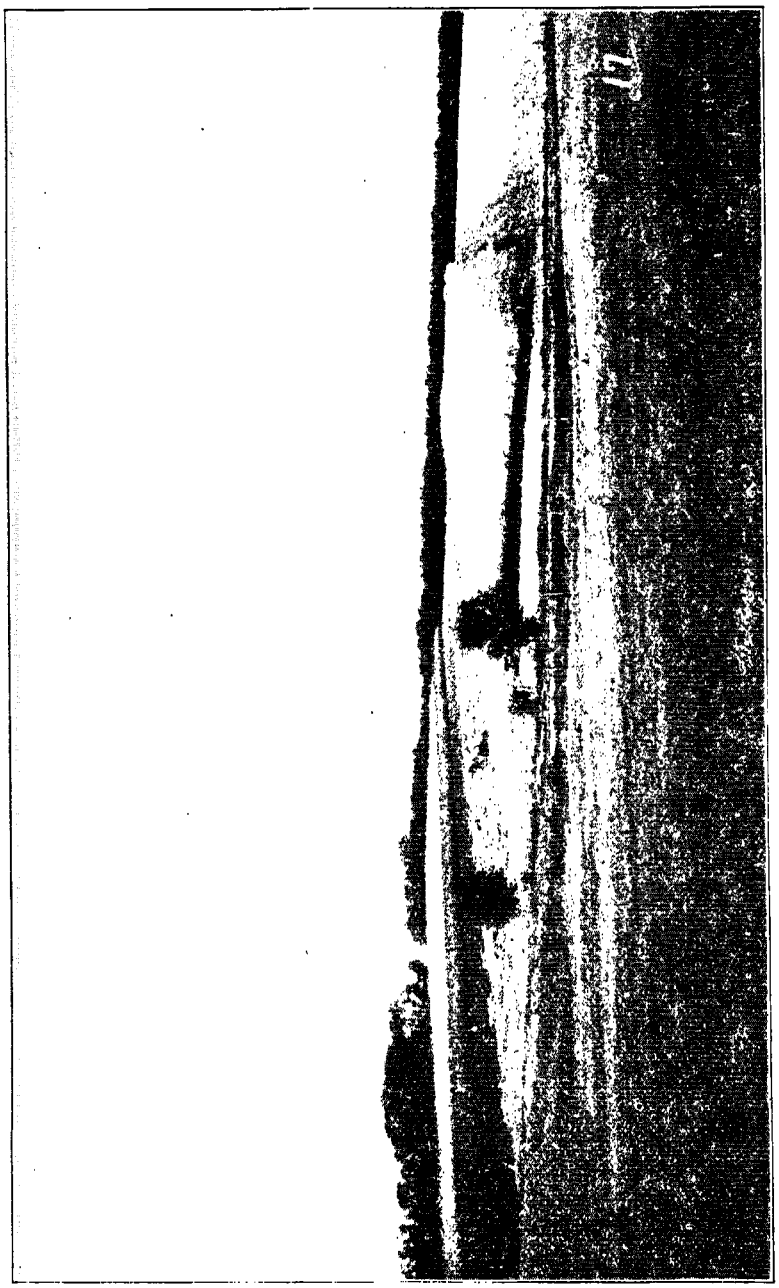

Plate VIII.—Field trial of late forage crops.

Plate IX.—A field of corn and cowpeas planted together in drill rows.

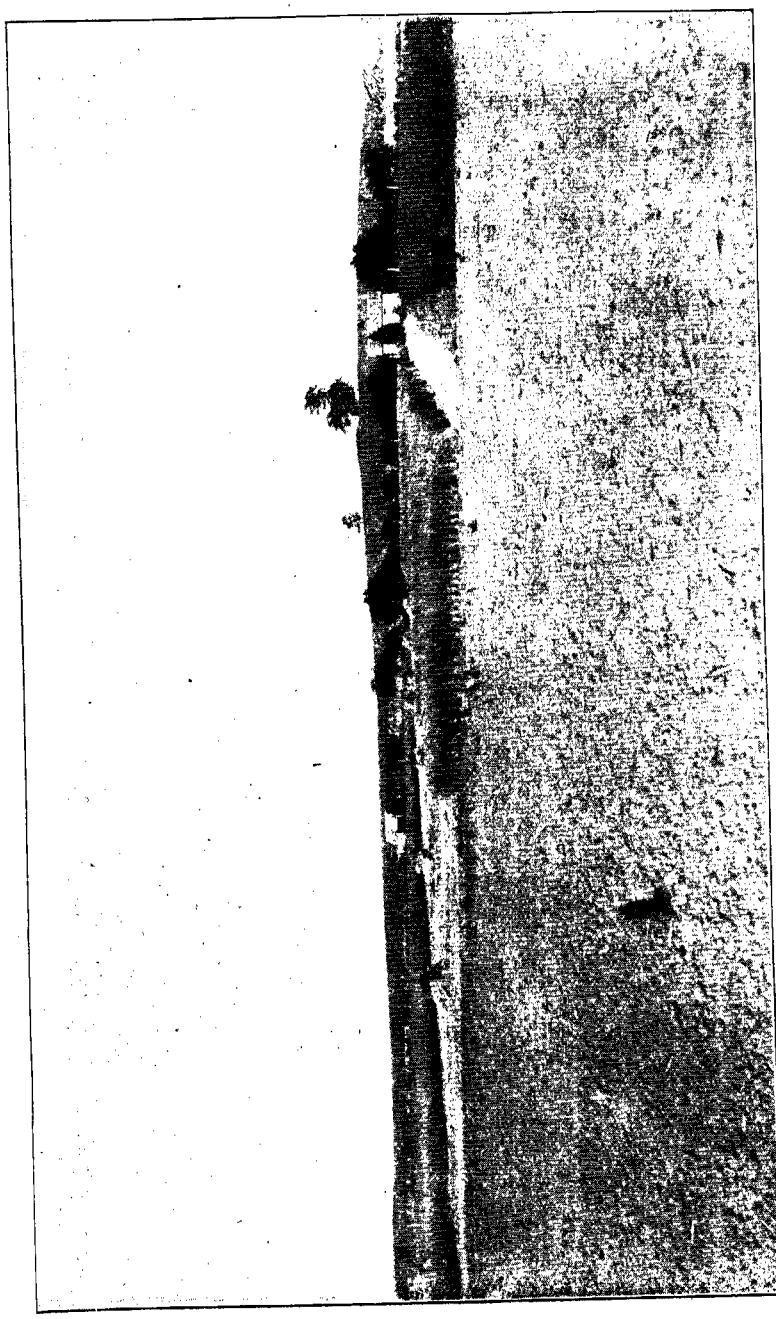

Plate X.—Rotation plots with alleys cut out, ready for harvest.