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Soybeans and Cowpeas in Kentucky

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Soybeans and cowpeas are valuable in Kentucky chiefly as emergency hay crops. They yield well, are very dependable and the hays are of high feeding value. However, the forage is extremely difficult to cure, a decided disadvantage, and the cost of production is relatively high; hence they are not so desirable for general use as alfalfa, red clover and lespedeza. The production of soybean seed is fairly profitable where high average yields can be obtained, but this is possible only on fertile soil that retains moisture well; as, for example, on the better bottom lands in the State. Because soybean oil is coming into use in the manufacture of varnish and lacquer, and the press cake for making plastics, it is likely that production of the seed may become more important, in localities where conditions are favorable for this industry.

Both soybeans and cowpeas, especially the former, are good crops for hogging down in connection with corn and are excellent green-manure crops for the quick improvement of worn soil. As explained later, when soybeans or cowpeas are harvested, there is a loss in soil nitrogen unless the manure made by feeding the hay or straw, or the straw itself is returned to the soil.

In many respects soybeans are more desirable for hay than cowpeas. On soil of fair productivity they both yield about the same tonnage of hay and the hays are very similar in feeding value. Soybeans are easier to harvest, however, than cowpeas. They can be handled with less difficulty and cure more quickly. Soybeans grow much better than most other legumes on poorly-drained land, while cowpeas require well-drained land. At the same time soybeans are more drouth resistant than cowpeas.

On badly depleted soil cowpeas make a much better growth than soybeans and where it is necessary to produce hay on very thin land with a minimum expenditure for soil treatment, they should always be grown in preference to soybeans. In fact, there is no other

crop, legume or non-legume, that equals cowpeas as a hay crop on unproductive land. Their superior growth on thin land also makes them a better green-manure crop than soybeans. Cowpeas hold weeds in check much better than soybeans, particularly in the early stages of growth; consequently they are preferable for very weedy land. A dense stand of cowpeas is very effective in smothering such perennial weeds as quack grass, nut grass, etc.

Soybeans are much more productive of seed than cowpeas except on the most unproductive soils, and the seed crop can be harvested by machinery much more readily. Hence the cost of production is less.

IMPORTANCE OF COWPEAS AND SOYBEANS IN KENTUCKY

According to the United States Census of Agriculture, soybeans were grown on 19,454 farms in Kentucky, in 1934, and cowpeas on 18,459 farms. Soybeans grown alone occupied 94,510 acres; and grown with other crops, 9,101 acres. Cowpeas alone occupied 80,881 acres, while 3,788 acres were grown with other crops. The quantity of soybean seed harvested was 90,954 bushels and of cowpeas, 65,636 bushels. Compared with the agricultural census figures for 1929, the soybean acreage was about 3 percent larger in 1934 and the cowpea acreage 160 percent larger. Approximately 30 percent more of both soybean and cowpea seed was harvested in 1934 than in 1929. It is difficult to explain why the cowpea acreage was so much larger in 1934, especially since the soybean acreage was but little larger. In certain parts of the State cowpeas are still much more popular than soybeans and possibly the large use of cowpeas in 1934 was the result of a shortage of other hay crops in these areas. Prices of cowpea and soybean seed were about the same in both years.

In view of the tremendous increase in the use of lespedeza in recent years it might be expected that some decline in cowpea and soybean acreage would have occurred. Instead, as shown, not only by the census figures but also by the yearly crop reports of the United States Department of Agriculture, there has been some increase. This indicates the perennial need in Kentucky for emergency hay crops.

The combined acreage of soybeans and cowpeas in Kentucky is about one and one-third times that of alfalfa, and about half that

of red clover, including clover grown alone and in combination with grasses. It is about one-fifteenth as large as the lespedeza acreage.

PLACE IN THE CROPPING SYSTEM

When grown regularly, either for hay or seed production, the most logical place in the rotation for cowpeas and soybeans is after corn or other cultivated crop. The rotation generally used in the corn belt is: first year, corn; second year, soybeans or cowpeas; third year, wheat or other fall-sown grain; fourth year, pasture and meadow crops, generally a timothy-clover mixture. The same rotation may be employed in Kentucky, but it is usually advantageous to make it longer by leaving fields in pasture two or three years before plowing again for corn. Since these two legumes are most extensively used as emergency hay crops, they occupy any land that may be available. They are often sown after the removal of a small-grain crop where the hay or pasture crops sown with the small grain fail, or perhaps are grown the next year after the small-grain crop. Both cowpeas and soybeans leave soil loose and subject to erosion; hence a cover crop should always be sown as soon as possible after peas or beans are harvested. This also prevents loss of nitrogen.

EFFECT ON YIELD OF SUCCEEDING CROPS

All legumes obtain about the same proportion of their nitrogen from the air, which is estimated as two-thirds of the total amount contained in the mature plants, including the roots. The other third is obtained from the soil. If the root growth is extensive, as is true of clover, alfalfa and most legumes, the amount of nitrogen in the roots and stubble, taken from the air, just about equals the amount in the top growth taken from the soil; hence, when a hay crop is removed, there is neither loss nor gain in soil nitrogen. However, in many instances a gain in nitrogen results from pasturing the first year's growth of clover or similar crop or leaving it on the land. Also clover fields are usually pastured the second year to some extent, particularly after the first crop is harvested.

In comparison with most other legumes, soybeans and cowpeas have a much less extensive root system and more soil nitrogen is taken up by the top growth than the amount in the roots obtained from the air. Consequently there is a loss of soil nitrogen. This explains why, as previously stated, these two legumes exhaust the

soil nitrogen, unless the manure made by feeding the hay is returned to the soil or the straw returned when a seed crop is grown. It also explains why crop yields following cowpeas and soybeans are often lower than after clover, alfalfa and lespedeza.

At the Kentucky Experiment Station the yields of corn and wheat in a rotation of corn, wheat and clover, have been compared to the yields in a corn-wheat-soybeans rotation. The rotation was not fully established until 1923 and since then 13 crops each of corn and wheat have been harvested. The clover and soybean crops were removed for hay and no manure or crop residues was returned to the land. A small-grain cover crop was sown after harvesting the soybeans. The average yield of corn following clover was 62.3 bushels per acre and, following soybeans, 51.8 bushels — a difference of 10.5 bushels an acre. Wheat in the corn-wheat-clover rotation yielded 22.0 bushels an acre and 19.2 bushels in the corn-wheat-soybean rotation.

VARIETIES OF SOYBEANS FOR KENTUCKY

According to Morse*, more than 2000 different lots of soybean seed have been brought to this country from eastern Asia by the U. S. Department of Agriculture. In addition, seedsmen and experiment stations have made numerous introductions. Certainly over 1000 distinct varieties have been obtained from these various lots of seed. It is doubtful if varieties of any other crop display such wide differences in plant characteristics as occur among soybean varieties. In length of time required for maturity, the range is 80 days to 175 days. Some of the earliest-maturing varieties grow only 15 to 18 inches tall, while very late varieties often reach 6 feet. Great differences also occur in size, shape and color of seed. With some of the largest-seeded varieties, 1500 to 2000 seeds weigh a pound, while as many as 10000 seeds are required to make a pound of one or more of the smallest-seeded sorts. Between these extremes all graduations in size occur. In shape, the seeds vary from nearly round to much flattened. The seeds of one variety resemble small lima beans. The most common seed colors are yellow, greenish-yellow, brown, black and green. There are also varieties with banded or mottled seeds.

Fortunately, perhaps, only a limited number of varieties — certainly not over 40 or 50 — have become commercially important,

* Farmers' bulletin 1520.

and only part of these are very extensively grown. Despite this, considerable confusion exists in regard to varietal names, the same variety often being known under several different names. Another difficulty arises from the fact that the seeds of several varieties, otherwise very different, are so similar in appearance that they cannot always be distinguished even by experts. This has permitted unscrupulous seedsmen to substitute seed of a less desirable variety, and therefore cheaper, for the variety wanted. Seed should be purchased only from reputable dealers or varieties used with distinctive seeds.

Medium late varieties are best adapted to Kentucky for the production of hay. They yield much better than the early varieties grown so extensively in the North for the seed crop, especially on soil of only moderate productivity. Later varieties yield well but since the beans do not reach the proper stage to harvest for hay until late it is often difficult to get the forage properly cured. The medium late varieties are also more profitable to raise for seed than early varieties. They yield equally well and the seed commands a higher price, as a rule.

Following is a brief description of the most popular varieties in Kentucky:

Laredo. Plants tall, slender, leafy. Lodges considerably on rich land. Seeds ripen 10th to 15th of October from May or early June seeding. Seeds small, flat, black, about 8000 to the pound. This is perhaps the most desirable of all varieties for hay. It yields well and because the stems are so fine, the forage cures faster than that of most other varieties and there is less waste in feeding the hay. Laredo is a little later maturing than is desirable, but it ripens seed before frost, as a rule, and is grown successfully for seed in western Kentucky. Laredo is not a heavy seed producer; hence the seed sells at a relatively high price. Because of the very small size of the seeds, however, a much lower rate of seeding can be practiced than with most other varieties, so that seeding costs are no higher. For example, 5 or 6 pecks of Virginia are required to sow an acre, but only half as much seed of Laredo is necessary because a bushel of the latter contains more than twice as many seeds as a bushel of Virginia and the individual plants grow as large or larger. Actually one can afford to pay twice as much for seed of Laredo as for seed of

Virginia. The seeds of Laredo are very resistant to rotting and frequently germinate after lying in the ground thruout the winter.

The seeds of several other varieties of soybeans are similar in size, shape and color to those of Laredo, and are frequently sold for the latter. The most common of these are Peking, often known as Sable, Wilson 5 and Kingwa. Peking is sometimes sold in Kentucky as Indiana Laredo. These varieties are very good but are not as fine-stemmed as Laredo nor do they yield as much hay.

Virginia. Plants tall, fairly slender with twining tips. Seeds ripen September 15 to 20 from May or early June seeding. Seeds brown, flattened, medium small, about 3500 per pound. It is easy to distinguish seed of Virginia from that of any other commercial variety. Virginia is an excellent hay bean, particularly on soil of moderate productivity, and it is very popular in Kentucky. It is also a heavy seed producer and adapted for seed production in all parts of the State.

Wilson. Often called Wilson Black. Plants tall, fairly slender, erect. Seeds ripen a few days earlier than Virginia; seeds black, medium large, about 2500 to 3000 per pound. Wilson is one of the older varieties but still popular in Kentucky for hay. A heavy seed producer and adapted for seed production in all parts of the State. It should be noted that seeds of Wilson are much larger than those of Virginia and a higher rate of seeding is required to give equally thick stands. When prices are about the same Virginia is a better buy.

Ebony. Sometimes called Black Beauty. Quite similar to Wilson but does not grow as tall and lodges more on rich land. Yields less hay than Wilson, as a rule. Seeds glossy black, rather plump, about 5500 to the pound, or considerably smaller than Wilson. Often sold for the latter.

Peking. Also known as Sable, and as noted previously, seed is often sold for Laredo. Plants very bushy, medium height, rather stout, erect. Seeds small, black, much flattened. Slightly larger than Laredo but difficult to distinguish from the latter. Peking is not as vigorous as other varieties described, especially on moderately productive soil. Matures with Virginia. Kingwa is a selection from Peking and said to be superior. It has become popular in southern Indiana and seed is reaching Kentucky markets in considerable volume. Very similar to Peking.

Wilson 5. Plants taller and more slender than Peking. Tips twining. Matures with Wilson. Seeds larger than Peking, about 5000 to the pound. A very good hay bean for Kentucky.

Mammoth Yellow. Plants tall, rather coarse, erect. Ripens about October 15 from May or early June seeding. Seeds rather large, straw yellow, almost round; about 2200 to 2500 seeds per pound. Until recent years Mammoth was the most extensively grown of all varieties in Kentucky and it is still popular in the mountain region. Farmers in that region claim it gives better yields on thin land than any other variety. In many parts of the State, Mammoth is greatly injured by leaf hoppers which probably has been an important reason for its waning popularity. Mammoth is too late for seed production in Kentucky.

Midwest. Plants stout, medium tall, erect, seeds ripen about September 15, from May and early June seeding, or a few days earlier than Virginia. Seeds straw yellow, slightly oblong, about 3500 to the pound. Midwest is usually sold in Kentucky under the name of Southern Hollybrook. It was formerly grown extensively in the Corn Belt and was well liked by Kentucky farmers. In recent years, however, much of the seed shipped to this State and sold under the name of Midwest and Southern Hollybrook was of other yellow-seeded varieties now extensively grown in the North, particularly Manchu, which is not a desirable hay bean.

Manchu. This is an early-maturing bean, particularly adapted for seed production in the Central Corn Belt. It is not a good hay bean and farmers are advised not to use it even if the seed can be purchased at a much lower price than that of other varieties. It is particularly disappointing on thin land.

Illini. This is another Corn Belt variety but a much better hay bean than Manchu. Seeds pale yellow, almost round, glossy, about 3000 to the pound. In the writer's opinion, this is the best for hay of the early varieties grown in the North.

In addition to those described, there are a number of other very desirable varieties but seed of these is not often available. Lexington is an excellent hay bean. Haberlandt and Morse are especially desirable for hogging down. Sooty is a vining variety with rusty black seeds about the size of Peking. It is excellent for hay and at one time was quite popular in parts of western Kentucky. Tokio is a late-maturing bean, only slightly earlier than Mammoth. It is

desirable for hogging down. Other late varieties, seed of which is sometimes offered for sale in Kentucky, are Tar Heel Black, Biloxi and Otootan. All are fairly desirable for hay.

VARIETIES OF COWPEAS FOR KENTUCKY

While there are numerous varieties of cowpeas, only a few are of commercial importance. By far the most important is the Whippoorwill and nearly all of the seed produced in Kentucky is of this variety. A considerable proportion of the cowpea seed sold in Kentucky is obtained from the Cotton Belt. Much of this is Whippoorwill, but some seed of New Era, Groit, and a few other varieties is also brought in. In addition, considerable mixed seed is sold.

Whippoorwill. In speaking of this variety, the name is usually shortened to "Whips." Occasionally farmers call it Speckled. It is so popular that seed of other varieties is sometimes designated as a certain kind of Whips; as, for example, Blue Whips, Black Whips, etc. The Whippoorwill was so named because the markings on the seed resemble those on the eggs of the Whippoorwill; buff marked with brown. The Whippoorwill is a medium-early semi-bushy variety maturing its first pods in about 90 days when planted in May or early June, and the majority of the pods in 120 days. Like all cowpeas, growth continues until the plants are killed by frost. Perhaps no other variety is so well adapted to Kentucky as the Whippoorwill.

New Era. This is the earliest of the cowpeas, the first pods ripening in from 75 to 80 days. It is more bushy and less inclined to vine than Whippoorwill and does not grow quite so rank; hence not so productive of hay, as a rule. The seeds are small and of a buff color densely speckled with blue.

Grout. A cross between Whippoorwill and New Era. It grows almost as large as Whippoorwill and as bushy as New Era. The seeds are similar in size to those of the latter. The markings of the seeds show the characteristics of both plants. The seeds can be distinguished from New Era without difficulty as the general color is brown instead of blue. Groit is regarded as one of the best cowpeas for regions north of the Cotton Belt.

Iron. This variety is of great value because immune to root-knot caused by mematodes, and to cowpea wilt. However, these seldom cause trouble in Kentucky. Iron is not a heavy producer of seed and the seed is not abundant on the market. The seeds are solid buff color and very angular.

Taylor. This is semi-bushy in habit of growth and moderately early. Seeds are somewhat larger than those of Whippoorwill and with bluish markings. This variety is often sold under the name "Blue Whips." It is not a vigorous grower and therefore not so desirable as the true Whippoorwill.

Blackeye. Several varieties with white seeds and black spots at the hilum or eye are known as "black-eyed peas." They are chiefly grown for the table.

Mixed seed consists chiefly of later maturing, vining varieties grown in the South. They are quite satisfactory for hay and green manuring.

CULTURAL METHODS

Preparation of the seed bed. Fairly deep plowing is desirable for soybeans and cowpeas so that trash and stubble may be well covered. Trash on the surface interferes with drilling, resulting often in an irregular stand. It also interferes with cultivation necessary where the crops are grown in rows and with soybeans, when sown broadcast or drilled solid. Early plowing is desirable as it saves moisture and makes conditioning of the seed bed easier. A smooth, well-pulverized seed bed is desirable for both these crops, especially soybeans. In rough, cloddy ground it is impossible to get the seed covered evenly and at the proper depth. Drilling is made easier if a roller or cultipacker precedes the drill. Cowpeas thrive fairly well after small grain on a seed bed prepared with a disk harrow or cultivator but this is not satisfactory for soybeans.

Fertilizers. If only a limited amount of money is available for fertilizers, it can be most profitably spent for superphosphate wherever the soil is deficient in phosphorus, which is true of practically all soils in Kentucky outside of the Bluegrass region. One hundred and fifty to two hundred pounds per acre usually supplies crop needs fairly well. It may be drilled in with the seed safely. Liming acid soil greatly increases the yield of soybeans and cowpea hay. In fertilizer tests on the soil fertility fields of the Experiment Station located on the various soil types outside of the Bluegrass region, superphosphate has increased the yield of soybean hay an average of about 600 pounds an acre, while limestone and superphosphate have increased the yield 1500 pounds an acre. The 900 pounds increase from limestone would pay for at least a ton of ground lime-

stone per acre and succeeding crops would benefit from its use for several years. Cowpeas respond to the use of limestone as well as soybeans.

Inoculation. Soybeans and cowpeas can take nitrogen from the air only when the nitrogen-gathering bacteria are present on the roots of the plants as indicated by the development of nodules. On very fertile land the plants often make a good growth in the absence of nodules but obviously at the expense of soil nitrogen. On thin land inoculation is absolutely essential for a satisfactory growth. Moreover the hay and seeds from innoculated plants are richer in protein and consequently have greater feeding value. The cowpea nodule organism seems to be present in most Kentucky soils but artificial inoculation is always necessary when soybeans are grown on land for the first time. To be on the safe side, inoculation for cowpeas is also advisable.

It is not easy to get thoro inoculation of soybeans and cowpeas by seed inoculation, especially on thin land. At the Kentucky Experiment Station it has been found that sowing a small amount of soil from a well-inoculated field with the seed is by far the most reliable method for inoculation. This can be done either by mixing the soil with the seed or preferably by sowing it thru the fertilizer attachment of the grain drill. Less soil is required by the first method, but it is not quite so reliable. The inoculated soil should be dried and put thru a fine screen. A piece of window screen is ideal. To mix with the seed, spread the seed out on a floor or tarpaulin and moisten slightly. Then sift the soil over the seed meanwhile shoveling over and over as in mixing concrete until each seed is coated. Dry sufficiently to drill readily. About a gallon of soil to each bushel of seed is required. In sowing thru the fertilizer attachment, the drill should be set to sow as small an amount as possible which will be about 100 pounds an acre.

Commercial cultures, if used strictly according to directions, usually give fair inoculation, especially when the soil is productive. It should be understood that cowpea cultures will not inoculate soybeans nor soybean cultures, cowpeas.

Time of seeding. Soybeans may be sown as early as late April, in Kentucky, but such early seeding is no advantage and is not advisable. Cowpeas should not be sown until the middle of May as the seed will rot in the ground if the soil is cold and damp. Both cow-

peas and soybeans make fair yields of hay when sown as late as July 15, in most seasons. Seedings up to the middle of June usually yield as much hay as crops sown earlier. In raising a seed crop, however, it is not advisable to sow much later than June 1 unless early varieties are used. For very late seeding, medium late varieties should always be chosen for hay because early varieties when sown late make little plant growth.

Methods of seeding. Cowpeas and soybeans for hay should be drilled solid. Less seed is required when sown in rows but the saving does not compensate for the cost of cultivation necessary in row seeding. Besides, when seeded solid, the hay is finer and more easily cured. Soybeans grown in rows on rich land are often very difficult to mow, especially if the rows have been hilled slightly in cultivating. For seed production cowpeas are often sown in rows about three feet apart as they are more productive of seed than when seeded solid. The method of sowing soybeans depends upon the method to be followed in harvesting. In the Corn Belt they are always drilled solid like wheat, and either cut with the binder or harvested with the combine. In the South, where row harvesters are used, it is necessary to sow in rather wide rows.

To sow in rows for cultivation, corn planters, cotton drills and grain drills are used. The grain drill is desirable because the depth of seeding can be regulated and the soil is not packed over the seed. To sow rows 35 inches apart with a 10-disk 7-inch drill, stop all but the third and seventh feed cups and proceed as in drilling wheat. Rows of various desired widths may be obtained by stopping up the proper seed cups and arranging some kind of a marker on the drill. For planting with a corn planter, special attachments are provided or special plates may be used.

In planting soybeans or cowpeas with corn, most Kentucky farmers use a soybean attachment on the corn planter. If this is not available the corn may be planted first and the beans or peas by going over the corn row but at a shollower depth so as not to disturb the corn. Mixing the seeds in the corn planter box is not advisable.

Rate of seeding. The amount of soybean or cowpea seed required to sow an acre varies according to method of seeding and size of seed. Only about one-third to one-half as much seed is re-

quired when seeded in rows for cultivation as when drilled close with the grain drill.

Whippoorwill cowpeas are usually sown at the rate of 5 to 6 pecks per acre if drilled solid, and about 2 pecks per acre in rows 30 to 36 inches apart. Only about 4 pecks of New Era and Groit are required for drilling solid.

The size of soybean seed varies so greatly that wide differences in rate of seeding are possible. The best plan for getting the proper amount of seed sown in using the grain drill is to set the drill so as to space the seeds about two to three inches apart in the drill rows. This may be observed by drilling the seed on the surface of the ground. The oats runs of the drill should be used for all varieties except the small-seeded black sorts — Laredo, Peking, etc. For these use the wheat runs.

A spacing of 3 inches apart in the drill rows requires about 120 pounds an acre of Mammoth, 75 lbs. of Virginia, 100 lbs. of Wilson, 40 lbs. of Peking or Sable, 75 lbs. of Midwest, 110 lbs. of Manchu, 35 lbs. of Laredo, and 90 lbs. of Illini. For calculating the number of beans drilled per foot, count the number drilled in a space of 5 feet and take the average. In sowing in rows for cultivation, the seeds should be spaced much closer in the rows — say an inch apart. Most experienced growers, particularly those growing seed, believe it pays to sow heavily in order to ensure a good stand and to better control weeds. Cowpeas should always be sown thru the oats run of the drill to avoid cracking. A setting of about 5 pecks on the oats scale will sow 80 to 90 pounds an acre of Whippoorwill cowpea seed. For sowing in rows set the drill at 10 pecks on the oats scale.

Depth of sowing. It is important that cowpea and soybean seed, particularly the latter, be sown as shallow as moisture conditions permit. Deep seeding followed by a heavy rain which crusts the soil, usually gives a poor stand. Better a few seeds left uncovered than to drill too deep.

Cultivation. Cowpeas sown in rows require the same cultivation as corn. The young plants are tender and usually broadcast cultivation as practiced with soybeans is not advisable. However, a rotary hoe causes little injury. When drilled solid, no cultivation is required as they smother weeds effectively. Soybeans either in rows or drilled solid, should be cultivated with a harrow, weeder or rotary hoe soon after coming up, running across the rows and again

in about 10 days. The soybeans in rows will require two to three additional cultivations with row cultivators. The grower who has had no experience in cultivating soybeans with the harrow or other implement is likely to conclude that most of the beans are being destroyed. If the seed bed has been well prepared, little injury results, however, and small weeds are effectively destroyed. Cultivation has become a general practice wherever soybeans are grown extensively.

STAGE OF MATURITY TO HARVEST FOR HAY

Soybeans. Soybeans are harvested for hay at various stages of maturity. Feeding tests show, however, that the hay has the highest feeding value, at least for cattle, if harvesting is delayed until the seeds are almost mature, but before many of the leaves are lost. Actually the product obtained by cutting at such a mature stage is both a roughage and a concentrate. The weight of the seed is almost as great as from fully ripe beans and may constitute 20 to 30 percent of the total weight of the hay. Thus a ton of hay has in it 400 to 600 pounds of seed which contains 15 to 20 percent fat and about 12 percent protein. The hay does not appear so palatable as that from less mature beans but both beef and dairy cattle seem to eat it just as readily and there is little more waste. For sheep and lambs, cutting at a less mature stage would seem advisable.

In tests at the Kentucky Experiment Station soybeans harvested after the pods had just begun to fill yielded almost as much hay as when cut at later stages of maturity. The protein content is slightly greater in the hay made from less mature beans, the nitrogen-free extract about the same and the fat content considerably less.

It has been the writer's observation based on many years' experience in producing soybean hay, that it is best to harvest the crop when the seeds are less than half grown or to wait until they are almost mature. In the stages between, much more time is required to cure the hay because the plump, green pods dry out slowly. If the hay is housed before they are dry, some mould always develops. If the seeds have become firm, however, with an occasional pod beginning to yellow, the hay cures rather quickly. In a thick stand of soybeans some of the leaves drop before this stage is reached, especially with certain varieties, but this is compensated for by the greater ease of curing.

Cowpeas. Cowpeas should not be cut for hay until at least a few pods have ripened, and the longer harvest can be delayed without serious loss of leaves, the better the yield and the higher the feeding value of the hay. Cowpeas are indeterminate in growth and unless attacked by disease or injury by drouth, continue growth until killed by frost. When the plants become well loaded with ripe pods, vegetative growth is checked and the vines become less succulent and cure more readily. In wet weather, especially in rich land, the leaves of cowpeas are likely to become affected by disease which causes most of them to drop. Under such conditions a crop should be cut as soon as possible.

CURING SOYBEAN HAY

Where a good-sized acreage is sown, probably the most practical method of curing the hay is a combination of swath and windrow curing. The cutting bar of the mower should be tilted to cut as high as possible. A high stubble holds the hay off the ground and prevents its becoming dusty. After curing in the swath for about two days, the hay should be raked into small windrows, using a side delivery rake where available. The raking should be done in early morning to prevent shattering and loss of leaves. Three to four days in the windrow will complete the curing, if the weather is favorable. Soybean hay should not be put into the barn or stacks when the leaves are "in case"; that is, have taken up enough moisture to be limp. If rain occurs before curing is completed, the windrows should be turned as soon as the outside hay is dry. If this is not done, the wet leaves mat together and rot quickly. Some growers cure soybeans entirely in the swath. The hay bleaches badly, but seems to be quite palatable. Partial windrow curing prevents excessive bleaching, and the hay does not become so dusty in case of rain.

Many farmers feel that the finer quality of soybean hay produced by shock curing more than justifies the heavier cost, and this method is quite widely practiced in the South. Curing frames are used extensively for curing both soybeans and cowpeas. A very fine quality of hay is produced by the use of frames at a cost not much greater than that of the usual method of curing in shocks. For the farmer who has only a small acreage of soybeans, the use of frames is entirely practical. For the extensive grower, it is a question of labor supply

and hay values. In shock curing, soybeans should be left in the swath twenty-four to forty-eight hours, depending upon the weather, but should be raked before the leaves are dry enough to crumble. The hay should be shocked in tall, narrow shocks, carefully built. If frames are used, the shock should be built over the frame. Soybeans pack down closely if shocked when only slightly cured, and the leaves mat together so that moderate rain penetrates the shock but little. Where frames are used, it is rarely necessary to tear down the shocks for drying. Eight to ten days usually completes the curing. Each frame holds enough beans to make about 200 pounds of dry hay.

The best form of curing frame is the pyramid. These can be constructed of cheap lumber and if protected from the weather when not in use, will last several years. Collapsible frames are easier to handle and require little storage space. The Kentucky Experiment Station will furnish free of charge plans for making a collapsible frame.

Another way of handling hay when the beans are quite mature, is to cut them with a binder and cure in small shocks. About 6 bundles are placed in each shock with the butts of the bundles wide apart.

CURING COWPEA HAY

Cowpeas require more time to cure than soybeans because the coarse stems are so succulent — that is, contain so much water. The leaves are also thicker and more succulent. In the event of rain, the leaves mat together and often mould or partially rot before they can be dried out. While windrow and swath curing are practiced, it is seldom that hay of good quality is produced by these methods because most of the leaves are lost and the hay becomes badly discolored. A practice which seems to be quite common in Kentucky in curing both cowpeas and soybeans is to put the peas or beans into small piles as soon as well wilted. These piles contain only a few forkfuls of hay — say about 75 pounds each. If rain occurs, the piles are turned over after the top has dried and the hay is loosened up somewhat so air can penetrate. The chief advantage over windrow curing is the greater ease of turning the hay.

Curing on frames is the only method by which cowpeas can be cured with reasonable assurance of getting a good quality of hay. Most Kentucky farmers raise only a few acres of peas and these

small crop can be cured on frames just about as cheaply as by any other method. Actually less help is needed because there is no need to rush the work. If the hay is carefully shocked, the shocks shed water very effectively after settling and may be left in the field for two or three weeks without much injury to the hay.

When cowpeas and soybeans are cut at a mature stage, the hay can be stored when not perfectly cured if put into the mow or shed without tramping; that is, just forked in and allowed to settle by its own weight. Some growers state that by following this practice cowpeas can be housed within three or four days when weather is favorable for curing.

BALING COWPEA AND SOYBEAN HAY

It is seldom indeed that cowpea or soybean hay baled from the field is free of mould. Usually hay that appears almost bone dry carries enough moisture in the stems to cause moulding when packed tight in bales. It is much safer to stack the hay and leave in the stack for a month or six weeks before baling. The hay should never be baled when the leaves are in case nor should the hay be compressed very tightly. In fact, baling should be avoided unless absolutely necessary.

HARVESTING SOYBEAN SEED

In recent years a large proportion of the soybean crop in the Corn Belt has been harvested with small combined harvesters which cut and thresh the beans in one operation. This is by far the most satisfactory method of harvesting and the only method by which considerable loss from shelling of the pods may be avoided. Where combines are used, soybeans must be allowed to become thoroly ripe before harvesting; consequently varieties should be grown that do not shatter their seeds on ripening. However, few of the varieties now grown have this fault. In harvesting soybeans with the combine, the straw is left on the land which is a distinct advantage unless it is needed for feed or bedding. In such instances it may be raked up with sweep rakes and baled. In the Corn Belt most owners of combines do custom work after harvesting their own crops. The charge for this varies from 10 to 15 cents per bushel of beans. This is much cheaper than the crop can be harvested and threshed by other methods and, as stated, very little seed is lost by shattering. Combines are now used to some extent in Kentucky.

The next best way of harvesting is with the grain binder. The usual custom is to cut the beans as soon as the leaves have dropped. At this stage the pods are not ripe enough to shatter easily. The bundles are shocked in small shocks and threshed with an ordinary grain separator when thoroly dry. Some growers prefer to let the beans get fully ripe before cutting, and to thresh at once. The losses from shattering are likely to be heavy but labor is saved.

Self-rake reapers are used to some extent. They leave the beans in bunches and the bundles are deposited behind the machine where they will not be run over as cutting progresses. The bunches are allowed to dry and in rainy weather three or more may be set together to make small shocks. In loading to haul to the thresher, every effort should be made to avoid tangling so the beans can be fed to the separator readily.

Mowers are also used to some extent but it is impossible to avoid serious losses by shattering unless a windrowing attachment is used, or each swath, as cut, forked to one side out of the way of the mower and team when the next round is made. Raking also caused shattering and the tangled beans are difficult to feed into the separator.

In the South most of the seed crop is harvested by row harvesters which beat the beans from the standing plants. Where these harvesters are used, the beans are planted in rows 3 to 4 feet apart. It is advantageous to hill the rows slightly in cultivating. The beans must be thoroly ripe and perfectly dry to thresh well. Harvesting with row threshers is slow and losses from shattering heavy. However, this is the most practical method where the acreage is small. With the single-row harvester in use on the Kentucky Experiment Station farm, it is possible to harvest about 4 acres of beans per day unless heavy dew delays starting in the morning. The loss by shattering varies with the height of the plants. If short, the loss is heavy. If tall and not lodged badly, a much smaller loss occurs, but perhaps never less than 10 percent.

At the price paid for beans for oil extraction — less than $1.00 per bushel on the average — it is probably unwise to attempt to raise soybean seed unless the crop can be harvested with a combine.

HARVESTING COWPEA SEED

Most farmers who raise cowpeas for seed use the straw for roughage. If the peas are cured without loss of leaves and damage from

rain the straw is excellent roughage — much better than soybean straw. Practically the same methods are followed in saving seed as in curing hay. Curing frames are particularly desirable for handling the cowpea seed crop. If the straw is not wanted, the peas may be cured in the swath. If exposed long, however, the seed becomes badly discolored.

THRESHING SOYBEANS

Soybeans are usually threshed with an ordinary grain separator altho bean threshers and pea threshers are often used. The latter are made especially for threshing cowpea seed.

When the grain separator is used for threshing soybeans the speed of the cylinder must be reduced to about 600 to 700 revolutions per minute to avoid cracking the seed. At the same time the rest of the machinery must run at normal speed. This is accomplished usually by use of an attachment known as a "jack." In older machines which use a straw carrier instead of a blower, the desired speeds are obtained by increasing the size of both cylinder pulleys. In addition to decreasing the speed of the cylinder, it is necessary to use blank concaves, or concaves with thin teeth. If the beans are perfectly dry the use of blank concaves is satisfactory. If a bit tough, however, some teeth are needed. It is well, therefore, to have both kinds of concaves available. Some varieties crack easily and much care is necessary in threshing to avoid cracking. Other varieties are not so subject to cracking and a somewhat higher cylinder speed is permissible which increases the capacity of the machine. Laredo and other small-seeded sorts may be threshed without much cracking at ordinary cylinder speed if blank concaves are used. Generally experienced custom threshers can be trusted to make the changes necessary for successful threshing of soybeans. Charges for custom threshing vary from 10 cents to 25 cents per bushel. Beans cannot be threshed as rapidly as grain and are "hard" on the separator.

THRESHING COWPEAS

Cowpea seeds crack very easily and it is almost impossible to thresh them with an ordinary grain separator without considerable cracking. The speed of the cylinder must not exceed 600 revolutions per minute and only blank concaves should be used. In most sections where cowpeas are grown for seed, special pea threshers are

available. These have thin cylinder teeth, sometimes sharpened, and similar teeth in the concaves. In some machines two slow-speed cylinders are employed.

A large part of the cowpea seed grown in this country is hand picked in the Cotton Belt by women and children. Much of this hand picking is from peas grown in connection with corn. Large yields of seed are obtained when the pods are picked as they ripen. It is practical, however, only where cheap labor is available.

STORING SOYBEAN AND COWPEA SEED

Soybean seed is seldom attacked by insects but if not fully dry, it heats readily in bulk. If quite damp, it is advisable to spread the seed out in a thin layer and allow it to dry for several days. Usually, however, it keeps satisfactorily if stored in burlap sacks. This is much safer than bin storage, at least until the seed has dried out very thoroly.

The big problem in keeping cowpea seed is to prevent damage by the cowpea weevil. If these appear the seed must be fumigated or it will soon be destroyed. To kill weevil, the beans must be placed in a tight bin or other container and fumigated with carbon disulfide. For small amounts, clean oil drums may be used. A 50-gal. drum holds about 5 bushels of seed and 1 ounce of carbon disulfide is sufficient for a drum full of seed. Put the carbon disulfide in a shallow pan on top of the peas and cover tightly with sacks or tarpaulin. Leave for about 36 hours, after which the seed should be aired, or the germination may be impaired. If fumigation is done in bins, use carbon disulfide at the rate of ½ pound for each 25 bushels of seed if the bin is quite tight; otherwise use twice as much. Bins are seldom tight enough to make airing necessary after fumigation as the fumes will escape thru cracks. Leaky bins may be made tight by lining with building paper. The seeds must be well covered after applying the carbon disulfide. Fumigation is not effective at temperatures lower than 65° F. Carbon disulfide is very inflammable and its vapor, mixed with air, is explosive, therefore all flame must be kept away from it. The heat from a lighted cigarette is sufficient to ignite the vapor. The vapor is poisonous if inhaled in large amounts. In quantity, in drums, carbon disulfide can be bought for about 10 cents per pound. Stored cowpea seed

must be inspected at frequent intervals after fumigation for subsequent infestation may occur.

VIABILITY OF COWPEA AND SOYBEAN SEED

The length of time seeds remain viable — that is, retain their ability to grow — depends greatly on conditions of storage. If the storage place is dry and well aired and insect injury is prevented, cowpea seed retains its viability for several years. Under ordinary conditions, however, germination becomes poor after the second year. Viability is retained longer if the seed is stored in bags than if in bulk.

Soybean seed, even when stored under very favorable conditions, seldom germinates well when more than two years old. In fact, it is unsafe to plant two-year-old seed until germination has been tested.

YIELDS OF SOYBEAN AND COWPEA HAY

It was stated previously that soybeans and cowpeas produced about the same yields of hay. This is true on soil of medium productivity but on very fertile soil soybeans may greatly outyield cowpeas, while cowpeas yield better than soybeans on thin land. Some of the large-growing late-maturing varieties of soybeans such as Mammoth, Otootan and Biloxi may produce 4 or 5 tons of hay an acre on rich land that holds moisture well. Cowpeas seldom yield over 3 tons an acre under the most favorable conditions.

Soybeans were grown for hay on the Kentucky Soil Experiment Field at Lexington during a 7-year period. The soil of this field produces 75 to 85 bushels of corn in the most favorable seasons and has produced an average yield of about 55 bushels an acre for the past 25 years. The yield of soybean hay averaged about 4200 pounds an acre, the highest yields exceeding 3 tons.

On land capable of making 40 to 50 bushels of corn an acre in good seasons, cowpeas and soybeans should average about one and a half tons of hay an acre, depending upon fertilization.

Seed yields. Soybeans were grown for seed on the Experiment Station Soil Field for 20 years with an average yield of approximately 19 bushels an acre. Possibly the average loss by shattering amounted to 2 to 3 bushels an acre. The best crops yielded nearly 30 bushels an acre. Better yields may be obtained on soil that is more retentive of moisture than the Bluegrass soil. The average

yield in Kentucky is about 13 bushels an acre, according to the crop estimates of the U. S. Department of Agriculture.

Cowpeas yield the best crops of seed on land of moderate productivity. On very productive land which produces a rank growth of vines few pods are formed, as a rule, especially in years of normal rainfall. If the pods of cowpeas are picked as they ripen, yields as high as 35 to 40 bushels an acre are sometimes obtained. When the crop is cut and threshed, however, yield seldom exceed 15 bushels an acre; in fact, 10 bushels an acre is a good average.

The legal weight of soybean and cowpea seed is 60 pounds per bushel in Kentucky. One hundred pounds of cowpeas in the pod usually make about 70 pounds of seed when shelled.

COWPEAS AND SOYBEANS IN CORN

The custom of planting cowpeas and soybeans, especially the former, in corn is quite general in the Cotton Belt. It is also common in some parts of Kentucky. They are sown chiefly for soil improvement, but often some seed is picked or occasionally they are cut for hay after the corn crop is harvested. The method followed in most instances is to drill one or more rows between the rows of corn following the final cultivation of the corn. Sometimes the seed is sown broadcast and covered with a cultivator. On land sufficiently productive to produce a rank growth of corn, the Kentucky Experiment Station has not been able in many instances to get sufficient growth from peas and soybeans sown in corn at this time to pay for the seed and the cost of sowing. On thinner land, particularly where corn rows are wide apart, much better results are usually obtained.

Soybeans and cowpeas, chiefly the former, are often planted in the hills or drills when the corn in planted. This practice has been quite extensive at times in Kentucky and also thruout the Corn Belt. It was believed that the use of the beans would be beneficial to the soil and where the corn was hogged down or used for silage a larger amount of nutrients would be obtained than from corn alone. Much experimental work has been done to determine the value of the practice, and results have been quite conflicting. At the Kentucky Experiment Station tests of different methods of planting corn and soybeans together were conducted over a 7-year period. The results of these tests were reported in Bulletin 272. There was not

a year when beans planted in corn at any of the rates used did not reduce the yield of corn. Roughly stated, for each bushel of beans obtained in the combined planting a reduction of two bushels in yield of corn occurred. In no instance was the combined yield as great as that from corn alone. Moreover the quality of the corn was considerably poorer. It is true that in hogging down corn, the mixture of beans with the corn tends to balance the ration so that the total value of the mixture might be as great as that of corn alone, or greater. It is seldom, however, that hogs eat the beans very well and many are wasted. It is probably better to balance the ration with tankage or other protein concentrate. Many experiments have been conducted to determine whether or not it is profitable to plant soybeans with corn intended for the silo. In most instances the total yield of the corn-soybean mixture was slightly greater than that obtained from corn alone and the amount of protein in the silage was greater. In theory, at least, the corn-bean silage should have greater feeding value.

Drilling corn and soybeans together for silage seems to give better results than planting in hills. This is best accomplished by using an attachment on the planter for sowing the beans. About equal quantities of seed of each should be planted. For Kentucky the Wilson soybean is one of the best varieties to use, as it stands up well and reaches the proper stage for making silage at the same time as silage varieties of corn. Soybeans in corn make harvesting more difficult and the mixture should never be used unless a corn binder can be used for harvesting. It is doubtful if any gain that may result from the mixtures is worth the extra trouble.

HAY MIXTURES INCLUDING SOYBEANS AND COWPEAS

Soybeans and cowpeas are sometimes grown together and often one or both is planted with some other forage crop for hay. A number of combinations have been tried on the Kentucky Experiment Station farm at Lexington. A mixture of cowpeas and soybeans gives a forage much harder to cure than soybeans alone and the hay is not improved. On poorer land it is believed that a larger yield is obtained than from either crop alone, but there seems to be no experimental evidence to prove this.

A Sudan grass-soybean mixture is often used. Unless a very light seeding of Sudan is made, the hay will be chiefly Sudan.

Moreover, the Sudan is ready to harvest before the soybeans are sufficiently mature. The hay is just as difficult to cure as soybeans alone and much harder to handle. Yield is somewhat larger but the hay is not nearly so desirable as pure soybean hay, at least for most kinds of livestock.

ENEMIES OF SOYBEANS AND COWPEAS

In the Cotton Belt, both soybeans and cowpeas are subject to attack by several rather destructive diseases. In Kentucky, however, very little trouble has been experienced as yet. Many insects feed on the leaves of soybeans, including grasshoppers, Southern bean beetle, Mexican bean beetle, blister beetle, leaf hoppers and various caterpillars. Perhaps grasshoppers cause the most damage, but generally their attacks are confined to the edges of the field where they may completely defoliate the plants. They are best controlled by means of the poison bran mash. As stated previously, the growth of Mammoth Yellow soybeans in various parts of Kentucky is greatly reduced by attacks of leaf hoppers. None of the other commonly grown varieties shows injury, however. The other insects named are seldom numerous enough to cause much damage.

The Mexican bean beetle attacks cowpeas but does not seem to breed as rapidly on the peas as on garden beans. No reports of serious damage from this pest have reached the Kentucky Experiment Station.

Rabbits are very fond of soybeans particularly when they are only a few inches high; at this stage plants may be eaten off so close to the ground that they are killed or dwarfed. In areas where rabbits are very numerous it is practically impossible to raise soybeans unless fields are surrounded by rabbit-proof fencing. Dusting the outside rows with lime is said to prevent serious damage in some instances. The Tennessee Experiment Station found that injury could be reduced by using scarecrows in the field on each of which a lighted lantern was hung at night.