THE SEARCH FOR NEW LEGUMINOUS FORAGE CROPS.

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NEED FOR NEW LEGUMES.

Leguminous crops play so important a part in agriculture that unusual interest attaches to any new ones, especially if adapted to sections of our country where a satisfactory legume is still a desideratum. The need of satisfactory legumes is greatest at present in our semiarid regions, though a good perennial species adapted to the Cotton Belt would be of incalculable value. If it be true that no system of agriculture can anywhere be permanent without the use of a leguminous plant in rotation, this makes imperative the search for such a crop for every part of our country where agriculture is possible.

Botanists now recognize no less than 10,782 species of leguminous plants, distributed in 487 genera. Of these, 3,846 species in 203 genera are American; 6,930 species in 355 genera belong to the Old World. The Old World thus contains nearly twice as many species as the New. Asia is by far the richest continent both in genera and species. One-fourth of all the species consists of woody plants; the remainder, herbaceous. On each continent the members of this family show a very great range of adaptation to conditions. Many species occur in the coldest of arctic and alpine regions; others in the hottest of the Tropics, and few desert regions are so dry that they can not exist. Indeed, it may be said that wherever other flowering plants exist there occur also legumes.

It would surely seem that in so vast an array of species there must exist some of forage value adapted to every soil and climate where agriculture is possible. When we recall that only about 200 species of legumes are cultivated and only 40 of these as forage crops, the possibility of finding others is very far from hopeless.

AMERICAN LEGUMES AND GRASSES NOT AGGRESSIVE.

It is a striking fact that of the 26 species of legumes more or less cultivated in America only 3 are of New World origin, namely, the common bean, the Lima bean, and the Florida beggarweed. This fact is paralleled with a similar condition among the grasses: Of our 32 cultivated species only 3 are certainly of American origin, and these of but minor importance, namely, slender wheat-grass, rescue grass, and *Paspalum dilatatum*. The last two are from South America and are well adapted only to our warmer States.

It might be assumed from these striking contrasts that native American legumes and grasses had been sadly neglected, but this is far from the case. The evidence is overwhelming that Old World plants as a whole are more aggressive, occupying the land or retaining their hold on it in a way that few American species do. This ability to occupy the land to the exclusion of other plants is a quality of fundamental importance when a crop is sown broadcast, as are most legumes and grasses. Unfortunately the same inherent quality makes numerous Old World plants pernicious weeds, for nearly all of our serious weeds have come from across the seas. If examples are needed one need only recall quack-grass, wild garlic, Canada thistle, ox-eye daisy, field bindweed, orange hawkweed, Johnson grass, sorrel, wild mustard, and wild oats, not to mention about fifty others.

The American Hemisphere has contributed many of the most important plants to agriculture. Indeed it is difficult to imagine agriculture without them. Among them are corn, cotton, tobacco, potatoes, beans, sweet potatoes, tomatoes, cassava, strawberries, peanuts, and pumpkins, but without exception all of these must be so cultivated as to eliminate the competition of weeds. This consideration would tend further to show that the most hopeful source of new forage legumes is the Old World.

CONDITIONS AFFECTING THE SEARCH FOR NEW SPECIES.

Viewing the United States as a whole, it is only the northeastern fourth and the Pacific coast that present considerable similarities in climate to the different parts of Europe. The semiarid regions and the South have qualities of climate that are for the most part absent in Europe. We should, therefore, expect that forage crops of European origin would scarcely be adapted to these regions, which in a large measure has proved true. For these sections our forage crops have come largely from regions of similar climates. It may also be pointed out that there are such pronounced differences in climate between Europe and most parts of America that a number of important European leguminous crops have never been found useful here, or at least only in extremely limited sections; among them are sainfoin, serradella, lupines, horse beans, and sulla.

The importance of these considerations lies in the fact that there are immense regions in the Old World with climates totally different from Europe, but which closely approximate parts of our domain, so that the result of European experience with any such plant is no satisfactory criterion of what it will do in appropriate localities in this country. There are many reasons to make us believe that much of agricultural value will yet come out of these regions. Indeed, it is not too much to say that this is year by year proving to be the case.

COMPARISON OF CLIMATIC CONDITIONS.

When two regions on different hemispheres possess similar climates there is nearly always a similarity in their native vegetation, and it is a demonstrated fact that many of the plants native to one of the regions find themselves perfectly at home in the other. California conditions are markedly similar to those of the Mediterranean region, so that it is no surprise to find more than fifty plants from the latter region that thrive in California with marvelous vigor. It is conservatively estimated that over 75 per cent of the forage on the California range lands is made up of Mediterranean immigrants, mostly annuals, such as wild oats, bur clover, alfilerilla, bromegrasses, fescues, wild barleys, and many others.

The Great Basin and the Columbia Basin resemble California in one marked respect, namely, that the summers are dry and the winters wet. Indeed, the principal difference from California lies in the colder winters. The difference has not prevented the introduction and rapid spread of most of the European annuals now so conspicuous in California. It is really little short of amazing how rapidly and extensively some of these plants have occupied the range lands at the expense of the native vegetation.

The conditions in Arizona are not very favorable to the plants that have found California conditions so congenial, with the exception of alfilerilla. Arabia of all Old World regions is most like Arizona, and from there if anywhere we should expect plants adapted to Arizona conditions.

Western Washington and western Oregon closely approximate in climate the British Isles, and practically everything that thrives in the one region is at home in the other.

The Middle and South Atlantic States are similar to Japan and China in climate. It has long been recognized that all Japanese plants, especially ornamentals, thrive in this region perfectly. A number of them are so at home, indeed, that they have literally taken to the woods and behave as natives; witness the Japanese honeysuckle, Japan clover, ailanthus, Paulownia, and the recently introduced Chinese violet.

The cotton States evidently have much in common with India and southeastern Asia, whence we have obtained cowpeas, crab-grass, Bermuda grass, velvet beans, and many weeds, and to a less degree with Argentina, where rescue grass, carpet grass, paspalum grass, and a number of common southern weeds are native.

Of late years there has been increasing evidence that the high plains of northern Texas resemble the highlands of India. At least practically every plant introduced from the India highlands has succeeded better in the Texas Panhandle than elsewhere in the United States.

The Great Plains region lying east of the Rocky Mountains and west of the one hundredth meridian finds its nearest parallel in climate in Asia, whence we are most likely to obtain better forage crops resistant to cold or drought, or both. The task is far from easy, as very few of the native forage plants of central Asia have ever been grown under cultivation even in their native land. This is the region that gave us alfalfa, so we have good reason to expect that other valuable forage plants will be found there.

POSSIBILITIES NOT LIMITED.

It must not be forgotten that over much of the regions referred to forage crops, as such, have scarcely been grown. Where the population is dense, domestic animals have been fed largely on the refuse of plants grown for human food. Until they were grown in this country agriculturists were acquainted with cowpeas, soy beans, sorghums, and millets principally as crops for human consumption. In this country they have all become important, but mainly as forage crops. In the parts of Asia where the population is sparse, animals are fed almost wholly on native meadows and pastures, so that the value of these forage plants under cultivation yet remains largely to be determined.

Broadly speaking, the search for legumes fitted to the semiarid States must be in similar regions in Asia and, perhaps, northern Africa; and for those suited to our Southern States the search must be made in India, China, and, to a less degree, South Africa. In all of these regions there yet remain hosts of legumes to be tested agriculturally. The possibilities are by no means confined to obtaining new species, as the results of recent years' work have disclosed the existence of numerous varieties of such old crops as alfalfa, clover, soy beans, cowpeas, velvet beans, bur clovers, vetches, and others which have been for the most part heretofore unknown in this country. A number of these have already proved to be distinct acquisitions to American agriculture.

During the past ten years the Department of Agriculture has tested no less than 187 species and 800 varieties of legumes as forage, mostly new things obtained by the Office of Foreign Seed and Plant Introduction. This was not merely a miscellaneous lot of species gathered as a collection, but there was definite reason to believe that each might prove of value. Out of these only a small proportion has proved to be useful or promising to American agriculture. The more important are discussed in the following pages.

THE LYON BEAN.

One of the very important legumes for Florida and the sandy soils of the South Atlantic and Gulf coasts is the Florida velvet bean, which has been known in Florida for more than fifty years. The

FIG. 1.—LYON BEAN (MUCUNA LYONI) GROWING ON A TRELLIS AT BILOXI, MISS., IN 1908.

[The clusters of pods are from 2 to 4 feet long.]

FIG. 2.—A PATCH OF KUDZU (PUERARIA THUNBERGIANA) GROWING AT WASHINGTON, D. C.

[These plants were cut down to the ground in the spring and the illustration represents the growth of a single season. The mass is about 5 feet high.]

FIG. 1.—FIELD OF BRABHAM COWPEAS GROWN AT ROGERSVILLE, TENN., IN 1908.

[Note the great abundance of pods.]

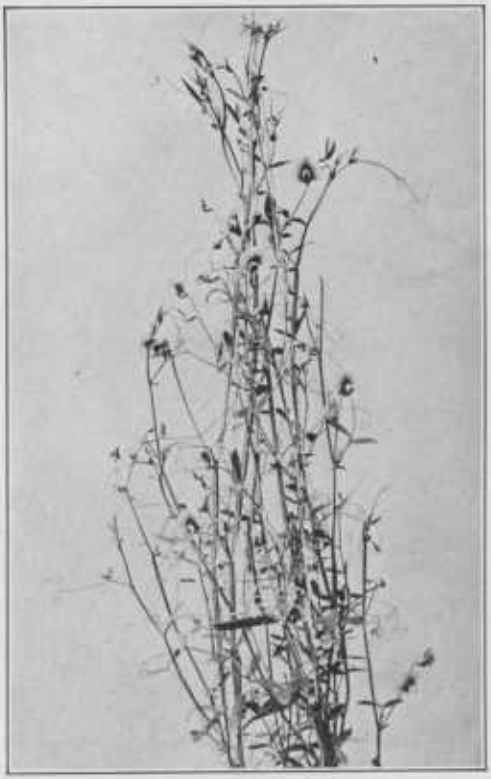


FIG. 2.—THE TOP PORTION OF A SINGLE TANGIER PEA PLANT (LATHYRUS TINGITANUS) WHICH GREW TO A HEIGHT OF 9 FEET.

FIG. 1.—FIELD OF ADZUKI BEANS (PHASEOLUS ANGULARIS) GROWN AT ARLINGTON FARM, VIRGINIA, IN 1908.

[Yield of seed, 26.4 bushels per acre.]

FIG. 2.—FIELD OF ADZUKI BEANS (PHASEOLUS ANGULARIS) GROWN AT ARLINGTON FARM, VIRGINIA, IN 1908.

[Yield of seed, 27.3 bushels per acre.]

FIG. 1.—BONAVIST (DOLICHOS LABLAB) GROWING WITH CORN AT ARLINGTON FARM, VIRGINIA, IN 1907.

FIG. 2.—BONAVIST (DOLICHOS LABLAB) GROWING WITH CORN AT ARLINGTON FARM, VIRGINIA, IN 1908.

[The corn was beaten down by a storm, so that the field is almost entirely bonavist.]

original source of this bean is unknown, and it has never been obtained through any foreign source, notwithstanding that a good deal of this seed was long ago distributed throughout the world by the Department of Agriculture and others. During the past two years an active search was made to obtain other species of Stizolobium to test in comparison with the Florida velvet bean, and there have been secured from various sources, principally southeastern Asia, no less than eight distinct varieties or closely related species. Three of these have been grown in comparison with the Florida bean at many different places; the remainder at but a few places, owing to the small amount of seed. The Florida velvet bean is used primarily as a pasture plant, cattle being turned into the fields late in the season when the crop of pods is mature or nearly mature.

Other things being equal, the best species or variety would be that which produces the largest amount of pods and seed. In this respect the Lyon bean (*Stizolobium lyoni*) has thus far proved to be superior to the Florida velvet bean. This species was described from the Philippine Islands, and 1 pound of the seed was received in 1907 from Mr. W. S. Lyon, of Manila, who discovered the plant. From the Florida velvet bean this plant is distinguished by having rather broader leaflets, in which the surface is not plane, but more or less billowy; by having white instead of purple flowers; by having the pods covered with short, white, appressed hairs, instead of the black velvety hairs of the Florida bean; and by having the seeds white and much more compressed than those of the Florida bean. The important points, however, from an agronomic point of view are that this bean is somewhat earlier and produces much more seed. Judging by its behavior during the past two seasons, this species is quite certain to replace the Florida velvet bean as a forage crop. As it is hardly proper to call this a velvet bean, the name "Lyon bean" has been adopted. (See Pl. IX, fig. 1.)

In this connection it may be interesting to note that two other varieties of Stizolobium, S. P. I. No. 21952, from Buitenzorg, Java, and S. P. I. No. 22463, from Saharanpur, India, have white seeds, very much like the Lyon bean, but in each case there is a small dark spot at one end, and both have purple flowers. Neither of these species is nearly equal to the Lyon bean as a forage crop, notwithstanding the close similarity of the seeds.

KUDZU.

Kudzu (*Pueraria thunbergiana*, Pl. IX, fig. 2) is a large-leaved, woody, leguminous vine, native of Japan. For many years it has been more or less grown in the United States as an arbor plant, for which its extremely rapid growth, dense leafiness, and attractive foliage well fit it. Its limited horticultural use has indicated that it is hardy as far

north as Nova Scotia and that it also succeeds admirably in Florida. It is not drought resistant and therefore is adapted mainly to the more humid States. Mr. David Fairchild reports that in Japan it is allowed to grow mostly on rough land or cliffs which do not permit of cultivation. The herbage is there gathered and used as green feed for cows.

The Japanese also utilize the plant in other ways. From the thick roots is extracted a starch of unusually fine quality that is used principally for confectionery. The fiber of the stems is also used in making a sort of cloth of coarse texture for wrapping purposes, some of which is imported into this country under the name "grass cloth."

The kudzu is an extremely vigorous grower, well-established plants growing numerous running branches to the length of 40 feet a season at Washington, D. C., and 75 feet in Florida. These branches root readily at the joints, especially where they are covered with a little soil. In this way additional plants can very easily be obtained.

So far as is known, the kudzu has never ripened seed in this country, although it blooms in Florida. Seed, however, is obtainable from Japan. When grown from seed the plant the first year makes prostrate branches 6 to 12 feet long, and during the second season the growth is much greater. It is not until after the second season that the plant is strong enough to make anything like its maximum growth. While Mr. Fairchild suggested, as long ago as 1902, the advisability of testing kudzu as a forage plant in waste places, this does not seem to have been done until recently, when several investigators reported results.

Samples of kudzu hay from Florida were exhibited at the Jamestown Exposition in 1907. One Florida experimenter states that kudzu makes at least double the growth of the Florida velvet bean, and that the hay is much more easily cured. Cattle eat the green leaves readily. When cut and cured for hay, horses are fond of it. While if grown on level ground it is possible to cut the kudzu for hay, it seems altogether likely that its value will be primarily as a permanent pasture plant, especially on lands too rough or too poor to till.

Judging from the growth of the plant at many places, it would seem to be entirely practicable and profitable to plant it in two or more pasture fields, grazing in rotation. Where such plantings are made, the plants should be set out at intervals of 15 or 20 feet each way. Where seed is used it will be advisable to start the plants in a bed and then transplant them when they have attained sufficient growth. From a single plant any number of rooted cuttings can easily be obtained by layering. If the land is brushy that is really an advantage, as kudzu grows better when supported above the ground.

In a number of parts of the country stock raisers have become very much interested in the possibility of utilizing this plant on poor or rocky land, and numerous experimental tests are under way. It would seem to be the part of wisdom for anyone in experimenting with this to confine his first test to a small area. It is very doubtful, indeed, whether land that can be profitably tilled should be planted with this vine, as on account of the large woody roots it would be somewhat expensive to remove in case it were not found altogether desirable. No data are at hand regarding the yield per acre of starch from the roots, and it is problematical whether the yield of roots and of fiber would pay for clearing the land.

GUAR.

Guar (*Cyamopsis tetragonoloba*) is an East Indian annual legume, the seed of which was first obtained by the Department of Agriculture in 1903. It is very different in appearance from any other legume grown in this country. From an agricultural standpoint it is especially promising on account of its great drought resistance and prolific seed yield. With sufficient moisture it grows to a height of 5 or 6 feet, but under arid conditions only 3 to 4 feet. It is the most drought-resistant annual legume yet obtained. At Chico, Cal., a fine crop was produced without irrigation and without a drop of rain from the time it was planted until nearly mature. During the whole season it showed no suffering from the drought, which seriously affected adjoining plots of Kafir corn and of sorghum. In Texas it has also demonstrated its high drought resistance.

In India the plant is grown both for green forage and for the seed, which, according to Duthie, is used mainly to fatten cattle. The seeds are somewhat pungent in taste, but highly nutritious, containing over 32 per cent of protein. Some Hindu tribes also use the green pods as a vegetable after the manner of string beans.

Guar is very prolific, a single plant grown at Chico producing 260 pods. The yield in India is stated to be about 13 bushels per acre. Small plots in this country have shown a considerably greater yield, as the rather crude methods of Hindu agriculture would lead us to expect. Owing to the upright habit of the plant and to the fact that the ripe pods are broken open only with difficulty, guar can readily be harvested with a binder and thrashed.

There are many varieties, some of them with single stems; others branched from the base. The upright-growing varieties are preferable, at least from a seed-producing standpoint. Some of the varieties have much larger seeds than others, and on this account are more desirable.

In regard to its palatability to live stock, the evidence is thus far somewhat conflicting. At the Oklahoma experiment station the cattle ate the straw readily after the seeds had been thrashed out,

notwithstanding that it was decidedly coarse and the leaves had fallen. Most experimenters report that their mules and cows eat it as well as cowpeas. Mr. G. A. Schattenberg, of Boerne, Tex., found that his sheep ate it readily, and he regards it as an exceedingly valuable plant for pasture. A few experimenters have had less satisfactory experiences, in some cases the animals absolutely refusing to eat it. The mixed results would lead to the belief that most animals will acquire a taste for it, as animals commonly refuse a new forage at first. Its use in India certainly confirms this idea.

Guar requires a long season and considerable heat to mature. It is likely that it will prove valuable in dry farming in the southwestern portion of the United States, especially where it is too dry for any other legume to succeed. It is practically certain that the cowpea is to be preferred wherever it will grow, but the guar is very much more drought resistant.

TANGIER PEA.

The Tangier pea (*Lathyrus tingitanus*, Pl. X, fig. 2) is a native of North Africa. In a general way it resembles the garden sweet pea and has been grown to a slight extent as an ornamental for more than one hundred years. As a forage crop it was first cultivated by Dr. L. Trabut in Algeria with very gratifying results. It has been extensively tried in this country in the Pacific States and in the South in comparison with common vetch, which, under favorable conditions, it far outyields. Some fear has been expressed that this plant might prove harmful to stock, as a number of species of Lathyrus are considered poisonous, at least under certain circumstances. Doctor Trabut, however, has never experienced ill results in feeding it, and in a number of places in this country it has been fed quite largely with only favorable results. The Tangier pea has been found not well adapted to the drier portions of the Plains region. As a crop its final place in American agriculture will depend upon its ability to compete with vetch, but it is doubtful whether the seed can ever be raised as cheaply as that of common vetch.

SIBERIAN ALFALFA.

The explorations of Prof. N. E. Hansen in Siberia have brought into prominence the yellow-flowered alfalfas native to that region and which flourish under excessively severe conditions of cold and drought. From the similarity of this region to that of western Montana and the Dakotas it was only reasonable to believe that these alfalfas would prove to be well adapted to those States, which the tests as far as conducted verify. Unfortunately, these yellow-flowered alfalfas do not have so upright a habit as ordinary alfalfa. Some recent critical studies, however, have proved beyond doubt that several hardy strains of alfalfa differing but little in appearance from

ordinary alfalfa owe their hardiness to the fact that they are hybrids between ordinary alfalfa and one of the yellow-flowered alfalfas. This fact is of great interest and importance, as undoubtedly breeders will develop by similar hybridizations superior hardy alfalfas adapted to our coldest and driest States. Thus far the hybrids obtained are all the result of crossing *Medicago sativa* with *M. falcata*, but in Siberia there are at least two other yellow-flowered species, *Medicago ruthenica* and *M. platycarpa*, both of which possess desirable qualities and which have recently been obtained by Professor Hansen. It is not too much to hope that hybrids with these species will result in varieties of additional value. This is one of the most hopeful lines of inquiry in the search for better legumes adapted to our cold and arid States.

MOTH BEAN.

The moth bean (*Phaseolus aconitifolius*) is an annual legume, native of India, where it is grown principally for its seeds, which are used as human food. In habit it forms mats 2 to 3 feet in diameter and 12 to 18 inches high, with very numerous viny branches, the lower ones lying prostrate on the ground. This bean has proved to be exceedingly well adapted to the conditions in the Texas Panhandle, where in many ways it is superior to the cowpea. The prostrate habit and immense amount of foliage enable it to cover the ground so completely that there is practically no evaporation of water from the soil. The very viny branches and the persistency with which the leaves are held make an unusually fine quality of hay, which stock of all kinds eat greedily. No difficulty has been found in mowing this plant if cultivated in rows, as is usually necessary in semiarid regions, and the mower is started under the first plant.

The yield per acre during the three years in which it has been under trial averages about 2 tons, fully equal to that of the cowpea and superior in quality. Under favorable conditions the pods are produced in large numbers and show no tendency to shatter. The roots are remarkably well provided with tubercles, indicating that the plant is a very efficient nitrogen gatherer. So far as can be ascertained in limited experience with it, it is somewhat more drought resistant than the cowpea, with which crop it will necessarily compete agriculturally. It seems reasonably certain that this plant will become of considerable use in southwestern Kansas, western Oklahoma, and the Panhandle of Texas. Where the rainfall is greater comparative experiments indicate that the cowpea is distinctively preferable.

ADZUKI BEAN.

The adzuki bean (*Phaseolus angularis*, Pl. XI) is a native of southeastern Asia, being largely grown for human food in China and

Japan, and to a less extent in India. The plant is erect growing, leafy, and strictly "bunch" in habit, growing 1 to 3 feet in height according to variety and soil. It possesses root tubercles in great numbers and is probably very efficient as a nitrogen gatherer. The numerous varieties are distinguished most markedly by their different times of maturity and by the color of the seeds, which may be yellow, brown, red, gray, or variously mottled. For several years this plant has been tested as a hay plant, but it does not possess sufficient ability to fight weeds to enable it to compete with the cowpea. When grown in cultivated rows, however, it has produced very heavy crops of seed, up to 40 bushels per acre on the relatively poor soils of the Arlington Experimental Farm, a yield that is not exceeded even by the soy bean. It is somewhat doubtful whether this bean will become popular in this country as human food. On account of the high yield of grain per acre it will doubtless become valuable as stock feed, as no other legume, with the exception of the soy bean, will yield larger seed crops.

COWPEA.

The cowpea (Pl. X, fig. 1; Pl. XIV) has for nearly one hundred years been the chief leguminous crop in the Southern States, and there has been a constantly growing appreciation of its value. Over forty varieties have been more or less cultivated in the United States, all belonging to the species *Vigna unguiculata*. It is quite likely that many of these varieties originated in America by hybridization or by mutation. The cowpea, together with the closely related catjang (*Vigna catjang*) and the asparagus bean (*Vigna sesquipedalis*), has been cultivated since ancient times, especially in southern Asia and Africa, as human food. From these regions a very large number of varieties unknown in this country have been obtained in recent years. Very few of these have points of superiority not possessed by our best cowpeas, except certain upright-growing varieties of catjang. These varieties are exceedingly vigorous, very late, not subject to disease, and hold their leaves perfectly. The seeds are small and hard, and retain their vitality much longer than the larger-seeded cowpeas. Furthermore, on account of their hardness these seeds exhibit a pronounced resistance to the attack of weevils, a matter of great importance. Mr. George W. Oliver has made numerous hybrids between some of the catjang varieties and the best American cowpeas, in which are combined the desirable qualities of both. It now seems practically certain that some of these hybrids will prove distinctly superior to any cowpeas that we now possess.

THE BRABHAM COWPEA.

Of late years breeders have been actively engaged in developing improved varieties of the cowpea, and from time to time have ap-

peared new varieties arising through accidental hybridization. One of these is the Brabham cowpea, a hybrid between the Iron and a half Crowder form of Whippoorwill, which originated spontaneously on the farm of Mr. A. W. Brabham, at Olar, S. C. Mr. Brabham first obtained this hybrid in 1902 by planting the Iron and the Whippoorwill Crowder, locally called "Shinney," in alternate hills. The Iron was planted eight days earlier so as to bring the two in bloom together. There can be little question as to the Brabham being a hybrid of the two supposed parents, though natural hybrids of the cowpea are far from common.

A small packet of seed was first obtained by the Department of Agriculture in 1907, and in a preliminary row test the Brabham showed up remarkably well, being of excellent habit and most prolific. On account of its showing, a few bushels of seed were obtained from Mr. Brabham, which were tested in 1908 at Arlington, Va., Louisville, Ga., Rogersville and Knoxville, Tenn., Auburn, Ala., Monetta, S. C., and Chillicothe, Tex. At Monetta it was found to be perfectly resistant to wilt and to root-knot, and when grown alongside of the Iron proved to be 15 or 20 per cent better than its parent. Where grown for hay, the Brabham plants were fully 4 inches taller than those of the Iron, and in a comparative test for seed yield the former was distinctly superior, the yield per acre being 21.7 bushels against 15 bushels of Iron. As the Brabham pea is somewhat smaller than the Iron, this difference is very much more in its favor than appears on the surface. At Auburn, Ala., Louisville, Ga., and Chillicothe, Tex., the Brabham pea made the same excellent showing. The fields at Knoxville and Rogersville, Tenn., likewise showed a most excellent yield of pods, but the plants here showed a tendency to continue growth at the top, forming viny tips 4 inches to a foot in length. At Arlington, Va., and Springfield, Md., this tendency was still more pronounced, the great growth of viny tip materially cutting down the seed crop. This habit did not appear in the pea during 1907 and may be due to the season. From the fact, however, that the same characteristics showed in Maryland and Virginia and in two plantings in Tennessee it would seem to be an inherent character of the variety. If this is the case, the variety will be of prime importance only on the sandy coastal lands from North Carolina southward. The variety is considered promising enough to justify the distribution of it throughout the Southern States. Its mode of growth is such that it can be easily harvested with a mower without losing any of the pods, which will also help to make it popular.

Plate XV shows the seed of the Brabham cowpea and the seeds of its two parents. It will be noted that the seed of the Brabham is somewhat smaller than that of the Iron, but of the same shape, and has the markings of the Whippoorwill variety.

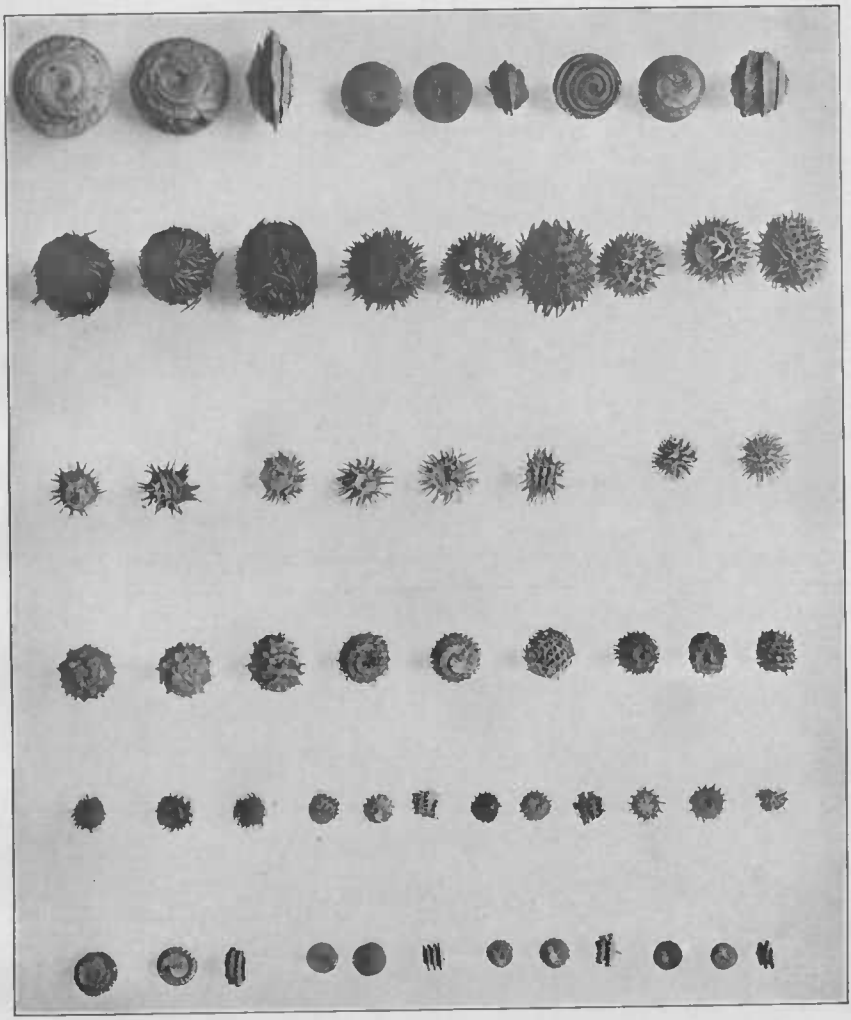
THE GROIT COWPEA.

The Groit cowpea is a hybrid between the New Era and the Whippoorwill, and likewise probably originated spontaneously. The first seed was obtained by the Department of Agriculture in 1903, and was grown by Mr. F. C. Little, of Louisville, Ga., who had not noticed that it was different from the New Era. The seed was also obtained in April, 1904, from Richmond, Va., but the original source of this seed we have been unable to trace. It was also grown by the Arkansas experiment station in May, 1904. It is possible that all these lots of seed were of the same origin, but it has not been possible to determine this positively. That this cowpea is a cross between the New Era and the Whippoorwill is rendered certain from the fact that Mr. George W. Oliver has created this variety anew by crossing the New Era and the Whippoorwill. Until 1906 this variety was confused with the New Era and distinct characters had not been noted. It was grown at the Missouri experiment station in 1905 and 1906 under the name of Groite, and the following notes were published concerning it:

> It is difficult to determine whether or not the New Era and Groite are the same variety, as in the habit of growth, the form of vine, and the color of seed, they are nearly identical in the two varieties.

It is especially interesting that in the test of fourteen varieties at this experiment station the Groit gave the largest average yield of seed per plant.

In numerous tests conducted in 1907 and 1908, the Groit has proved to be distinctly superior to the New Era. Mr. J. C. Little, who originally introduced the New Era, considers the Groit fully 25 per cent superior, and at various places in Maryland, Delaware, and Virginia the showing is nearly as great. The Groit has exactly the same habit as the New Era, but is somewhat taller and distinctly more prolific, and at most but a few days later. Upon careful examination, however, it is very easy to distinguish the seed of the Groit from the seed of the New Era. The seeds of the New Era, when viewed under the lens, are seen to have a clay or ocher colored ground color, which may turn to an orange-brown in age, especially if the seeds have become moist. This ground color is thickly strewn with minute specks of a blue-black color. The Groit pea has the same coloration as the Whippoorwill cowpea, with the blue-black specks of the New Era in addition. If the Groit is viewed under the lens one can easily detect the brown splotches of the Whippoorwill, with the fine specks of the New Era apparently superimposed. The seeds of the Groit are usually larger than those of the New Era, and intermediate in form between its two parents. On account of the superiority of this pea, it is important that growers recognize the differences, so that this valuable new variety may receive the attention that it justly deserves.



PODS OF TWENTY VARIETIES OF BUR CLOVER NOW BEING TESTED TO DETERMINE THEIR COMPARATIVE AGRICULTURAL VALUE.

FIELD OF HINDU COWPEAS (VIGNA CATJANG) GROWN AT ARLINGTON FARM, VIRGINIA, IN 1908.

[Note the erect or nearly erect pods.]

THE BRABHAM AND GROIT COWPEAS.

[The Brabham cowpea (1) and its parents, Iron (2) and Whippoorwill Half-Crowder (3). The Groit cowpea (4) and its parents, New Era (5) and Whippoorwill (6). Small figures natural size; large figures magnified 5 diameters.]

In regard to the origin of the name Groite, as published by the Missouri experiment station, nothing definite can be learned further than that this name was on the package of seed planted in 1906.

SOY BEANS.

Recent explorations in China and extensive correspondence with missionaries and others have yielded during the past few years a very large number of varieties of soy beans. Fully 200 distinct varieties have now been obtained, showing a diversity of growth and of possible value wholly unsuspected. Previous to these investigations only 5 or 6 varieties were known to American agriculture. The rapidly increasing prominence of the soy bean, especially in the Southern States, makes it important to secure the very best varieties. It is a curious fact that the variety most widely grown in the United States, the Mammoth, which was introduced at least thirty years ago, has never again been obtained. It is equally strange that of the other numerous new varieties obtained, nearly all of them, except certain Japanese varieties, have been secured in only a single locality. The truth is that throughout most of the Chinese Empire every variety is grown locally. Mr. F. N. Meyer, who has traveled widely in China, states that this extreme localization of these varieties is a very striking fact in Chinese agriculture, due, as he thinks, to the fact that for ages every Chinese farmer has grown his own seed, and there has been little or no exchange of seeds from province to province. It would therefore appear likely that numerous other varieties yet remain to be obtained.

Among the new varieties of soy beans are some from far north in Manchuria and Siberia, which mature in seventy to eighty days, and others from southern China that are so late that they scarcely mature in our warmest States. Several of these new varieties in the trials thus far conducted promise to be decidedly superior to the Mammoth variety.

Especially valuable are the Riceland soy beans, grown by the Chinese in rotation with rice. These varieties are very distinct from others and on account of their numerous slender stems, large size, and leafiness make hay of unusually fine quality.

While at the present time soy beans are most important in the Southern and Middle Southern States, they will doubtless in time become of great value in the arid regions on account of their marked drought resistance. Unfortunately, rabbits are extremely fond of soy beans, causing so much destruction that it is practically impossible to grow this crop where these animals abound, as is still the case throughout our semiarid regions.

BONAVIST OR HYACINTH BEAN.

The Bonavist or hyacinth bean (*Dolichos lablab*) is a native of India and contains about twenty distinct varieties. These have been grown more or less in southern Asia for human food, and to a slight extent for that purpose in Europe and this country. They have also been employed quite largely as ornamental climbers. Experiments to determine their possible value as forage have been under way for a number of years. They have been compared especially with cowpeas, both being grown as a field crop for hay and with corn for silage. When grown in fields for hay they have given very promising results in southern Kansas and northern Texas, being at least equal to cowpeas in yield and palatability. Some varieties are heavy seed producers, yielding about as much as cowpeas. The habit of all the varieties is very much more viny than cowpeas, in a general way being intermediate between cowpeas and velvet beans. When grown in Virginia with corn for silage or with sorghum for hay they have outyielded cowpeas, the vines being much more rapid growers. There are two possible objections to them, however. The vines grow very much more rapidly than the cornstalks and tend to bind the rows of corn together, and there is also a much larger mass of herbage covering the ground than in the case of cowpeas, much of which can not be saved in harvesting. (See Pl. XII.)

In Florida and Cuba this bean has also given considerable promise, in Cuba especially being considered superior to the cowpea. Like many other legumes, however, the Bonavist is susceptible both to the root-knot caused by nematodes and to wilt, although it is possible that varieties resistant to these diseases may be found, as has been the case with the cowpea. At the present time, however, the Bonavist offers no particular promise throughout the Cotton Belt except in Texas. In drought resistance it is at least equal to the cowpea and apparently somewhat superior. In all respects it will have to meet the cowpea in competition and it still remains to be determined whether in any part of the country it will be sufficiently superior to the cowpea to warrant farmers generally in growing it. The most hopeful locality for its agricultural utilization at present would seem to be in the semiarid regions, although its possibilities as a silage crop are sufficiently promising to warrant continued investigations. The roots are remarkably well provided with tubercles; indeed, in this respect far surpassing the cowpea.

KULTI.

Kulti (*Dolichos biflorus*) is an annual legume, native of India, where it matures even up to an altitude of 7,000 feet. The plant forms a matted vine which densely covers the ground, and it also read-

ily climbs up other plants, such as corn. It blooms in the latitude of Washington, D. C., but matures very few seeds. It has been tested in many places, but it is only in the semiarid portions of Texas and adjoining States that it seems to possess any marked promise. At Chillicothe, Tex., a late-growing variety produced as much forage as any other annual legume and of an exceptionally fine quality, owing to the slender stems and the persistency with which the leaves are held in curing. The principal objection to it is its viny nature, and yet, as the plant grows under conditions of light rainfall, this is by no means so serious as in humid regions. In India the plant is grown chiefly for its seed, which is eaten by the poorer classes. According to Roxburgh, in dry, light, rich soils it will yield sixtyfold. Other writers state that heavy crops of seed are obtained only where the land is limed heavily, as under other conditions the plant runs to vine. To some extent the Hindus grow it as fodder for cattle, for which purpose it is said to be highly esteemed. It is recognized as an exceedingly good soil improver, increasing the yield of subsequent crops even when the vines are removed for fodder.

From the splendid results that the plants have yielded in Texas the kulti is well worthy of extensive testing in the Southern States.

BUR CLOVERS.

Two species of bur clover have long been grown in the United States. One of these, *Medicago denticulata*, was early introduced into California, where it rapidly spread over the whole State and other Pacific Coast States, behaving much like a native plant. It not only appears spontaneously season after season in orchards and in wheat fields, but forms an important part of the forage on the range lands. So readily does this bur clover, like other species, reseed itself that but little seed is ever gathered, and it can therefore hardly be spoken of as a cultivated plant.

In the Southern States the spotted bur clover (*Medicago arabica*), which was introduced long since, has behaved in very much the same manner. The spotted bur clover in California succeeds nearly as well as its close relative, but is much better adapted to the Southern States, because it will withstand frosts that are destructive to its near relative. About 25 species of bur clover are known to botanists, all annuals. The astonishing variety of pods that the different varieties produce is well shown in Plate XIII. Practically all of these are native to the Mediterranean region of southern Europe, northern Africa, and Asia Minor, and few species grow naturally outside of this area. From an agricultural point of view the species with large smooth pods would on theoretical grounds appear to be the most valuable for forage, as in California especially it is largely the pods that sheep and other animals feed upon. It is

somewhat questionable, however, whether the smooth-podded forms will ever spread over the State in the manner that at least one spiny-podded species has. All of these species have been grown now for three seasons in California, where they all succeed admirably. In cultivation some are distinctly superior to the common California bur clover, but, after all, their value will be determined largely by their ability to spread naturally.

In some varieties the pods are so hard and so spiny that they might become pernicious if introduced. The others are being tested both in California and in the Southern States in the hope that some of them will be found so well adapted to the conditions as to spread naturally. One of these species never before introduced into the United States has long been utilized by the Chinese in their rice fields. It is believed that it will also prove very useful in the same manner on our American rice lands.

VETCHES.

Throughout the Old World there is a very large number of species of vetches belonging to the genus Vicia. Many of these species have been introduced and have been under trial for some years past, especially in the hope of finding some adapted to our semiarid States. The common vetch (*Vicia sativa*) is now extensively grown in the Pacific States and in the Southern States. The hairy vetch is also utilized in these States, and has been found more or less adapted to nearly every State in the Union. Neither of these species, however, is satisfactory in the semiarid States, especially southward. Three of the numerous species that have been tried, however, give much promise of becoming of crop value for these regions, namely, the scarlet vetch (*Vicia fulgens*), a native of North Africa; the black-purple vetch (*Vicia atropurpurea*), a native of Algeria, and the woolly pod vetch (*Vicia dasycarpa*), from the Mediterranean region. Scarlet vetch has given very satisfactory results in Arizona and in southern Texas. It also succeeds admirably in the three Pacific States and in the South. It is much more upright growing and finer stemmed than common vetch or hairy vetch and yields nearly as much per acre. The black-purple vetch has proved far superior to all others in northern Texas; indeed, the results are so promising that there can be little doubt that this vetch is destined to be largely grown in that region. The woolly pod vetch is comparable to the hairy vetch, being quite as hardy and maturing very much earlier in spring. Like the hairy vetch, this has given splendid results in many parts of the country and will be found of high value wherever the hairy vetch is objectionable on account of its lateness.