SOYBEANS
CULTURE · · · · ·
· and VARIETIES

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U. S. DEPARTMENT OF AGRICULTURE

THE SOYBEAN, an annual summer legume, now occupies a highly important place in American farm systems for forage, feeds, and soil-improving purposes and as a source of raw material in the manufacture of numerous feed, food, and industrial products. The United States now produces more soybeans than any other country, having increased its acreage from 1,785,000 to 12,427,000 and annual seed production from 5,000,000 to 201,275,000 bushels in the 21 years between 1925 and 1946. Commercial seed production has become a well-established industry, especially in the North Central States. It is expanding in the South.

Among the important factors contributing to this phenomenal increase are the development of improved varieties adapted to a wide range of soil and climatic conditions, improvement in machinery for handling the crop, adaptability of the legume to fit favorably into most rotations and crop-control programs, high resistance to diseases and insects in comparison with other common crops, and available industrial markets.

State agricultural experiment stations cooperate with the Department in the study of varietal adaptation and are therefore in a position to recommend the best varieties for their respective States.

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SOYBEANS: CULTURE AND VARIETIES

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Contents

HISTORY

The early history of the soybean is lost in obscurity. Ancient Chinese literature reveals that the soybean was extensively cultivated and highly valued as a food centuries before written records were kept. The first record of the plant is contained in a materia medica describing the plants of China, written by Emperor Sheng Nung, the heavenly farmer, in 2838 B. C. The crop is repeatedly mentioned in later records and was considered the most important cultivated legume and one of the five sacred grains essential to the existence of Chinese civilization. The records of methods of culture, varieties for different purposes, and numerous uses indicate that the soybean is among the first crops grown by man.

Europeans first knew of the soybean in the seventeenth century through Engelbert Kaempfer, a German botanist, who spent 2 years, 1691–92, in Japan. Seed sent by Chinese missionaries was planted as early as 1740 in botanic gardens in France. The soybean was grown in 1790 in the Royal Botanic Gardens, Kew, England. Apparently no effort was made toward its culture as a crop. The greatest impetus given to its culture in Europe was the work in 1875 and subsequent years of Friedrich Haberlandt, of Austria, who published in much detail the results of his investigations. Although promising results were obtained with the early varieties in several European countries, the soybean did not attain the place in European agriculture Haberlandt had hoped it would. In general, the climatic conditions there are not well suited to its culture except in certain parts of Rumania, Czechoslovakia, Austria, and the Union of Soviet Socialist Republics.

The first mention of the soybean in American literature was made

in 1804 by James Mease, who wrote that "the soybean is adapted to Pennsylvania and should be cultivated." For many years following, however, the soybean was regarded more as a botanical curiosity than as a plant of much economic importance. In 1878, G. H. Cook, of New Brunswick, N. J., obtained seed of the soybean from the Bavarian Agricultural Station. In the same year James Neilson, of New Jersey, obtained seeds of several varieties at Vienna, Austria. Both gentlemen planted the seeds and gathered crops in 1879. These varieties were without doubt some of those grown and distributed through Europe by Haberlandt. W. P. Brooks, of the Massachusetts Agricultural Experiment Station, brought back several varieties from Japan, and in 1890 C. C. Georgeson, of the Kansas Agricultural Experiment Station, obtained three lots of seed from the same country. Undoubtedly, other early importations were obtained from oriental countries through missionaries, but no definite records have been found.

Since 1890 most of our agricultural experiment stations have experimented with soybeans, and many bulletins treating of various phases of the crop have been published. In 1898, the United States Department of Agriculture began the introduction of a large number of soybeans from Asiatic countries. Since that time the acreage of soybeans has increased nearly three-hundred-fold—from less than 50,000 acres in 1907 to 12,427,000 acres in 1946. Increase of acreage and production has been closely correlated with the introduction of varieties and their improvement through selection. Remarkable progress has been made in the last few years in developing food and industrial uses.

DESCRIPTION

The soybean (*Glycine max* (L.) Merrill), also called the soya bean, soja bean, Manchurian bean, is an annual summer legume native of southeastern Asia. It is an erect, branching plant, resembling in its early growth the ordinary field and navy beans (fig. 1). The different varieties range in maturity from very early (about 75 days) to very late (200 days or more). With few exceptions, earliness is correlated with size, the tallest varieties being latest.

Nearly all varieties are pubescent; that is, the stems, leaves, and pods are covered with fine, tawny (brown) or gray hairs. Several yellow-seeded varieties in the Orient are entirely glabrous; that is, lack pubescence. Glabrous soybean varieties are smaller, shorter, and yield less seed than most pubescent varieties, and when grown in the United States are subject to considerable injury from leafhoppers. In the Orient, the glabrous varieties have been found highly resistant to attacks from the pod borer, a serious insect pest, which as yet has not been found in the United States.

The leaves of the soybean vary widely in shape, size, color, and degree of persistence (leaf remaining attached to stem), and they nearly always begin to turn yellow as the pods ripen; usually they have fallen by the time the pods are mature. The small, inconspicuous flowers are borne in the axil of the leaf and are either white or purple.

The pods, usually containing two or three seeds, range in color from very light straw through numerous shades of gray and brown

to nearly black. The seeds are usually straw yellow, olive yellow (greenish yellow), green, brown, or black. In some varieties straw-yellow seeds are very pale, especially when old, and they are sometimes erroneously called white.

No truly white or red seeds are known in soybeans. Bicolored seeds occur in several varieties, the most common patterns being green or yellow with a saddle of black or brown. In some varieties the seeds are brindled brown and black, the two colors being somewhat concentrically arranged.

The cultivated soybean is thought to have been derived from *Glycine ussuriensis* Regel and Maack, which grows wild throughout much of eastern Asia. This species is prostrate in habit of growth, has long, fine, twining stems; small, narrow leaves; purple flowers; small, compressed pods that shatter very readily; and small, oblong seeds of sooty black.

Figure 1.—The wild soybean (left in the immediate foreground) and the intermediate type (right foreground), growing in a field of commercial type soybeans.

DISTRIBUTION AND PRODUCTION

The soybean is grown more intensively in Manchuria than in any other country of the world. It occupies about 25 percent of the total cultivated area and is the cash crop of the Manchurian farmer. China, Korea (Chosen), and Japan are large producers, and it is cultivated more or less also in the Philippines, Thailand, Cochin China, India, and the East Indies. In the central part of the Union of Soviet Socialist Republics the districts of the Don River and the Southwest are said to be especially suited to the culture of this crop. Parts of Czechoslovakia, Rumania, Austria, Bulgaria, and Yugoslavia have also succeeded in growing soybeans, and the production of seed is

rapidly increasing. In other parts of the world, particularly England, Germany, Union of South Africa, British East Africa, Algeria, Egypt, New South Wales, France, Italy, and Spain, soybeans have been tried or are being grown in a small way.

In the Western Hemisphere the acreage and production of soybeans are concentrated chiefly in the North Central States of the United States (fig. 2). In acreage planted to soybeans and in production of seed, the United States leads the world. The acreage of soybeans grown for all purposes in the United States has shown marked increase during the past decade, advancing from 7,183,000 acres in 1936 to 12,427,000 acres in 1946. In 1920, 14 States produced 3,000,000 bushels of seed, the leading States being North Carolina, Virginia,

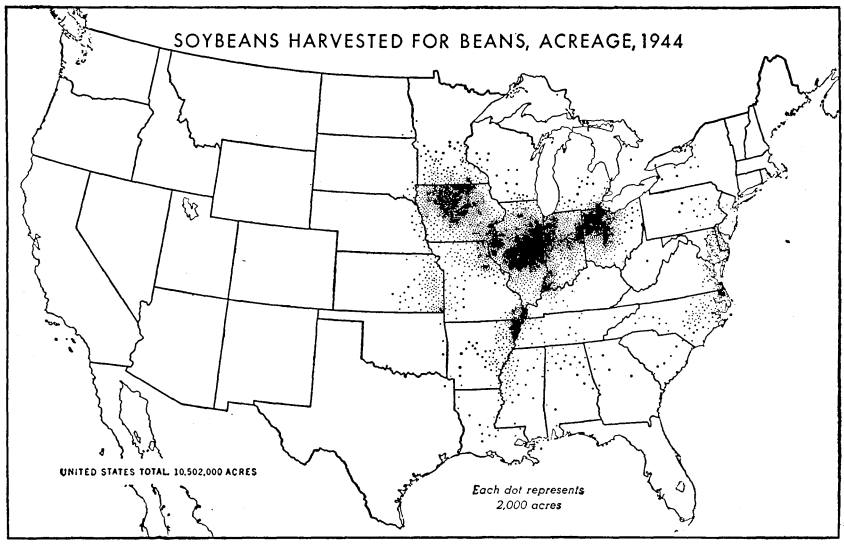

Figure 2.—Soybeans for beans are an important crop in three general regions, the North Central region, the Mississippi Delta, and the Middle Atlantic coast, about 90 percent of the production being in the North Central region.

Alabama, Missouri, and Kentucky. North Carolina alone produced about 55 percent of this total.

By 1931 seed production had increased to 15,158,000 bushels, with Illinois, Indiana, North Carolina, and Missouri leading. In 1946, 201,275,000 bushels of seed were produced, of which 181,019,000 bushels (88 percent) were harvested in Illinois, Iowa, Ohio, Indiana, Missouri, and Minnesota, the first four States producing about 86 percent. In Canada, production is confined chiefly to the Province of Ontario. In other parts of the Western Hemisphere, acreage grown in any country is comparatively small.

CLIMATIC ADAPTATIONS

In general, the climatic adaptation of soybeans may be said to be about the same as for corn. The crop is especially well adapted to the northern half of the Cotton Belt and to the central and southern parts of the Corn Belt. In these localities, the large and later varieties,

which give yields that make soybean cultivation profitable, can be grown. In the Northern States, however, early varieties introduced from northern Manchuria mature good yields of seed and later varieties can be grown successfully for hay, pasture, and silage. The largest concentration of soybean production in the Orient is in Manchuria, where the climate compares with that in the North Central section of the United States.

After the soybean plant is well started, it withstands short periods of drought and is not seriously retarded in growth nor reduced in yield by a wet season, provided weed growth is controlled. The soybean plant seems to adapt itself not only to soils but also to seasons. The period of germination is the most critical stage, when excess moisture or prolonged drought is likely to be injurious. It does, however, withstand drought relatively better than corn. The soybean is less susceptible to frost than are corn, cowpeas, and field beans. Light frost has little effect on the plants when young or nearly mature.

VARIETIES

Prior to the introduction of numerous varieties of soybeans by the United States Department of Agriculture in 1898, not more than 8 varieties had been grown in the United States, and the culture of these was limited to a few well-defined areas. The Department has made more than 10,000 introductions from China, Manchuria, Japan, Korea, East Indies, and India, representing more than 2,500 distinct types. This large collection, ranging in maturity from 75 to 200 or more days, has shown wide differences in size, shape, color, composition, and quality of seed and in adaptation to the various soil and climatic conditions in the United States.

State agricultural experiment stations and special cooperators have cooperated with the Department for several years in the study of adaptation of varieties, and those stations are, therefore, in a position to recommend the best varieties for their respective States. Growers and seedsmen are urged to use the varietal names here adopted, and buyers should be careful to specify the variety desired. Because of the similarity in seed of certain varieties and of extravagant claims for old discarded varieties under new names, the prospective purchaser should buy seed from reliable sources only. The planting of imported seed is not to be recommended. Such seed usually consists of a mixture of varieties, many of which are inferior to the varieties already grown, and little is known about their maturity and adaptation.

More than 100 named varieties are now handled by domestic growers and seedsmen and are under test by the United States Department of Agriculture and State agricultural experiment stations. Unfortunately, there is more or less confusion in the names of varieties, the same variety frequently being known under different names. Since new varieties are easily obtained through introduction, selection, and hybridization, it is desirable to limit the varieties in trade to the very best. In many States where the soybean has become an important crop, seed of the best varieties is certified by crop-improvement associations.

Soybean varieties have been classified as early or late, depending upon when they ripen under the latitude and climatic conditions at the location where they are grown. Another means of expressing

maturity that is coming into general use among plant breeders is a classification according to relative maturity groups. The varieties being grown in the United States have been divided into nine maturity groups (O through VIII), group O and group I being adapted to the northern part of the country. The succeeding groups are adapted farther south, group VIII being grown in the Gulf-coast region.

Areas where varieties in each of the maturity-classification groups are especially adapted as a full-season crop are shown on the map (fig. 3). Farmers may choose varieties in the next earlier group if they wish to harvest the soybean crop early in preparation for seeding a winter grain crop or lengthen the combine harvesting season.

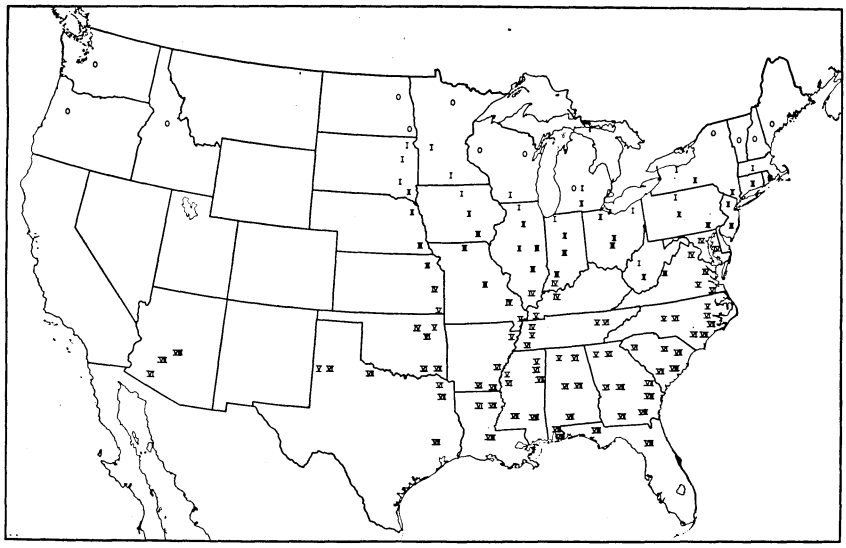

Figure 3.—Areas in the United States where varieties in each of the soybean maturity-classification groups are adapted as a full-season crop.

Varieties may be divided into three utilization groups; namely, commercial, forage, and vegetable. Varieties for commercial seed production are preferably yellow-seeded and are used for oil, oil meal, and flour, but these varieties may be used also for forage purposes if heavier rates of seeding are used. Vegetable varieties are those that have been found best for eating as green shelled and mature beans. They have a mild or nutty flavor and cook easily. The most suitable vegetable varieties are those with straw-yellow or olive-yellow (greenish) seed, although a few black, brown, and bicolored varieties have been found to have superior qualities as green shelled beans. The varieties used for processing and forage purposes usually do not cook easily and have a raw beany flavor. The following varieties are recommended for different uses and are listed according to maturity-classification groups:

Group O:
- Commercial — Capital, Flambeau, Goldsoy, Kabott, Minsoy, Montreal Manchu, Norsoy, Pagoda, Pridesoy.
- Green vegetable — Agate, Sac, Sioux.

Group I:
- Commercial — Blackhawk, Cayuga, Habaro, Manchu 3, Manchu 606, Manchukota, Mandarin, Mandarin (Ottawa), Mandarin 507, Monroe, Ontario, Wisconsin Black.
- Forage — Cayuga, Wisconsin Black.
- Green vegetable — Giant Green, Hidatsa.

Group II:
- Commercial — Bavender Special, Earlyana, Granger, Harman, Hawkeye, Mandell, Mingo, Mukden, Richland, Seneca.
- Vegetable:
  - Green bean — Bansei, Etum, Hakote, Jogun, Kanro, Kanum, Mendota, Sato, Sousei.
  - Mature bean — Bansei, Etum, Jogun, Kanro, Kanum, Mendota, Sousie.

Group III:
- Commercial — Adams, Chief, Dunfield, Illini, Lincoln, Manchu, Pennsoy, Scioto, Viking.
- Vegetable:
  - Green bean — Chusei, Hokkaido, Kura, Tastee, Willomi, Wolverine.
  - Mature bean — Chusei, Hokkaido, Willomi, Wolverine.

Group IV:
- Commercial — Boone, Gibson, Hongkong, Macoupin, Mansoy, Midwest, Morse, Mount Carmel, Patoka, Wabash.
- Forage — Ebony, Kingwa, Norredo, Peking, Virginia, Wilson.
- Vegetable:
  - Green bean — Aoda, Chame, Emperor, Funk Delicious, Imperial.
  - Mature bean — Emperor, Funk Delicious, Imperial.

Group V:
- Commercial — Haberlandt, Herman, Hollybrook, S100.
- Vegetable:
  - Green bean — Easycook, Hahto, Higan.
  - Mature bean — Easycook, Higan.

Group VI:
- Commercial — Arkan, Arksoy, Arksoy 2913, Armredo, Delsoy, Dortchsoy 2, Magnolia, Mamredo, Ogden, Ralsoy, Rose Non Pop.
- Forage — Laredo.
- Vegetable:
  - Green bean — Rokusun, Delsoy.
  - Mature bean — Rokusun, Delsoy.

Group VII:
- Commercial — Charlee, Clemson, C. N. S., Georgian, Hayseed, Mammoth Brown, Mammoth Yellow, Missoy, Monetta, Palmetto, Roanoke, Tennessee Non Pop, Tokyo, Volstate, Woods Yellow, Yelredo.
- Forage — Barchet, Charlee, Clemson, Georgian, Hayseed, Missoy, Monetta, Palmetto, Tanner, Yelredo.

Group VIII:
- Commercial — Acadian, Arisoy, Creole, Delsta, LZ, Mamloxi, Mamotan, Nanking, Pelican, Seminole, Yelnando.
- Forage — Avoyelles, Biloxi, Creole, Gatan, Otootan.
- Vegetable:
  - Green bean — Cherokee, Nanda, Seminole.
  - Mature bean — Nanda, Seminole.

DESCRIPTION OF VARIETIES [1]

ACADIAN.—Selection, La. No. 40–293, from a natural cross by the Louisiana Agricultural Experiment Station. Maturity classification, group VIII; [2] pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 4,000 to the pound; germ, yellow; oil, 20.1 percent; [3] protein, 43.5 percent; iodine number, 136.

ADAMS.—Selection, A5–2683 (A–3–176), from a cross between the Illini and Dunfield varieties made in 1938 by the Iowa Agricultural Experiment Station in cooperation with the United States Regional Soybean Laboratory. Maturity classification, group III; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with buff to light-brown hilum, about 3,100 to the pound; germ, yellow; oil, 21.8 percent; protein, 40.8 percent; iodine number, 131.

AGATE.—Introduced under P. I. No. 81037, native name, "Kura Kake Daizu," from Sapporo, Hokkaido, Japan, in 1929, and used as an early green shelled bean. Maturity classification, group O; pubescence, tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with brown saddle and brown hilum, about 2,800 to the pound; germ, yellow; oil, 19.2 percent; protein, 37.3 percent.

AODA.—Introduced under P. I. No. 81043, native name "Ao Daizu," from Hakodate, Hokkaido, Japan, in 1929. A green-seeded variety used as a green shelled bean because of its excellent flavor. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, green with light-brown hilum, about 1,400 to the pound; germ, green; oil, 18.2 percent; protein, 46.2 percent; iodine number, 123.

ARISOY.—Introduced under P. I. No. 86736, native name "Izari Mame Kinai, No. 1," from Konosu, Japan, in 1930, and used principally as a green manure crop. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 4,200 to the pound; germ, yellow; oil, 17.4 percent; protein, 44.9 percent; iodine number, 132.

ARKAN.—Introduced under P. I. No. 87050, native name "Urusankon," from Niummen, Keisha Nanko, Korea, in 1930. Maturity classification, group VI; pubescence, tawny; flowers, white; pods, two-seeded; shattering, much; seeds, straw yellow with light-brown hilum, about 3,800 to the pound; germ, yellow; oil, 19.6 percent; protein, 44.2 percent; iodine number, 125.

ARKSOY.—Introduced under P. I. No. 37335 from Pingyang, Korea, in 1914. Maturity classification, group VI; pubescence, gray; flowers, both purple and white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 3,800 to the pound; germ, yellow; oil, 19.1 percent; protein, 45.2 percent; iodine number, 132.

ARKSOY 2913.—Selection No. 2913 from the Arksoy variety, by the Rice Branch Experiment Station, Stuttgart, Ark. Maturity classification, group VI; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown to brown hilum, about 3,700 to the pound; germ, yellow; oil, 19.6 percent; protein, 44.6 percent; iodine number, 132.

ARMREDO.—Selection from the Mamredo variety, by the Arizona Agricultural Experiment Station in 1942. Maturity classification group VI; pubescence, tawny;

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[1] The following varieties of soybeans do not appear in the present publication as they are no longer handled by growers and seedsmen and have been superseded by improved varieties: A. K., Aksarben, Arlington, Austin, Black Eyebrow, Chernie, Chestnut, Chiquita, Columbia, Delnoshat, Dixie, Early Brown, Elton, Fuji, George Washington, Goku, Goshen Prolific, Hamilton, Harbinsoy, Hiro, Hoosier, Hurrelbrink, Ilsoy, Ito San, Jet, Lexington, Medium Green, Merko, Mikado, Ogemaw, Old Dominion, Oloxi, Osaya, Ozark, Pee Dee, Pine Dell Perfection, Pinpu, Shiro, Sooty, Southern Green, Southern Prolific, Soysota, Suru, Tarheel Black, Toku, Waseda, Wea, White Biloxi, Wilson-Five, and Yokoten. Descriptions of these varieties may be found in United States Department of Agriculture Farmers' Bulletins 973 (1918), 1520 (1927), and 1520 (1939, revised). These publications are out of print, but may be consulted in libraries.

[2] Maturity classification in this and subsequent descriptions refers to relative maturity groups described under "Varieties," p. 5.

[3] Percentages of oil and protein are reported on a moisture-free basis in this and subsequent descriptions.

flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 4,100 to the pound; germ, yellow; oil, 19.5 percent; protein, 42.2 percent; iodine number, 133.

AVOYELLES.—Selected as a sport in 1932 from the Otootan variety in Avoyelles Parish, La. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, black with black hilum, about 4,400 to the pound; germ, yellow; oil, 16.8 percent; protein, 43.2 percent; iodine number, 137.

BANSEI.—Introduced under P. I. No. 81031, native name "Bansei O Saya Eda Mame," from Sapporo, Hokkaido, Japan, in 1929, and used as a green shelled bean. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 2,300 to the pound; germ, yellow; oil, 20.4 percent; protein, 44.2 percent; iodine number, 119.

BARCHET.—Introduced under P. I. No. 23232, native name "Ma Liao Tou," from Shanghai, China, in 1908. This variety is grown as a second crop in low-lying rice fields, and used mainly as a forage crop for domestic animals. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, brown with brown hilum, about 9,700 to the pound; germ, yellow; oil, 14.6 percent; protein, 48.2 percent; iodine number, 138.

BAVENDER SPECIAL.—A selection said to have been made from a cross between the Mukden variety and a North Carolina variety by Mr. Bavender, Whitten, Iowa. Maturity classification, group II; pubescence, tawny; flowers, both purple and white; pods, three-and four-seeded; shattering, little; seeds, straw yellow with both black and brown hila, about 2,900 to the pound; germ, yellow; oil, 20.2 percent; protein 41.5 percent; iodine number, 137.

BILOXI.—Introduced under P. I. No. 23211, native name "Tsze Pi Tou," from Tangsi, China, in 1908. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, dark brown with brown hilum, about 2,700 to the pound; germ, yellow; oil 16.5 percent; protein, 48.6 percent; iodine number, 131.

BLACK BEAUTY.—Same as Ebony.

BLACKHAWK.—Selection, A6K–937, from a cross between the Mukden and Richland varieties developed by the Iowa Agricultural Experiment Station in cooperation with the United States Regional Soybean Laboratory. Maturity classification, group I; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 2,900 to the pound; germ, yellow; oil, 20.2 percent; protein, 41.9 percent; iodine number, 129.

BOONE.—Pure-line selection from P. I. selection No. 54563–3 by the Missouri Agricultural Experiment Station in 1930. Maturity classification, group IV; pubescence, gray; flowers, white; pods, two-seeded; shattering, little; seeds, straw yellow with pale to brown hilum, about 3,500 to the pound; germ, yellow; oil, 20.3 percent; protein, 41.8 percent; iodine number, 127.

BROWN OTOOTAN.—Same as Tanner.

CAPITAL.—Selection from a cross between strain No. 171 and A. K. (Harrow) by the Central Experimental Farm, Ottawa, Canada. Maturity classification, group O; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 3,600 to the pound; germ, yellow; oil, 19.7 percent; protein, 39.3 percent; iodine number, 137.

CAYUGA.—Introduced under P. I. No. 65393 from Harbin, Manchuria, in 1925. Maturity classification, group I; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, black with black hilum, about 3,500 to the pound; germ, yellow; oil, 17.2 percent; protein, 43.3 percent; iodine number, 132.

CHAME.—Introduced under P. I. No. 80473, native name "Cha Mame," from Tokyo, Japan, in 1929, and used as a green bean boiled in the pod. Maturity classification, group IV; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, much; seeds, light brown with brown hilum, about 1,900 to the pound; germ, yellow; oil, 19.5 percent; protein, 40.9 percent; iodine number, 124.

CHARLEE.—Introduced under P. I. No. 71663 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about

4,300 to the pound; germ, yellow; oil, 17.6 percent; protein, 44.4 percent; iodine number, 133.

CHEROKEE.—Introduced under P. I. No. 93057, native name "Ke Lu Tou," from Hangchow, China, in 1931. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, green with brown hilum, about 2,400 to the pound; germ, green; oil, 17.9 percent; protein, 46.2 percent; iodine number, 132.

CHIEF.—Selection, Illinois Type No. 119, from a cross between the Illini variety and Illinois Type No. 95 by the Illinois Agricultural Experiment Station. Maturity classification, group III; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with slate to brown hilum, about 3,500 to the pound; germ, yellow; oil, 20.9 percent; protein, 41.2 percent; iodine number, 129.

CHUSEI.—Introduced under P. I. No. 80472, native name "Chusei O Saya Eda Mame," from Tokyo, Japan, in 1929. A large yellow-seeded variety used for garden purposes. It has a sweet flavor and is used principally as a green shelled bean. Maturity classification, group III; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale-brown hilum, about 2,100 to the pound; germ, yellow; oil, 18.2 percent; protein, 45.3 percent; iodine number, 125.

CLEMSON.—Introduced under P. I. No. 71569 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with black hilum, about 3,900 to the pound; germ, yellow; oil, 16.3 percent; protein, 45.8 percent; iodine number, 132.

C. N. S. (CLEMSON NONSHATTERING).—Selection from the Clemson variety by J. E. Wannamaker, Saint Matthews, S. C. Maturity classification, group VII; pubescense, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown to brown hilum, about 3,500 to the pound; germ, yellow; oil, 18.4 percent; protein, 44.8 percent; iodine number, 130.

CREOLE.—Introduced under P. I. No. 71614 from Nanking, China, in 1927. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about 3,100 to the pound; germ, yellow; oil, 17.6 percent; protein, 45.7 percent; iodine number, 131.

DELSOY.—Introduced under P. I. No. 85355 from Suwon, Korea, in 1930. Maturity classification, group VI; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with dark-brown hilum, about 3,500 to the pound; germ, yellow; oil, 17.4 percent; protein, 45.2 percent; iodine number, 133.

DELSTA.—Selection, Delta Station No. 6677, developed by the Delta Branch Station, Stoneville, Miss., in 1924. Maturity classification, group VIII; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 2,600 to the pound; germ, yellow; oil, 17.8 percent; protein, 43.9 percent; iodine number, 132.

DORTCHSOY 2.—A selection from the Ogden variety by the Robert Dortsch Seed Co., Scott, Ark. Similar to the original Ogden variety. Maturity classification, group VI; pubescence, gray; flowers, purple, pods, two- to three-seeded; shattering, medium; seeds, olive yellow with light-brown hilum, about 3,100 to the pound; germ, yellow; oil, 20.5 percent; protein, 42.8 percent; iodine number, 132.

DUNFIELD.—Introduced under P. I. No. 36846 from Fanchiatum station, Manchuria, in 1913. This variety is said to be highly prized for the quantity of oil that the seeds contain. Maturity classification, group III; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 3,000 to the pound; germ, yellow; oil, 21.2 percent; protein, 40.1 percent; iodine number, 127.

EARLYANA.—Selection, Indiana No. C-28, from a natural cross in a row of the Dunfield variety by the Indiana Agricultural Experiment Station in 1931. Maturity classification, group II; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale hilum and a brown speck at one end of the hilum, about 3,000 to the pound; oil, 19.8 percent; protein 42.7 percent; iodine number, 135.

EARLY GREEN.—Same as Medium Green. See footnote 1 on page 8.

EARLY INDIANA LAREDO.—Same as Norredo.

EARLY LAREDO.—Same as Norredo.

EARLY MANDARIN.—Same as Mandarin.

EARLY VIRGINIA BROWN.—Same as Virginia.

EARLY WILSON.—Same as Wilson.

EARLY WILSON BLACK.—Same as Wilson.

EARLY WISCONSIN BLACK.—Same as Wisconsin Black.

EARLY WOODS YELLOW.—Same as Arksoy.

EARLY YELLOW.—Same as Ito San. See footnote 1 on page 8.

EASYCOOK.—Introduced as P. I. No. 34702 from Shantung Province, China, in 1894. Maturity classification, group V; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with dark-brown hilum, about 2,700 to the pound; germ, yellow; oil, 18.2 percent; protein, 44.0 percent; iodine number, 137.

EBONY.—Introduced under P. I. No. 6386 from Pingyang, Korea, in 1901. Maturity classification, group IV; pubescence, tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, medium; seeds, black with black hilum, about 5,700 to the pound; germ, yellow; oil, 16.9 percent; protein, 41.4 percent; iodine number, 137.

EDSOY.—This variety has been renamed Delsoy.

EMPEROR.—Introduced under P. I. No. 97155 from Shariin, Korea, in 1931. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two-seeded; shattering, much; seeds, straw yellow with light-brown hilum, about 1,200 to the pound; germ, yellow; oil, 20.0 percent; protein, 43.4 percent; iodine number, 137.

ETUM.—Introduced as P. I. No. 86100, native name "Oyachi," from Obihiro, Hokkaido, Japan, in 1930. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown hilum, about 1,600 to the pound; germ, yellow; oil, 19.0 percent; protein, 44.8 percent; iodine number, 117.

FLAMBEAU.—Selection, Wisconsin No. 839–14, from the Manchu variety by the Wisconsin Agricultural Experiment Station. Maturity classification, group O; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,000 to the pound; germ, yellow; oil, 18.8 percent; protein, 43.6 percent; iodine number, 132.

FUNK DELICIOUS.—Introduced by the Funk Seed Farms, Bloomington, Ill., in 1932. It is said to have been received from Japan. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 1,600 to the pound; germ, yellow; oil, 21.4 percent; protein, 40.4 percent; iodine number, 130.

GATAN.—Selection from a natural cross in a row of the Otootan variety by the Georgia Agricultural Experiment Station, Experiment, Ga. Maturity classification group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, brown with brown hilum, about 4,400 to the pound; germ, yellow; oil, 17.0 percent; protein, 44.1 percent; iodine number, 137.

GEORGIAN.—Introduced under P. I. No. 71583 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale to pale-brown hilum, about 4,000 to the pound; germ, yellow; oil, 17.6 percent; protein, 43.0 percent; iodine number, 132.

GIANT BROWN.—Same as Mammoth Brown.

GIANT GREEN.—Introduced by the Illinois Agricultural Experiment Station from the Takii Seed Co., Kyoto, Japan, in 1935. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two-seeded; shattering, much; seeds, green with black hilum, about 1,500 to the pound; germ, yellow; oil, 20.7 percent; protein, 44.3 percent; iodine number, 120.

GIBSON.—Selection from a cross between the Midwest and Dunfield varieties by the Indiana Agricultural Experiment Station. Maturity classification, group IV; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale hilum, about 3,300 to the pound; germ, yellow; oil, 20.4 percent; protein, 41.9 percent; iodine number, 129.

GOLDSOY.—Selection from O. A. C. No. 211 by the Ontario Agricultural College, Guelph, Ontario, Canada. Maturity classification, group O; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 2,200 to the pound; germ, yellow; oil, 18.3 percent; protein, 44.0 percent; iodine number, 134.

GRANGER.—Selection, Ohio No. 31–4, from the Manchu variety by the Ohio Agricultural Experiment Station and released by the New Jersey Agricultural Experiment Station in 1941. Maturity classification, group II; pubescence,

tawny; flowers, purple; pods, two- or three-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,700 to the pound; germ, yellow; oil, 19.6 percent; protein, 42.9 percent; iodine number, 134.

GREEN.—Same as Medium Green. See footnote 1 on page 8.

GUELPH.—Same as Medium Green. See footnote 1 on page 8.

HABARO.—The variety now grown as Habaro in the North Central States is a selection, Minn. No. 109, made by the Minnesota Agricultural Experiment Station from Habaro, P. I. No. 20405, and distributed to the farmers in Minnesota in 1913. The original introduction was received from Khabarovsk, Siberia, in 1906. The Chinese are said to use the sprouts of this variety as a winter vegetable. The beans are also pressed for oil and the oil cake used as a feed for hard-working horses. Maturity classification, group I; pubescence, gray; flowers, purple; pods, two- or three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 2,500 to the pound; germ, yellow; oil, 18.8 percent; protein, 43.0 percent; iodine number, 134.

HABERLANDT.—Introduced under P. I. No. 6396 from Pingyang, Korea, in 1901. Maturity classification, group V; pubescence, tawny; flowers, both purple and white; pods, two- or three-seeded; shattering, much; seeds, straw yellow with dark-brown hilum, about 2,400 to the pound; germ, yellow; oil, 19.2 percent; protein, 39.6 percent; iodine number, 122.

HAHTO.—Introduced under P. I. No. 40118, native name "Hahto Koroshi Daizu," from Wakamatsu, Japan, in 1915. It is commonly known in Japan as "Dove Killer" and is said to be used chiefly as a green shelled bean. Shortly after its introduction into the United States it was known in some sections as "Lima Soy," due to the close resemblance of its seed to that of the lima bean. Maturity classification, group V; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, olive yellow with black hilum, about 1,200 to the pound; germ, yellow; oil, 18.7 percent; protein, 42.3 percent; iodine number, 131.

HAKOTE.—Introduced under P. I. No. 81039. Native name "Ao Shiro Daizu," from Sapporo, Hokkaido, Japan, in 1929, and used as a green shelled bean. Maturity classification, group II; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, much; seeds, olive yellow with black hilum, about 1,400 to the pound; germ, yellow; oil, 18.4 percent; protein, 43.8 percent.

HAMILTON.—See footnote 1 on page 8.

HARMAN.—Selection from the Manchu variety by the Central Experimental Farm, Ottawa, Canada. Maturity classification, group II; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about 2,900 to the pound; germ, yellow; oil, 19.1 percent; protein, 42.6 percent; iodine number, 135.

HAWKEYE.—Selection from a cross between the Mukden and Richland varieties made in 1938 by the Iowa Agricultural Experiment Station in cooperation with the United States Regional Soybean Laboratory. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about 2,600 to the pound; germ, yellow; oil, 20.6 percent; protein, 41.2 percent; iodine number, 130.

HAYSEED.—Introduced under P. I. No. 71525 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with dark-brown hilum, about 5,000 to the pound; germ, yellow; oil, 18.5 percent; protein, 44.6 percent; iodine number, 132.

HERMAN.—Selection, Haberlandt No. 38, from the Haberlandt variety by the North Carolina Agricultural Experiment Station in 1915. Maturity classification, group V; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with dark-brown hilum, about 2,500 to the pound; germ, yellow; oil, 20.7 percent; protein, 43.6 percent; iodine number, 131.

HIDATSA.—Introduced under P. I. No. 81038, native name "Chusei Eda Mame," from Sapporo, Hokkaido, Japan, in 1929, and used as an early green shelled bean. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, olive yellow with black hilum, about 2,400 to the pound; germ, yellow; oil, 18.9 percent; protein, 39.9 percent.

HIGAN.—Introduced under P. I. No. 80475, native name "Higan Mame," from Tokyo, Japan, in 1929. This variety has a sweet flavor and is used as a green shelled bean. Maturity classification, group V; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 2,000 to the pound; germ, yellow; oil, 18.6 percent; protein, 43.5 percent; iodine number, 131.

HOKKAIDO.—Introduced under P. I. No. 85666, native name "Hokkaido Tsurunoko," from Tokyo, Japan, in 1930. It is one of the largest yellow-seeded varieties and is used exclusively for food purposes. Maturity classification, group III; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown hilum, about 1,200 to the pound; germ, yellow; oil, 19.1 percent; protein, 45.2 percent; iodine number, 123.

HOLLYBROOK.—Originally found in the Mammoth Yellow variety and introduced by T. W. Wood & Sons, Richmond, Va., in 1902. Maturity classification, group V; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with light-brown hilum, about 2,600 to the pound; oil, 16.4 percent; protein, 44.1 percent.

HOLLYBROOK EARLY.—Same as Midwest.

HONGKONG.—Introduced under P. I. No. 22406 from Hongkong, China, in 1908. Maturity classification, group IV; pubescence, both gray and tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 3,100 to the pound; germ, yellow; oil, 21.0 percent; protein, 40.0 percent; iodine number, 134.

ILLINI.—Pure line selection made from the A. K. variety by the Illinois Agricultural Experiment Station in 1921. Maturity classification, group III; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown to brown hilum, about 3,500 to the pound; germ, yellow; oil, 20.4 percent; protein, 41.6 percent; iodine number, 131.

ILLINOIS VC–VT.—Same as Ilsoy. See footnote 1 on page 8.

IMPERIAL.—Introduced under P. I. No. 81780, native name "Tsurunoko," from Kotoni, Hokkaido, Japan, in 1929. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale to light-brown hilum, about 1,900 to the pound; germ, yellow; oil, 19.4 percent; protein, 43.0 percent; iodine number, 127.

ILSOY.—See footnote 1 on page 8.

INDIANA HOLLYBROOK.—Same as Midwest.

ITO SAN.—See footnote 1 on page 8.

JAPAN PEA.—Same as Ito San. See footnote 1 on page 8.

JOGUN.—Introduced under P. I. No. 87615, native name "Shiro Bana Daizu," from Dojogun, Korea, in 1930. Maturity classification, group II; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale to light-brown hilum, about 1,400 to the pound; germ, yellow; oil, 17.1 percent; protein, 42.9 percent; iodine number, 130.

KABOTT.—Selection from a Manchurian introduction in 1933 by the Central Experimental Farm, Ottawa, Canada. Maturity classification, group O; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 2,300 to the pound; germ, yellow; oil, 18.2 percent; protein, 44.4 percent; iodine number, 132.

KANRO.—Introduced under P. I. No. 84928, native name, "Kanro," from Pingyang, Korea, in 1929. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown to brown hilum, about 1,500 to the pound; germ, yellow; oil, 19.0 percent; protein, 43.7 percent; iodine number, 119.

KANUM.—Selection, P. I. No. 84668–1, made in 1930 at Arlington Farm, Va., from P. I. No. 84668 received from Suwon, Korea, in 1929. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with light-brown to brown hilum, about 1,800 to the pound; germ, yellow; oil, 19.1 percent; protein, 44.4 percent; iodine number, 117.

KINGWA.—A pure line selection, No. 1–21–7, made from the Peking variety and named Pekwa by the West Virginia Agricultural Experiment Station in 1931. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, three-seeded; shattering, little; seeds, black with black hilum, about 3,800 to the pound; germ, yellow; oil, 17.7 percent; protein, 41.6 percent; iodine number, 133.

KURA.—Introduced under P. I. No. 81042, native name "Kura Kake Daizu," from Sapporo, Hokkaido, Japan, in 1929. This variety has a distinct, nutty flavor and is used as a green shelled bean. Maturity classification, group III; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, much; seeds, black with olive-yellow saddle and black hilum, about 1,500 to the pound; germ, yellow; oil, 19.0 percent; protein, 45.8 percent; iodine number, 128.

LAREDO.—Introduced under P. I. No. 40658 from Yangping Kwan, China, in 1914. In China this variety is said to be adapted to drier lands than other varieties. It has been found highly resistant to nematodes in the United States.

Maturity classification, group VI; pubescence, both tawny and gray; flowers, both purple and white; pods, two- to three-seeded; shattering, little; seeds, black with black hilum, about 7,800 to the pound; germ, yellow; oil, 14.5 percent; protein, 43.9 percent; iodine number, 138.

LARGE BROWN.—Same as Mammoth Brown.

LARGE YELLOW.—Same as Mammoth Yellow.

LATE.—Same as Mammoth Yellow.

LATE YELLOW.—Same as Mammoth Yellow.

LINCOLN.—Selection L6–685, from a cross between the Mandarin and Manchu varieties by the Illinois Agricultural Experiment Station in 1934. Maturity classification, group III; pubescence, tawny; flowers, white; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,200 to the pound; germ, yellow; oil, 21.7 percent; protein, 39.5 percent; iodine number, 134.

LZ.—Selection, La. No. 40–400, from a natural cross by the Louisiana Agricultural Experiment Station. Maturity classification group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with mostly black hilum, a few brown, about 4,200 to the pound; germ, yellow; oil, 18.7 percent; protein, 44.1 percent; iodine number, 136.

McCLAVE.—Same as Midwest.

MACOUPIN.—Selection developed by Elmer Hulcher, Nilwood, Ill., in 1930. Maturity classification, group IV; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 3,100 to the pound; germ, yellow; oil, 21.0 percent; protein, 42.5 percent; iodine number, 136.

MAGNOLIA.—Introduced under P. I. No. 85537 from Suwon, Korea, in 1929. Maturity classification, group VI; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale hilum, about 3,800 to the pound; germ, yellow; oil, 20.4 percent; protein, 43.7 percent; iodine number, 129.

MAMLOXI.—Selection from a cross between the Mammoth Yellow and Biloxi varieties by the Delta Branch Station, Stoneville, Miss., in 1925. Maturity classification, group VIII; pubescence, tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 2,700 to the pound; germ, yellow; oil, 17.5 percent; protein, 44.3 percent; iodine number, 135.

MAMMOTH.—Same as Mammoth Yellow.

MAMMOTH BROWN.—No definite information has been obtained as to the origin of this variety. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, brown with brown hilum, about 1,900 to the pound; germ, yellow; oil, 18.7 percent; protein, 38.6 percent; iodine number, 136.

MAMMOTH YELLOW.—Although nothing definite is known regarding the origin of this variety, it is said to have been introduced into North Carolina about 1880 by a returning missionary. Maturity classification, group VII; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with brown hilum, about 2,700 to the pound; germ, yellow; oil, 17.1 percent; protein, 45.6 percent; iodine number, 133.

MAMOTAN.—Selection, Delta Station No. 6600, from a cross between the Mammoth Yellow and Otootan varieties by the Delta Branch Station, Stoneville, Miss., in 1929. Maturity classification, group VIII; pubescence, gray; flowers, both purple and white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 3,000 to the pound; germ, yellow; oil, 18.6 percent; protein, 43.0 percent; iodine number, 137.

MAMREDO.—Selection, Delta Station No. 488–607, from a cross between the Mammoth Yellow and Laredo varieties by the Delta Branch Station, Stoneville, Miss., in 1924. Maturity classification, group VI; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, much; seeds, straw yellow with black and brown hila, about 3,700 to the pound; germ, yellow; oil, 19.6 percent; protein, 42.2 percent; iodine number 128.

MANCHU.—Introduced under P. I. No. 30593, native name "Huang Tou," from Ninguta, Manchuria, in 1911. This variety is known to have been grown in the Ninguta district for 40 years and is said to be highly prized by the Chinese for its thin skin, high weight to the bushel, and high oil content. Maturity classification, group III; pubescence, tawny; flowers, both purple and white; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with both black and brown

hila, about 2,400 to the pound; germ, yellow; oil, 19.8 percent; protein, 42.8 percent; iodine number, 131.

MANCHU 3.—Selection, Wis. Manchu No. 3, by the Wisconsin Agricultural Experiment Station from the Manchu variety. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,700 to the pound; germ, yellow; oil, 20.0 percent; protein, 41.5 percent; iodine number, 134.

MANCHU 606.—Selection, Wis. Manchu No. 606, by the Wisconsin Agricultural Experiment Station from the Manchu variety. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,700 to the pound; germ, yellow; oil, 20.0 percent; protein, 41.5 percent; iodine number, 134.

MANCHUKOTA.—Selection, Manchu No. 831, by the South Dakota Agricultural Experiment Station from the Manchu variety. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,000 to the pound; germ, yellow; oil, 19.0 percent; protein, 41.9 percent; iodine number, 138.

MANCHURIA.—Same as Pinpu.

MANDARIN.—Introduced under P. I. No. 36653 from Pehtuanlintza, Manchuria, in 1911. Maturity classification, group I; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale hilum, about 2,600 to the pound; germ, yellow; oil, 18.5 percent; protein, 44.6 percent; iodine number, 131.

MANDARIN 507.—Selection, Wis. Mandarin No. 507, by the Wisconsin Agricultural Experiment Station from the Mandarin variety. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale hilum; about 2,800 to the pound; germ, yellow; oil, 17.6 percent; protein, 45.2 percent; iodine number, 135.

MANDARIN (OTTAWA).—Selection from the Mandarin variety by the Central Experimental Farm, Ottawa, Canada. Maturity classification, group I; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale hilum, about 2,500 to the pound; germ, yellow; oil, 18.9 percent; protein, 43.4 percent; iodine number, 133.

MANDELL.—Selection, Purdue No. 3, by the Indiana Agricultural Experiment Station from the Manchu variety in 1926. Maturity classification, group II; pubescence, tawny; flowers, purple; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,400 to the pound; germ, yellow; oil, 18.8 percent; protein, 45.1 percent; iodine number, 132.

MANSOY.—Selection from the Manchu variety at Arlington Farm, Va., in 1915. Maturity classification, group IV; pubescence, tawny; flowers, purple; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,500 to the pound; germ, yellow; oil, 19.9 percent; protein, 44.3 percent; iodine number, 130.

MEDIUM EARLY GREEN.—Same as Medium Green.

MEDIUM EARLY YELLOW.—Same as Ito San.

MEDIUM GREEN.—See footnote 1 on page 8.

MEDIUM YELLOW.—Same as Midwest.

MENDOTA.—Selection from P. I. No. 84668 by the Wisconsin Agricultural Experiment Station in 1937. Introduction received from Suwon, Korea, in 1929. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown to brown hilum, about 2,100 to the pound; germ, yellow; oil, 17.5 percent; protein, 40.9 percent; iodine number, 139.

MIDWEST.—Introduced under P. I. No. 6556 from central China in 1901. Maturity classification, group IV; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale to brown hilum, about 3,700 to the pound; germ, yellow; oil, 18.9 percent; protein, 41.0; iodine number, 135.

MINGO.—Selection, Ohio Manchu No. 1, by the Ohio Agricultural Experiment Station from the Manchu variety. Maturity classification, group II; pubescence, tawny; flowers, purple; pods, two-, three-, and four-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,000 to the pound; germ, yellow; oil, 19.7 percent; protein, 43.4 percent; iodine number, 132.

MINSOY.—Introduced under P. I. No. 27890 from the Vilmorin-Andrieux Co., Paris, France, in 1910. Maturity classification, group O; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw

yellow with dark-brown hilum, about 3,700 to the pound; germ, yellow; oil, 18.8 percent; protein, 41.7 percent; iodine number, 131.

MISSOY.—Introduced under P. I. No. 71664 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown and black hila, about 4,300 to the pound; germ, yellow; oil, 18.4 percent; protein, 43.4 percent; iodine number, 132.

MONETTA.—Introduced under P. I. No. 71608 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about 4,000 to the pound; germ, yellow; oil, 16.1 percent; protein, 44.3 percent; iodine number, 134.

MONGOL.—Same as Midwest.

MONROE.—Selection, H5, from a cross between Mukden and Mandarin varieties developed by the Ohio Agricultural Experiment Station in cooperation with the United States Regional Soybean Laboratory. Maturity classification, group I; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with colorless hilum, about 3,100 to the pound; germ, yellow; oil, 19.7 percent; protein, 42.9 percent; iodine number, 132.

MONTREAL MANCHU.—An early selection from the Manchu variety by the late T. B. Macaulay, Montreal, Canada. Maturity classification, group O; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,000 to the pound; germ, yellow; oil, 18.9 percent; protein, 40.5 percent; iodine number, 136.

MORSE.—Introduced under P. I. No. 19186 from Yingkow (Newchwang), Manchuria, in 1906. This variety is said to be most commonly used for oil in South Manchuria, the pressed cake being used locally and also exported to South China for fertilizing purposes. When mature, its pods are said to withstand moist conditions much better than the yellow-seeded varieties grown in central and northern Manchuria. Maturity classification, group IV; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, olive yellow with brown hilum, about 2,500 to the pound; germ, yellow; oil, 19.4 percent; protein, 44.2 percent; iodine number, 132.

MOUNT CARMEL.—Selection, P. I. No. 70218–2, from Harbin, Manchuria, in 1926. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,800 to the pound; germ, yellow; oil, 20.5 percent; protein, 42.7 percent; iodine number, 129.

MUKDEN.—Selection, P. I. No. 50523–Q, at Arlington Farm, Va., in 1921 from P. I. No. 50523, native name "Hsiao Chin Huang Tou," received from Mukden, Manchuria, in 1920. Maturity classification, group II; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 3,100 to the pound; germ, yellow; oil, 19.4 percent; protein, 44.2 percent; iodine number, 127.

NANDA.—Introduced under P. I. 95727 from Shariin, Korea, in 1932. Maturity classification, group VIII; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown to dark-brown hilum, about 2,600 to the pound; germ, yellow; oil, 18.9 percent; protein, 43.5 percent; iodine number, 131.

NANKING.—Introduced under P. I. No. 71597, from Nanking, China, in 1927. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with brown to dark-brown hilum, about 5,600 to the pound; germ, yellow; oil, 17.2 percent; protein, 52.1 percent; iodine number, 132.

NORREDO.—No definite information has been obtained as to the origin of this variety, which was previously grown in southern Indiana as Vanderburg Black. Maturity classification, group IV; pubescence, both gray and tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, medium; seeds, black with black hilum, about 5,900 to the pound; germ, yellow; oil, 16.0 percent; protein, 41.4 percent.

NORSOY.—This variety was obtained from a North Dakota seed company by the North Dakota Agricultural Experiment Station. It is said to have been originally obtained from a farmer in Minnesota. Nothing is known of its origin. Maturity classification, group O; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum and a brown speck at one end of the hilum, about 3,300 to the pound; germ, yellow; oil, 17.1 percent; protein, 44.8 percent; iodine number, 137.

NORTHERN HOLLYBROOK.—Same as Midwest.

OGDEN.—Selection from a cross between the Tokyo variety and P. I. No. 54610 by the Tennessee Agricultural Experiment Station. Maturity classification, group VI; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, olive yellow with light-brown to brown hilum, about 3,000 to the pound; germ, yellow; oil, 20.5 percent; protein, 43.4 percent; iodine number, 132.

OHIO 9035.—Same as Hamilton.

ONTARIO.—Introduced under P. I. No. 65344 from Harbin, Manchuria, in 1925. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with black hilum, about 2,300 to the pound; germ, yellow; oil, 20.0 percent; protein, 41.9 percent; iodine number, 133.

OTOOTAN.—Introduced from the Hawaiian Islands in 1911 by C. K. McClelland, Georgia Agricultural Experiment Station, Experiment, Ga. It is said to have come originally from Formosa, where it is used as a green manure crop. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two-to three-seeded; shattering, medium; seeds, black with black hilum, about 6,100 to the pound; germ, yellow; oil, 16.0 percent; protein, 45.4 percent; iodine number, 138.

PAGODA.—Selection from a cross of the Manitoba Brown and Mandarin varieties by the Central Experimental Farm, Ottawa, Canada. Maturity classification, group O; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 3,000 to the pound; germ, yellow; oil, 18.4 percent; protein, 43.8 percent; iodine number, 128.

PALMETTO.—Introduced under P. I. No. 71587 from Nanking, China, in 1927. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two-to three-seeded; shattering, much; seeds, straw yellow with black hilum, about 4,100 to the pound; germ, yellow; oil, 17.1 percent; protein, 46.0 percent; iodine number, 136.

PATOKA.—Selection, P. I. No. 70218–2–19–3, from selection P. I. No. 70218–2 in 1934 by the Indiana Agricultural Experiment Station. P. I. No. 70218 was originally introduced from Harbin, Manchuria, in 1926. Maturity classification, group IV; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 2,600 to the pound; germ, yellow; oil, 20.4 percent protein, 44.0 percent; iodine number 129.

PEKING.—Selection P. I. No. 17852–B, at Arlington Farm, Va., in 1907, from the Meyer variety. P. I. No. 17852 received from Peking, China, in 1906. Maturity classification, group IV; pubescence, tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, much; seeds, black with black hilum, about 6,400 to the pound; germ, yellow; oil, 17.3 percent; protein, 40.2 percent; iodine number, 138.

PELICAN—Selection by the Louisiana Agricultural Experiment Station from a natural cross. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 4,400 to the pound; germ, yellow; oil, 18.9 percent; protein, 44.2 percent; iodine number, 135.

PENNSOY.—Selection from a natural cross between the Manchuria–13177 variety and an unknown variety by the Pennsylvania Agricultural Experiment Station. Maturity classification, group III; pubescence, gray; flowers, purple; pods, two-to three-seeded; shattering, medium; seeds, straw yellow with slate to brown hilum, about 2,800 to the pound; germ yellow; oil, 19.3 percent; protein, 42.9 percent; iodine number, 131.

PINPU.—See footnote 1 on page 8.

PRIDESOY.—Originally obtained from the Twin City Seed Co., Minneapolis, Minn., but origin unknown. Maturity classification, group O; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with pale hilum, about 3,500 to the pound; germ, yellow; oil, 18.1 percent; protein, 42.7 percent; iodine number, 136. Very similar to Norsoy.

PURREDO.—Same as Norredo.

RALSOY.—Selection from Arksoy 2913 by G. H. Banks, Ralston-Purina Co., Osceola, Ark. Maturity classification, group VI; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown to dark-brown hilum, about 3,900 to the pound; germ, yellow; oil, 19.5 percent; protein, 44.4 percent; iodine number, 132.

RED OTOOTAN.—Same as Tanner.

RED TANNER.—Same as Tanner.

RICHLAND.—Selection P. I. No. 70502–2, made in 1927 at Arlington Farm, Va., and developed by the Indiana Agricultural Experiment Station. P. I. No. 70502 was introduced from Changling, Manchuria, in 1926. Maturity classification, group II; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown to brown hilum, about 2,800 to the pound; germ, yellow; oil, 20.6 percent; protein, 41.1 percent; iodine number, 128.

ROANOKE.—Selection, N. C. 41–90, from a mixed lot of seed by the North Carolina Agricultural Experiment Station in 1941. Maturity classification, group VII; pubescence, gray; flowers, white; pods, two- to three-seeded, shattering, little; seeds, straw yellow with light-brown to brown hilum, about 3,000 to the pound; germ, yellow; oil, 21.8 percent; protein, 40.1 percent; iodine number, 132.

ROKUSUN.—Introduced under P. I. No. 80481, native name "Rokusun Daizu," from Tokyo, Japan, in 1929, and used as a green shelled bean. Maturity classification, group VI; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with brown hilum, about 1,600 to the pound; germ, yellow; oil, 18.5 percent; protein, 46.4 percent; iodine number, 129.

ROOSEVELT.—Same as Midwest.

ROSE NON POP.—A nonshattering selection by W. P. Rose, Goldsboro, N. C., apparently from the Haberlandt or the Herman variety. Maturity classification, group VI; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with dark-brown hilum, about 3,400 to the pound; germ, yellow; oil, 20.4 percent; protein, 41.1 percent; iodine number, 130.

S100.—Selected from Illini by a farmer in Missouri and developed by the Missouri Agricultural Experiment Station. Maturity classification, group V; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 3,400 to the pound; germ, yellow; oil, 19.0 percent; protein, 42.2 percent; iodine number, 134.

SABLE.—Same as Peking.

SAC.—Introduced under P. I. No. 80462, native name "Furisode," from Tokyo, Japan, in 1929, and is used in the manufacture of bean curd, soy sauce, and miso (fermented soybean paste). Maturity classification, group O; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, olive yellow with black hilum, about 1,600 to the pound; germ, yellow; oil, 20.2 percent; protein, 44.6 percent; iodine number, 119.

SATO.—Introduced under P. I. No. 81041, native name "Kuro Daizu," from Sapporo, Hokkaido, Japan, in 1929, and, having a sweet flavor, is used as a green shelled bean and in making sweet bean paste, sweet boiled beans, candied beans, and a health wine. Maturity classification, group II; pubescence, tawny; flowers, white; pods, two- to three-seeded; shattering, much; seeds, black with black hilum, about 1,500 to the pound; germ, yellow; oil, 19.1 percent; protein, 45.4 percent; iodine number, 117.

SCIOTO.—Selection from the Manchu variety by the Ohio Agricultural Experiment Station in 1925. Maturity classification, group III; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,400 to the pound; germ, yellow; oil, 20.7 percent; protein, 42.4 percent; iodine number, 138.

SEMINOLE.—Introduced under P. I. No. 93058, from Hangchow, China, in 1931. Maturity classification, group VIII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 2,200 to the pound; germ, yellow; oil, 18.0 percent; protein, 46.2 percent; iodine number, 134.

SENECA.—Selection 03654–A, made at Arlington Farm in 1921 from a variety introduced as "Imported Yellow" from Manchuria in 1920 by the Albert Dickinson Seed Co., Chicago, Ill. Maturity classification, group II; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 3,000 to the pound; germ, yellow; oil, 19.7 percent; protein, 42.5 percent; iodine number, 132.

SHANGHAI.—Same as Tarheel Black.

SIOUX.—Introduced under P. I. No. 81021, native name "Ao Shiro Eda Mame," from Sapporo, Hokkiado, Japan, in 1929, and used principally as a green shelled bean. Maturity classification, group O; pubescence, tawny; flowers, purple; pods, two-seeded; shattering, much; seeds, olive yellow with black hilum, about 3,000 to the pound; germ, yellow; oil, 13.8 percent; protein, 52.2 percent; iodine number, 133.

SOUSEL.—Introduced under P. I. No. 80476, native name "Sousei O Saya Eda Mame," from Tokyo, Japan, in 1929. This variety has a sweet flavor and is used as a green shelled bean. Maturity classification, group II; pubescence, tawny;

flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with light-brown to brown hilum, about 1,800 to the pound; germ, yellow; oil, 20.7 percent; protein, 44.1 percent; iodine number, 120.

SOUTHERN.—Same as Mammoth Yellow.

SOUTHERN MEDIUM GREEN.—Same as Tokyo.

TANNER.—A brown-seeded selection from the Otootan variety by Tom Tanner, Decatur, Ala., previously called Red Otootan and Red Tanner. Maturity classification, group VII; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, brown with brown hilum, about 4,500 to the pound; germ, yellow; oil, 17.7 percent; protein, 44.8 percent; iodine number, 140.

TARHEEL.—Same as Tarheel Black. See footnote 1 on page 8.

TARHEEL BLACK.—See footnote 1 on page 8.

TARHEEL BROWN.—Same as Mammoth Brown.

TASTEE.—Introduced under P. I. No. 86019, native name "Kuro Kake Be," from Obihiro, Hokkaido, Japan, in 1930, and used principally as a green shelled bean. Maturity classification, group III; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, olive yellow with black hilum, about 1,500 to the pound; germ, yellow; oil, 20.2 percent; protein, 40.4 percent; iodine number, 130.

TENNESSEE NON POP.—Selection from a cross between the Tokyo variety and P. I. No. 54610 by the Tennessee Agricultural Experiment Station. Maturity classification, group VII; pubescence, gray; flowers, both purple and white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with pale to light-brown hilum, about 2,900 to the pound; germ, yellow; oil, 19.4 percent; protein, 43.4 percent; iodine number, 135.

TOKYO.—Introduced under P. I. No. 8424, native name "Ita Mame," from Yokohama, Japan, in 1901. Maturity classification, group VII; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, olive yellow with pale hilum, about 2,500 to the pound; germ, yellow; oil, 19.0 percent; protein, 42.7 percent; iodine number, 135.

VANDERBURG BLACK.—Same as Norredo.

VIKING.—Selection, Illinois T–118, from a cross between the Illini variety and a strain of the Manchu variety by the Illinois Agricultural Experiment Station in 1926. Maturity classification, group III; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with black hilum, about 3,600 to the pound; germ, yellow; oil, 21.1 percent; protein, 39.7 percent; iodine number, 130.

VIRGINIA.—Selection P. I. No. 19186–D, from the Morse variety at Arlington Farm, in 1907. Maturity classification, group IV; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, brown with brown hilum, about 3,500 to the pound; germ, yellow; oil, 18.3 percent; protein, 39.9 percent; iodine number, 137.

VIRGINIA BROWN.—Same as Virginia.

VIRGINIA EARLY BROWN.—Same as Virginia.

VOLSTATE.—Selection from a cross between the Tokyo variety and P. I. No. 54610 by the Tennessee Agricultural Experiment Station. Maturity classification, group VII; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 3,000 to the pound; germ, yellow; oil, 20.9 percent; protein, 40.7 percent; iodine number, 134.

WABASH.—Selection, C463, from a cross between the Dunfield and Mansoy varieties developed by the Illinois and Indiana Agricultural Experiment Stations in cooperation with the United States Regional Soybean Laboratory. Maturity classification, group IV; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, little; seeds, straw yellow with light-brown hilum, about 3,200 to the pound; germ, yellow; oil, 21.0 percent; protein, 40.3 percent; iodine number, 130.

WILLOMI.—Selection P. I. No. 81044–1, made in 1931 at Arlington Farm, Va., from P. I. No. 81044, native name "Akita Daizu," introduced from Hakodate, Hokkaido, Japan, in 1929. Maturity classification, group III; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with light-brown to brown hilum, about 1,300 to the pound; germ, yellow; oil, 18.2 percent; protein, 44.3 percent; iodine number, 126.

WILSON.—Introduced under P. I. No. 19183 from Yingkow (Newchwang), Manchuria, in 1906. Maturity classification, group IV; pubescence, both gray and tawny; flowers, both purple and white; pods, two- to three-seeded; shattering, much; seeds, black with black hilum, about 2,400 to the pound; germ, yellow; oil, 17.0 percent; protein, 44.6 percent.

WILSON BLACK.—Same as Wilson.

WILSON EARLY BLACK.—Same as Wilson.

WISCONSIN BLACK.—Received as Early Black by the Wisconsin Agricultural Experiment Station in 1898 and developed into a pedigreed strain. Maturity classification, group I; pubescence, tawny; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, black with black hilum, about 3,100 to the pound; germ, yellow; oil, 16.9 percent; protein, 46.5 percent; iodine number, 135.

WISCONSIN EARLY BLACK.—Same as Wisconsin Black.

WOLVERINE.—Selection, P. I. No. 80490–1, made in 1930 at Arlington Farm, Va., from P. I. No. 80490, native name "Tamba Otsubu Daizu," introduced from Yokohama, Japan, in 1929, used as a green shelled bean and in the manufacture of bean curd. Maturity classification, group III; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, much; seeds, straw yellow with pale to light-brown hilum, about 1,800 to the pound; germ, yellow; oil, 21.2 percent; protein, 39.4 percent; iodine number, 131.

WOODS YELLOW.—Selection from the Mammoth Yellow variety by T. W. Wood & Sons, Richmond, Va., in 1934. Maturity classification, group VII; pubescence, gray; flowers, white; pods, two- to three-seeded; shattering, medium; seeds, straw yellow with brown hilum, about 2,400 to the pound; germ, yellow; oil, 16.6 percent; protein, 44.2 percent; iodine number, 133.

YELLOW.—Same as Mammoth Yellow.

YELNANDO.—Selection, Coker's No. 433, from a cross between the Nanda and Yelredo varieties by the Coker Pedigreed Seed Co., Hartsville, S. C. Maturity classification, group VIII; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 2,800 to the pound; germ, yellow; oil, 18.8 percent; protein, 43.5 percent; iodine number, 133.

YELREDO.—Selection, Coker's No. 31–9, from a cross between the Mammoth Yellow and Laredo varieties by the Coker Pedigreed Seed Co., Hartsville, S. C. Maturity classification, group VII; pubescence, gray; flowers, purple; pods, two- to three-seeded; shattering, little; seeds, straw yellow with brown hilum, about 5,100 to the pound; germ, yellow; oil, 17.2 percent; protein, 44.8 percent; iodine number, 135.

IMPROVEMENT OF VARIETIES

The soybean was first used in the United States for forage and pasture; therefore, the first varieties were selected mainly for their value for hay and for interplanting with corn for hogging down.

The expansion in the use of soybean seed by processing mills in recent years has led to a demand for yellow-seeded, high oil-content varieties. Plant breeders attempted to meet this demand by selecting new types from foreign introductions and from locally grown varieties. A number of improved varieties have been produced as a result of this work, the most popular among these being the Dunfield, Illini, Manchu, S100, Mukden, Mandarin, Boone, Patoka, and Roanoke. These varieties have been responsible in part for the rapid expansion of acreage planted for processing.

The source of new breeding material lies in the several thousand plant introductions brought into this country from the Orient and studied for their agronomic and chemical value. Among the important agronomic characters are (1) seed yield, (2) seed quality, (3) freedom from tendency of the seed to shatter before harvest, (4) ability of the plants to stand erect at maturity, and (5) resistance to disease and insect injury.

Among the important chemical characters of soybean seed are high oil content and quality of the oil. One of the factors in oil quality is the drying power of the oil, expressed as the "iodine number," or number of grams of iodine a hundred grams of oil will absorb under certain conditions. For food use an oil with a low iodine number is said to be desired. For paints and varnishes and other film-forming uses a

good drying oil, that is, an oil with high iodine number, is preferred. Among the present commercial soybean varieties the iodine number of the oil ranges from 125 to 140, with that of wild soybean (*G. ussuriensis*) running as high as 150.

Roughly one-fifth of the phosphorus in the soybean is in the form of phosphatides. These soybean compound phosphatides, present in the oil in varying quantities from 1.5 percent to 2.5 percent, depending on variety and environment, are excellent emulsifying agents, and it is for this purpose that they are especially useful. They are also used extensively in the baking and confectionery trades and in the manufacture of cosmetics, pharmaceuticals, textiles, leather goods, plastics, soaps and detergents, and petroleum products.

The most important outlet for soybean protein is in the manufacture of livestock feed. Soybean seed ranges in protein content from 30 to 48 percent, depending on variety and environment. The protein of the soybean shows a wide range in the percentages of the important amino acids—cystine, triptophane, and tyrosine—increasing the possibilities of the plant breeder in the development of more nutritious protein for food and feed.

The major objective of the plant breeder now is to develop high-yielding soybean strains with improved chemical composition for use in processing. To accomplish this objective, the agronomists are making crosses between varieties and strains to combine the good qualities of one strain with certain other good qualities of another strain, thus producing new and superior types by selection. As a result of this program, the following superior varieties have been introduced in recent years: Acadian, Hawkeye, Lincoln, Ogden, and Volstate.

Each soybean variety has a critical length-of-day period at which blooming and seed development are begun. Because of the relation between length of day and latitude, a soybean variety is generally found to be adapted to a rather narrow belt north and south but a relatively wide belt east and west. Therefore, plant breeders find it necessary to develop many improved strains to provide adapted, high-yielding types with desirable agronomic and chemical characters to meet the needs of the producer and processor over the wide range in latitude and other environmental conditions found in the United States.

SOIL PREFERENCES

The soybean will succeed on nearly all types of soil, but the best results are obtained on mellow, fertile loams or sandy loams. In general, the soil requirements are about the same as those of corn, but the soybean will make a more satisfactory growth than corn on soils low in fertility, provided inoculating organisms are present. The crop will not make nearly such good growth as cowpeas on the lighter sandy soils and soils low in fertility, nor does it succeed so well as cowpeas on the heavier clay soils. The soybean will do better than clovers or alfalfa on soils of low fertility or on acid soils, but for the best results acid soils must be limed and soils low in fertility must be supplied with those mineral elements in which they are deficient. Some varieties of soybeans, however, appear to succeed better than others on soils of different fertility levels.

A well-drained soil is not necessary, but the best results will not be obtained where water stands on the surface for any considerable length of time. The crop grows well on drained swamplands, provided acidity, when present, is corrected by the use of lime. Excellent yields of seed and forage are procured on some muck soils, and the crop is of considerable importance where such soils occur.

SOIL EROSION

The soybean is generally classed as an intertilled crop and, as with all intertilled crops, should not be planted on land that is subject to severe erosion.

During the growing season various cultural practices may be followed on sloping land to reduce the extent of soil erosion. Severe

Figure 4.—Drilling and cultivating soybeans on the contour reduces soil and water losses. (Courtesy Soil Conservation Service.)

erosion caused by drilling soybeans up and down the slope may be reduced by planting the crop in close-drilled rows following the contour (fig. 4). Seed harvesting methods that leave the rest of the plant on the ground aid materially in reducing erosion during the fall and winter seasons. Efficient straw-spreading attachments on combine harvesters are helpful in obtaining even distribution of the residue. The growing of early-maturing varieties allows for early harvesting of the crop and the seeding of some winter grain or cover crop that will protect the soil from erosion. Successive crops of soybeans or any other intertilled crop will generally deplete the soil organic matter and bring about a poor physical condition of the soil, thus reducing yields and increasing the tendency for erosion.

Good soil-management practices, such as the growing of sod crops or soil-building legumes before the soybean crop, are beneficial in reducing erosion, increasing soybean seed yields, and controlling some of the soil-borne diseases that attack the crop. The soybean crop then leaves the soil in a good mellow condition for the succeeding crop.

PREPARATION OF SEEDBED

The successful production of soybeans is dependent in part on a well-prepared seedbed. Land should be prepared as carefully for soybeans as for corn, and, like corn, soybeans respond to any extra preparation of the soil. The seedbed is best prepared by either fall or early spring plowing, which, followed by frequent harrowings or light diskings before seeding, kills the weeds starting in the surface soil. Spring plowing is favored by most of the experienced growers because soybeans frequently follow corn, which often is not harvested

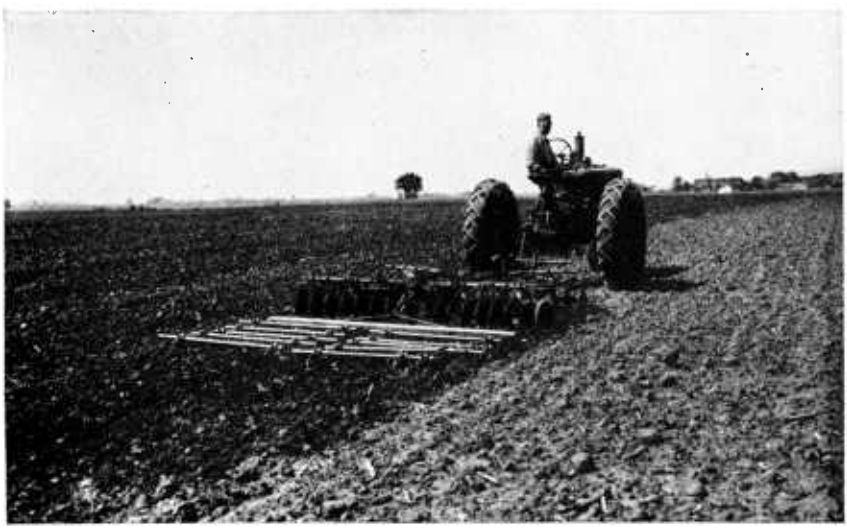

Figure 5.—A well-prepared seedbed is conducive to uniform depth of planting and a good stand of soybeans.

in time for fall or early winter plowing, and also the cornstalks remaining on the surface have some value in erosion control. Thorough and proper preparation of the soil will to a great extent control weeds that otherwise would be likely to choke out the young plants or cut down seriously the production of forage or seed later in the season. A firm seedbed with a light, loose covering of fine soil, well smoothed by the harrow (fig. 5), aids in seeding to a uniform depth and in obtaining a good stand of plants. A soil free from clods insures the best results, especially when seeding is done in close drills.

In the preparation of a seedbed for soybeans, disking alone is seldom sufficient except after a crop of early potatoes or peas or after oat or wheat stubble where the soil is moist, mellow, and relatively free of weeds. Land plowed early and prepared properly for soybeans and cultivated thoroughly during the growing season makes an ex-

cellent seedbed for grains without further preparation. In such a rotation it is essential to have a variety of soybeans that will mature well ahead of the time for seeding grain.

FERTILIZERS AND LIME

When soybeans are grown on land giving good yields of corn, they should produce a good crop without any additional fertilizers. On the more productive soils the soybean does not generally give better yields if fertilizers are added. Often the soybean will respond to soil management practices that increase the general productivity level of the soil.

On sandy soils or soils of low fertility the use of fertilizers is usually recommended. In cases where fertilizers are needed, an application of 200 or 300 pounds of a mixed fertilizer is desirable and should be worked into the soil thoroughly before seeding.

In general it has been found that on fertile soils with adequate lime the application of nitrogenous fertilizers is not necessary, as the soybean, like other legumes, is able to obtain a large part of its nitrogen requirement from the air when it is inoculated with nodule bacteria. On soils of low fertility, however, an application of a nitrogenous fertilizer is helpful in starting the crop.

The soybean is more acid-tolerant than many other legumes but will respond to applications of lime on acid soils. An adequate quantity of lime to sweeten the soil is usually necessary before satisfactory response will be obtained from applications of potash or phosphate. If the soybean plants are well inoculated with the nodule-producing bacteria, lime tends to increase the protein content of soybean seed and decrease oil content; however, in such cases yield is usually stimulated sufficiently to result in an increase in total quantity of oil produced per acre.

An application of dolomitic limestone is generally recommended for those acid soils that are low in magnesium as well as calcium.

Phosphate fertilizers have little influence on yield and composition of soybean seed on most of the productive soils. On soils low in available phosphorus, however, the application of phosphate fertilizers will increase yield as well as the protein and phosphorus content of the seed.

On some soils relatively deficient in potassium, heavy applications of potash have been reported to increase yield and also improve the seed quality by reducing the number of shriveled seed. Potash applications alone generally tend to increase the percentage of oil in the seed.

On some infertile acid soils low in manganese the application of sufficient lime to adjust the acidity to a point above pH 6.0 may result in severe manganese deficiency. Applications of 20 or 30 pounds of manganese sulfate will usually correct this deficiency.

INOCULATION

Like other legumes, such as clovers, alfalfa, peas, beans, and vetch, soybeans are able to utilize the nitrogen of the air through the action of bacteria on the roots. The presence of these organisms is indicated by the development of nodules, or tubercles, on the roots (fig. 6).

The bacteria of the soybean nodules will not inoculate any of the other commonly cultivated legumes, nor will the bacteria found in the nodules of other legumes inoculate soybeans. Extensive bacteriological investigations have shown that some varieties of soybeans are more difficult to inoculate than others. Some strains of soybean bacteria are more vigorous on certain varieties of soybeans.

Where the crop is grown for the first time, soybeans make a rather poor growth unless inoculated. The lack of inoculation is usually indicated by a pale or yellowish-green color of the plant. The soybean, however, may give good results on fertile land, even though the bacteria are lacking; on such land the plant draws most of its nitrogen from the soil rather than from the air, as it does when inoculated. Natural inoculation now occurs throughout much of the region where

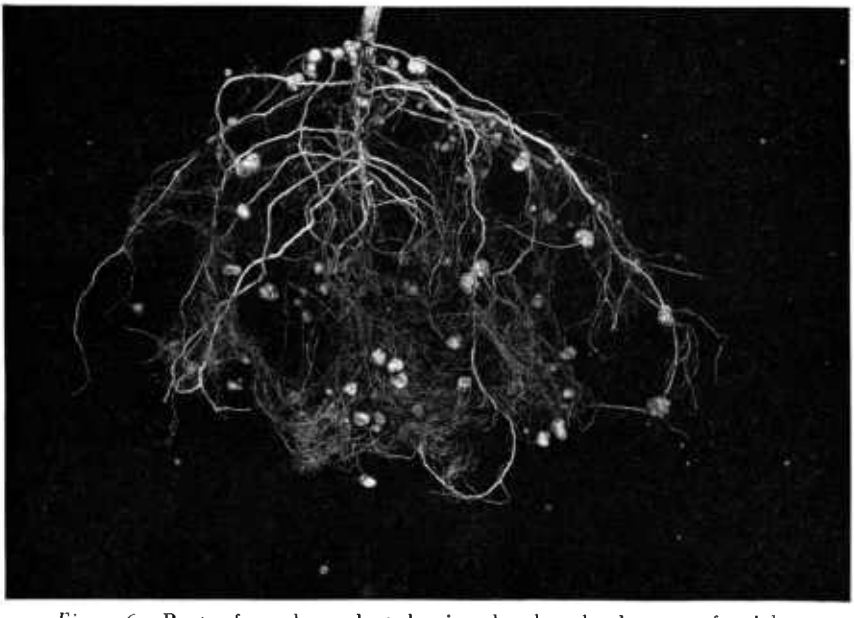

Figure 6.—Roots of a soybean plant showing abundant development of nodules.

soybeans are extensively grown. It is advisable, however, to inoculate to obtain the best results when the crop is planted on land on which it has not been previously grown.

Inoculation is most easily accomplished when the soil is neutral or alkaline. Sometimes it pays to inoculate soybeans each time the crop is seeded in a given field, especially on acid soil, until two or three crops have been grown, or examination of the root system shows an abundance of nodules.

When a soil once becomes well inoculated, no further attention to this feature is necessary, provided a crop of soybeans is grown occasionally (every 3 to 4 years) on the land. The Wisconsin Agricultural Experiment Station reports that in a fertile, neutral loam, soybean bacteria were known to have lived more than 18 years. As a rule, however, the number of bacteria in a soil decreases rapidly after 2 or 3 years. The disappearance is more rapid in an acid than in a neutral or alkaline soil.

Inoculation may be effected through the use of pure cultures of the bacteria or by the application of soil from a field where well-inoculated soybeans were grown the previous year. Pure soybean cultures may be purchased from commercial seed firms or from State agricultural experiment stations, which furnish them at cost.

In former years, the soil-transfer method was used. About 400 to 600 pounds of inoculated soil to the acre was broadcast and harrowed in. Although good results were generally obtained with this method, it involved considerable labor. It also could be the means of scattering weed seed and spreading plant diseases. Modified soil methods involve less labor and are just as effective. A common method consists of moistening 1 bushel of seed with a solution of 3 ounces of glue or sugar dissolved in 1 quart of water and thoroughly mixing 2 quarts of finely sifted, inoculated soil with the moistened seed. Another method is to make a thin mud of inoculated soil and apply it to the seed. Also, a bushel of seed may be thoroughly mixed with a gallon of finely sifted, inoculated soil.

Extensive investigations by various agricultural experiment stations show that well-nodulated soybeans give larger crops, have a higher nitrogen content, are more vigorous, and are better able to withstand unfavorable early-growing conditions. Although soybeans are known to be more tolerant of soil acidity than most other legumes, experiments have shown that increases in yield and protein content of soybeans with the use of inoculants were greater on soils that had received enough lime to neutralize the acidity. On very acid soils it is often difficult to obtain good inoculation without first applying lime, whereas on soils well supplied with lime good inoculation is readily obtained.

TIME OF SEEDING

Soybeans may be sown during a period extending from early spring until midsummer, depending on the variety sown, the latitude, and the use to be made of the crop.

In the Northern States soybeans generally do well when planted in warm soil about corn-planting time. Soybean seed germinates and grows slowly in cold, wet soil, and one of the principal objections to early sowing is the difficulty of working the seedbed sufficiently to kill weeds and give the soybean crop a favorable start.

In general, time-of-seeding studies in the Corn Belt have shown that delaying the planting of an adapted soybean variety 3 weeks beyond the optimum date will usually delay maturity in the fall about a week and will generally reduce seed yields and the oil content of the seed.

In the Southern States the soybean planting season extends through a long period, from the first of April to the last of June. Long-season varieties do well when planted early. They shade the ground during the summer, holding weed growth in check. Early varieties, when planted early in the South, will mature during unfavorably warm summer weather and produce seed that is generally of poor quality and low in viability. Short-season varieties, however, seeded in late spring or early summer after spring grain or early potatoes, with favorable moisture conditions, will produce a satisfactory crop.

For pasture or green manure or even for hay, the soybean may be sown as late as the first of August in the Southern States or the first of July in the Northern States and still produce a fair crop.

METHODS OF SEEDING

The two principal methods of seeding soybeans are by drilling in close rows and in rows wide enough apart for cultivation. The method of seeding will be determined largely by the type of planting and cultivating equipment available, the variety used, type of soil, climatic conditions, and the purpose for which the crop is grown.

For seed production, under nearly all conditions, the soybean crop should be grown in rows and cultivated a sufficient number of times to keep down weeds. With the development of machinery adapted to soybean production there has been a rapid change to the row method of planting. Among the advantages of row planting are higher yield

Figure 7.—Seeding large acreages is easily accomplished with a six-row soybean planter.

of seed, seed of a higher quality, lower seeding rate, less lodging, more uniform stands, and less chance of poor results on account of weeds. An objection has been advanced against row seeding on account of the ridges that may result from cultivation. This difficulty can be overcome on most fields by planting around and around. Cultivation can be done in the same manner, and then at harvesttime the combine or binder can follow around the field and not have to cross rows, enabling the cutter bar to be run much lower without damage to the equipment.

In the Northern States, when soybeans are seeded on fertile soil under favorable seasonal conditions, the row spacing may be 18 to 24 inches for best yields of seed; however, on less fertile soil the rows should be farther apart. In some sections, especially in the Southeast, the row method is employed in the production of forage. In that section it is also common practice to grow corn in rows 6 to 7 feet apart, with rows of soybeans for seed production alternating. In the South-

ern States, where larger and later soybean varieties are grown, they are usually planted in rows 3 or 4 feet apart. It should be emphasized that one of the chief advantages of seeding in rows is the greater opportunity afforded for controlling weeds by cultivation.

Under certain conditions seeding soybeans solid, that is, in close rows, may be desirable. One advantage is that on sloping land subject to erosion the solid drilling of soybeans on the contour will result in less loss of soil than row seeding. If the land is free from weeds or can be thoroughly cultivated with a harrow or rotary hoe while the weeds are small, good yields of seed or good yields of a fine quality of hay will be obtained by drilling in close rows. The main objections to the method are the larger quantity of seed required, the increased competition of weeds in cold wet seasons, greater loss in lodging, and the decrease in yields of seed and forage under drought conditions.

Special soybean planters (fig. 7) or corn planters with soybean feed plates are very satisfactory for row planting, especially if cultivating equipment is available to fit the planter row spacing. The ordinary grain drill is the most satisfactory for solid seeding, provided the proper feed setting is used to prevent cracking of the seed. The grain drill may be used for row planting by covering the feed cups not wanted. In the Southern States the cotton planter is used extensively. Broadcasting of soybean seed and covering with a harrow does not provide a uniform depth of seeding and is not considered an advisable method of planting soybeans.

Within the last few years the seeding of one or two drill widths of soybeans about fields of corn has become a common practice in several areas of the Corn Belt. When the corn is cultivated, the border in soybeans permits the turning of cultivators at the ends of the corn rows without damage to the corn and practically no injury to the soybeans. Later the soybeans are harvested for hay, leaving ample room for the harvest of the corn without loss at the row ends.

RATE OF SEEDING

The quantity of seed to be sown to the acre will necessarily vary according to the purpose for which the crop is grown, the variety or size of seed, viability of seed, method of planting, character of the soil, condition of the soil at planting time, and the method of cultivation to be used. Because so many factors are involved, no standard rule can be given as to the exact quantity of seed to be used under all conditions. Extensive investigations indicate that the rate of seeding can vary between fairly wide limits without greatly affecting the yield of forage or seed.

Most commercial soybean varieties have about 3,000 seeds per pound; however, some vegetable types have rather large seed, running only 1,200 to the pound, whereas some types used for hay or as green manure have extremely small seed, running 6,000 to 9,000 to the pound. Furthermore, the size of seed in the same variety may vary somewhat from season to season, depending on environmental conditions. Because of the variation in seed size, it is often desirable to determine the seeding rate that will space the viable seeds the proper distance apart. For row planting, a spacing about 1 inch apart in the row will give good stands under ordinary conditions.

Viability of seed is an important factor in determining seeding rate, and a germination test should be run, especially if the seed quality is poor or if seed-storage conditions have not been ideal. Under some adverse seeding conditions, such as planting in cold, wet soils, it may be desirable to treat the seed with an effective fungicide to retard rotting in the soil and further loss of viability.

Heavy clay soils may form a crust after a beating rain, making emergence of the seedlings difficult. Heavy seeding rates are advantageous under such conditions as the plants, if spaced close together in the row, furnish mutual help in breaking the soil crust.

Much heavier rates of seeding are practiced in those sections where soybeans are grown in close rows and the weeder, harrow, or rotary hoe is used for cultivation. Heavier rates of seeding provide a more complete ground cover and allow for certain loss of plants that may result from thorough cultivation. Relatively heavier seedings are generally practiced in the fertile, productive soils, whereas in the less fertile soils and under dry conditions lighter seeding rates should be used.

In the main soybean-producing areas a seeding rate of 45 to 60 pounds of good-quality seed per acre in rows and about double that rate for solid seeding would be a general recommendation for the average soil and favorable planting conditions. When soybeans are sown in mixtures with corn for silage, an addition of 6 to 8 pounds of soybean seed to the usual quantity of corn is desirable. If soybeans for grain are planted in alternate rows with corn, a setting of the seeder that will give the usual rate per row will be found satisfactory.

DEPTH OF SEEDING

The depth of seeding is of much importance as poor stands frequently result from covering the seeds too deeply, especially in the case of the large-seeded varieties. The most favorable depth is governed by the character of the soil, the quantity of moisture present, and the size of seed. In clay and other heavy types of soils, shallow seeding—about 1 inch—tends to lessen the chance of failure caused by the formation of a soil crust after heavy rains. In light loams and sandy soils the seeding may be deeper, but it should not exceed 3 inches; if the seeding is done during a dry period, 3 inches will not be too deep. General results show that small-seeded varieties, such as Laredo, Barchet, and Otootan, are able to come through deeper coverings of soil than such large-seeded varieties as the Rokusun, Biloxi, and Mammoth Yellow. Even with small-seeded varieties, however, covering too deeply should be avoided. Under very dry conditions the use of a furrow-opener type of seeder that plants the seed an inch or more deep in the bottom of a 3- or 4-inch furrow, may serve to place the seed in moist soil, thus improving conditions for prompt, uniform germination. After a rain, a smoothing harrow weeder or rotary hoe should be employed to break any crust that may form on the surface. Under usual spring conditions, comparatively shallow plantings will give the best results.

CULTIVATION

The seedbed should be thoroughly prepared and all weeds destroyed ahead of seeding. Under favorable conditions soybeans germinate in a few days and cultivation should begin as soon as the seedlings ap-

pear. When soybeans are drilled solid or in rows, frequently a cultivation is necessary before the young plants appear. If the weed seeds have germinated, a shallow cultivation with the weeder, harrow, or rotary hoe should be given before the seedlings break through the ground. If the soil is of a heavy type and forms a hard crust after a rain, a light cultivation with the rotary hoe, weeder, or harrow should be given to break the crust.

When soybeans are sown in close drills for hay or grain, the weeder, harrow, or rotary hoe may be used, if necessary, until the plants are 8 to 10 inches high. The cultivation of drilled or broadcast seeds will give much larger yields of hay with a smaller percentage of weeds. If the seeds are allowed to get started, the weeder or harrow is quite effective in killing them as they emerge. The most effective cultivation is to kill weeds in the seedling stage rather than to attempt to de-

Figure 8.—A rotary hoe kills small weeds and breaks the soil crust.

stroy them by cultivation after they get well started. The rotary hoe (fig. 8) is a valuable implement to cultivate both closely drilled and row seedings, and is particularly effective when pulled rapidly through the field. It is especially valuable for working practically all soils that are inclined to crust, and it gives excellent results when followed by a weeder or harrow. In using the spike-tooth harrow, the teeth should be slanted backward slightly and the cultivations should be across the rows. On loose, sandy types of soils, the weeder, carrying a light weight, is preferred to the rotary hoe because the hoe is much heavier and in loose soils cultivates too deeply.

Soybeans in rows are usually cultivated with the ordinary corn cultivator, the two-horse cultivator being the most commonly used. The sugar beet cultivator gives excellent results when the soybeans are planted in narrow rows. Soybean cultivators designed for row pro-

duction are rapidly gaining favor. Four- or six-row attachments for cultivating soybeans are available for two-row tractor corn cultivators.

Cultivation of soybeans should be frequent enough to keep down weeds. At the blooming stage the soybean plants should produce sufficient shade to control the growth of weeds. Comparatively little injury results if they are cultivated during the heat of the day when the plants are tough. It is not advisable to cultivate soybeans when they are turgid from rain or dew as the plants are then easily bruised or broken. Usually two or three cultivations after the beans are up will be sufficient. If continued after flowering, cultivation may cause injury to the blossoms and reduce the seed yield by breaking the branches. Level cultivation, especially when the soybeans are laid by, is preferable as it makes harvesting easier.

SOYBEANS IN ROTATIONS

The soybean may be used advantageously as either a grain or a hay crop in many systems of crop rotations, but no standard rotation can be given that will apply to every farm. The soybean, in common with other legumes, supplies most of its nitrogen requirement from the air if properly inoculated and does not need to follow a deep-rooted legume in the rotation. The soybean crop, when plowed under, is an excellent soil builder, adding much organic matter and nitrogen and improving soil tilth. On the other hand, if the soybean crop in the rotation is harvested for hay or seed and the crop removed, it draws on the minerals of the soil the same as other intertilled crops and adds very little nitrogen or organic matter. Thus, the use that is made of the crop determines its soil-building value.

In the Corn Belt a common rotation is corn, soybeans, small grain, and a deep-rooted legume. If winter wheat is to follow soybeans combined for seed, the crop must be removed early enough to allow the wheat to be seeded at the proper time. This usually necessitates the planting of early-maturing strains of soybeans. In regions where cowpeas are grown, soybeans are adapted to practically the same place in the rotation as cowpeas. In general, soybeans should replace an intertilled crop, such as corn, rather than a small-grain or sod crop. A winter cover crop in the rotation following soybeans is important to reduce soil erosion and leaching. The return of the plant residue from combine harvesting also aids materially in protecting the soil during the fall and winter, a period when severe erosion may otherwise occur if the soil is allowed to remain bare.

When small grains follow soybeans, little preparation of the soil is necessary for seeding the grain. If a winter grain follows soybeans harvested by combine, the drill may follow immediately behind the combine and thus seed the grain before the soybean residue is deposited on the ground. If this practice is followed, most of the soybean residue is left on the surface, making an excellent mulch.

In certain sections of the South the soybean is especially valuable as a crop after early potatoes or canning peas and also produces a satisfactory seed yield when seeded late in spring after winter grain. In the rice-growing districts where soybeans are grown in rotation, soybeans have yielded well, weeds have been controlled, and the yields of rice have been greater than where commercial fertilizers alone were used.

The soybean can also be used as a catch crop where new seedings of grass and clover have failed and furnishes an excellent emergency hay crop in the rotation. It also furnishes excellent cover in orchards, adding to the organic matter and nitrogen supply of the soil and smothering out weeds.

SOYBEANS IN MIXTURES

Soybeans may be satisfactorily grown in combination with other crops, such as corn, Sudan grass, Johnson grass, cowpeas, and sorghums. The chief advantage of the mixture is the production of better balanced feed, and the yields are often somewhat better than when the crops are grown separately. When grown for hay, the mixture is more easily cured. The practice of combining soybeans with other crops, especially corn, has increased very rapidly during the past few years, indicating that the results are highly satisfactory.

SOYBEANS AND CORN

Soybeans are more generally grown with corn than with any other crop. When grown with corn, the mixture is commonly used for pasture or silage. In some of the Southern States, however, corn and soybeans are grown in alternate rows for seed production.

Extensive investigations have been carried on by various experiment stations to determine the results that may be expected from a mixed planting of soybeans and corn. Experimental results show the yield of corn is invariably reduced, especially in the grain, from 5 to 25 percent or more, the decrease depending on the soil, seasonal conditions, and method and rate of planting. At the South Carolina Agricultural Experiment Station the average reduction in corn yield with soybeans in the drill for a period of 8 years was 3.4 bushels per acre. It was noted that in certain years, when the moisture was sufficient during the earing period, there was little or no reduction, while in other years with a moisture shortage at this period the reduction ranged from 2 to 7 bushels per acre. For a period of 5 years, corn planted with soybeans in alternate hills produced approximately 5 bushels per acre less than corn planted alone in similar plots at the Northeast Louisiana Station. The smaller yield of corn may be partly compensated for by the yield of soybeans. In general, the yield of soybean seed has not equaled the loss of corn, but the mixed crop has produced more nitrogen than corn alone.

SOYBEANS AND COWPEAS

Soybeans and cowpeas in combination make a very satisfactory mixture for hay, pasture, or green manure. The yield of this mixture is nearly always greater than that of either crop alone, and when the mixture is used for hay the curing of the cowpeas is easier because of presence of the soybean plants. Varieties of these crops that mature about the same time should be used.

In sowing a mixture of soybeans and cowpeas, it is best to have more soybean plants than cowpeas so that the vining cowpeas may have support. From 1 to 1½ bushels of soybeans and ½ to 1 bushel of cowpeas are required per acre in close drills, whereas in 3-foot

rows, half these quantities is sufficient. The ordinary grain drill is the best implement for seeding.

The time of cutting this combination for hay will depend on the relative growth of the two crops. Both plants should be cut at that stage of growth giving the best quality of hay, which is when the soybean seed is half- to full-grown and the first pods of the cowpea are mature.

SOYBEANS AND SUDAN GRASS

Sudan grass is an excellent crop for growing in combination with soybeans for hay, soilage, or pasture. The best results of this mixture are obtained in regions most suitable for soybeans or where irrigation is possible, under which conditions not only a better yield but a better balanced forage is obtained. Under semiarid conditions, Sudan grass invariably crowds out the soybeans.

The seeding of Sudan grass and soybeans as a main hay crop has increased rapidly during the past few years. Extensive tests carried on by several experiment stations show the yields to range from 2 to 4 tons per acre. Good results are obtained by seeding with a grain drill about 60 pounds of soybeans and 10 pounds of Sudan grass to the acre. Another method practiced successfully is to plant the soybeans in rows at the usual rate of seeding. The land should be kept free of weeds by level, shallow cultivation until the plants are about 6 inches high. Sudan grass should then be seeded between the rows, either drilled or broadcast, at the rate of 20 to 25 pounds to the acre, according to the fertility of the soil, and worked lightly into the soil. The harvesting of the mixture is not difficult as the erect, stiff stems of the Sudan grass support the soybean plants, which tend to vine more or less when grown in combination with tall-growing crops. The mixture should be cut for hay about the time the Sudan grass is in full bloom.

Investigations at the Illinois Agricultural Experiment Station showed that a Sudan grass and soybean mixture is a valuable annual pasture to supply extra feed during the summer, when grass pastures are low in yield. The combination is planted on a well-prepared seedbed about the usual time for planting soybeans. The seeding is done with a grain drill, 90 pounds of soybeans and 25 pounds of Sudan grass being used per acre. The crop is ready for pasture when from 18 to 24 inches high and should not be pastured earlier because of the danger of prussic-acid poisoning. Close pasturing also should be avoided.

SOYBEANS AND MILLET

Although soybeans and millet have not been especially recommended as a mixture, good results have been obtained by drilling in close rows 1 bushel of soybeans and 20 pounds of millet to the acre.

SOYBEANS AND SORGHUM

Soybeans may be grown in combination with sorghum for hay as a soilage crop or for silage. The best results are obtained in cultivated rows, as the sorghum is likely to choke the soybeans when sown

broadcast unless the sorghum is sown thinly. When sown in rows, about 15 pounds of sorghum and 45 pounds of soybeans per acre will be sufficient.

INSECT ENEMIES OF SOYBEANS [4]

Soybeans usually are comparatively free from serious insect pests, but losses due to their attacks are gradually becoming of greater importance. At present the most important ones are grasshoppers, velvetbean caterpillar, leafhoppers, blister beetles, bean beetles, and various leaf-eating caterpillars.

GRASSHOPPERS

Grasshoppers attacking soybeans belong to the species commonly injurious to alfalfa throughout the country, such as the red-legged (*Melanoplus femur-rubrum* (Deg.)), lesser migratory (*M. mexicanus mexicanus* (Sauss.)), and differential (*M. differentialis* (Thos.)) grasshoppers. They are more likely to become injuriously numerous in semiarid climates, but during dry summers they may multiply sufficiently to cause serious injury wherever soybeans are grown. Fortunately, grasshoppers attacking soybeans may be destroyed by means of the usual remedy, which consists in the application of poison-bran bait prepared as follows:

Wheat bran	pounds	100
Sodium fluosilicate	pounds	6
Water	gallons	12

The poison and the bran should be thoroughly mixed while dry. Water should then be added to make a damp but not sloppy mash. The bran should be thoroughly dampened, but not wet enough to interfere with ease in distribution. This bait should be broadcast thinly and uniformly at the rate of about 10 pounds (dry weight) to the acre.

If the bait is distributed in lumps, there may be danger of poisoning fowls or farm animals, but there is no danger when it is properly distributed.

The best time for scattering the bait is early morning.

Recent experiments indicate that 1 pound of benzene hexachloride (containing 10 to 12 percent of the gamma isomer) or 1 pound of chlorinated camphene may be substituted for the sodium fluosilicate in the bait formula.

Sprays and dusts containing chlordane or chlorinated camphene, applied directly to the infested crop by means of a power sprayer or duster or by airplane, have been found very effective. Whether applied in a spray or dust, the active ingredient should be used at the rate of 1 to 1½ pounds per acre in the case of chlordane and 1½ to 2 pounds in the case of chlorinated camphene.

Vegetation that has been treated with either of these insecticides should not be fed to dairy animals at any time and should not be fed to meat animals that are being finished for slaughter.

VELVETBEAN CATERPILLAR

The velvetbean caterpillar (*Anticarsia gemmatilis* (Hbn.)) is the young stage of a night-flying moth. This species probably does not

[4] Revised by C. M. Packard and F. W. Poos, entomologists, Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine.

survive the winter in continental United States, but works northward from the Tropics during the summer. It may however, produce as many as three generations in a single season in Louisiana, and it has done serious injury to soybeans in Louisiana, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina.

The full-grown caterpillar is about 1½ inches in length. It is usually black but sometimes green in ground color, with a middle stripe of green on the back and from one to three light stripes along the sides. The under side is always dark.

The caterpillars begin feeding on the tender leaves near the tops of the plants, working downward and ragging the leaves or eating them and the buds completely as they go. Even the tender stems, together with the developing pods, may be devoured. Soybeans, peanuts, velvetbeans, cowpeas, and kudzu seem to be their favorite food.

Prompt application of a control measure is important, because a heavy infestation may completely strip the plants within a very few days. The velvetbean caterpillar may be very quickly controlled by applying a dust containing 2 to 3 percent of DDT in pyrophyllite, talc, or a good dusting sulfur, at the rate of 15 pounds per acre.

Vegetation that has been treated with DDT should not be fed to dairy animals at any time or to meat animals that are being finished for slaughter.

Control may also be obtained by dusting soybeans with a good grade of either natural or synthetic cryolite. This dust should be applied at the rate of 10 to 15 pounds per acre. A second application may be necessary about 10 days later to destroy the newly hatched caterpillars.

Soybeans planted for hay may be saved without applying poison if they are cut promptly when the caterpillars appear in them. The late varieties of soybeans have been most seriously attacked, whereas the earlier varieties have been observed to escape injury.

LEAFHOPPERS

The most important leafhopper attacking soybeans is the potato leafhopper (*Empoasca fabae* (Harr.)). This is a wedge-shaped, pale-green insect about one-eighth inch long. It is not easily seen because it feeds mostly on the lower surfaces of the leaves and jumps or flies when disturbed. The use of DDT dust, with the proper precautions as already recommended for the control of the velvetbean caterpillar, is effective against this insect.

BLISTER BEETLES

The striped blister beetle (*Epicauta vittata* (F.)), the black blister beetle (*E. pennsylvanica* (Deg.)), and the three-striped blister beetle (*E. lemniscata* (F.)) are often injurious to soybeans in the Southern and Central States. These are slender black or striped beetles about one-half to three-quarters of an inch long and are active fliers. They may appear suddenly in great numbers in limited portions of a field and may strip these spots completely in a very short time. They may be readily controlled by applying the DDT dust to the infested areas, as already recommended for velvetbean caterpillar, with the same precautions.

When soybeans are being grown for hay, they may be cut immediately and thus saved from the beetles, but very prompt action is necessary as blister beetles feed rapidly and may consume much of the crop before it can be cut.

BEAN BEETLES

Soybeans sometimes are attacked by the Mexican bean beetle (*Epilachna varivestis* Muls.), although it evidently prefers other legumes as food. Some varieties are more susceptible to attack than others. The convexly rounded adult is about one-third of an inch long and copper-colored, with 16 small black spots on its back. The larva of this insect is a yellow spiny worm about one-third of an inch long when full-grown. Both adults and larvae feed mostly on the under sides of the leaves, but most of the damage is done by the larvae.

The bean leaf beetle (*Cerotoma trifurcata* (Forst.)) occasionally feeds on soybean plants, eating holes through the leaves. The adults are about one-quarter of an inch long. They are reddish to yellowish, with four black spots on the back and a black band around the outer margin of the wing covers.

To protect the crop against either of these beetles, when it is not being grown for hay, spray with either natural or synthetic cryolite in the proportion of 3 pounds in 50 gallons of water at the rate of about 100 gallons per acre. Care should be taken to apply the spray to the under sides of the leaves for control of the Mexican bean beetle. If a crop that is to be used for hay becomes badly infested, it should not be sprayed but should be cut immediately.

JAPANESE BEETLES

Where the Japanese beetle (*Popillia japonica* Newm.) is abundant, the adults sometimes seriously injure soybeans in midsummer by feeding on the foliage. The adult beetle is nearly half an inch long, about one-fourth inch wide, and shining metallic green. The hard outer wings are coppery brown. There are two small tufts of white hairs just behind the wing covers and five small patches along each side of the body, which make this insect readily distinguishable from other beetles.

Dusts containing 2 to 10 percent of DDT have been used with some success against the beetles in soybeans, but DDT sprays are more effective. The spray is prepared by mixing 2 pounds of a wettable powder containing 50 percent of DDT in 100 gallons of water, and applied at the rate of about 75 gallons per acre. Since the beetles are present for several weeks during the summer, two or more applications, a week or two apart, may be necessary to protect the crop.

The leafy parts of soybeans that have been treated with DDT should not be fed to dairy animals at any time and should not be fed to meat animals that are being finished for slaughter.

Some varieties of soybeans are less attractive or susceptible than others to the Japanese beetle. Farmers should consult their county agent or State agricultural experiment station for more specific information as to the varieties best adapted to their particular localities.

OTHER BEETLE ENEMIES

Flea beetles of several species (*Systena* spp.) are especially numerous in the Gulf States and frequently attack soybeans. These extremely small, active beetles feed on the leaves and jump like fleas when disturbed. They may be controlled with DDT dust used in the same way and with the same precautions as for the velvetbean caterpillar.

The grape colaspis (*Colaspis flavida* (Say)) has caused considerable damage to soybeans in Illinois and other North Central States in recent years. The uniformly yellowish-brown adult is about three-sixteenths of an inch long. The larvae live over winter in the soil and cause most of the damage by attacking the roots of corn and various leguminous crops, including soybeans. This insect usually requires more than 1 year to build up a population of serious proportions. Most of the damage to soybeans may be avoided by not planting soybeans or other legumes more than 1 year in succession on the same ground and by plowing land to be planted to soybeans early in the fall of the preceding year.

ARMYWORMS AND OTHER CATERPILLARS

The armyworm (*Cirphis unipuncta* (Haw.)), the fall armyworm (*Laphygma frugiperda* (A. and S.)), the green cloverworm (*Plathypena scabra* (F.)), and the corn earworm (*Heliothis armigera* (Hbn.)), and other climbing cutworms frequently cause damage to soybeans by eating the foliage. In general these caterpillars may be controlled by applying DDT dust to the infested plants as recommended for the velvetbean caterpillar, with the same precautions.

Where it is desired to destroy armyworms and cutworms without applying the insecticide directly to the soybeans, a good control measure is to distribute the poisoned bait recommended for the destruction of grasshoppers. It is, of course, necessary to apply such remedies before the plants have been defoliated.

Caterpillars that feed within webs, such as the garden webworm (*Loxostege similalis* (Guen.)), are usually difficult to control with insecticides, although some success with DDT dust has been reported. Where a crop is being raised for hay and becomes severely infested with these caterpillars, immediate cutting is recommended.

CHINCH BUGS

The chinch bug (*Blissus leucopterus* (Say)) does not feed on soybeans, and there is evidence that injury to corn by this insect is considerably lessened when soybeans are grown with the corn. The chinch bug thrives best in locations that are dry and warm. A fatal fungus disease attacks it under humid conditions, and where soybeans are grown with corn a dense shade is produced about the lower parts of the plant, which is unfavorable for the bugs. Extensive experiments conducted by the Illinois Agricultural Experiment Station have demonstrated that the bugs are much less numerous on corn grown with soybeans than on corn grown alone. Fields planted to soybeans and corn produced good crops, whereas in adjoining fields of corn alone the crop was destroyed or very severely injured.

DISEASES OF SOYBEANS

The enormous expansion in soybean acreage and production during the past few years has greatly accentuated the disease problems of this crop.[5] Although no widespread epidemics of disease have been observed or reported, several serious diseases of the soybean are occurring quite generally over the major producing areas and have caused appreciable losses on some farms. Various agricultural experiment stations and the United States Department of Agriculture are conducting extensive investigations of the organisms causing the various diseases and methods for their control.

OTHER ENEMIES OF SOYBEANS

Rabbits are exceedingly fond of the soybean and when numerous cause considerable damage. In the Great Plains region where moisture conditions are favorable and in the Gulf Coast region, failures with the soybean have been due chiefly to rabbits. The greatest damage is done while the plants are young and tender. Several instances have been noted where rabbits have showed particular preference for certain varieties. Where rabbits are numerous, soybean culture is practically impossible unless the field can be enclosed with rabbitproof fencing or very large areas of the crop are grown. The dusting of the plants in small plantings or of the outer rows in larger plantings with lime and either dusting or spraying with some arsenical poison (calcium arsenate) have prevented serious damage from rabbits.

Pigeons, when numerous, will cause considerable injury to soybean plantings by picking off and eating the cotyledons just as the seedlings are emerging or picking out the planted seed from the rows. In North Dakota and South Dakota, because of shortage of vegetation, pheasants have done considerable damage to soybean fields, eating the seedlings as they appear and the seed as the plants matured.

In many sections deer have done much damage. Reports have been made of damage by woodchucks to small areas of soybeans in localities in some Northern States.

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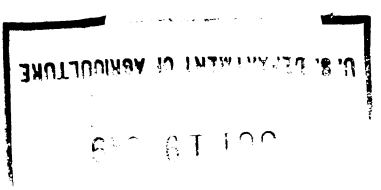
[5] JOHNSON, H. W., and KOEHLER, B. SOYBEAN DISEASES AND THEIR CONTROL. U. S. Dept. Agr. Farmers' Bul. 1937, 24 p., illus. 1943.



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