SEPTEMBER, 1942 (BULLETIN 282, REVISED) BULLETIN 306

AGRICULTURAL EXPERIMENT STATION
KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

MANHATTAN, KANSAS

SOYBEAN PRODUCTION IN KANSAS

PRINTED BY THE
KANSAS STATE COLLEGE PRESS
MANHATTAN, KANSAS

1942

SUMMARY

1. The soybean is adapted to the eastern three or four tiers of counties in Kansas. Drought and rabbits are the principal hindrances to growing it farther west.

2. It is adapted to about the same general conditions as corn, but will produce a fair crop on land which is too poor to raise good corn. It will also grow on soils that are too acid for alfalfa or sweet clover.

3. No other grain crop in Kansas will produce so much protein per acre as the soybean. The seed may be substituted for expensive protein concentrates as cottonseed or linseed meal or it may be marketed as a cash crop.

4. Soybean hay compares favorably with alfalfa or clover in feeding value and may be used to supplement a shortage of alfalfa in the eastern third of the state.

5. When grown as a companion crop with corn and pastured off a better balanced feed is produced on which sheep or hogs make good gains with a saving of the cost of harvesting.

6. The seed should not be planted until the ground is thoroughly warm and the first two or three crops of germinating weed seed are destroyed.

7. Choosing a variety that is adapted to the locality and suited to the purpose for which it is grown is essential to success.

8. Inoculation and clean cultivation are necessary for successful soybean production.

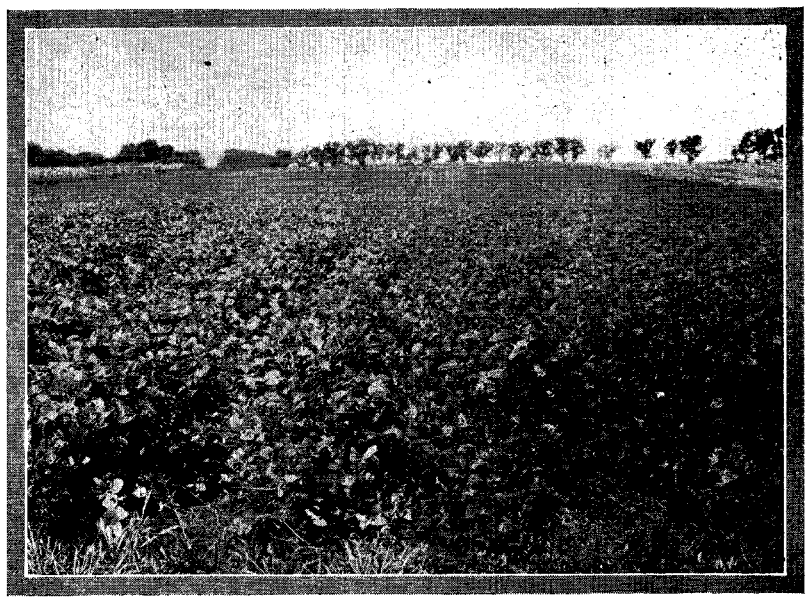

Fig. 1.—A field of soybeans in 38-inch rows on the Agronomy Farm at Manhattan.

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SOYBEAN PRODUCTION IN KANSAS

J. W. Zahnley

The soybean has recently become one of the major crops in several states, mainly throughout the corn belt. Although the soybean is still of relatively minor importance as a crop in Kansas, the acreage increased more than fourfold during the ten-year period, 1925 to 1934. A decrease during the period of 1935 to 1940 may be attributed to a reduction in the number of livestock and a marked increase in the acreage of wheat in eastern Kansas. War conditions account for the increase since 1940.

The increased interest in the crop is due largely to the constant need for protein feed on the farm and the high cost of protein concentrates. The difficulties in maintaining a normal acreage of alfalfa have directed attention to the soybean as a possible substitute for alfalfa. (Fig. 1.) Improved marketing conditions and the use of uniform federal standards for grading the seed have also aided in establishing the crop. Further increase in the acreage of soybeans is justified in the eastern one-fourth of Kansas.

UTILIZATION OF SOYBEANS

The soybean has certain characteristics and adaptations which make it suitable for growing in eastern Kansas. It will grow on a wide range of soils, fits well into short rotations, and may be substituted for part of the oat acreage to good advantage. Being planted later than corn and harvested after oats and wheat have been threshed, the soybean provides good distribution of labor. It may be grown as a hay crop, as a grain or feed crop to be fed to livestock, marketed as a cash crop, or grown in mixtures with corn for silage or for pasturing off. It is also a valuable crop for green manure.

Soybean seed has a very high feeding value because of the large protein and oil content. For this reason the seed can be substituted for the high-priced protein concentrates such as tankage, cottonseed meal, and linseed meal. A 15-bushel crop of soybeans will contain as much digestible protein as 850 pounds of prime cottonseed meal, which at $35 a ton gives an acre value of $14.87 for the soybeans, considering the protein alone. In addition the soybean seed contains approximately twice as much fat as cottonseed meal.

Soybeans are usually sold direct to mills for the oil which they contain. The meal left after extraction of the oil is equal to cottonseed or linseed meal as a feed for livestock. It is not equal to tankage as a feed for pigs, but may replace part of the tankage in the ration.

The utilization of the crop for hay increased from 23 percent of the total acreage harvested to 45 percent during the

[1] Contribution No. 340 from the Department of Agronomy.

twelve-year period 1925-1936. Since that time less hay has been harvested and more seed, most of which has been marketed as a cash crop.

Good results have been obtained from using soybeans as a winter ration for young cattle, sheep, horses, and hogs. In limited tests at Manhattan soybean hay of good quality compared favorably with alfalfa for dairy cows. The alfalfa was only slightly superior on the basis of equal quantities of feed, the small difference probably being due to the wastage of soybeans because of the coarse stems.

Experimental tests at the Illinois Agricultural Experiment Station show that, considered on the basis of the hay consumed, soybean hay is equal to alfalfa, red clover, or cowpeas for milk or butter production. Owing to the coarseness of the stems of soybeans there is more waste in feeding, usually amounting to from **10** to **15** percent of the total weight of the hay.

Growing soybeans with corn for silage or pasturing off improves the quality of the feed. Pasturing off with sheep or hogs is probably the best means of utilizing such mixtures, as there is less loss of feed and a considerable saving of labor in harvesting. An important advantage of the soybean is that when properly utilized it is a valuable feed for all classes of livestock.

SOYBEANS AS A SOIL BUILDER

Soybeans are an excellent crop to plow under for green manure. In experiments at the Michigan and at the Connecticut Agricultural Experiment Stations they compared favorably with cowpeas and with clover for this purpose. The Arkansas Agricultural Experiment Station secured an increase in yield of corn of approximately 45 percent from plowing under a crop of soybeans. Similarly the Mississippi Agricultural Experiment Station reports an increase of 48 percent in the yield of cotton following a soybean crop used as green manure. Generally speaking, soybeans are not so good as sweet clover for green manure where the latter can be grown successfully. In Kansas, this means that soybeans are preferable for that purpose only on acid soils.

Soybeans apparently bring about some improvement in the soil when grown for hay in rotation with grain crops. Thus at Manhattan in a rotation of corn, soybeans, and wheat, there was an increase of 3.3 bushels of corn and 2.2 bushels of wheat over the yields of these crops where soybeans were not included, when the corn followed corn, and the wheat was planted on corn stubble land. The soybean is not a desirable one to precede wheat even though the land is usually left in excellent physical condition for the preparation of a seedbed after the removal of the soybeans. Probably this is because the soybean is a late maturing crop and leaves little time between soybean harvest and wheat seeding for the accumulation of moisture and available plant food materials.

When the crop is grown for seed (fig. 2) most of the leaves are shed before harvesting; thus more plant food is returned to the soil than when cut for hay.

It should be borne in mind that, although the soybean is a legume, it will not increase the nitrogen content of the soil appreciably if all of the crop is removed. Investigations at the

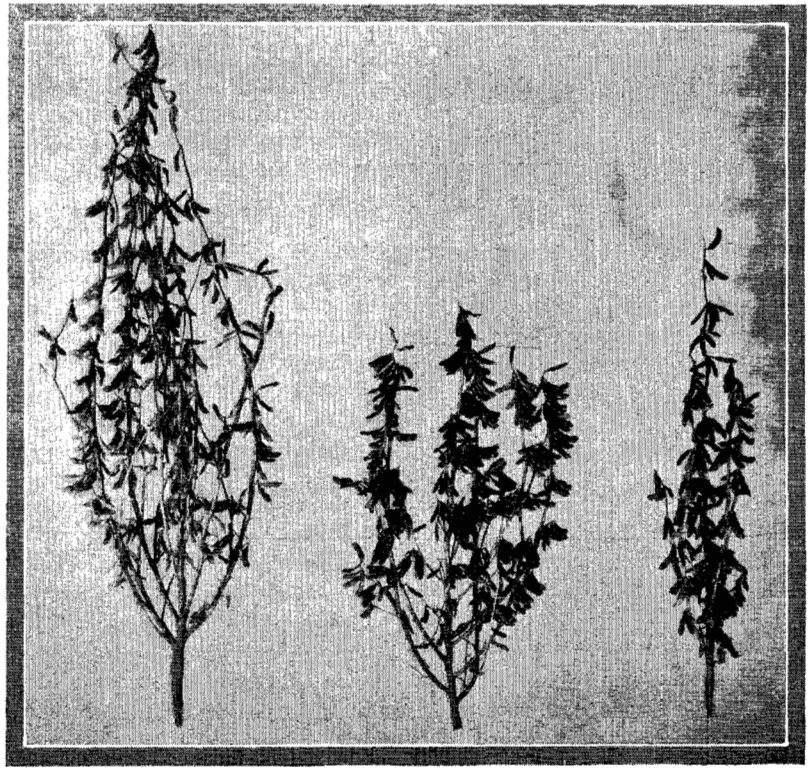

Fig. 2.—Typical plants of three good seed-producing varieties.

Ohio Agricultural Experiment Station indicate that perhaps not more than one-fifth of the crop is left on the soil as roots and stubble. Since approximately one-third of the nitrogen used by the plant comes from the soil it is evident that when only roots and stubble are left no more nitrogen is returned to the soil than was removed in the growth of the crop.

ADAPTATIONS

Soybeans are adapted to about the same general conditions as corn. Any soil which will produce good corn will grow good soybeans. They will grow on nearly all types of soil in eastern Kansas and will produce fair crops on soils which are too poor

for growing a high yield of corn. They will stand more wet weather than corn and are not so seriously injured by hot, dry weather during the period of flowering. They will grow on land that is too acid for alfalfa and sweet clover, but better yields are obtained on soils well supplied with lime. A crop of soybeans can be plowed under for green manure or harvested for hay in approximately 100 days after planting. Most of the best seed-producing varieties in Kansas require about 110 to 125 days to produce ripe seed.

When grown on fertile soil there is a tendency for most varieties to lodge, making harvesting difficult and causing loss of a large amount of seed which is not gathered by the ordinary harvesting methods. Consequently a better yield of seed is often obtained when the crop is grown on soil of medium fertility.

CONTROL OF RABBITS[2]

Jackrabbits are very destructive to soybeans particularly while the plants are young. Entire fields may be destroyed in a few nights while the plants are in the seedling stage. Even cottontail rabbits will do much damage where they are numerous. The following three methods of control of these pests are recommended:

1. **Poisoned Salt.** One quart of strychnine alkaloid, powdered, mixed with two or three quarts of salt. Put in auger holes in blocks of wood placed along rabbit runways. The auger holes should be one inch or slightly more in diameter and a little over an inch deep. Do not fill full. The purpose of the auger holes is to prevent the salt being licked by livestock.

2. **Poisoned Oats.** Poisoned oats prepared by the College may be used. A little salt may be sprinkled on the oats to make them more attractive to the rabbits. The prices range from 30 cents for one quart, and 80 cents for one gallon or $4.50 a bushel. The oats are placed in tablespoonful quantities around the borders of fields, in paths where rabbits enter, and in other places where the rabbits are most likely to find them.

3. **Dipping Kafir Heads in Strychnine Mixture.** Poison formula for 15 pounds of milo or kafir heads: Use an old dishpan or a can the size of a lard can. Dissolve one heaping tablespoonful laundry starch in one-half pint of cold water, add one ounce of strychnine (alkaloid) and one heaping tablespoonful baking soda, stir well, add two quarts hot water, heat until mixture boils. Remove from fire and add one-half pint dark corn syrup, one-tenth ounce saccharin, very slowly, stir whole mixture well. Dip the kafir heads in the mixture and let the surplus solution drain back into the pail or dishpan. The kafir heads are tied to stakes around the edges of the field where the rabbits may find them. This method is very successful.

[2] Recommendations furnished by the Department of Zoology, Kansas Agricultural Experiment Station and prepared by E. H. Herrick, Mammalogist.

The electric fence has been tried recently with apparently good results.

Caution. In methods (2) and (3) it is important that livestock be kept away from the poisoned grain. Baits should be so placed or marked by stakes that they can be taken up and burned when no longer needed. Strychnine may be secured from the Zoology Department at 70 cents an ounce in five-ounce cans. Individuals are requested to have their orders sent through the county agent or county clerk or to have their order approved by their local postmaster.

PRODUCTION METHODS

PREPARATION OF THE GROUND

Preparation of the ground for soybeans does not differ materially from that for corn which is to be surface planted. It is especially important that the land be cultivated thoroughly to destroy all weeds before planting as the young soybean plants start slowly and do not compete well with weeds. The practice of fall or early spring plowing, and cultivating several times during April and May to provide a smooth, well-settled seedbed free from weeds, is essential even though this may necessitate some delay in seeding. Cultivation to destroy weeds can be done more effectively and economically before the crop is planted.

INOCULATION

The soybean, like other legumes, is able to secure a large part of its nitrogen from the air through the action of bacteria that live on the roots. (Fig. 3.) In order to do this, however, it must be provided with the proper kind of bacteria. The particular kind necessary for the soybean is seldom, if ever, present in Kansas soils except where this crop has recently been grown. Hence inoculation usually is necessary.

Inoculation is most easily accomplished on soils that are neutral or slightly alkaline. Although soybean bacteria will thrive in soils more acid than will those of most other legumes, special attention will be required to obtain thorough inoculation on soils that are distinctly acid.

There are several methods of inoculating the soybean, any of which will be effective if good material is used and the work carefully done. Specially-prepared pure cultures may be purchased from commercial seed firms, or direct from companies that produce them. Directions for using these cultures are printed on the packages. The method of applying is very simple, consisting usually of mixing with a little water and moistening the seed just before planting. It is essential that such inoculating materials be fresh when used.

The soil-transfer method may be used. This consists of spreading 250 to 500 pounds of thoroughly inoculated soil per acre evenly over the field to be planted and harrowing in. While

this method is effective it is expensive because of the labor involved, and may result in the introduction of weeds and plant diseases. A more economical method is to apply finely-sifted inoculated soil directly to the seed. The soil should be taken from the spot where well-inoculated plants grew. Two quarts of such soil is sufficient for one bushel of seed, provided the seed

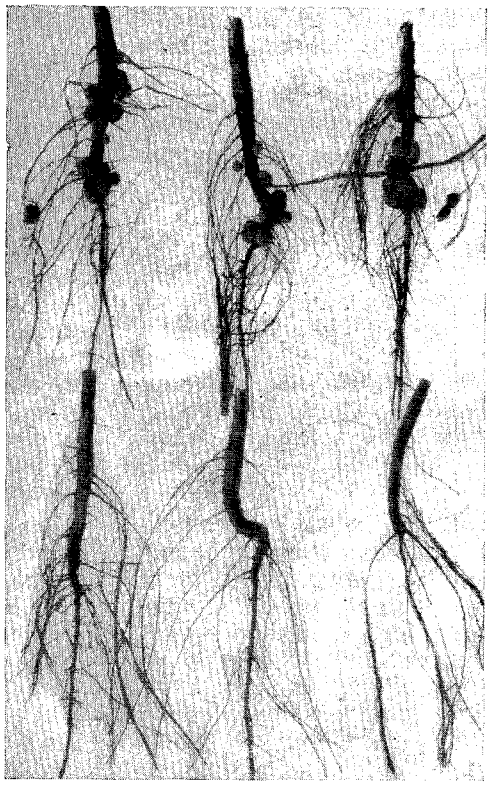

Fig. 3.—Above. Well-inoculated soybean roots. Below. Roots without nodules showing lack of inoculation.

is first moistened with a solution consisting of three ounces of glue or sugar and one quart of water. If the glue or sugar is not used, a gallon of the soil per bushel of seed should be used; or this soil may be mixed with water to make a thin mud and applied to the seed. In all cases planting should be done as soon as convenient after inoculation. The use of commercial cultures is more convenient, usually more satisfactory, and the cost is little if any greater than the use of inoculated soil.

It is frequently advisable to inoculate the first two or three crops of soybeans that are grown in a field. While soybean bac-

teria may live in the soil for many years, the number usually decreases rapidly when other crops are grown. This decrease is more rapid in an acid than in a neutral or alkaline soil. Therefore, if the soil is acid, it may be necessary to re-inoculate the field before planting soybeans if that crop has not been grown for three or four years.

On fertile soil the soybean will produce a fairly good crop without inoculation. Under such conditions, all of the nitrogen used by the plant is taken from the soil, leaving the soil poorer in nitrogen than if soybeans were not grown. Inoculation not only enables the plant to function as a soil builder, but both the hay and seed are richer in protein and the yield is usually higher than when grown without inoculation. Inoculation produces more marked increases in yield and quality of the crop on poor soil than on fertile soil. At the Michigan Agricultural Experiment Station, the protein content of the crop was increased by inoculation on fertile soils where no increase in yield was obtained. Increases resulting from inoculation at the Illinois station amounted to 42 percent in yield of hay and 24 percent in yield of seed, with increases in protein content of 1.19 percent for the hay and 4.2 percent for the seed.

IMPORTANCE OF GOOD SEED

Good seed is important for successful soybean production. The seed loses its vitality much more rapidly than is the case with most other legumes, and it is seldom advisable to plant seed which is more than one year old if it can be avoided. The seed is often chipped, cracked, or broken in threshing, making it unsafe for planting. It is advisable always to have it tested for germination before planting time. Good seed should be pure as to variety, free from cracked or broken seed, and of strong vitality.

TIME AND METHODS OF PLANTING

Soybeans may be planted toward the latter part of the corn-planting season, although it is desirable to plant them two or three weeks later. There is little to be gained by early planting as the young plants grow more slowly and much more trouble results from weeds. It is better to delay planting until the first part of June than to plant in weedy ground or in a poorly-prepared seedbed. Experiments have shown that soybeans planted as late as the tenth of June at Manhattan matured only three or four days later than the same varieties planted three weeks earlier. If the crop is to be used for seed, May 25 to June 5 is sufficiently early in this section. A heavier yield of hay will usually be produced in this state when the crop is planted two weeks earlier than the above dates. In tests at the Missouri Agricultural Experiment Station, seeding from June 1 to 15 was more favorable than any other period for the production of seed and hay. Planting should be done at a time when moisture con-

ditions are favorable for quick germination of the seed.

The method of planting will depend mainly upon the purpose for which the crop is grown, *i. e.,* whether it is primarily for seed, hay, silage, pasturing off, or for green manure. The various methods are described in the following pages.

SEED PRODUCTION

PLANTING

With weed conditions as found on the average farm, soybeans for seed production should be planted in rows and given sufficient cultivation to keep down weeds. A corn planter with furrow-opener attachment places the seed in a shallow furrow 2 to 3 inches deep. This permits early, safe, and effective cultivation with a harrow. Damage may be caused by heavy rain-

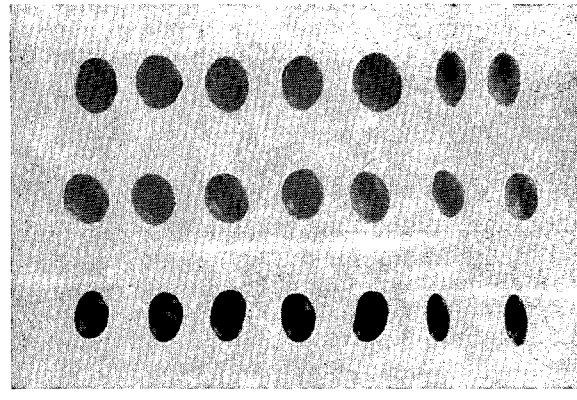

Fig. 4.—Seed of different soybean varieties differ in size. Top, A. K.; center, Hongkong; lower, Laredo.

fall in deeper furrows. Planting with a lister is seldom advisable. A grain drill may be used, if part of the holes are closed.

In most cases, the rows may be 4 to 8 inches closer than the usual distance for corn. If planted closer than 3 feet, the cultivator must be adjusted to prevent the wheels running over the row on one side or the other. On the agronomy farm at Manhattan, 38 inches has proved to be a satisfactory width between rows.

Poor stands frequently result from planting too deeply. A depth of 1 to 1½ inches usually is sufficient; and only on sandy soil should the depth exceed 2 inches.

The rate of planting varies somewhat with the kind of soil and especially with the size of seed. Small seeded varieties, such as Peking and Laredo have 6,000 to 7,500 seeds per pound, while A. K., Hongkong and Manchu have medium size seed running 2,500 to 3,000 to a pound. Most of the varieties commonly grown for seed in Kansas have seed of medium size and

should be planted at the rate of 25 to 30 pounds per acre, in rows 36 to 40 inches apart. The planter should be adjusted to plant at the proper rate and to distribute the seed evenly in the row. An average of one seed every two inches in the row will require 26 pounds per acre in 40-inch rows. If the seed is of good germination this rate is sufficient for maximum yield in Kansas.

Corn or kafir plates may be adapted by reaming out the holes and then increasing the gear ratio.

The number of cells needed in the seed plate to plant at the proper rate will depend on the planter drive gear or sprockets, the size of the drive wheel and the size of the cells in the plate. Changing sprockets or gears will change the number of wheel turns to make the plate revolve one turn. Assuming that the cells will admit three seeds the number of cells per plate to plant at different rates may be determined by reference to Table 1.

For example, assume that the drivewheel turns around 1.5 times to one turn of the plate and the diameter of the wheels is 30 inches. The plate cells will admit 3 seeds per cell and it is desired to plant an average seed spacing of 2 inches. Locate in the table the 2-inch seed spacing and 30-inch wheel. Follow across from the 1.5 turns of the drivewheel and down the column

TABLE 1.—NUMBER OF CELLS NEEDED IN THE SEED PLATE, ASSUMING 3 SEEDS PER CELL.

Turns of drivewheel to make 1 turn of seed plate	1½" spacing Drivewheel Diameter		2" spacing Drivewheel Diameter		2½" spacing Drivewheel Diameter	
	30"	36"	30"	36"	30"	36"
1.0	21	25	16	19	13	15
1.1	23	28	17	21	14	17
1.2	25	30	19	23	15	18
1.3	27	33	20	24	16	20
1.4	29	35	22	26	18	21
1.5	31	38	24	28	19	23
1.6	34	40	25	30	20	24
1.7	36		27	32	21	26
1.8	38		28	34	23	27
1.9	40		30	36	24	29
2.0			31	38	25	30

headed 2-inch spacing and 30-inch wheel diameter. The intersection of these lines gives 24 cells required in the seed plate. If the drive wheels are 36 inches, 28 cells will be required. More complete details regarding plates and adjustments will be found in Extension M Circular No. 44, Planter Adjustments for Soybeans published by the Extension Service, Kansas State College, Manhattan.

On land that is especially free from weeds good yields may be obtained from double-planting with a corn planter in rows 18 to 21 inches apart or by drilling solid with a grain drill, placing the rows 7 inches apart. When planted in 18- to 21-inch rows about 40 pounds of seed to the acre should be used. When

drilled solid with a grain drill 80 to 100 pounds per acre is a satisfactory rate. Table 2 shows the yields of seed obtained in southeast Kansas from these methods of planting.

TABLE 2.—YIELD OF SEED FROM DIFFERENT METHODS OF PLANTING IN SOUTHEASTERN KANSAS.

	Bushels per acre						
	1930	1932	1933	1935	1936	1937	Average
7-inch rows	8.66	13.58	20.35	18.75	5.79	8.80	12.66
21-inch rows	12.16	17.50	23.12	5.28	11.68	9.40	13.19
42-inch rows	10.33	13.92	16.65	5.36	4.84	8.60	9.95

These results show that somewhat higher yields of seed can be obtained in Southeast Kansas by planting in 7- and 21-inch rows. At Manhattan (Table 3) higher yields of hay were obtained by planting in 7- and in 19-inch rows but the yield of seed was about the same as in the 38-inch width.

Since no cultivation can be given except with a harrow where rows are planted close together, these methods should not be used except on land that is relatively free from weeds. Where the weeds have been kept out, higher yields have been obtained on experimental plots by planting solid with a grain drill than from the 38- to 42-inch rows. Without hoeing or hand weeding, however, weeds would have destroyed the crop in some seasons, and seriously damaged it in others.

Experiments at Manhattan show that within a wide range of rates of planting by the same method no significant difference in yields is obtained over a period of years. Over a seven-year period 1933 to 1940 the average yield in 38-inch rows from

TABLE 3.—YIELDS OF SOYBEANS FROM DIFFERENT METHODS OF PLANTING AT MANHATTAN, KANSAS.
(Average 5 years, 1936-1940.)

Method of planting	Width of rows	Rate of seeding per acre (Pounds)	Yield	
			Seed, Bu.	Hay, tons
Grain drill	7	86	11.3	1.58
Corn planter, double rows	19	38	10.8	1.25
Corn planter	38	26	11.4	1.13

15 pounds of seed was 13.65 bushels of seed and 1.39 tons of hay while from 32 pounds planted per acre the yield was 14.26 bushels of seed and 1.48 tons of hay. The yields from planting 58 pounds per acre with the grain drill were 16.76 bushels of seed and 1.90 tons of hay, compared with 17 bushels of seed and 1.95 tons of hay by planting 102 pounds of seed per acre.

CULTIVATION

Great care should be given to cultivation during the early growth of the crop. As stated before, as many weeds as possible

should be destroyed before planting. If weed seeds germinate, or if a crust forms before the young plants come through the ground, the first cultivation should be given at once with a weeder, rotary hoe or spike-tooth harrow. This type of cultivation may be repeated until the plants are six or eight inches high. Such implements may destroy many plants if used immediately after they break through the soil, as they are brittle and tender at that stage. After they get three or four inches high, little damage will be done, especially if cultivated in the middle of the day when the plants are somewhat wilted. The rotary hoe and weeder destroy fewer plants than the harrow, but the harrow is more effective in killing weeds. Less damage will be done to the crop if harrowed crosswise of the rows or at an angle of about 45 degrees. Succeeding cultivations with the ordinary corn cultivator should be given as often as necessary to keep down weeds until the plants begin to bloom.

HARVESTING

For seed production, soybeans should be cut when fully ripe and just before the first pods begin to shatter. At this stage, most varieties will have lost practically all of their leaves. Cutting before the pods are fully mature will cause the seed to wrinkle on drying and increase the difficulty of keeping in storage. Delay in harvesting will almost certainly result in serious losses from shattering.

Various methods of harvesting for seed are used. The combine, grain binder, and mower are used for this purpose.

Combine Harvesters. — The combine has recently come into extensive use for harvesting soybean seed. To prevent cracking the beans, the speed of the cylinder should be reduced to approximately one-half that required for wheat, but the remaining parts of the machine should run at the usual speed. Among the advantages of the combine over other methods of harvesting are: (1) A great saving of time in harvesting. This shortening of the harvesting period enables the grower to wait until the crop is fully mature and then to harvest it quickly before shattering occurs. (2) There is less loss of beans than when the binder or mower is used. The greatest loss is due to low branches and lodged plants which are not picked up by the cutter bar. However, with the new combines, there need be little loss from this cause. (3) The straw is spread on the ground where it grew.

Where the crop is weedy at harvest time it is usually advisable to cut and leave in windrows and let it dry several days and thresh from the windrow. If a windrow attachment for the combine is not available a binder stripped of binding equipment may be used for cutting.

The Grain Binder. — The taller and more erect varieties may be harvested successfully with the grain binder, the bundles

being shocked and handled in every way similar to wheat or oats.

Extension guards on the binder may be necessary when the plants are spreading or lodged. The bundles should be small and loosely bound and set up into small shocks. Rain will do little damage to small shocks standing in the field as the bundles contain very few leaves and dry out readily. Threshing must be done as soon as the pods are dry enough. Close attention should be given to the crop as shattering is hastened by wetting and drying and by sudden changes in temperature. Heavy dew or frost followed by warm sunshine makes the pods open as soon as they are dry enough to thresh. If threshing cannot be done promptly stacking may be necessary to save the seed. Stacking is very desirable, also, where the ground is to be planted to a fall crop soon after harvesting.

Harvesting with the Mower. — A mower may be used when the plants are short and the branches low and spreading, or when the crop is lodged. In that case, extension guards on the mower may be used to good advantage. A side-delivery attachment is desirable to move the cut swath aside so that the beans will not be tramped out when the next swath is cut. If cut with a mower without such an attachment, cutting should be done when the crop is damp, or the swath should be moved out of the way of the team at every round. After cutting with a mower, the crop should be raked as soon as possible and placed into small cocks. From five to ten days of good drying weather will allow the pods to become dry enough to thresh. If the piles become wet through with rain, they should be turned frequently to avoid damage to the seed.

THRESHING

The ordinary grain thresher can be adjusted to thresh soybeans successfully by reducing the speed of the cylinder to approximately one-half without changing the speed of the fan or separator. This may be done by doubling the size of the pulley on both ends of the cylinder shaft. If the beans are dry, all of the concave teeth should be removed. A special set of thin concaves may be used to good advantage when the beans are tough, or most of the teeth of the standard concave removed. Soybean seed is often badly cracked in the threshing, which seriously reduces its value for seed, lowers the market grade, and increases the danger from heating in storage. With proper adjustment of the ordinary separator, cracking the seed may be almost eliminated. Some manufacturers have special pea- and bean-hulling attachments which are very satisfactory, and which may be added to the ordinary separator at small cost.

HANDLING THE THRESHED SEED

Threshed soybean seed does not keep well in storage unless thoroughly dry. Losses from molding and heating can be prevented by exercising care to dry the seed thoroughly before storing it in bulk. Ordinarily, seed containing over 15 percent moisture should not be stored in quantity in a tight bin. Seed containing immature beans high in moisture, a high percentage of cracked or otherwise damaged beans, or that is to be used for planting, should receive special care to avoid heating or molding. In some cases it is necessary to spread it out in a layer a foot or two in depth on the floor of a well-ventilated room and stir frequently if it begins to heat. Usually little difficulty will be experienced if the seed is placed in sacks as soon as threshed and stored by standing the sacks upright in rows in an open shed, leaving plenty of room between the rows for the free circulation of air. Piling the sacks in twos crosswise, leaving a little space between them, will also afford some ventilation. It is always advisable to watch the seed closely for some time after threshing and if heating starts, to stir and dry it immediately.

MARKETING THE SEED

Soybean seed is handled on the market in much the same way as wheat or corn. Federal standards have been established and the different classes and grades are clearly defined. The seed is classified according to color, the class "Yellow soybeans" being generally preferred to green, brown, black, or mixed classes. The grade is determined by the test weight, moisture content, split seed, damage, and foreign material.

Several soybean-oil mills have been put into operation in eastern Kansas recently and these provide a ready market for most of the producing territory of the state.

SOYBEAN HAY PRODUCTION

PLANTING SOYBEANS FOR HAY

On ground which is fairly free from weeds, soybeans may be drilled solid with a grain drill, using about 80 to 100 pounds of seed per acre. The heavier rates of seeding allow for the destruction of some plants by cultivation with the harrow, weeder, or rotary hoe, and produce a finer quality of hay. A thicker stand also affords more competition for weeds in the early stages of growth.

On weedy land, it is better to plant in rows three to three and one half feet apart and cultivate in the same manner as for seed production. Spacing the rows 18 to 21 inches apart by double planting with a corn planter is also a satisfactory method. However, it introduces more difficulty in cultivating than the wider rows and permits less competition with weeds than close drilled plantings. Yields by this method average slightly above

those in the 38-inch rows. Tests conducted by the Agricultural Experiment Station at Manhattan and in southeast Kansas as shown in Table 4 indicate a somewhat greater yield from planting with a grain drill in rows 7 inches apart. These tests were on clean land and the 19-inch and the 7-inch rows were cultivated with a harrow or rotary hoe, or both. The ordinary six-shovel corn cultivator was used on the 38-inch rows.

TABLE 4.—YIELD OF HAY FROM DIFFERENT METHODS OF PLANTING, IN TONS PER ACRE.

Width of rows, inches	Seed planted, pounds per acre	Manhattan, 5-year av.	Southeastern Kansas, 8-year av.
38-42	22-26	1.13	.88
19-21	38-44	1.25	1.19
7	86-90	1.58	1.16

On weedy land where the crop is planted in wide rows to allow thorough cultivation, 30 pounds per acre will produce a better quality of hay and fully as much as if planted in 7 or 8 inch rows with a grain drill.

HARVESTING FOR HAY

Soybeans should be cut for hay when the seeds are about half developed. At this stage the oldest pods will be well filled while the younger pods will be nearly full length but will contain no seed. The crop may be cut any time from the formation of pods until the leaves begin to fall, and a good quality of hay produced. The earlier cut plants contain a higher percentage of protein, but the yield is less and the crop is difficult to cure. If left too long, the plants rapidly become woody, and there is more waste in feeding because of the hard stems. A good rule is to cut soon after the first pods are full grown and beginning to bulge with seed, provided weather is favorable for curing the hay.

The hay crop is ordinarily cut with a mower, although the binder is sometimes used. Hay cut with a mower is handled in about the same manner as alfalfa. Usually it is left in the swath until thoroughly wilted and then raked into light windrows before the leaves become dry enough to shatter. It may be left in this condition for a day or two and then placed in cocks and left until fully cured. A brighter hay is produced by putting it in cocks; and, in case of rain, there is less loss as the cocks, if carefully made, shed rain very well. The cocks should be opened a few hours before hauling to dry out thoroughly.

The hay is sometimes almost completely cured in the swath. When this practice is followed, a side-delivery rake can be used to good advantage. The windrows may be turned once or twice as is often done with alfalfa to bring about more uniform and thorough curing.

If the crop is cut with a binder, the bundles must be small and loosely bound. Even then, they may mold unless the weather is very favorable for curing.

Soybean hay molds readily in stack or mow unless it is thoroughly cured and free from dew or rain when stored. Layers of a grass hay or straw alternating with layers of the soybean hay will help prevent heating or molding.

Fig. 5.—A good hay crop of Virginia soybeans.

SOYBEANS AND COWPEAS COMPARED AS HAY CROPS

In Kansas soybeans are more desirable for hay than are cowpeas for the following reasons: They grow more erect, are more easily harvested, and the hay is much more readily cured. The leaves of cowpeas shatter more easily in handling, leaving a more stemmy hay. Soybean hay is not so quickly injured by wet weather and the yield is consistently higher than that of cowpeas. The average yield of hay produced by the Laredo variety at Manhattan for the 11-year period, 1931 to 1941, was 1.73 tons as compared with 1.5 tons for the best variety of cowpeas.

GROWING SOYBEANS WITH CORN

Planting soybeans with corn for pasturing or hogging off is practiced extensively in some sections. (Fig. 6.) This combination is also used for silage. The two crops may be planted in the same row at the time the corn is planted by using a bean and pea attachment on the corn planter. The corn is planted at

the usual rate; and the beans, from four to eight pounds per acre. Another method is to first plant the corn and then follow as nearly as possible in the same row, planting the soybeans shallower to avoid disturbing the corn. A third method consists in mixing the two in the planter box, using equal parts by weight and adjusting the planter to plant about twice the usual rate for corn alone. This is probably the least satisfactory

Fig. 6.—Soybeans in corn for silage or pasturing off.

method because the soybeans tend to work to the bottom and plant out first. Fairly satisfactory distribution can be obtained by filling the boxes only about half full and stirring the mixture frequently.

The usual result when such a mixture is grown is a reduction in the yield of corn, especially of the grain, the decrease depending upon the thickness of stand of the two crops. The increase in feeding value will in most cases compensate for the smaller yield of corn. The yield of soybeans grown in the corn will rarely equal the loss in yield of corn, but on the average as much or more protein per acre will be produced. Where the crop can be harvested by hogging off, the saving of labor in harvesting and larger gains on the stock from a better-balanced ration than corn alone make this practice, in many instances, a desirable one.

Seeding soybeans in corn for silage has not been a satisfactory practice according to experiments carried on at Manhattan.

When the soybeans make sufficient growth to add materially to the feeding value of the silage, the yield of corn is seriously reduced. In dry seasons, the soybeans make little growth and are largely lost in harvesting due to the failure of the binder to gather and hold them in the bundle.

TABLE 5.—YIELDS OF SOYBEANS AND CORN GROWN TOGETHER AND SEPARATELY FOR SILAGE.

(Three-year average, 1924 to 1926.)

Stand of		Method of planting	Silage produced		Protein per acre
Soybeans	Corn		Total weight of both crops	Percent soybeans	
			Tons		Pounds
Full	Full	Grown in same row	13.23	19.5	378
Half	Half	Grown in same row	10.72	24.0	328
One-fourth	Full	Grown in same row	14.34	10.0	344
Half	Full	Grown in same row	13.68	15.5	367
Full	Full	Grown separately, ½ plat of each	11.59	26.0	365
	Full	Corn alone	17.14		343

Results of three-year tests with the two crops grown together and separately are shown in Table 5. One plant of corn every 20 inches and one plant of soybeans every 3 to 4 inches was regarded as a full stand. Pride of Saline corn and A. K. and Virginia soybeans were used.

In no case was the combined yield of the two crops when grown together equal to the yield of corn grown alone. The yield was materially reduced when only 10 percent of the total crop consisted of soybeans. The inconvenience of planting, cultivating, and harvesting the two crops together should also be considered. Since the green soybeans contain approximately three times as much protein pound for pound as the corn, the total amount of protein produced is slightly greater where the two crops are grown together. Growing soybeans and corn together for silage cannot be recommended for Kansas. Results in some states farther east, *e. g.,* Iowa, Pennsylvania, Connecticut, and Virginia, have been somewhat more in favor of growing the two crops together.

When mixtures of soybeans and corn are desired for silage, such mixtures may be made by growing the two crops separately and mixing them at the ensilage cutter. It is often practicable to cure the soybeans as hay and feed a ration of soybean hay and silage.

VARIETIES

IMPORTANCE OF CHOOSING A GOOD VARIETY

Success with soybeans depends largely upon choosing a variety which is adapted to the locality and suited to the purpose for which it is grown. There are hundreds of varieties of soy-

beans, some of which are very early, low-growing, and unproductive, while others are extremely late, rank-growing plants which will scarcely begin to bloom before frost in this state. There are already too many varieties being grown in Kansas. This is due to the lack of information regarding the adaptation and relative value of varieties for Kansas conditions.

Fig. 7.—Varieties of soybeans grown for comparative yields of hay and seed.

More than 200 varieties and selections have been tested by the Kansas Agricultural Experiment Station at Manhattan since 1915. (Fig. 7.) Some of the best of these have also been grown in co-operative experiments with farmers in the eastern part of the state. Yields of 43 varieties are given in tables which follow.

CHARACTERISTICS OF A DESIRABLE VARIETY

Yield is not the only criterion to be considered in the choice of a variety for either hay or seed. For example, some varieties which produce very heavy yields of forage are so late that the plants do not reach the proper stage of maturity to make a good quality of hay. Likewise, a variety may produce heavy yields of seed yet not be a desirable one to grow because of its tendency to lodge or to shatter. The most important characters to be considered in choosing a variety to grow for seed, in addition to yield, are:

1. Uprightness of growth.
2. Freedom from lodging.
3. Freedom from shattering of seed.
4. Color of seed.

The increased demand for seed for processing and the advent of the combine has brought into favor the varieties most suitable for combine harvesting. In addition to the characters listed above such varieties branch fairly high from the ground, the branches retain an upright position after the crop is ripe and the plants ripen uniformly. For seed production, varieties with light-colored seed are usually preferred as such seed is in better demand on the market and is more readily eaten by certain kinds of livestock.

For hay production the color of the seed is not important, but freedom from lodging, fineness of stems, leafiness, and adherence of leaves before cutting and during curing and handling, are essential characteristics of a desirable hay variety. The rate and hence the cost of seeding can be reduced with varieties like the Peking and Laredo which have small seeds.

RESULTS OF VARIETY TESTS AT MANHATTAN

Yields of seed of varieties which have been tested during the eleven year period 1931 to 1941 and the average number of days required to mature are given in Table 6. Yields of three varieties of cowpeas and two of tepary beans are given for comparison with soybeans. Yields of hay of the same 18 varieties are given in Table 7.

All of the varieties named in Table 6 have yellow seeds except Laredo, Peking and Kingwa which have black seed. The first five varieties named are well suited to seed production in this state. Dunfield which is included in Table 8 is a good medium early variety which has met with considerable favor because of its erectness and uniformity of ripening making it somewhat better adapted to combine harvesting than most other varieties.

Hongkong and A. K. are medium late varieties and rank among the highest in seed production in this state. These varieties also produce good yields of hay and are believed to be the most desirable varieties for general use. Where an earlier variety is wanted, Illini, Dunfield, Manchu, and Pinpu have been among the best producers at Manhattan.

Varieties which have produced the highest yields of hay at Manhattan are those which mature very late and are not among the highest in seed production. Late, rank-growing varieties like Laredo and Chiquita will not always become fully mature north of the Kansas river in seasons when a killing frost comes before October 15. A seed crop of these varieties is therefore uncertain. They will mature sufficiently to make good hay and are particularly desirable for that purpose. The Laredo possesses the qualities essential for a good hay variety; namely, high yield, fine stems, abundance of leaves, and the tendency to hold leaves during curing and handling. It should be regarded as the leading hay variety for Kansas. Other good varieties for this purpose are Chiquita, A. K., Hongkong, and Peking.

New varieties are continually being tested and the less desirable ones are being omitted. For this reason a relatively small number of varieties have been grown continuously throughout the eleven year period covered in Tables 6 and 7. Some of the varieties which have been recently included in the tests are Scioto, Mandell, Mukden, Macoupin, Richland and Chief.

The mung bean is not a soybean but is more closely related to the garden bean. The plants are erect similar to the soybean but stems and leaves remain green after the seed ripens in which respect it resembles the cowpea. It is not so desirable for either hay or seed as the soybean. The seed of certain varieties is sprouted and used as a green vegetable for human consumption.

Tepary beans also are closely related to the garden bean. They are resistant to drouth and heat and produce good yields of both hay and seed. The plants spread out almost prostrate on the ground and seldom reach more than 1 foot in height, when grown in cultivated rows altho the rows will have a spread of as much as 3 feet. Difficulty of harvesting because of the low spreading growth is probably the main reason why the crop is not more generally grown.

EARLIER TESTS AT MANHATTAN

During the four year period 1927 to 1930, 33 varieties were tested. Results of these tests for yields of both seed and hay are given in Tables 8 and 9. Among the varieties will be found the Hongkong, A. K., Dunfield, Illini, Manchu and Laredo which are now being used on most of the soybean acreage in the state.

RESULTS OF VARIETY TESTS IN SOUTHEASTERN KANSAS

Tests have been conducted on the southeastern Kansas experiment fields throughout the 17-year period, 1924 to 1940. These fields are located in Cherokee, Allen, Labette, and Wilson counties, and are representative of the soils of that portion of the state where the soybean is an important crop. Yields of both seed and hay of nine varieties grown in these tests and the number of tests in which each variety was grown are shown in Table 10.

The Hongkong variety has produced the highest yield of grain of the nine varieties tested in southeastern Kansas with a significant lead over A. K. At Manhattan (Table 6), the yield of Hongkong has been the same as that of A. K. Laredo, a very late-maturing variety, particularly adapted for hay production, matures seed more consistently in southeastern Kansas and ranks higher in yield of seed compared with other varieties than at Manhattan.

The Laredo has given higher yields of hay in southeastern Kansas than any other variety. The high yield, and the superior

TABLE 6.—YIELD OF SEED AND AVERAGE TIME OF MATURITY OF SOYBEAN VARIETIES, MANHATTAN, KANS.
(11-year period 1931-1941.) (Cowpeas and tepary beans given for comparison.)

Variety	Days to mature	Bushels per acre											4 yr. av. 1935 to 1938	3 yr. av. 1939 to 1941	6 yr. av. 1935 to 1940	11 yr. av. 1931 to 1941
		1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941				
A. K.	122	29.7	21.0	20.8	4.6	26.3	9.1	10.0	14.5	7.1	17.7	15.7	15.0	13.5	14.3	16.1
Hongkong	122	35.6	23.0	18.0	5.2	22.7	9.8	11.5	16.0	8.2	14.7	22.1	15.0	15.0	15.0	16.1
Illini	115	33.3	19.1	21.6	3.5	14.7	16.9	13.3	16.9	11.2	14.0	11.1	15.5	12.1	14.0	16.0
Manchu	112	32.8	19.0	17.1	2.9	23.4	6.9	11.7	18.8	9.2	16.5	14.4	15.2	13.4	14.4	15.7
Pinpu	112	33.2	22.7	18.0	3.8	25.8	16.4	13.7	17.8	7.5	12.6		18.4		15.6	17.1[1]
Chiquita	135	26.6	11.1	17.5	5.3	20.8	8.0	5.4	6.4	4.0	13.6		10.1			11.9[1]
Laredo	140	31.8	12.8	18.0	4.6	13.0	5.5	0.0	3.3		13.2	7.0	5.5		7.0[2]	10.9[1]
Mansoy	114					21.0	6.2	7.9	15.8	9.7	16.1	17.2	12.5	14.3	12.8	
Scioto	110					23.8	11.6	12.2	18.7	8.9	14.7		16.6		15.0	
Kingwa	115					16.9	11.5	8.3	16.9				13.4			
Austin	120	34.3	22.2	19.9	2.6	22.4	7.3	8.4	14.2				13.1			
125 Selection	112		21.6	19.8	2.4	20.0	10.2	8.0	17.6				14.0			
146 Selection	112		21.2	18.4	2.6	17.2	9.1	11.6	20.2				14.5			
Peking	117	32.2	17.6	16.9	1.7	16.7	10.4	10.6	15.8				13.4			
Mandell	110					24.7	6.3		16.2				15.7[3]			
Macoupin	120									7.6	11.1	14.9		11.2		
Mukden	110									12.5	9.8	14.3		12.2		
Richland	107									15.6	7.7	15.2		12.8		
Mung bean	115	18.0								9.4	12.9	6.0		9.4		
Cowpeas		Cowpeas and tepary beans														
New Era		9.8	.7	17.5	0.0	11.2	.6	1.9	12.8	.9	15.4	4.0	6.6	6.8	7.1	6.8
Whippoorwill		8.1	.2	3.0	0.0	1.7	.3	.6	12.7	4.1	11.6	5.2	3.8	7.0	5.2	4.3
Victor		7.9	.9	16.9	0.0	9.5	.5	2.0	15.5	1.6	12.7	11.1	6.9	8.5	7.0	7.1
Tepary Beans																
Redfield White	118			24.0	0.0	7.2	3.7	8.4	24.6	20.3	23.7	25.0	11.0	23.0	14.8	
Local Yellow	118			11.4	0.0	2.8	4.6	5.4	19.5	11.0	24.2	23.9	8.1	19.7	11.3	

[1]—ten-year average.
[2]—five-year average.
[3]—three-year average.

TABLE 7.—YIELD OF HAY OF SOYBEAN VARIETIES AT MANHATTAN, KANS.
(11-year period 1931-1941.) (Cowpea and tepary beans given for comparison.)

Variety	Tons per acre											4 yr. av. 1935 to 1938	3 yr. av. 1939 to 1941	6 yr. av. 1935 to 1940	11 yr. av. 1931 to 1941
	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941				
A. K.	2.71	2.03	1.66	.34	1.20	.93	1.06	1.40	1.29	1.24	2.07	1.15	1.53	1.19	1.45
Hongkong	2.67	2.35	1.66	.40	1.18	1.05	1.22	1.48	1.21		1.86	1.23	1.53[3]	1.23[2]	1.51[1]
Illini	2.43	1.62	1.15	.34	1.18	.80	1.22	1.40	1.46	1.08	1.27	1.15	1.27	1.19	1.27
Manchu	2.57	1.63	1.10	.38	1.31	.69	1.07	1.37	1.51	.98	1.89	1.11	1.46	1.16	1.32
Pinpu	2.53	1.74	1.41	.32	1.20	1.31	1.14	1.13	1.18	1.03		1.20		1.17	1.30[1]
Chiquita	3.07	2.30	1.50	.43	3.06	1.05	1.35	1.47	1.33	1.36		1.73		1.60	1.69
Laredo	2.40	2.37	2.29	.45	2.87	1.09	1.22	1.52		1.42	1.71	1.68			1.73[1]
Mansoy					1.31	.56	.87	1.23	1.12	.82	1.61	.99	1.18	.99	
Scioto					1.19	.75	1.07	1.20	1.56	1.14		1.05			
Kingwa					1.33	.78	.99	1.74				1.09			
Austin	2.75	1.95	1.59	.33	1.10	.80	.96	1.27				1.03			
125 Selection		1.64	1.40	.38	1.13	.75	1.01	1.27				1.04			
146 Selection		1.78	1.08	.25	.96	.95	1.09	1.29				1.07			
Peking	2.76	2.03	2.00	.28	1.29	1.09	1.13	1.19				1.18			
Mandell					1.07	.75		.83				.88[4]			
Macoupin									1.17	1.07	1.81		1.35		
Mukden									.89	.61	1.19		.90		
Richland									.91	.79	1.32		1.01		
Mung bean	1.87								1.49	.77	1.27		1.18		
Cowpeas	Cowpeas and tepary beans														
New Era	2.53	2.21	2.90	0.0	1.12	.32	1.17	1.14	1.32	1.40	2.27	.94	1.66	1.08	1.49
Whippoorwill	2.51	1.59	3.29	0.0	1.15	.41	.82	1.86		1.32	2.19	1.06	1.76[3]	.88[2]	1.51[1]
Victor	2.70	2.36	2.74	0.0	1.14	.22	.87	1.28	1.17	1.61	1.90	.88	1.56	1.05	1.45
Tepary beans															
Redfield White			1.76	0.0	2.45		1.41	1.85	1.51	1.17	1.73	1.43	1.47	1.66[2]	
Local Yellow			1.68	0.0	2.86		1.49	2.04	1.56	1.41	2.10	1.60	1.69	1.87[2]	

[1]—Ten-year average.
[2]—Five-year average.
[3]—Two-year average.
[4]—Three-year average.

quality of the hay produced, makes this the outstanding variety for hay in southeastern Kansas.

YIELDS IN COOPERATIVE TESTS WITH FARMERS

Soybean variety tests have been conducted on farms in the eastern half of Kansas since 1922. Most of these tests were located in the eastern three tiers of counties. Comparative yields of grain and hay and the number of tests in which yields of each variety were taken are given in Table 11.

TABLE 8.—YIELDS OF SEED OF SOYBEANS AT MANHATTAN, KANS.
(Four-year period 1927-1930.) (Cowpea yields given for comparison.)

Variety	Days to mature (Average)	Bushels per acre. 1927	1928	1929	1930	Av.
Hong Kong	122	27.8	25.4	20.8	21.2	23.8
Pinpu	112	25.3	23.6	20.8	23.6	23.6
Austin	120	20.1	28.6	18.7	23.9	23.0
A. K.	122	25.1	21.8	20.0	24.4	22.8
Manchu	112	24.4	26.3	19.0	21.3	22.7
Wea	115	26.8	25.3	16.9	21.1	22.5
Morse	130	20.9	27.2	17.8	23.0	22.2
Blacker	122	21.1	21.0	19.1	16.7	21.9
Hoosier	115	22.9	21.2	21.1	22.8	21.9
Illini	115	26.5	19.0	17.6	24.1	21.8
Aksarben	114	25.0	26.1	16.4	19.4	21.7
Southern Prolific	135	20.9	21.4	22.8	21.4	21.6
Dunfield	108	23.8	24.0	15.4	22.2	21.3
Pine Dell Perfection	132	33.0	17.8	15.3	15.4	20.5
Columbia	125	21.0	19.0	17.6	22.5	20.0
Hamilton	130	20.2	20.7	18.8	18.2	19.9
Easy Cook	132	21.2	18.0	.....	.....	19.6[1]
Peking	117	22.7	19.7	18.9	17.4	19.6
Elton	115	17.0	20.9	15.1	22.7	18.9
Laredo	140	19.8	18.0	17.8	20.2	18.9
Mikado	136	19.6	20.6	18.1	17.5	18.9
Herman	136	16.7	23.8	12.4	20.6	18.2
Ebony	120	18.2	17.3	14.7	20.5	17.6
Virginia	120	13.9	23.0	15.1	18.0	17.5
Jet	118	17.8	18.8	15.3	.....	17.3[2]
Chiquita	135	17.4	16.7	15.7	19.0	17.2
Ilsoy	130	22.1	19.0	13.3	15.6	17.2
Lexington	120	19.9	16.8	15.8	16.8	17.2
Midwest	122	18.2	15.9	.....	.....	17.0[1]
Merko	120	16.5	18.0	12.7	.....	15.7[2]
Yokoten	132	13.0	12.9	16.7	.....	14.2[2]
Arlington	132	11.8	10.8	10.1	16.8	12.3
Tarheel Black	145	14.9	10.6	11.4	.....	12.3[2]
Mung bean	115	16.6	4.4	12.2	.....	11.1[2]
Cowpeas						
Victor		10.0	14.2	7.3	13.5	11.2
Whippoorwill		3.2	12.8	5.8	9.7	7.9
New Era		1.8	12.9	2.2	13.6	7.6

[1]—Two-year average. Yield of A. K. for same two-year period was 23.4 bushels.
[2]—Three-year average. Yield of A. K. for same three-year period was 22.3 bushels.

Only a few varieties have been included in recent years and the number of comparisons were regarded as insufficient to warrant including the yields of these in the table as comparable yields. The following statements, however, will show the performance of these varieties for the years they were tested. Illini, in 16 tests from 1935 to 1941, yielded 15.7 bushels of grain while A. K. produced 18.0 bushels in the same tests. Dunfield, in 10 tests in 1940 and 1941, harvested with a combine produced

18.7 bushels of seed compared with 17.8 bushels for A. K. in the same tests. Richland and Chief yielded 13.8 and 18.1 bushels per acre, respectively, in three tests in 1941 compared with 17.9 bushels for A. K. in the same tests.

TABLE 9.—YIELDS OF HAY OF SOYBEANS AT MANHATTAN.
(Four-year period, 1927-1930.) (Cowpeas given for comparison.)

Variety	Tons per acre 1927	1928	1929	1930	Av.
Laredo	2.68	3.13	2.43	3.17	2.85
Tarheel Black	3.40	2.68	2.14	.....	2.74[1]
Chiquita	2.60	3.18	2.64	2.27	2.67
Easy Cook	2.19	2.99	.....	.....	2.59[2]
Jet	2.12	2.87	2.34	.....	2.44[1]
Pine Dell Perfection	3.04	2.29	2.13	2.20	2.41
Hong Kong	2.34	2.78	2.11	2.07	2.32
Morse	2.28	2.65	2.19	2.03	2.28
Mung bean	2.62	2.65	1.51	.....	2.26[1]
Hamilton	2.34	2.67	2.10	1.77	2.22
Austin	2.23	2.67	2.16	1.71	2.19
Lexington	2.85	2.28	1.90	1.77	2.19
Southern Prolific	2.39	2.81	1.95	1.62	2.19
A. K.	2.05	2.51	1.86	1.93	2.14
Columbia	1.89	2.85	1.88	1.93	2.14
Herman	2.40	2.74	1.71	1.69	2.13
Aksarben	2.28	2.82	1.95	1.39	2.11
Blacker	1.82	2.61	2.20	1.75	2.09
Midwest	1.98	2.20	.....	.....	2.09[2]
Arlington	2.34	2.22	1.78	1.84	2.04
Peking	2.14	2.06	1.89	1.72	1.95
Virginia	1.97	2.44	1.75	1.65	1.95
Ebony	2.03	2.13	1.82	1.70	1.91
Ilsoy	2.15	2.45	1.59	1.43	1.90
Merko	2.01	2.10	1.52	.....	1.88[1]
Manchu	2.08	2.09	1.95	1.35	1.87
Yokoten	2.14	1.82	1.63	.....	1.86[1]
Hoosier	1.99	2.21	1.77	1.33	1.82
Mekado	2.05	2.17	1.72	1.35	1.82
Dunfield	1.47	2.55	1.63	1.27	1.72
Illini	1.72	2.23	1.60	1.35	1.72
Pinpu	1.63	2.19	1.53	1.56	1.72
Elton	1.61	2.14	1.66	1.33	1.68
Wea	1.74	1.84	1.72	1.38	1.67
Cowpeas					
New Era	1.93	1.84	1.39	1.86	1.75
Victor	1.25	1.99	1.74	1.85	1.70
Whippoorwill	1.42	1.75	1.10	1.82	

[1]—Three-year average. Yield for A. K. for same three-year period was 2.14 tons.
[2]—Two-year average. Yield for A. K. for same two-year period was 2.28 tons.

DESCRIPTION OF VARIETIES

Of more than 200 varieties and selections tested at Manhattan, only about 12 have given results which were sufficiently satisfactory to attract special attention. Brief descriptions of some of the varieties which appear to be well adapted to Kansas conditions are given here. Plants of the same variety vary somewhat when grown under different conditions. This is especially true of the time required to reach maturity. The descriptions given here are based on the growth of plants at Manhattan. The number of seeds per pound is given to aid somewhat in determining the rate of planting as well as for identification. The number given approximates an average for the variety but varies with the conditions under which the seed is grown, and

TABLE 10.—YIELDS OF SOYBEAN VARIETIES IN SOUTHEAST KANSAS. 1924-1940.

Variety	1924-1940—17 year period Seed Number of comparisons	Seed Yield bu. per A.	Hay Number of comparisons	Hay Yield tons per A.	1924-1930 7 yrs. Seed bu.	1924-1930 7 yrs. Hay tons	1931-1937 7 yrs. Seed bu.	1931-1937 7 yrs. Hay tons	1938-1940 Seed bu.	1938-1940 Hay tons
A. K.	29	13.0	31	1.37	16.3	1.70	14.2	1.56	10.9	.98
Hongkong	16	14.5	17	1.21			15.6	1.70	13.4	.90
Manchu	29	12.0	30	1.08	14.8	1.29	12.9	1.46	13.0	.75
Virginia	27	9.6	29	1.17	12.2	1.42	9.2	1.47	9.9	.94
Laredo	23	11.2	22	1.65	12.9	2.07	10.8	1.73	8.3	1.09
Peking (Sable)	23	11.4	25	1.44	13.1	1.72	10.2	1.49		
Austin					15.1	1.60				
Morse					13.0	1.39				
Wilson					12.3	1.20				

Note: All yields corrected with A. K. The above data are the results of tests made on the southeastern Kansas experiment fields at Columbus, Moran, Parsons, and Rest in Cherokee, Allen, Labette and Wilson counties, respectively.

whether it has been cleaned and graded, and the closeness of the grading.

TABLE 11.—YIELD OF SOYBEAN VARIETIES IN COOPERATIVE TESTS 1922 TO 1941, INCLUSIVE.

Variety	Number of comparisons	Yield of bu. per acre	Number of comparisons	Yield in tons per acre
Hongkong	77	12.4	48	1.52
A. K.	178	12.1	119	1.49
Manchu	174	11.1	117	1.19
Morse	111	10.5	87	1.40
Wilson	79	10.1	68	1.33
Virginia	114	10.0	96	1.35
Sable	159	9.7	117	1.48
Midwest	73	8.3	61	1.14
Laredo	87	8.2	80	1.95

Note. All yields corrected with A. K.

A. K. — Plants of this variety are erect and fairly bushy with medium-size stems and branches. The variety lacks uniformity in growth and maturity. Pubescence or hairs over the entire plant may be either tawny or gray. Flowers are both white and purple; pods range from gray to brown. Seeds of medium size (2,800 per lb.), straw yellow with hilum (seed scar) varying from light to dark brown, sometimes surrounded by an irregular brown splotch on the seed coat. Oil 18.78 percent; protein 44.65 percent. Plants have a tendency to lodge on fertile soils in seasons of abundant rainfall. This is an excellent variety for both hay and seed. Matures in 120 to 125 days.

Chiquita. — A tall late variety similar to Laredo in growth habit, but a few days earlier. Maturity about **135** days; pubescence gray; flowers both purple and white; seed straw yellow with brown hilum, medium small about 4,000 to the pound; oil **18.18** percent, protein 43.77 percent. It produces high yields of hay but the yield of seed is relatively low.

Dunfield. — An erect, medium early variety, branching high from the ground, uniform; well suited to combine harvesting. Maturity 110 days; pubescence gray; flowers purple and white; seed straw yellow with light brown hilum, about 3,175 to the pound. Oil 20.78 percent; protein 39.69 percent.

Hongkong. — Plants similar to those of A. K. but more uniform in growth and maturity. An excellent all-purpose variety and stands at the top in seed production in this state among all varieties tested. Maturity 120 to 125 days; pubescence both gray and tawny; flowers both purple and white; seed straw yellow with dark brown hilum; about 2,950 to the pound; oil 19.01 percent; protein 43.50 percent.

Illini. — A selection from A. K. made by the Illinois Agricultural Experiment Station. Maturity 110 to 115 days; pubescence gray; flowers white; seed straw yellow about 2,800 to the pound; oil 20.40 percent; protein 39.25 percent. This has

been a popular variety throughout much of the Corn Belt where it is grown mainly for seed.

Laredo. —This is a late rank-growing variety which produces heavy yields of hay where the season is sufficiently long. The plants are slender, erect, and have a tendency to lodge on fertile soils. Pubescence tawny; flowers both purple and white; seeds very small (7,500 per lb.), only two-fifths the size of those of A. K. oblong, much flattened and black with black hilum. Oil 14.93 percent; protein 42.85 percent. Matures in 140 days. It is well suited for growing in southeastern Kansas for hay or green manure. Its late maturity, small size, color, and low oil content of seed discriminate against it as a variety for seed production.

Manchu. —This is a medium-early variety maturing about two weeks earlier than A. K. or Hongkong. It is especially suitable for seed production. The stems and leaves are somewhat coarse and the yield of hay is relatively low compared with other adapted varieties. Pubescence tawny; flowers both purple and white; pods brown; seeds straw-yellow with black hilum; medium size (2,500 per lb.); oil 18.85 percent; protein 41.43 percent. The branches are rather erect and pods are well distributed over the plant. The plants stand up well and the seed does not shatter readily. Matures in about 112 days.

Peking (Sable). —This is a compact, erect bushy variety with fine branches and very leafy. It is very resistant to lodging and makes a good quality of hay. Pubescence tawny; flowers both purple and white; pods brown; seeds glossy black, oblong, flattened and very small (6,000 per lb.), little more than half as large as those of Virginia. Oil 15.16 percent; protein 38.65 percent. Matures in about 120 days. The fineness of branches, leafiness, good yield, and small size of seed, which permits a lighter rate of planting, thus reducing the cost of seeding, make this one of the best medium-maturing hay varieties.

Pinpu. —This is distinctly a seed variety similar to Manchu in earliness, but slightly shorter and the branches more spreading at maturity. Pubescence gray; flowers purple; seeds of medium size (about 2,700 per lb.), straw-yellow with brown blotches prominent in some seasons; hilum brown varying from light to slaty-brown. Oil 20.42 percent; protein 39.98 percent. One of the best producers among the early seed varieties, its chief defect being its short spreading growth habit which makes harvesting inconvenient.

Virginia. —This is mainly a hay variety. It is one of the best for poor soils but lodges badly on fertile soil. The plants are tall and slender with twining tips. Pubescence tawny; flowers purple; pods brown and distributed along the full length of the stem and branches; seeds medium small (3,600 per lb.), oblong, much flattened, olive-brown with inconspicuous hilum of nearly the same color; oil 19.82 percent; protein, 40.08 percent. Matures in 120 to 125 days.