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PLATE I. Cow-peas planted with corn for ensilage.

COW-PEAS.

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COW-PEAS.

INTRODUCTION.

THE cow-pea, botanically named *Vigna unguiculata*, has long been recognized as a valuable crop for the Southern states, where it has been extensively grown for forage and green manuring, but it has only been within comparatively recent years that the general cultivation of this crop has extended into the Northern states. The cow-pea is a native of India, and it is supposed to have been introduced into this country from England in 1734 by the Oglethorpe colonies in Georgia. The cow-pea is an annual leguminous plant, varying in form and habit of growth with the variety, season, soil, moisture and cultural conditions. As a rule, it has a trailing habit of growth, vining profusely during seasons of heavy rainfall. The blossoms are of various colors, ranging from white to purple, while the pods are usually straw-colored when ripe and vary in length from five inches to over a foot. As a rule, the pods do not ripen at the same time. With many varieties there are periods of several weeks when all stages of growth, from blossoms to mature peas, may be found upon the same vine. This makes the time of cutting for seed a difficult matter to judge. The time must be selected for cutting when the largest number of pods are mature and before the peas have started to shell. The seeds vary greatly in size and shape. In color they range from white to the deepest black. The root development is deep for an annual, there being a well-developed tap-root, with a number of large branch roots which start from the upper part of the tap-root, spread horizontally for a short distance and then turn downward. These roots go deeply into the subsoil, enabling the plant to draw freely upon the plant-food and water below the reach of shallower-rooted crops. Upon the numerous small roots in the upper surface of the soil are found the nodules or tubercles which contain the nitrogen-gathering bacteria. These nodules are always present upon the well-developed plants. They enable the plants to make use of the nitrogen of the atmosphere. (Plate X.)

USES OF THE COW-PEA.

HAY.

Cow-peas make excellent hay which, if properly handled, is equal to alfalfa in nutritive value, although as a rule stock do not eat cow-pea hay as readily as alfalfa. When sown for hay it is usually preferable to plant in close drills, requiring about one bushel of seed peas per acre, and when so planted the plants tend to grow more upright, which makes the crop easier to cut with a mower. If grown in rows, although the production of forage may be as great, it is more difficult to harvest, and the ranker growth of the individual plants often makes the hay more woody. It is not an easy matter to cure cow-pea hay; the vines, being so large, cure slowly, and with unfavorable weather the hay is apt to be badly injured, if not spoiled, before it is cured enough to stack. The difficulty of harvesting and curing cow-pea hay, its tendency to become woody, and the lower yield per acre, make this crop, for hay production, less valuable than alfalfa where alfalfa can be successfully grown. In certain sections of the state, where difficulty has been experienced in growing alfalfa, cow-peas fill a need by producing hay and pasture of high feeding value. The crop is also especially valuable as a soil fertilizer when used in rotation with other crops or plowed under as green manure.

The cow-pea is sometimes sown in combination with other crops, such as corn, Kafir-corn, and sorghum for hay. When planted in these combinations there is danger of cow-peas being stunted in growth if the crop with which it is combined is planted too thick. Sown broadcast, cow-peas often make but little growth with these crops, but when planted in rows with corn and cultivated the growth is quite satisfactory.

SOILING AND ENSILAGE.

As a soiling crop cow-peas are very satisfactory. As they should not be planted until the weather and soil are warm, the crop is not available for feed until the latter part of summer, where they fill a place in a well-planned system of soiling and furnish an abundance of succulent green feed, although perhaps less palatable than alfalfa.

When used alone the cow-pea does not make an exceptionally good quality of ensilage, due to the large amount of water in

the green vines making a watery silage that keeps poorly and is not well relished by stock. When combined with corn in the proportions of about one-fourth cow-peas to three-fourths corn, it makes an excellent silage that keeps well and is relished by all classes of stock. This combination has greater feeding value than corn silage, for the reason that cow-peas, being relatively high in protein, make the cow-pea-corn silage a more nearly balanced ration.

It is a common practice in dairy sections to grow cow-peas and corn in separate fields and mix them as the silo is being filled. It would seem a more desirable practice to grow the corn and cow-peas together. An experiment along this line was conducted at this Station during 1903, 1904 and 1905, the corn and cow-peas being planted together in rows. When planted the right thickness—corn 12 to 24 inches and peas 4 to 6 inches apart in drill-rows $3\frac{1}{2}$ feet apart—each grew equally well and produced from ten to fourteen tons of green fodder per acre. The cow-peas twined around the corn-stalks, making the crop easy to harvest with the corn-binder. (See frontispiece.)

PASTURE.

While the cow-pea, because of its general habit of growth, is not a natural pasture plant, few farmers are using it for this purpose. Maturing as it does in the latter part of the summer, the crop furnishes succulent pasture during the time when natural pastures run short. When used with corn to supplement the ration, such pasture can hardly be excelled, especially for hogs and sheep. The stock are usually turned on cow-peas when the crop has reached the stage of maturity considered best for hay, or when some of the pods have begun to turn yellow. Cattle are usually turned on earlier than sheep or hogs; hogs may be pastured on ripe peas. If the stock are turned on the field too early, before the plants have attained full size, there is more waste from the trampling. The plant at this time is more watery and does not furnish its full feeding value. As with many green-pasture crops there is danger of bloat when sheep or cattle are first turned onto cow-peas, yet the danger is far less than with alfalfa, and is lessened as the cow-peas become more mature.

Where cow-peas are to be used for pasture, especially with hogs, it would be preferable to plant with corn. In this way

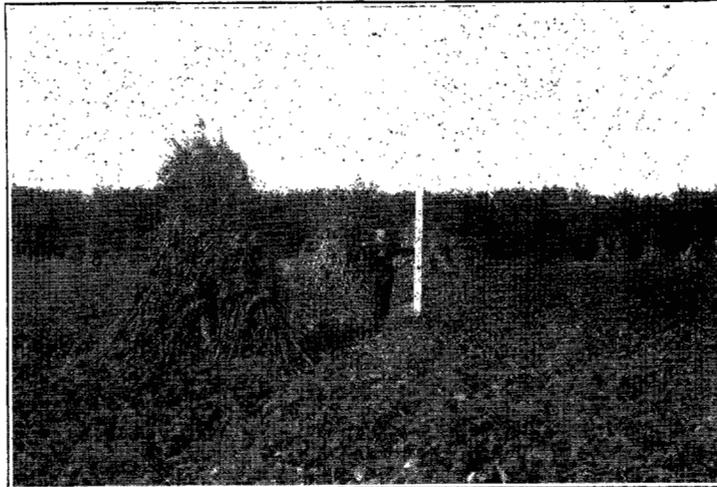


PLATE II. Cow-peas planted in corn at the last cultivation.

the mixture makes a ration on which hogs do exceptionally well without other grain. When planted with corn for hogging down, the usual method is to plant the same as for ensilage, taking care not to plant the corn so thick as to stunt the growth of the cow-peas. Another method, and one often practiced in pasturing sheep in the more humid climates, is to plant the cow-peas in the corn between the rows at the last cultivation. At this Station we have planted cow-peas in corn at the last cultivation for a number of seasons, and they usually make a fair growth if there is sufficient moisture, but when the early fall is dry the cow-peas do not make much growth until the corn is mature. There seems to have been no injurious effect on the corn resulting from this practice, but rather in most seasons the result has been an increased yield of corn in fields in which cow-peas have been planted. Table I gives the comparisons and yields for five years of corn planted alone and with cow-peas drilled between the rows at the last cultivation.

TABLE I. Yield of corn per acre, bushels.

HOW PLANTED.	1903.	1904.	1905.	1906.	1907.	Average.
Corn alone.	23.36	56.57	37.80	64.17	38.01	43.98
Corn with cow-peas, planted at last cultivation.	23.13	67.28	45.98	59.89	41.81	47.62

The average for five years shows that corn in which cow-peas were planted produced 3.64 bushels more grain per acre than corn alone. In 1906, which was relatively dry in August

and September, the corn with cow-peas yielded 4.28 bushels per acre less than corn alone. In 1903 the yield was slightly in favor of corn alone. For the other three years the yield was greater where the cow-peas were planted with the corn.

In the drier sections of the state, where fall pasture is needed, it would be better to plant the cow-peas in wheat, oats, or barley stubble rather than in corn. When planted after wheat or oats the cow-peas make a much ranker and more rapid growth, are not checked so severely by a dry fall, and will produce in nearly every instance more fall pasture than could possibly be secured by planting in corn. After pasturing, the cow-peas may be turned under in the fall, leaving the ground in excellent condition for corn the following spring.

SOIL IMPROVEMENT AND GREEN MANURING.

The growing of cow-peas greatly improves the soil. Being a rank feeder and deep-rooted, the crop is able to use plant-food which the roots of other plants may not secure. Much of this plant-food later becomes available to other crops planted after the rotation with cow-peas. This crop has the advantage over other crops which are not legumes, in that it is able to use the free nitrogen of the air through the aid of the bacteria which live upon its roots. The plowing under of a crop of green cow-peas will greatly increase the supply of humus and nitrogen in the soil, and even when the crop is harvested for hay or seed some increase in soil nitrogen will result from the decay of the roots left in the soil.

In most soils of this state nitrogen is the limiting element of fertility, and anything that will increase the nitrogen supply of the soil will increase the soil's productiveness. The cow-pea, having this ability to secure nitrogen from the atmosphere, not only produces more abundantly than a crop not having this power, but leaves the soil in better condition for crops which follow.

Mr. H. T. Neilsen, of the United States Department of Agriculture, in Farmers' Bulletin No. 318, in speaking of the effect of the cow-pea upon following crops, says: "The increase in yield of wheat due to the cow-peas is generally given as from three to five bushels per acre. At the Missouri Experiment Station, an increase in yield of 63 per cent. with oats and 49 per cent. with wheat following cow-peas as a catch-crop was

secured. The Arkansas Experiment Station reports, as an average of four years' test with wheat, an increase in yield of 25 per cent. from plowing under cow-pea stubble in the fall, 39 per cent. from plowing under cow-pea vines, and 42 per cent. when cow-peas were grown each year as a catch-crop between the wheat crops, only the stubble of the peas being plowed under."

At this Station we have sown cow-peas as a catch-crop between the wheat crops for the past five years, plowing under the entire growth of peas about the middle of September, two or three weeks before seeding to wheat. The cow-peas have been sown each year soon after wheat harvest, in close drills, at the rate of about one bushel of peas per acre. The field was usually double-disked ahead of the drill. Both plots were plowed on the same date and given similar preparation before seeding. The field used for this work was upland soil low in fertility. The yields for the past five years are given in table II.

TABLE II. Yield per acre of wheat.

TREATMENT.	1904.	1905.	1906.	1907.	1908.	Average.
Wheat continuously	18.40	12.02	13.41	11.79	11.08	12.34
Wheat continuously with cow-peas as catch crop.	14.49	16.53	15.54	16.37	20.13	16.61

Each season the catch-crop of cow-peas has given an increased yield of wheat and the effect has been accumulative, the increase in yield being gradual from year to year. The first year of the trial there was a difference of only one bushel in favor of the cow-pea rotation, while after five years the plot which received the green manuring produced nine bushels more wheat per acre, the average difference being four and one-third bushels per acre in favor of planting cow-peas as a catch-crop between crops of wheat. In carrying out this test every effort was made to put the seed-bed in as good condition as possible before the wheat was sown. After plowing, the subsurface packer was used and the seed-bed made as firm as possible.

While the effect of the cow-peas in maintaining the fertility of the soil, where used as a catch-crop with wheat, is clearly shown by this experiment, the practice can hardly be recommended in general farming. In the wheat belt of the central and western parts of the state there is not sufficient moisture to produce a crop of cow-peas for green manuring and still



PLATE III. Plowing under cow-peas for green manure, September 21, 1908.

leave the ground in condition for starting the wheat the same fall, except in very favorable seasons. Also, the extra labor involved in preparing a good seed-bed for wheat after cow-peas makes this method unpractical. (Plate III.)

A more practical rotation is to plant cow-peas in wheat or oats stubble, plow the crop down before heavy frost in the fall, and follow with corn the next year. A common practice at this Station is to plant the cow-peas during the wheat harvest, following the binder directly with a single-disk drill; or, if the stubble-land is weedy or trashy, it is advisable to disk ahead of the drill behind the binder, thus preparing a more suitable seed-bed. Thus when the harvest is finished the field has been replanted and, if the extra labor can be supplied, this is an economy of time, and the new crop will have all the advantages which may come by timely rains and favorable growing conditions. If it is not possible to plant during the harvest of the grain, then the cow-peas may be sown as soon as possible after the harvest, preferably disking ahead of the drill between the rows of shocks. Occasionally, by early thrashing, the field may be cleared soon enough to plant the peas, but such planting should not be delayed long after July 1. Planted in this way at this Station, cow-peas have made a growth of twelve to eighteen inches by the last of September, when the crop was plowed under. Such fall-plowed land is in excellent

condition for corn the next season, since there is sufficient time between the plowing under of the cow-peas and the planting of corn for the cow-peas to decay and for the moisture to become replenished in the soil. Table III gives the yield of wheat and corn when grown in rotation with cow-peas used as a catch-crop after wheat, as compared with the yields when wheat and corn were grown in rotation without the intermediate green manuring crop of cow-peas.

TABLE III. Yield of corn per acre, bushels.

	1904.	1905.	1906.	1907.	Average.
Following cow-peas used as catch crop after wheat.	44.89	63.55	65.81	37.76	50.75
Following wheat without cow-peas.	32.40	44.89	57.57	32.21	41.77
Yield of wheat per acre, bushels, in rotation with corn, second year after cow-peas:					
	1904.	1905.	1906.	1907.	Average.
With cow-peas.	17.59	22.53	16.58	9.25	16.49
Without cow-peas.	17.20	18.67	14.74	9.05	14.91

These results show that cow-peas used as green manure have had a remarkable effect in increasing the yield of corn, the average annual increase in yield for the four years being nearly nine bushels per acre; also, there was a small increase (about one and a half bushels per acre) in the wheat crop following the corn the second year after the cow-peas were plowed under. The relatively low yield of wheat on all plots is in part due to the unsuitable seed-bed; the wheat was planted in the corn-stalks each fall.

This seems to be a more practical and successful method of using cow-peas for soil improvement than by growing the peas with corn or sowing them as a catch-crop in continuous wheat culture. Also this is a practical way of maintaining the nitrogen and humus supply of the soil, especially on farms keeping little live stock; but upon a stock farm a green manuring crop should not be expected to replace barn-yard manure but rather to supplement it. Upon stock farms where cow-peas are grown as a catch-crop after wheat or oats for soil improvement it will be found more profitable to pasture the cow-peas rather than to plow the entire crop under. Little of the beneficial effects of the cow-peas is lost by this practice, since by pasturing the droppings of the animals remain upon the field, and even when the cow-peas are cut for hay and fed there may be but little loss of fertilizing elements if care is taken to preserve the manure and return it to the land.

AS A ROTATION CROP.

When grown for seed or forage, cow-peas are a valuable crop to use in rotation with other crops. Preferably cow-peas should be used to precede potatoes, corn, Kafir-corn, cane and other rank-growing forage crops, rather than small grains, since in the more favorable seasons, in fertile soil, small grain is apt to lodge when grown after cow-peas. Also, since cow-peas are harvested late, the soil may be left too dry to start fall wheat well. Rotation experiments carried on at this Station for five years with cow-peas or soy-beans and wheat have given the following results :

Wheat Rotation with Soy-beans or Cow-peas.

Previous crop.	Wheat—yield per acre, bushels.					Av.
	1904.	1905.	1906.	1907.	1908.	
Wheat (continuously)	17.13	24.40	40.40	37.68	29.53	29.83
Soy-beans or cow-peas (alternate years)	21.10	26.54	31.10*	38.03	25.16	28.39

Wheat followed soy-beans in 1904-1906, and cow-peas in 1907-1908.
 * Lodged badly, which accounts for lower yield.

The rotation experiments with corn and soy-beans have resulted in increasing the yield of corn after soy-beans, the average annual increase in yield being over fourteen bushels of shelled corn per acre, as an average for four crops. The results are given as follows:

Corn Rotation with Soy-beans.

Previous crop.	Wheat—yield per acre, bushels.				Av.
	1904.	1905.	1906.	1907.	
Corn (continuously)	48.21	53.00	62.44	45.56	52.30
Soy-beans (alternately)	58.72	68.26	75.53	63.62	66.53

The straw and stalks invariably made a ranker growth after the cow-peas.

SEED.

Cow-peas are an uncertain crop for seed in this state, as the yield of seed varies greatly from year to year, depending upon weather conditions. When the summer is favorable and hot the yield of seed is quite satisfactory, but when the summer is cool or too wet or too dry, the yield is apt to be low. As shown by the trials at this Station, in favorable seasons, good producing varieties have yielded from fifteen to twenty bushels per acre, while in an unfavorable season the same varieties have produced only from five to seven bushels per acre. This uncertainty of a seed crop makes the cow-pea an undesirable crop to grow in a commercial way for seed production, but the value of the crop for soil improvement, pasture, hay and en-

silage, and the high price of the seed upon the market, makes it desirable for every farmer to grow enough cow-peas for seed to supply his own needs. At the present price of seed (\$3 per bushel) the average farmer does not feel that he can afford to buy the seed of cow-peas for green manuring, although the expenditure of this amount would doubtless be repaid by the increase in the yield of crops through the increased fertility of the soil. However, if the farmer can raise each year from five to ten acres of cow-peas for seed he will have a supply of seed on hand for his own use, which, in favorable seasons, will have cost him less than one dollar per bushel to produce, and in unfavorable seasons the cost should not be greater than the average market price of good seed peas.

OTHER USES.

Besides the uses for cow-peas discussed above there are a few minor uses for which the crop is sometimes grown. In some of the Southern states where cow-peas seed heavily the seed is grown and used for stock feed. Cow-pea seed has a high feeding value, furnishing about two and a half times as much protein and nearly as much carbohydrates as corn. At the present prices cow-pea seed cannot be profitably grown for feed, but in thrashing more or less of the seed may be broken, making it unfit for planting. Such seed should be ground and fed; mixed with corn-meal or other ground grain it makes especially good feed for hogs or dairy cows. Cow-peas are also used in a small way for human food, prepared in much the same manner as the garden bean.

COW-PEAS COMPARED WITH SOY-BEANS.

In some respects the soy-bean would seem to be a more desirable crop than the cow-pea, and in many sections of the country they grow well and are popular. However, in this state (Kansas) they have not proven as sure a crop as cow-peas. The soy-bean as a rule produces more seed than the cow-pea, the seed ripens more nearly at the same time and is easier to save and thrash, while the stalk, growing upright without vining, makes the crop easier to harvest; also, the hay of the soy-bean when properly saved has a little greater feeding value, being richer in protein. In spite of these qualities favorable to the soy-bean, it is surpassed in three respects by



PLATE IV. Varieties of soy-beans, showing upright habit of growth.

the cow-pea, which would seem to make the latter a more desirable crop for this state.

First. — The stand of cow-peas is more certain than the stand of soy-beans. The seed is more sure of germination, perhaps due to the fact that soy-bean seed is more apt to heat in storage. Also the soy-beans fail to come up well if the soil is crusted, while the cow-peas, being a more vigorous grower, push their way out of heavily crusted soil. This ability of the cow-pea to grow under unfavorable conditions and in a poorly prepared seed-bed is very essential, especially when stubbled in after wheat or oats. The soy-beans when sown in this state on land new to the crop usually require inoculation of the soil or seed before they will thrive well, while the cow-pea seems to find its bacteria in the soil, and will grow well on nearly every soil without inoculation. Rabbits trouble soy-beans more than cow-peas, and this is a very important consideration, especially in western Kansas. These several factors tend to favor a better stand of cow-peas than of soy-beans.

Second. — Cow-peas are better suited for planting with corn than soy-beans. Cow-peas when planted with corn not only produce more forage than soy-beans, but the vining habit of growth of cow-peas causes them to twine around the corn, so that the vines are held up, which makes the combined crop easier to harvest with a corn-binder.

Third. — The cow-pea is better adapted for hay than the soy-bean. The leaves of the soy-bean drop quickly as the crop approaches maturity, and it is often difficult to save the hay crop without the loss of a large proportion of the leaves. The leaves of the cow-pea do not drop but remain green and growing after many of the pods are ripe and dry. Again, if the soy-bean is allowed to become a little too mature, not only is there a loss of leaves in curing but the stems become hard and woody and less palatable to stock. On the other hand, soy-beans are somewhat more readily cured and handled for hay, and as pasture for cattle may excell the cow-peas, since the green soy-beans are apparently better relished by stock. (Plates IV and V.)

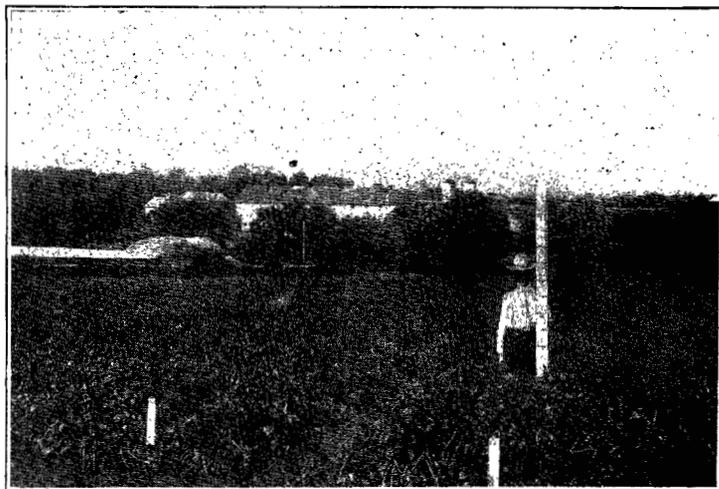


PLATE V. Varieties of cow-peas, showing vining habit of growth.

TABLE IV. Varieties of cow-peas.

Bulletin No.	NAME OF VARIETY.	Days to mature.....	Yield per acre.											Av. yield pr. acre.			
			1903.		1904.		1905.		1906.		1907.		1908.	1903-'07.		1903-'08.	
			Grain.	Hay.	Grain.	Hay.	Grain.	Hay.	Grain.	Hay.	Grain.	Hay.	Hay.	Grain.	Hay.	Grain.	Hay.
118	Mount Olive.....	114	bu. 7.24	tons. 1.72	bu. 14.96	tons. 6.35	bu. 11.60	tons. 2.05	bu. 15.00	tons. 1.65	bu. 4.86	tons. 2.84	tons. 1.47	bu. 10.73	tons. 2.68		
65	Whippoorwill.....	111	6.23	1.38	14.25	6.25	16.52	2.79	12.77	1.76	7.54	1.98	1.59	11.46	2.63		
271	Gray Goose or Taylor.....	113	2.74	2.12	23.31	3.32	15.87	2.78	15.62	2.54	1.78	2.21	1.85	11.86	2.47		
202	Hammond's Black.....	114	6.10	1.84	17.73	2.78	16.03	2.05	8.32	2.49	7.46	2.27	1.97	11.13	2.23		
277	Black Eye.....	111	8.00	1.66	19.78	3.28	16.33	2.05	12.37	2.68	7.05	1.40	1.97	12.71	2.17		
183	New Era.....	107	11.07	.86	18.86	3.75	12.03	2.57	15.62	2.14	4.62	2.53	.97	12.44	2.14		
188	Michigan Favorite.....	107	7.62	1.16	17.94	2.80	12.40	3.14	14.40	1.85	3.81	1.88	1.75	11.23	2.10		
274	Warren's New Hybrid.....	107	6.56	1.78	21.11	3.45	12.76	2.13	18.85	1.50	8.02	2.13	1.37	13.46	2.06		
270	Old Man's.....	108	9.10	1.82	20.97	2.90	12.91	2.17	9.12	1.86	5.35	2.38	1.05	11.49	2.03		
121	White Giant.....	108	8.62	1.22	17.57	4.88	16.42	1.45	9.33	1.16	2.11	1.73	1.23	10.81	1.95		
279	Clay.....	108	1.09	1.97	16.04	3.17	13.85	.....	15.20	1.53	8.10	1.59	1.45	10.86	1.94	
273	Warren's Extra Early.....	107	4.21	1.40	17.72	3.15	10.06	1.97	18.45	2.37	3.57	1.45	.87	10.80	1.87		

Varieties of soy-beans.

343	Early Yellow.....	99	14.80	.....	20.10	1.96	10.18	1.69	13.18	3.01	5.59	1.54	1.31	12.77	1.90
326	Ito San.....	102	14.80	.....	16.53	1.77	10.13	1.53	13.68	1.85	10.59	2.34	1.54	13.15	1.81
335	Small Yellow.....	109	15.80	.....	16.89	1.95	16.38	1.09	14.80	2.29	9.61	1.67	1.61	14.71	1.72
333	Green Samarow.....	105	14.50	.....	18.59	1.94	11.67	1.09	12.98	1.75	.....	1.23	.99	13.18	1.41

VARIETIES OF COW-PEAS.

During the past six years some forty varieties of cow-peas and thirty-five varieties of soy-beans have been tested by the Station for seed and hay production. Some of these varieties have been grown but one year, many of them showing good qualities have been grown two or more years, while the most promising varieties have been grown throughout the six years. Table IV gives the yield of different varieties which have been grown for the entire six years, arranged in the order of hay production. (See page 191.)

These varieties, being selected as the most productive from the forty varieties tested, do not show striking variations in yield. The Mount Olive ranks first, having produced an average of 2.68 tons of hay per acre for the six years, and Whippoorwill second, having produced an average of 2.63 tons of hay per acre. In the production of seed for an average of five years, 1903 to 1907, inclusive, the Warren's New Hybrid has produced the largest yield, 13.46 bushels per acre; Black Eye second, 12.71 bushels, and New Era third, 12.44 bushels.

For the production of cow-pea seed four characteristics are especially desirable, namely, yield, evenness of ripening, early maturity, and an upright habit of growth. The New Era seems to have these characteristics the most highly developed. It is a good yielder of both hay and seed; is as early and as evenly maturing as any good variety, ripening in 107 days; and has the most upright habit of growth of any of the varieties reported, thus making it the most easily harvested. Mount Olive, which leads in hay production, matures later and produces less seed. Hammond's Black, also a good hay producer, cannot be depended upon to mature seed. The Whippoorwill is a little late in maturing, but it is a high-yielding variety and is especially adapted for growing with corn for ensilage, as it has a twining habit of growth and ripens well with varieties of corn like Silvermine, Boone County White, Legal Tender and Reid's Yellow Dent. White Giant cannot be recommended, since it is troubled greatly by blight, which often nearly ruins the crop. Judging from these tests the following varieties may be recommended for growing in this state: For

seed, Black Eye, New Era, Warren's New Hybrid; for hay, Whippoorwill; for a catch-crop after wheat, New Era.

The following varieties of cow-peas have been grown one or more years at this Station, but for various reasons have not proven so well adapted to our conditions as other varieties named above: Extra Early, Unknown, or Wonderful, Iron, Black, Red Unknown, California, Red River, Yellow Sugar, Chowder, Extra Early Black Eye, Large Black Eye, and Lady or Galivant. The following varieties of soy-beans have also been tested one or more years: Green, Medium Green, Olive Medium, Ogema, Extra Early Black, Early Green, Flat Black, Early Black, Medium Early, Green, Yellow, Southern, Large Yellow, Late Yellow, Medium Yellow, Green Black, and Large Medium Late Yellow.

CULTURE OF COW-PEAS.

SOIL.

There is no more metropolitan crop grown in the corn belt than the cow-pea. It will grow and make profitable crops on nearly every type of soil in the state of Kansas when supplied with the necessary amount of moisture and given good culture. The plant is better adapted to the open soils of a sandy loam nature rather than to the clay loams or heavy clays. These more open soils allow good aeration, which favors bacterial activity and thus promotes a better development of the plant. The heavy clay soil produces but a small crop the first year, but the second year the crop grows better, which probably results from the soil being opened and enlivened by the deep root system of this plant. The deep rooting of the cow-pea in soils of this character puts these soils in better condition for all classes of crops which may follow the cow-peas.

The cow-pea is everywhere recognized as a rank feeder, being able to extract plant-food from soils almost barren to other crops, thus making it well adapted for growing on "worn-out" soils as a soil renewer. It has an especial advantage over some other leguminous crops in being able to grow from the start upon new land without inoculation with the bacteria which live upon its roots and which aid it in securing nitrogen from the atmosphere. Whether these bacteria are always present in sufficient numbers in soils new to the crop, or whether

the bacteria adhere to the seeds and are thus carried to the soil with the seed, has not been proven. Tubercles may nearly always be found upon the roots of cow-pea plants the first season the crop is grown on new land. This habit gives the cow-pea an advantage over the soy-bean, since new fields must usually be inoculated with the soy-bean bacteria before the crop will thrive. Also, the presence of these nitrogen-gathering bacteria is required in order that the legume crop may store nitrogen and improve the fertility of the soil.

A soil of medium fertility is considered best for the production of cow-peas. On poor soil the plants produce a light yield of hay, although often seeding well. Upon a very fertile soil there is apt to be an excessive growth of vines which fail to produce seed well and which are difficult to cure for hay. Cow-peas, like other legumes, will not grow well in a wet soil; nor are they particularly well adapted for dry farming, unless given very careful culture. They will grow wherever corn will grow successfully. For the drier portions of the state the earlier-ripening varieties are to be preferred.

PREPARATION OF SOIL.

While the cow-pea will grow upon a poorly prepared seed-bed it responds to good cultural methods. The seed-bed for cow-peas should receive as careful preparation as the seed-bed for corn. Although cow-peas are necessarily planted late in the spring, it is often desirable to plow the ground early and cultivate the field at intervals with the disk or harrow to destroy weeds and maintain a soil mulch to receive and retain the moisture. It is advisable to plow in the fall or winter certain types of heavy soil not inclined to drift, or land which has no cover of stubble or stalks. Such land may be disked and harrowed in the spring to clear it of weeds and put it in good condition for planting.

When seeded as a catch-crop after wheat or other small grain, the most practical method is to prepare a seed-bed with the disk-harrow, or to seed with a single-disk drill without previous cultivation, if the ground is clean and mellow. Plowing the ground at this time would put it in condition to hold more moisture and might give a greater growth and a more perfect stand of peas, but in order to plow wheat or oat stubble it would often be necessary to wait until after thrashing, which

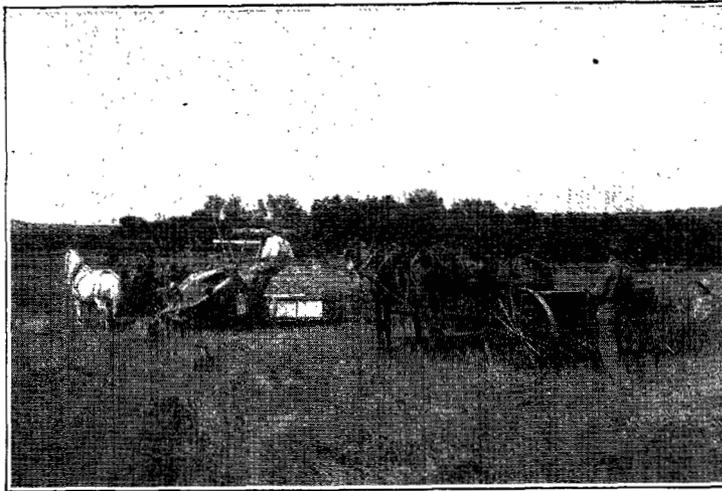


PLATE VI. Planting cow-peas in wheat stubble immediately following the binder, with a single-disk drill.

in most instances would mean planting too late to insure a good stand and good growth of cow-peas. Unless the stubble is disked behind the binder the amount of moisture lost before plowing would often more than offset the gain from a mellow condition of the surface soil secured by plowing. In planting cow-peas after small grain as a catch-crop at this Station, we have found it advisable to follow the binder immediately with the disk-harrow and the disk-harrow immediately with the disk-drill. This practice means a rush of work, but by this method the work of seeding does not interfere with the shocking of the grain and the peas are planted at the earliest possible date. The crop so planted has every advantage of rain-fall and favorable conditions for growth. The moist, mellow condition of the soil usual at harvest-time insures a rapid germination of the peas, while if the preparation and planting is delayed a few days the ground is apt to dry out and become hard. This practice can only be followed upon reasonably clean stubble land. (Plate VI.)

METHODS OF PLANTING.

The method of planting cow-peas will depend upon the purpose for which the crop is grown. For the production of seed, the best practice is to plant in rows about three feet apart, dropping the peas in the rows two or three inches apart. A

common corn-planter may be used for this purpose, but the rows will be farther apart than is necessary for the greatest production of peas. With the edge-drop planter, it is necessary to use the sixteen-cell plate and the highest gear in order to drop the peas thick enough. Some farmers use the corn-planter with the drill attachment, straddling each alternate row, which makes the rows from twenty to twenty-two inches apart. If this method is followed the peas should be placed about six inches apart in the row. Rows placed too close together are inconvenient for cultivating. A good method of planting practiced at this Station is to use a common grain-drill which will not split the peas (there is a difference in drills in this respect), stopping up part of the grain cups so as to leave the rows about three feet apart, setting the drill to sow about two bushels of wheat per acre. This rate of seeding drops the peas about two to four inches apart in the row and requires ten to twelve quarts of peas to seed an acre. The peas should be planted two to three inches deep in mellow soil.

The usual practice is to surface-plant cow-peas. They may, however, be successfully planted in furrows, either by listing or preferably by the use of the furrow-opener on the corn-planter. At this Station the usual plan is to plant with the furrow-openers. There may be advantage from furrow planting by getting the peas deeper in dry soil. In early cultivation the weeds are more readily destroyed by covering them as the furrow is filled. If cow-peas are listed care should be taken **not** to list over four or five inches deep. The plants start slowly in a deep-listed furrow and usually make a poor stand and a dwarf growth.

When the cow-peas are planted for hay or green manuring, the best method is to sow broadcast or in drill-rows six to eight inches apart. For planting in this manner the grain-drill will prove the most satisfactory implement, and should be set to sow about six pecks of wheat per acre, which will sow the peas at the rate of a bushel to one and a half bushels per acre. Planting in close drill-rows does not require later inter-culture. The peas do not vine so much, grow more upright, are easy to harvest with the mower, and make a less woody hay.

When planted for ensilage with corn the most successful method is that of planting the corn and cow-peas at one operation. The common two-row corn-planter, with the sixteen-

cell edge-drop plate, in which the notches have been filed out to make the cells as large as possible, may be used. The cow-peas and corn should be mixed about half and half by weight and the planter set with the drill attachment to plant as thickly as possible. This gives the proper stand of the combination crop, corn averaging about eighteen inches apart and cow-peas four to six inches apart in the drill-rows. If the corn is planted much thicker than suggested a rank growth of stalk is apt to smother the cow-peas, while if the corn is too thin the stalks fail to support the cow-pea vines, making the crop difficult to harvest.

When cow-peas are sown in corn at the last cultivation the usual method is to sow with the one-horse wheat-drill, planting two or three rows of peas between the rows of corn. A common practice also is to sow the peas broadcast in the corn at the last cultivation and cover them with the cultivator. This method is not so satisfactory, on account of the unevenness of the depth of covering and the consequent poorer stand of peas which may result. (Plates II and VII.)

TIME OF PLANTING.

Cow-peas, being a southern crop, are naturally sensitive to cold. When planted in cold, wet soil, the seed will either rot or the plants will make a poor, sickly growth. Cow-peas should not be planted until the soil has thoroughly warmed up and not until all danger of periods of cold weather has passed. Cold spells shortly after planting will often cause a poor stand of the peas. The time of planting will depend largely upon the purpose for which the peas are grown. For green manuring they may be sown as late as the last of July and will make a considerable growth of green material to be plowed under before frost, but if planted for hay or seed it is necessary to sow earlier. In order to determine the most satisfactory date at which to plant cow-peas, an experiment was started in 1904, planting cow-peas at different dates. This experiment was continued through 1905 and 1906. The results are shown in table V.

In this experiment the New Era, one of the earliest maturing varieties of cow-peas, was planted. Since the dates of planting in 1904 do not exactly correspond with those of 1905 and 1906, the yields of the 1904 crop have not been used in de-

TABLE V. Date to plant cow-peas—a summary of results for three seasons, 1904, 1905, 1906.

DATE PLANTED.	Yield per acre.						Average yield per acre for two years' trial, 1905-'06.	
	1904.		1905.		1906.			
	Hay.	Grain.	Hay.	Grain.	Hay.	Grain.	Hay.	Grain.
	<i>tons.</i>	<i>bu.</i>	<i>tons.</i>	<i>bu.</i>	<i>tons.</i>	<i>bu.</i>	<i>tons.</i>	<i>bu.</i>
May 12.....			0.87	3.93	1.51	10.39	1.19	7.16
May 19.....	2.01	15.92	1.61	7.77	2.39	12.88	2.00	10.32
May 26.....	3.55	17.98	1.85	8.98	2.15	10.85	2.00	9.91
June 3.....	4.00	19.90	2.32	11.20	2.20	10.14	2.26	10.68
June 9.....			2.57	12.03	1.60	11.15	2.08	11.59
June 16.....	3.76	23.81	1.82	5.85	1.73	6.08	1.77	5.96
June 23.....	2.23	22.89	1.21	5.75*	1.00	3.20	1.10	4.47
July 14.....	1.92	0.00*						

* Injured by frost.

termining the average. Taking the average yields for 1905 and 1906, we find that planting June 9 has given the highest yield of grain, and planting June 3 has given the largest production of hay. In 1904 the greatest yield of hay was produced from the June 3 planting, but for this season the later seedings of June 16 and 28 gave the largest production of grain. In 1905 the June 28 planting was injured by frost and in 1904 the July 14 planting was killed by frost, so that no seed matured. This experiment shows that it would not be a safe practice to plant New Era cow-peas for seed later than the 25th of June, and that the best results year after year will probably be obtained by planting from the 25th of May to the 10th of June. For the largest production of hay the cow-peas should be planted a week earlier. The early planting of the peas usually causes a heavy growth of vine and a decreased production of seed. It is a safe practice not to plant until about two to three weeks after the regular corn-planting time.

When planting cow-peas with corn for ensilage our experiments at this Station indicate that the best time for planting the combination crop is about the first week in June. If planted earlier than this, when the soil is cold, the cow-peas start slowly and are thus apt to be covered and destroyed by the early cultivation of the corn, or the corn, starting more rapidly, outgrows the cow-peas which make only a dwarf growth. If, however, the ground is permitted to warm up

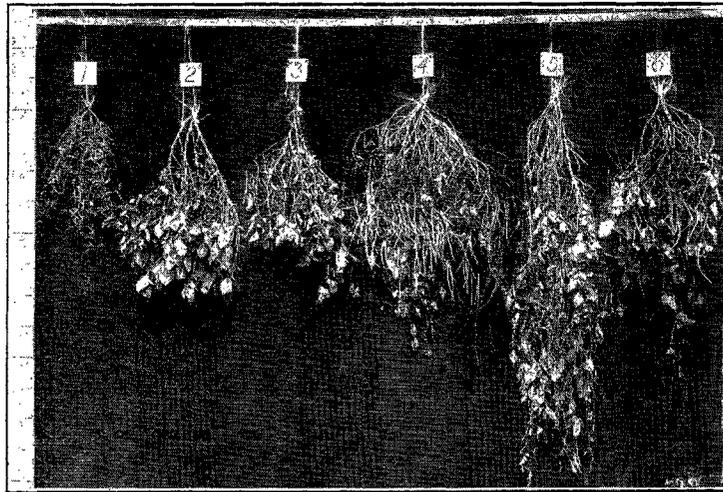


PLATE VII. Individual plants of cow-peas and soy-beans. No. 1, Early Yellow soy-bean; No. 2, Southern soy-bean; No. 3, Flat Black soy-bean; No. 4, New Era cow-peas; No. 5, Clay cow-peas; No. 6, Whippoorwill cow-peas.

before the combined crop is planted, the corn and cow-peas start together and grow equally well.

CULTIVATION.

If the soil is sufficiently warm when the cow-peas are planted the plants will start quickly and grow rapidly. When planted in rows for seed, the crop may be cultivated in two or three weeks after planting. Unlike corn, the young cow-pea plants are tender and should not be cultivated with the weeder or harrow; at least not until the plants have made some growth and are not so easily broken. If the peas are planted in furrows the crop may be harrowed during its early growth without injury to the young plants. It sometimes happens that a heavy rainfall soon after the seeding of cow-peas causes the soil to become crusted, making it difficult for the young plants to push their way out. In this condition a harrow may be used to advantage to break the crust without much danger of injury to the sprouting plants.

When cow-peas are sown broadcast they require little or no cultivation after they are out of the ground. If the ground was well cultivated and cleaned of weeds previous to seeding, the young plants with favorable weather grow rapidly and will usually smother any weeds which may start after the planting. When planted in rows the crop should be cultivated in about

the same manner as corn. Three cultivations with the cultivator are usually all that are required. It is perhaps preferable to cultivate the first time with the knife or Acme cultivator, which may be run close to the row without much danger of covering the plants. For the second and third cultivation, the six-shovel cultivator is preferred. For seed production, cow-peas should be cultivated the last time just before blooming. Very little is gained by later cultivation, as it causes greater vining of the plant and thus later maturity.

HARVESTING COW-PEAS.

FOR HAY.

Cow-peas should be cut for hay when most of the pods are developed and when the first pods and some leaves begin to turn yellow. At this stage the plant has attained its growth and none of the leaves have been lost. If cut before maturity the vines are watery and difficult to cure, while if left too late before cutting there will be an unnecessary loss of leaves in handling and the stems will be tougher and more woody. Cow-pea hay should be handled in curing in about the same manner as alfalfa, but it cures more slowly than alfalfa. A good practice is to begin cutting in the morning as soon as the dew is off when the indications are for favorable weather for a number of days. Before the leaves have become very dry the hay should be raked and allowed to cure in the windrow a short time. It should then be placed in cocks of moderate size, made as high in proportion to circumference as possible. The cocked hay should be allowed to remain in the field or three or four days until the stems of the peas are well cured, when the hay may be mowed or stacked. Where possible, cow-pea hay should be stored under shelter. The coarse nature of the forage makes it hard to keep in the stack, since it does not shed water readily.

FOR ENSILAGE.

When sown alone cow-peas should be harvested for ensilage at about the same stage of maturity as for hay. They should be cut only a short time before they are hauled to the silo; should be raked green, placed in small bunches or loaded onto the wagons directly from the windrow. When cow-peas are planted with corn for ensilage, the combined crop may be har-

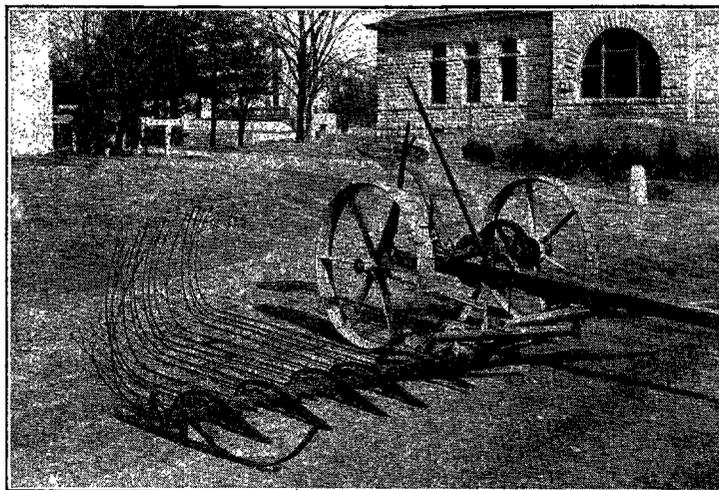


PLATE VIII. Cow-pea harvester attachment for the mowing-machine, showing the vine-lifters on guards, and windrowing attachment.

vested with the corn-binder and handled in the same manner and as easily as corn planted alone for ensilage.

FOR SEED.

Cow-peas ripen so unevenly that it is difficult to judge at just what stage of maturity to cut for seed. With most varieties blossoms, green pods and ripe peas occur at the same time, and this condition continues usually until frost. Harvest before a heavy frost or when most of the pods are brown and the larger proportion of the peas are ripe.

In some of the Southern states, where labor is cheaper, the peas are picked by hand for seed as they ripen. On account of the scarcity of labor in this state this method is hardly practical, although where labor can be secured peas may be picked by hand and thrashed for about one dollar a bushel.

There are several makes of bean- and pea-picking machines manufactured and sold upon the market to-day, but they are not extensively used and it is doubtful if they could be successfully used in this climate, where the peas could not be allowed to complete ripening before picking. A method of harvesting cow-peas for seed is to pull the vines by hand, place in small shocks, and leave in the field until well cured. The peas may be thrashed directly as hauled from the field or they may be stacked and thrashed later. The vines often pull hard, thus it

is the practice at this Station to cut them with a straight corn-knife. This method of harvesting is slow and may not be practical where the peas are raised on a large scale, but upon a small scale it is the most satisfactory method. A man should harvest and shock by hand about one-half acre of peas in a day.

The difficulty in harvesting cow-peas by machinery is due to the twining habit of the plant, which causes it to run and entwine together from row to row. The mowing-machine with vine-lifters attached to the guards may be used in harvesting the cow-peas for seed, but one objection to the mowing-machine lies in the fact that the machine and horses have to pass over the peas while in the swath, which shells them badly. To avoid this a bunching or windrowing attachment has been manufactured to attach to the cutter-bar of the mowing-machine, which lifts the cow-peas as they are cut off by the mower and carries them to one side, leaving them directly behind and out of the way of the mower on the next round. If a rolling-coltter is used on the end of the cutter-bar to cut off the vines that entwine with the vines of the uncut row, this attachment may give satisfactory results, although the attachment is heavy and is hard upon the mowing-machine upon which it is used. The self-rake reaper has been used in harvesting peas for seed, and is quite satisfactory.

There are several types of bean-harvesters manufactured which are sometimes used in harvesting cow-peas. The most successful of these harvesters are constructed so that two long knives run under the vines cutting off the stems of the peas beneath the surface of the ground. These machines will harvest two rows of peas at a time and leave the vines thrown together in one windrow. With this harvester it is necessary to have rolling-coltters placed outside the knives to cut off the vines to prevent them dragging and clogging the machine. This machine has proven very satisfactory for harvesting soy-beans, but the cow-peas clog some, and the horses walking ahead of the machine, although walking between the rows, trample some of the vines and shell the peas. When cut with the bean-harvester the peas are thrown into a fair-sized windrow, where they may be allowed to partially cure. One day in the windrow is usually sufficient. The peas should then be placed in shocks and allowed to thoroughly cure. Three or four days of good drying weather will usually cure them suffi-

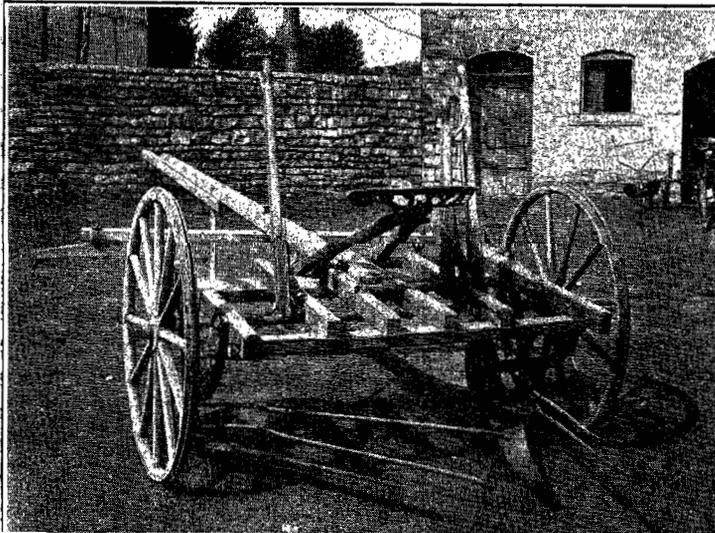


PLATE IX. Bean-harvester, with rolling-coller attached for harvesting cow-peas.

ciently in the shock so that they can be mowed or stacked. Since cow-pea hay takes water very easily, the stacks should be provided with some form of covering. The usual covering, and one that is very satisfactory, is wild grass or prairie hay. (Plates VIII and IX.)

THRASHING COW-PEAS.

When a few acres of cow-peas are grown for seed the most satisfactory method of thrashing is with the flail. This method is slow, yet one man can flail out about an acre of peas in a day, and the work may be done when other work on the farm is slack. Flailing out cow-peas will cost about eight to ten cents per bushel when the seed crop is good, and may cost as much as twenty-five cents when the crop is poor. Cow-pea hullers are manufactured and sold upon the market at prices ranging from \$300 to \$600, exclusive of the engine. These hullers are reported as doing satisfactory work, although none have been tried at this Station. When enough cow-peas are raised in a neighborhood to justify the purchase of a huller this is undoubtedly the most satisfactory method of thrashing, and when peas are stacked or stored in the barn one machine should be able to thrash 1500 to 2000 acres in a season.

The common thrashing-machine is sometimes used for thrashing cow-peas, but unless adjustments are made to adapt it to thrashing cow-peas it will split more than half of the peas, ruining them for seed. Different thrashing-machine companies make attachments for the common grain-separator to adjust it for thrashing peas and beans, but the trials of such attachments at this Station have not proven successful; either the cow-peas were not thrashed clean or else the seed was badly broken.

Our farm foreman, Mr. Floyd Howard, has made adjustments to the bean-thresher attachment for the Avery separator so that we were able to thrash cow-peas this past season fairly clean and with no more cracking of the peas than would occur by flailing. Determinations of cracked peas of average samples of the different varieties as they came from the separator showed that the percentage of peas cracked ranged from 3 to 12 per cent. The varieties having the largest sized seed, like the Gray Goose, were cracked the most, while the varieties having smaller seed, like the New Era and Whippoorwill, were cracked the least.

The attachment adjusting the Avery separator for thrashing cow-peas reduces the speed of the cylinder and at the same time maintains the speed of the rest of the machine. To accomplish this the speed of the engine is reduced so as to turn the cylinder at the rate of 500 revolutions per minute (the usual rate for thrashing wheat and oats being from 1000 to 1200 revolutions per minute). In order not to reduce the rate of movement of the rest of the machine it is necessary to increase the size of the pulleys that run the feeder, fanning riddles, cleaning pans, wind stacker, etc. The pulleys were changed as follows: Feeder, from 5 1/2 inches to 12 inches; crank-shaft, which runs the riddles, shaker, grain pan, etc., from 5 1/2 to 12 inches; wind stacker, from 7 to 12 inches. By these adjustments the speed of the separator, except the cylinder, was maintained. All of the cylinder teeth and two rows of concaves were left in the machine, for when any of these were taken out the peas were not thrashed clean. The above changes are included in the regular attachment furnished by the company. It was found, however, that the peas were split badly with the machine thus adjusted, and we were not able to do satisfactory work until Mr. Howard observed that most of

the peas were cracked in passing through the grating of iron bars directly behind the cylinder. This grating was removed and replaced by No. 8 wire strung from two to three inches apart and attached at the top and bottom to the bars that originally held the grating. With this adjustment we are able to thrash cow-peas successfully with our Avery separator.

STORING COW-PEA SEED.

Cow-pea seed can be stored for considerable time in this climate without much danger of loss of vitality. The soy-bean is difficult to keep in storage in large quantities, as the seed frequently heats badly. However, this is not the case with the cow-pea, and there is little danger of heating if the peas are sufficiently cured in the mow or stack before thrashing. Cow-pea seed, however, is subject to attack from insects, and especially from the cow-pea weevil, a beetle dark brown in color and about one-fifth of an inch long, that lays its eggs upon the newly formed pods in the field. These eggs hatch and the larva eats through the pod and enters the nearest pea. The insect usually lives within the pea until after the pea is thrashed and placed in storage, when with a suitably warm temperature it comes out of the pea as a mature beetle and lays its eggs upon other stored seed. These eggs soon hatch and produce other larvae, which cause further destruction of the peas. There may be several generations of these beetles in a single year, so that, unless precautions are taken to destroy the insect as soon as possible after the peas are placed in storage, a large proportion, if not all, of the peas may be infested. Peas infested with weevil can readily be discovered by throwing them lightly into water, when the infested peas will float.

Dr. T. J. Headlee, entomologist of this Station, in speaking of the pea weevil, says that these insects are so easily kept under control that no grower should lose a large amount of seed as a result of their work. He recommends as a preventive measure that the infected seed peas be treated with carbon bisulfid as soon as placed in storage, followed with a second treatment two or three weeks later, when any eggs not hatched at the time of the first treatment will have hatched and may thus be destroyed.

Carbon bisulfid costs about twenty cents a pound, and that



PLATE X. Showing root system of cow-peas 111 days after planting. Plants from adjacent rows three feet apart.

amount is sufficient to treat about 500 cubic feet of peas. The treatment is easily made if the peas are stored in bins as nearly air-tight on sides and bottom as possible. The carbon bisulfid should be placed in a dish on top of the seed, where it will evaporate, and, being heavier than air, will sink into the mass of the seed, destroying any insects present. The gas diffuses equally in all directions through the seed and the quantity of carbon bisulfid to be used must be determined by the total size of the bin. There is no danger of using too much of the liquid. A canvas covering may be thrown over the surface of the peas to insure a more perfect confinement of the gas during the treatment.

Caution.—Great care is necessary in using carbon bisulfid. It is a highly inflammable gas, and no fire of any nature should be allowed in the building where the gas is being used. Care must be taken not to enter the building with a lighted lantern,

pipe or cigar until after the building has been thoroughly aired. It is usually best to fumigate seeds with carbon bisulfid in a granary or shed removed some distance from other large buildings, but with proper precautions the fumigating may be done in any building.

SUMMARY.

1. The cow-pea is a leguminous crop enabled by the bacteria that live upon its roots to make use of the nitrogen of the atmosphere and store it in the soil for the use of non-leguminous crops like wheat and corn.
2. Cow-peas make nutritious hay relished by nearly all classes of stock, but the plant is a rank grower and the hay is somewhat difficult to cure.
3. Cow-peas planted with corn make ensilage of higher feeding value than corn alone, being richer in protein. Cow-peas planted with corn produce as much ensilage per acre as may be produced by corn alone.
4. Cow-peas planted with corn at the last cultivation increased the yield of corn in which the cow-peas were planted by more than three and one-half bushels per acre as an average for five years.
5. Cow-peas planted as a catch-crop between crops of wheat in continuous wheat growing increased the yield of wheat four and one-third bushels per acre as an average for five years. Where cow-peas were used the yield of wheat has continually increased. Where not used the yield of wheat has continually decreased.
6. Cow-peas used as a catch-crop after wheat in rotation of wheat and corn increased the yield of corn over nine bushels per acre as an average for four years.
7. Cow-peas have proven a better crop than soy-beans. They are more sure of making a stand, make a ranker growth and larger yield of forage, and are better suited for planting with corn for ensilage and for green manuring than soy-beans.
8. The following varieties of cow-peas have given the best results: For hay, Whippoorwill, Mount Olive, New Era, and Gray Goose; for ensilage, Whippoorwill; for a catch-crop after wheat, New Era.
9. Cow-peas will grow upon a poorly prepared seed-bed, but they respond to good cultural methods, and a seed-bed for

cow-peas should be prepared as carefully as a seed-bed for corn.

10. When sown broadcast or in close drills cow-peas do not require cultivation, but when sown in rows for seed they should be cultivated in about the same manner as corn. Nothing is gained by cultivating cow-peas after the blooming period for seed production, since the late cultivation produces a more vining growth and delays maturity.

11. The best method of planting cow-peas is with a common grain-drill, letting all seed-cups run when planting for hay and stopping up enough of the cups to plant in rows about three feet apart when planting for seed.

12. The best time for planting cow-peas in central Kansas is from May 25 to June 10 for seed, and about one week earlier than this for hay. When planting with corn for ensilage the combined crop planted about June 1 has given the best results.

13. Cow-peas should be cut for hay when the first pods and some of the leaves are turning yellow. For seed the crop should be cut when most of the pods are mature.

14. Cow-peas can be harvested for seed, in a small way, by hand; but when grown in large areas the bean-harvester and cow-pea attachment to the mowing-machine may be used.

15. With the flail is the most satisfactory way of thrashing cow-peas unless they are grown in areas large enough to justify the purchase of a pea-huller or a cow-pea attachment to the grain-separator.

16. The cow-pea weevil which attacks cow-peas in storage can be held in check by treating the stored peas with carbon bisulfid.

ACKNOWLEDGMENTS.

This bulletin has been largely prepared and written by L. E. Call, while several assistants in this department have been concerned with the experiments referred to, as follows: V. M. Shoesmith, now of the Ohio State University; M. D. Snodgrass, in charge of the Experiment Station, Kodiak, Alaska; E. G. Schaffer, present assistant in field crops, and Floyd Howard, farm foreman.

MANUFACTURERS OF COW-PEA MACHINERY.

Bean- and Pea-harvesters.

- C. H. Bidwell Thresher Co.,
Batavia, N. Y.
- Howland Manufacturing Co.,
Pontiac, Mich.
- Lehr Agricultural Co.,
Fremont, Ohio.
- Sterling Manufacturing Co.,
Sterling, Ill.
- J. S. Rowell Manufacturing Co.,
Beaver Dam, Wis.
- Le Roy Plow Co.,
Le Roy, N. Y.
- Cardwell Machine Co.,
Richmond, Va.
- Ohio Cultivator Co.,
Bellevue, Ohio.
- American Harrow Co.,
Detroit, Mich.
- Reed Manufacturing Co.,
Kalamazoo, Mich.
- Gale Manufacturing Co.,
Albion, Mich.
- Akron Cultivator Co.,
Akron, Ohio.
- Caledonia Bean Harvester Co.,
Caledonia, N. Y.
- Thos. G. Gordon Co.,
Elizabeth City, N. C.
- Thorp & Sexton Co.,
Salisbury, Md.
- Nettleship Bros.,
Fayetteville, Ark.

Bean-hullers.

- J. L. Owens Co.,
Minneapolis, Minn.
- Engelberg Huller Co.,
Syracuse, N. Y.

Bean-pickers.

- A. T. Ferrill & Co.,
Saginaw, Mich.
- Miller Bros.,
Rochester, Mich.
- Nettleship Bros.,
Fayetteville, Ark.

Bean- and Pea-rakers.

- Ohio Rake Co.,
Dayton, Ohio.
- Dain Manufacturing Co.,
Ottumwa, Iowa.
- Sandwich Manufacturing Co.,
Sandwich, Ill.
- Sterling Manufacturing Co.,
Sterling, Ill.

Bean-separators and Graders.

- Bacon Manufacturing Co.,
Pontiac, Mich.
- Smith Manufacturing Co.,
Valois, N. Y.
- A. T. Ferrill Co.,
Saginaw, Mich.

Bean-cleaners.

- A. P. Dickey Manufacturing Co.,
Racine, Wis.
- A. F. Ferrill Manufacturing Co.,
Saginaw, Mich.
- J. L. Owens Manufacturing Co.,
Minneapolis, Minn.
- Johnson & Field M'f'g Co.,
Racine, Wis.

Bean- and Pea-drills.

- Bacon Manufacturing Co.,
Pontiac, Mich.
- Campbell Corn Drill Co.,
Harrison, Ohio.
- Keystone Farm Machine Co.,
York, Pa.
- Deere & Mansur Co.,
Moline, Ill.

Two-row Bean-planters.

- Deere & Mansur Co.,
Moline, Ill.
- Moline Plow Co.,
Moline, Ill.
- Parlin & Orendorff Co.,
Moline, Ill.
- Ohio Rake Co.,
Dayton, Ohio.

NOTE.

The machines manufactured by the above-named companies, as a rule, have not been tested by this Station. The list is as complete as we are able to give from our present knowledge and is given for the convenience of those intending to purchase cow-pea machinery. Before purchases are made, we would recommend an investigation of the machines manufactured by the different companies.