Agriculture Handbook No. 285

DRY BEAN PRODUCTION

in the LAKE and NORTHEASTERN STATES

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

CONTENTS

This handbook contains information of the type formerly published in Farmers' Bulletin 2083, "Dry Bean Production in the Eastern States."

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DRY BEAN PRODUCTION

in the Lake and Northeastern States

By Axel L. Andersen, *Crops Research Division, Agricultural Research Service* [1]

Dry beans are an important item in the diet of the American people. They are relatively inexpensive and highly nutritious, being high in protein (20 to 25 percent), phosphorous, iron, and vitamin B_1. In the United States, nearly 20 million 100-pound bags are produced annually, and annual consumption is approximately 8 pounds for every man, woman, and child.

CENTERS OF DRY BEAN PRODUCTION

Nearly half the dry beans produced in the United States come from central Michigan and western New York (figs. 1 and 2). A small quantity is produced in central Maine and in neighboring States.[2] The remainder is produced in the Western States.

Dry beans are very important as a cash crop. The Michigan crop is valued at over $50 million annually. The New York crop is valued at nearly $10 million and the Maine crop at slightly less than $1 million.

Dry bean production is expected to increase to supply the domestic and foreign markets.

It has increased markedly in Michigan but decreased slightly in New York and Maine. Of the 9 million bags produced in 1963 in the three States, Michigan produced 86 percent, New York 13.5 percent, and Maine 0.5 percent.

Data on dry bean production for Michigan (table 1) and New York (table 2) from 1957 through 1963 have been summarized to illustrate the production trends and the importance of the industry in the economy of the two States. Data by varieties are given in table 3.

Michigan produces over 99 percent of all the Pea (Navy) beans [3] grown annually in the United States. Of all the Pea beans sold in the United States for domestic consumption, 85 percent are sold in cans.

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[1] The author gratefully acknowledges the assistance and suggestions provided by specialists at the Maine, Michigan, and New York Agricultural Experiment Stations and in various agencies of the U.S. Department of Agriculture and State departments of agriculture.

[2] The central Maine area includes parts of Kennebec, Penobscot, Piscataquis, and Waldo Counties. Each county harvested less than 500 acres in 1959.

[3] In Michigan the Pea bean is commonly referred to as the Navy bean.

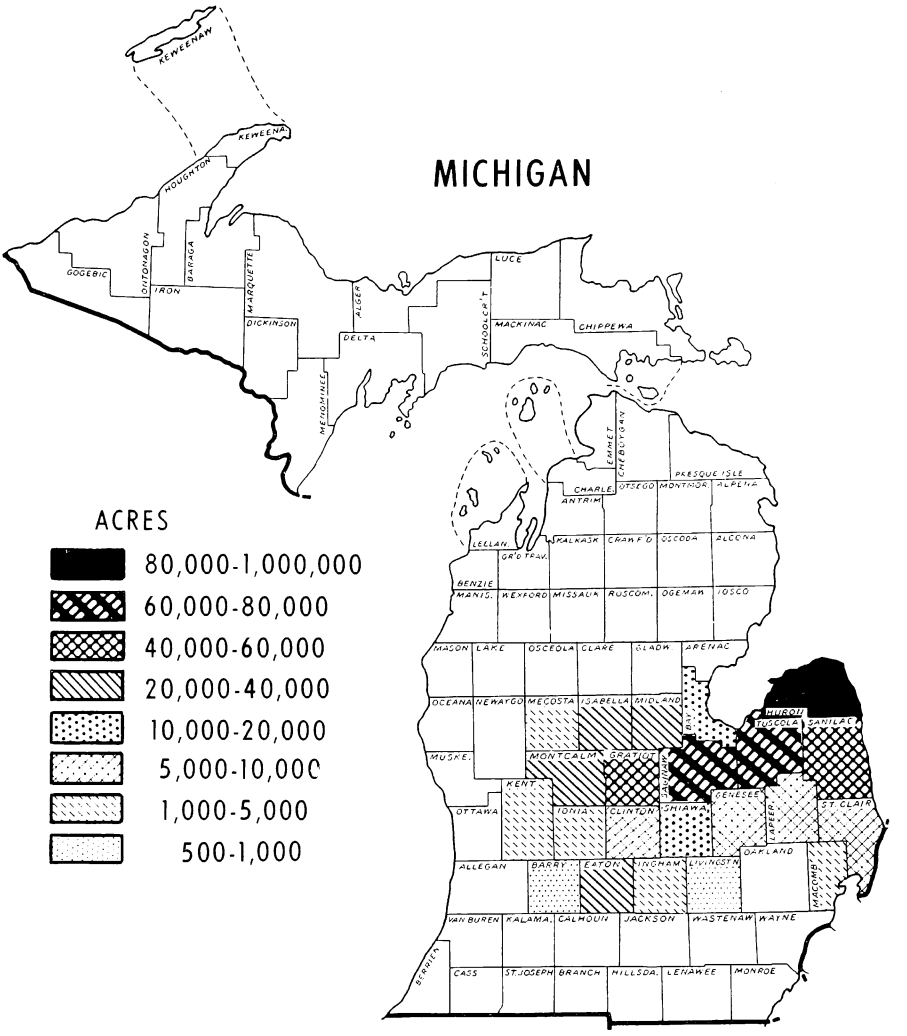

FIGURE 1.—Counties in Michigan with more than 500 acres of dry beans. Data obtained from the 1960 U.S. Census of Agriculture.

The industry in Michigan is geared to serve the canning trade, not only in the United States but in the foreign market as well. In 1963, over 200 million pounds of Pea beans were exported, mostly for canning.

Michigan-grown Dark Red and Light Red Kidney beans are sold for both the dry package and the canning trade. Yellow Eye, Cranberry, Pinto, and other beans are sold in the dry package form.

Only 50 percent of the Red Kidney beans produced in New York are canned. From 5 to 15 percent are exported, and the remainder are sold in dry packages. Nearly all the Black Turtle Soup beans are sold for export. A few are canned and sold as packaged beans. Other New York varieties are sold mainly as dry beans.

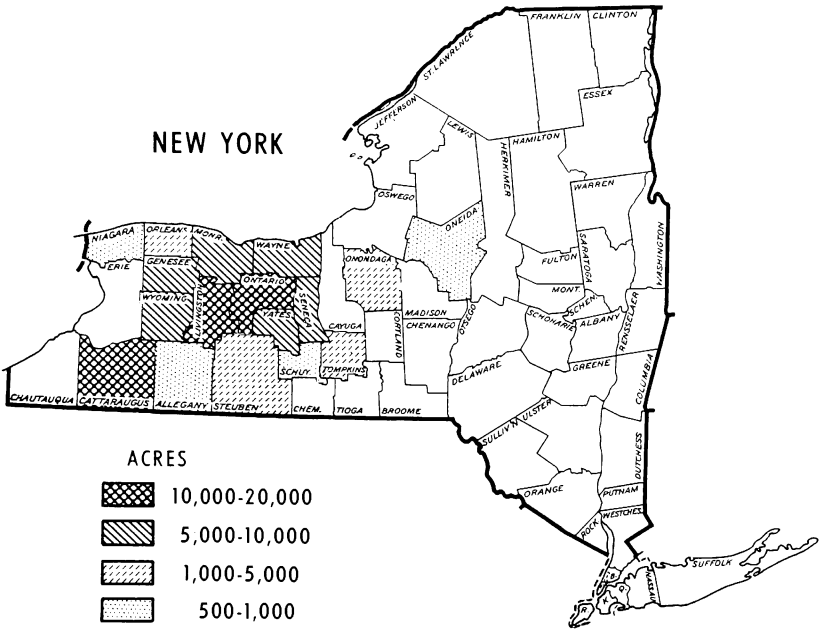

FIGURE 2.—Counties in New York with more than 500 acres of dry beans. Data obtained from the 1960 U.S. Census of Agriculture.

LIMITING FACTORS IN BEAN PRODUCTION

Bean prices, like the prices of other agricultural commodities, vary from season to season. Varieties that are under Government price supports tend to fluctuate less in price, except when the supply is low. Varieties of minor importance, such as Black Turtle Soup, Cranberry, White Kidney, White Marrow, and Yellow Eye, have limited markets and are not included under the Government price support program. Hence, their prices fluctuate considerably from year to year.

TABLE 1.—*Acreage, yield, production, and value of dry beans in Michigan, 1957–63* [1]

Year	Acres harvested	Yield per acre	Production [2]	Value of production
	1,000 acres	*Pounds*	*1,000 bags*	*1,000 dollars*
1957	474	740	3,508	27,012
1958	536	975	5,226	33,969
1959	509	1,260	6,413	35,913
1960	525	1,190	6,248	36,963
1961	541	1,360	7,358	47,091
1962	573	1,290	7,392	47,420
1963	573	1,480	8,480	51,000

[1] Source: Michigan Agricultural Statistics Reporting Service.
[2] Bags of 100 pounds.

TABLE 2.—*Acreage, yield, production, and value of dry beans in New York, 1957–63* [1]

Year	Acres harvested	Yield per acre	Production [2]	Value of production
	1,000 acres	*Pounds*	*1,000 bags*	*1,000 dollars*
1957	104	1, 120	1, 165	8, 932
1958	114	1, 150	1, 311	9, 541
1959	89	940	837	9, 746
1960	96	1, 270	1, 219	8, 777
1961	87	1, 530	1, 331	10, 070
1962	98	1, 300	1, 274	8, 876
1963	82	1, 200	984	9, 530

[1] Source: Statistical Reporting Service, New York Crop Reporting Service, Albany, N.Y.
[2] Bags of 100 pounds.

TABLE 3.—*Dry bean production by varieties for Michigan and New York, 1962–63* [1]

Variety	Michigan		New York	
	1962	1963	1962	1963
	1,000 bags [2]	*1,000 bags* [2]	*1,000 bags* [2]	*1,000 bags* [2]
Pea (Navy)	6, 696	7, 480	30	41
Red Kidney [3]	460	700	884	785
Cranberry	75	100	----------	----------
Yellow Eye	70	80	9	12
Pinto	70	95	----------	----------
White Marrow	----------	----------	23	26
Black Turtle Soup	----------	----------	317	99
Other	21	25	11	21
Total	7, 392	8, 480	1, 247	984

[1] Source: Michigan Agricultural Statistics Reporting Service, Lansing, Mich.
[2] In 100-pound bags; cleaned basis.
[3] The New York production was mainly Light Red Kidney beans. Michigan production consisted of 340,000 bags of Dark Red Kidney beans and 120,000 bags of Light Red Kidney beans in 1962; and 500,000 Dark Red Kidney and 200,000 Light Red Kidney beans in 1963.

The first factor for the prospective grower to consider is the availability of a bean elevator in the locality for handling and marketing his beans. The next consideration is the type of bean to grow. This will be determined by market preference and the ability of the dealer to handle the beans. Many elevators are equipped to handle only one or two types of beans.

All bean types are not in direct competition with each other. Pinto beans, for instance, are preferred by people of Mexican descent; most Yellow Eye beans are marketed in the New England and South Atlantic States; Cranberry beans are preferred in the Southeast; and Red Kidney beans are used mainly for canning.

Quality is more important than ever because of the competition among types of beans. Great Northern and Pea beans compete in the dry packaging trade throughout the country, but the canning trade prefers the Pea bean because of its canning qualities. Since quality is a major factor and since disease and weather conditions influence quality, the susceptibility of varieties to disease and climate must be considered in producing dry beans in the Lake and Northeastern States.

Bean weevil infestations, precipitation, and the occurrence of hot, dry winds during the flowering season determine the southern limits of production. Length of the frost-free growing season determines the northern limits. Because dry beans are a comparatively short season crop, they are especially adapted to areas where the frost-free growing season is from 105 to 120 days.

Extensive droughts during the growing season, and especially during pod-setting time, can lower the yields considerably. Cool, wet seasons are also highly unfavorable, because beans are easily injured by excessive moisture and are subject to attack by diseases that thrive under these conditions. Hot, dry winds during blossoming may cause severe blossom drop and hence lower the yield considerably, or they cause nonuniform ripening of the crop. Plants that lose many of their first blossom generally set more blooms a week or 10 days later. Beans are killed by freezing; however, they are adapted to a fairly wide temperature range. Temperatures between 65° and 75° F. are the most favorable for bean growing.

Soil types, drainage, crop sequence, and the availability of equipment for growing and harvesting the crop are other factors to be considered.

Anyone interested in the production of dry beans should consult his county agricultural agent. Additional information may be obtained from Extension Service specialists and State agricultural experiment stations, as well as from industry representatives. Dates of planting, rates of seeding, fertilizers, crop rotations, and varieties recommended will vary considerably within an area.

IMPORTANCE OF GOOD SEED

Probably the most critical item in the production of dry beans is the quality of the seed. A number of important diseases can be carried in or on the seed. These diseases are often responsible for the low yield and poor quality in beans sold.

Also, mechanical injury, frost damage, and wet weather damage at harvesttime prevent good germination of seed. Seed damaged by rough handling during harvest or subsequent processing results in retarded, nonvigorous, stunted, or baldheaded plants. Electric-eye sorters remove discolored beans, but not those that have been damaged mechanically (cracked seedcoats and broken cotyledons).

Many bean growers make the mistake of buying noncertified seed, because it is cheaper than certified seed. Noncertified seed may look clean, but it may be carrying bacterial blight or the bean common mosaic virus internally. The seed may also be carrying some anthracnose infection. It would be almost impossible to detect 20 or 30 anthracnose-infected beans in a 100-pound bag of beans. If distributed uniformly throughout the field at planting time, the infected beans would serve as a source of infection for the other beans in the field. This could result in heavy crop loss if wet, humid weather should occur during the growing season. The few extra dollars spent for certified seed is one of the best investments that can be made to insure a high-quality crop of better than average yield.

SEED SOURCES

Some of the dry bean seed used in the Lake and Northeastern States comes from the arid regions of California and Idaho and the remainder is produced locally. States in which certified seed of the principal dry bean types and varieties is grown are indicated in table 4. All certified seed has passed inspection for disease freedom, quality, germination, and varietal purity by the seed-certifying agency in the State in which it was produced. Specifications for certification vary with the different States, but the standards are high in all States; thus good-quality seed at the lowest possible cost is assured.

In Michigan, where bacterial blight is present and the annual requirements for Pea bean seed alone is over 20 million pounds, bean growers have to rely on locally produced seed. By following the recommended cultural practices for disease control as outlined on page 31, Michigan seed producers have been able to supply growers with certified Pea bean seed that is relatively free from bacterial blight and other seedborne diseases. This has been accomplished by contracting for the production of breeders seed in Idaho. The Idaho-grown seed, in turn, is planted for foundation seed in the upper part of the lower peninsula of Michigan, in an area away from the principal bean-producing areas in Michigan. The foundation seed fields are thoroughly inspected for the presence of seedborne diseases and for varietal purity. The following year the foundation seed is distributed to certified seed producers throughout the bean area of Michigan. Before harvest, the prospective certified-seed fields are inspected by the Michigan Crop Improvement Association, the seed-certifying agency in Michigan. If acceptable in the field, samples of the cleaned seed must be inspected in the Crop Improvement Laboratory to be certain the seed meets all the other requirements for certification.

A similar procedure is used for the production of certified Charlevoix Dark Red Kidney seed (figs. 3 and 4), but restrictions are greater as to the areas in which certified seed can be grown. Only seed fields of the Charlevoix variety located north of an east-west line running

TABLE 4.—*Principal types and commercial varieties of dry beans grown in the Lake and Northeastern States, resistance or susceptibility to certain diseases, and States in which certified seed is grown*

Type and variety	Common seedborne diseases[1]								State in which certified seed is grown
	Anthracnose strains			Bacterial blights		Mosaic[2]			
	Alpha	Beta	Gamma	Common and Fuscous	Halo (Race)	BCM-1	BCM-15	BCM-123	
Pea, or Navy									
Sanilac	R	R	R	S	MR	R	S	R	Michigan and New York.
Seaway	S	R	R	S	MR	R	R	R	Michigan.
Gratiot	R	R	R	S	MR	R	R	R	Michigan.
Michelite	S	R	R	S	MR	R–S	R	R–S	
Michelite-62	S	R	R	S	R	R	S	R	Michigan and New York.
Saginaw	R	R	R	S	MR	R	R	R	Michigan.
Kidney									
California Light Red Kidney.	R	S	S	S	S	S	S	S	California and Idaho.
Michigan Dark Red Kidney.	R	S	S	S	S	S	S	S	California and Idaho.
California Dark Red Kidney.	R	S	S	S	S	S	S	S	California.
Charlevoix	R	R	S	S	S	S	S	S	Michigan.
California White.	R	S	S	S	S	S	S	S	California.
Yellow Eye									
New York or Michigan Yellow Eye.	R–S	S	S	S	S	S	S	S	[3].
Steuben Yellow Eye.	R	S	S	S	S	S	S	S	New York.
New England Yellow Eye.	R	S	S	S	S	S	S	S	[3].
Miscellaneous									
Black Turtle Soup.	S	R	R	S	S	R	S	S	[3].
Perry Marrow	R	R	S	S	S	S	S	S	New York.
Michigan Cranberry.	R	S	S	S	S	S	S	S	California and Idaho.

[1] S=susceptible; R=resistant; MR=moderately resistant.

[2] Three strains of bean common mosaic attack beans. BCM-15, or Purkholder's strain, attacks varieties resistant to the common BCM-1 and BCM-123 strains of the virus.

[3] Seed of this variety not certified.

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FIGURE 3.—Charlevoix (breeders seed) increase field in Magic Valley near Twin Falls, Idaho. The environmental conditions in this and certain other areas make it possible to produce bean seed comparatively free from bacterial blight.

BN 23780

FIGURE 4.—Charlevoix foundation seed field planted in northern lower Michigan from breeders seed produced in Idaho.

through Clare County, Mich., are acceptable for certification. However, Charlevoix beans grown north of this line in Huron County are not eligible for certification.

In New York the official seed-certifying agency for dry beans is the "New York Certified Seed Growers Cooperative, Incorporated." This organization is comparable to the Michigan Crop Improvement Association, the official seed-certifying agency in Michigan. In Michigan and New York seed standards are developed cooperatively by those agencies concerned with certification. These include the colleges of agriculture and the agricultural experiment stations at the respective universities, the State seed laboratories, and the State departments of agriculture.

BEAN TYPES AND VARIETIES

Dry beans vary in shape, size, and color. Figure 5 shows the more important types grown in the Lake and Northeastern States.

The Pea (Navy) bean is the most economically important type grown in Michigan. Over 7 million 100-pound bags were produced in 1963. This was over 99 percent of the Pea beans produced in the United States. Michigan also produces about 85 percent of Yellow Eye and 98 percent of Cranberry beans.

Western New York leads in the production of Red Kidney beans. That variety accounts for 75 percent of New York bean production. The Black Turtle Soup variety accounts for another 20 percent. Small quantities of Pea, White Kidney, Yellow Eye, and White Marrow are produced.

Yellow Eye is the most economically important bean grown in Maine.

Other bean varieties occasionally grown in limited quantities in the Lake and Northeastern States are Red Mexican, California Pink, Jacobs Cattle, and Soldier. The last two varieties are grown in Maine.

Table 4 lists the principal types and varieties of beans grown in Michigan, New York, and Maine, the diseases to which they are resistant, and the States in which certified seed is grown.

Pea, or Navy

All the Pea bean varieties grown for commercial production except Michelite were developed and released through cooperative arrangement between the Michigan State University Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture.

Bush types

Bush-type Pea bean varieties have several characteristics in common. They are upright and produce large numbers of flowers over an ex-

tended period. The flowers are produced at the ends of determinant branches set high on the plant, so the pods are well off the ground at maturity. The seed is white, round, and uniform. "Screenings" are considerably less from the bush-type than from the vine-type beans, because small beans are generally associated with nonuniform ripening of beans on a vine and the presence of Sclerotinia wilt (white mold), which kills the beans prematurely. The number of beans discolored

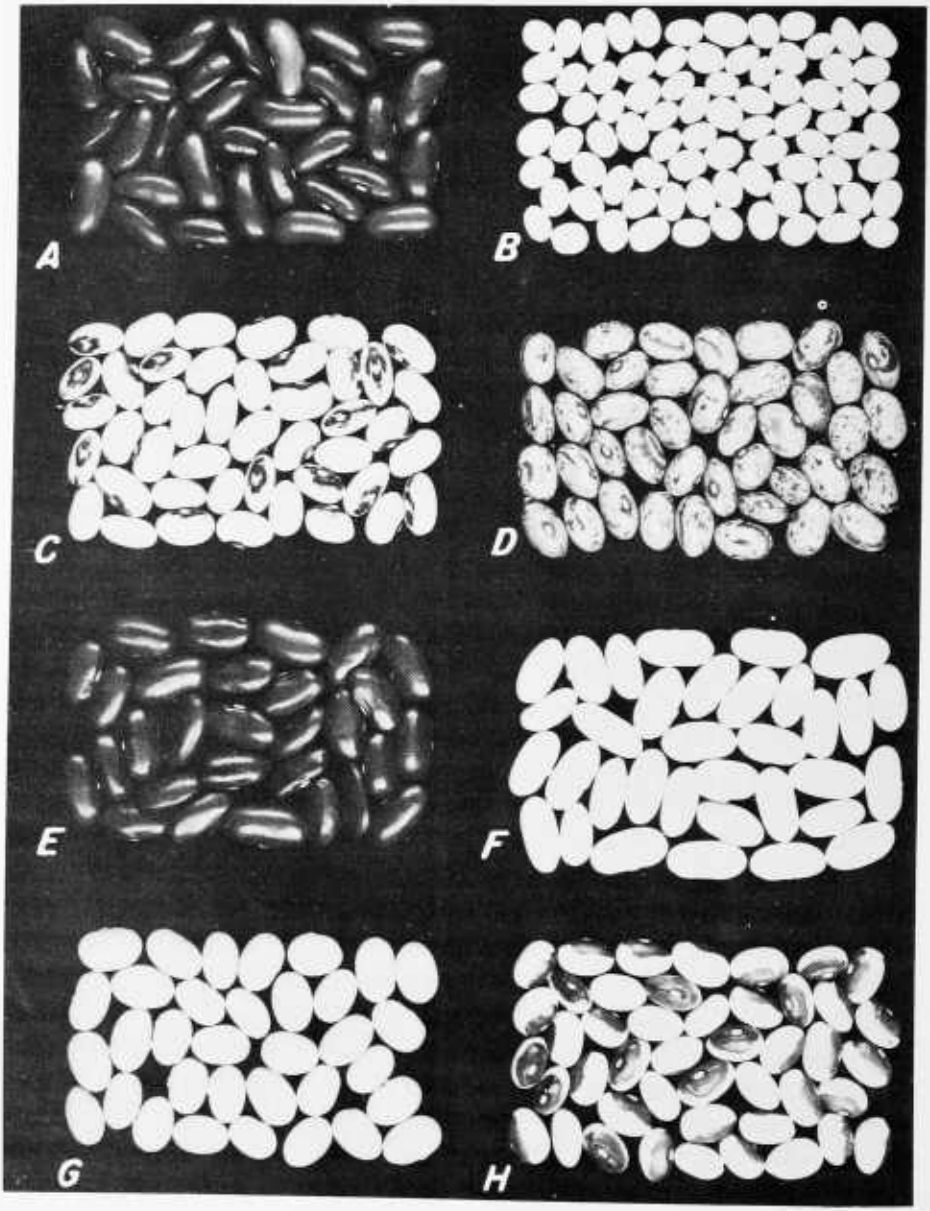

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FIGURE 5.—Principal dry bean types grown in eastern United States: *A*, Light Red Kidney; *B*, Pea (Navy); *C*, Yellow Eye (New England type); *D*, Cranberry; *E*, Dark Red Kidney; *F*, White Kidney; *G*, Marrow; and *H*, Yellow Eye (New York or Michigan type).

BN 23782

FIGURE 6.—Field of Sanilac beans in Bay County, Mich. Note the uprightness of plants and the location of the flowers. This is characteristic of all bush-type varieties derived from an X-ray mutant bean.

by fungal growth is also much lower in bush-type beans because they can normally be pulled and threshed the same day. Vine-type beans, on the other hand, normally have to be pulled at least 1 day before threshing and are more subject to damage while in the windrow.

The bush-type Pea beans normally escape serious damage from white mold or Sclerotinia wilt except during seasons of very high relative humidities. The reason is that the foliage does not ordinarily form a canopy over the row, as does the foliage of vine-type beans. The improved aeration between the rows and around the plants lowers the relative humidity and creates an environment less favorable for infection and development of the fungus.

The history of the varietal development is also similar. Thus the Sanilac and Seaway varieties were developed concurrently in a backcrossing program in which the recurrent parents were selections obtained from a cross between a small, early maturing, bush-type mutant bean (obtained by treating Michelite seed with X-ray) and the Michelite variety. The Gratiot variety is a selection from a cross between Sanilac and a bush selection similar to Seaway.

Sanilac.—Sanilac [4] (fig. 6) is a high-yielding, upright, midseason bush bean released in 1956. The plants vary from 14 to 21 inches in height and produce short determinant runners up to 14 inches in length. The variety blooms in approximately 42 days and matures in about 88 days. It is resistant to the alpha, beta, and gamma races of the fungus that causes anthracnose and to bean common mosaic virus

[4] Cover photo shows harvesting of a field of certified Sanilac beans near Saginaw, Mich.

races 1 and 123 (BCM–1 and BCM–123). Sanilac is susceptible to BCM–15. It has field resistance to halo blight but it is susceptible to common and fuscous bacterial blights.

Sanilac is an F_4BC_2 selection from a three-way cross in which a bush-type mutant was the principal recurrent parent. Other bean materials involved in the cross include a selection from Robust X Crawford, Emerson 847, and Emerson 53.

Seaway.—Seaway (fig. 7) is a high-yielding, upright, short-season bush bean released in 1960. The plants vary from 13 to 19 inches in height. Unlike Sanilac, no short determinant runners are produced. The variety blooms in about 39 days and matures in about 79 days.

Seaway is resistant to bean common mosaic virus races 1, 15, and 123, but is susceptible to the alpha race of the fungus that causes anthracnose. It has field resistance to halo blight.

Seaway is an F_4BC_4 selection from a cross in which a bush-type mutant Pea bean developed by X-ray was a recurrent parent in a backcrossing program. Topcrop, a mosaic-resistant snap bean with the dominant or Corbett Refugee type resistance to bean common mosaic, was used as the initial parent to procure resistance.

BN 23783

FIGURE 7.—Field of Seaway beans in Tuscola County, Mich., planted in 38-inch rows. Plants are approximately 8 weeks old.

Gratiot.—Gratiot is a high-yielding, upright, midseason bush bean released in 1962. It resembles Sanilac in most of its characteristics but has certain improvements. For example, it is the first bush-type bean that successfully combines resistance to two major bean diseases—anthracnose and mosaic. In addition, it has superior growth habit and canning quality.

Gratiot is a sixth generation from a cross between Sanilac (anthracnose resistant) and a high-yielding, mosaic-resistant, stiff-strawed, upright bush selection with excellent canning quality. It is resistant to the alpha, beta, and gamma races of the fungus that causes anthracnose and to bean common mosaic virus races 1, 15, and 123. It is also resistant to halo blight.

Vine types

Michelite.—Michelite is a late-maturing bean that is grown in limited quantities in New York and Michigan. It is only partly resistant to bean common mosaic virus 1 (BCM–1). It is less tolerant to diseases that attack Pea beans than are any of the varieties described earlier. In the Michigan Seed Certification program, it has been replaced with Michelite-62.

Michelite–62.—Michelite–62 is a uniform-maturing, full-season bean selected from the old Michelite variety and released in 1961. It is fully resistant to bean common mosaic virus races 1 and 123 but is susceptible to race 15. It is susceptible to anthracnose but is fairly tolerant to common bacterial blight. It has field resistance to halo blight.

Saginaw.—Saginaw is a high-yielding, disease-resistant, midseason, vine-type bean released in 1961. This variety matures 4 or 5 days earlier than does Michelite–62 and has excellent canning qualities. The plants stand up well and hold the pods well off the ground. The thin-walled pods thresh easily.

Saginaw is a selection from a cross involving two other plant selections, one with anthracnose resistance and the other with bean common mosaic resistance. Hence, it is fully resistant to two major bean diseases. In addition, it is capable of producing a crop of beans on soils with low quantities of available zinc (see discussion of zinc deficiency, p. 20).

Kidney

California Light Red Kidney (Red Kidney 7811).—California Light Red Kidney was introduced in 1937 by the California Agricultural Experiment Station. It was developed from a cross between Nagazura and Red Kidney backcrossed to Red Kidney.

Michigan Dark Red Kidney.—Michigan Dark Red Kidney is an old variety commonly grown in Michigan. Because it is very susceptible to bacterial blight and anthracnose, planting western-grown seed is recommended.

California Dark Red Kidney.—California Dark Red Kidney was developed and released by the California Agricultural Experiment Station. It is a selection from a cross between Michigan Dark Red Kidney and Maui.

Charlevoix.—Charlevoix (figs. 3 and 4) is an upright, dark red kidney bean with long slender pods. It was developed by the Michigan State University Agricultural Experiment Station and the U.S. Department of Agriculture and was released in 1960. In Michigan this variety matures 7 to 14 days earlier than California Dark Red Kidney. It is resistant to the beta race of fungus that causes anthracnose in Red Kidney beans, a disease that formerly caused heavy losses to Michigan Dark Red Kidney beans. It makes a high-quality canned product.

The Charlevoix variety is a sixth generation selection from the cross Michigan Dark Red Kidney × Brazilian Red Kidney.

California White Kidney.—California White Kidney is a selection made from the old White Kidney variety. It was released by the California Agricultural Experiment Station in 1943.

Yellow Eye

New York or Michigan Yellow Eye.—New York or Michigan Yellow Eye is a large, white, round to oblong bean. It is an old variety with a large, yellow, oval spot on the hilum ("eye" of bean).

Steuben.—Steuben is a selection made from the old New York or Michigan Yellow Eye by the New York Agricultural Experiment Station. It was released in 1960. The variety has a slightly larger and more uniform seed and is a better yielder than is the parent variety.

New England Yellow Eye.—New England Yellow Eye or Old-Fashioned Yellow Eye has an irregular yellow pattern around the hilum. The pattern consists of a narrow strip of pigment from the front of the micropyle to the apex of the bean and extends around the micropyle. It forms a horseshoe around the anterior end of the hilum. Furthermore, broad wings extend forward along the sides of hilum from behind the caruncle.

Miscellaneous

Black Turtle Soup.—Black Turtle Soup (or *Venezuelan*) is a black bean grown in limited quantities in New York.

Perry Marrow.—Perry Marrow is a large, white bean developed by the Agricultural Experiment Station of Cornell University and released to seed companies in 1921 for propagation. It was derived from a cross between Wells Red Kidney and White Marrow. In 1942 the seed on the market was found to be a mixture of Perry Marrow, Pea, and other white beans. Reselections were made by the Cornell

station and planted in the field in rows. The strain of Perry Marrow grown for certification resulted from an increase of these selections.

Michigan Cranberry.—Michigan Cranberry is an old variety of the Horticultural type. It is grown largely in Michigan.

Jacobs Cattle.—Jacobs Cattle is a large, red and white mottled bean produced in Maine.

Soldier.—Soldier is a large, white bean with a small brownish red "soldier" pattern around the hilum. It is somewhat more kidney shaped and longer than is New England Yellow Eye. Soldier is grown in Maine.

SOIL TYPES

Dry beans are suited to many soil types. They grow best in well drained, sandy loam, silt loam, or clay loam soils high in organic content. They are very sensitive to excessive soil moisture; under this condition they are susceptible to diseases. Standing water will injure the plants in a few hours. Where drainage is poor, tile drains are essential to the production of good yields. Sandy soils are not well suited for bean production; but by building up the organic content, soils of this class produce good yields.

CROP ROTATION

Some system of crop rotation or crop diversification is usually necessary to maintain high yields and quality of beans. A rotation with at least 3- or 4-year intervals between bean plantings on any one field is a good practice. Successive cropping of beans is hazardous, because of the danger of losses from diseases whose organisms are able to survive in the soil or on plant refuse in the soil. For the same reason, it is risky to spread bean straw or manure from bean straw onto land immediately before beans are planted.

Although the bean is a legume, other legumes, such as alfalfa, sweetclover, red clover, and alsike clover, are grown in the bean rotation to supply nitrogen and to replenish the organic matter in the soil. Dry beans normally deplete the soil nitrogen, even though nitrogen-producing bacteria develop in nodules on the root system. However, they take less nitrogen out of the soil than do many other row crops. A standard recommendation for rotations in the Lake and Northeastern States is one or two row crops followed by small grains seeded to a hay, pasture, or green-manure crop.

Crop sequence within a rotation is important in bean production. Planting beans after certain crops may reduce the severity of bean root rot and may increase yields. Investigations in Michigan suggest that beans should follow corn, wheat, or a green-manure crop. A much higher incidence of root rot occurred when beans followed barley and when beans followed beans.

Crop sequence can also affect the expression of certain nutrient deficiencies. For example, zinc deficiency is much more noticeable in some varieties of beans planted after sugarbeets (fig. 8). The yields of beans that show zinc-deficiency symptoms are also lower. Nutrient deficiencies can be corrected by incorporating minor elements with the fertilizers and applying them at planting time (fig. 9).

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FIGURE 8.—Sanilac beans in Saginaw County, Mich., in 1960. *A*, Normal plants following wheat; *B*, zinc-deficient plants following sugarbeets in the rotation. (Plants in *A* were in the row next to *B*.)

BN 23785

FIGURE 9.—Field of Sanilac beans growing in alkaline soils in Bay County, Mich., to which zinc sulfate was applied at planting time. Two center rows did not receive zinc.

When dry beans follow a leguminous green-manure crop in a rotation, the green-manure crop should be turned under before May 15. Sweetclover should be plowed under when it is 8 to 14 inches high. During seasons of subnormal spring rainfall, delaying the plowing under of the green-manure crop may damage the bean crop, because the green-manure crop may use most of the available soil moisture.

SOIL PREPARATION

The same farm machinery is used to prepare the soil for planting beans as is used for other row crops. Although the steps involved in preparing the land for seeding may vary according to the previous crop and the soil type, establishment of a friable seedbed is the best means for conserving soil moisture.

If a green-manure crop is not to be turned under, the type of soil and the terrain determine to a great extent the time to plow. Fall plowing usually provides a more friable seedbed in heavy soil. If there is danger of wind erosion and water runoff during the winter months, it is better to wait until spring to plow. A field cultivator or a chisel-type cultivator plow may be substituted for the conventional plow.

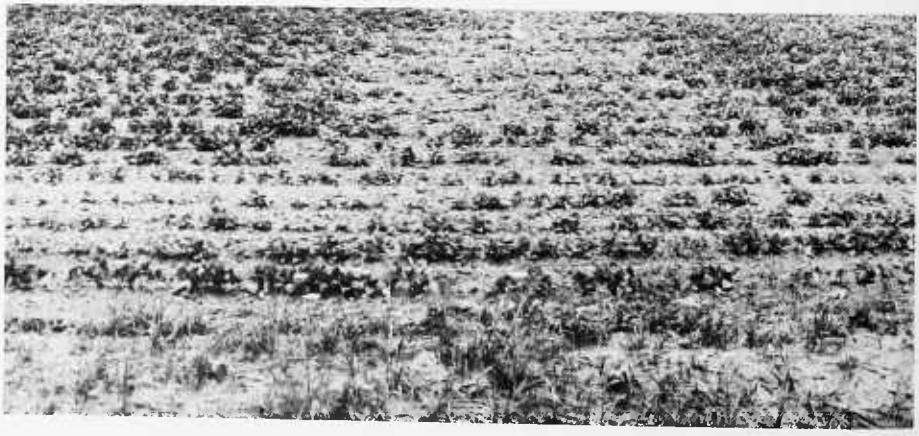
After the field is plowed, the disk and harrow are used to level the seedbed and control weeds. If the field was plowed early, secondary tillage to control weeds is usually necessary. Avoid packing the soil by excessive preparation with heavy farm equipment.

FERTILIZATION

Maximum bean yields cannot be obtained unless an adequate and balanced quantity of plant food minerals are present. Where the soil cannot supply the elements necessary for high yields, commercial fertilizer should be used.

To determine the amount and kind of fertilizer needed, the soil should be tested for available soil nutrients. Fertilizer recommendations are based on the results of soil tests, soil classification, previous cropping history, crop to be grown, and expected yield per acre. New York bean growers should follow the fertilizing recommendations presented in the publication entitled "Vegetable Production Recommendations," which is published annually and cooperatively by the New York State College of Agriculture, Cornell University, Ithaca, N.Y., and the New York State Agricultural Experiment Station, Geneva, N.Y. Michigan bean growers should follow the directions given in Michigan State University Extension Folder F–278, "How To Take Accurate Soil Samples," and Extension Bulletin E–159, "Fertilizer Recommendations for Michigan Crops." Information on soil classification can be obtained from published county soil survey maps and reports that are available at the county offices of the Extension Service and the Soil Conservation Service.

The need for fertilizers depends not only on the natural fertility of the soil, but on the other crops grown in the cropping system and the fertilizers applied to these crops. Liquid fertilizers, which are gaining in popularity in many areas, are just as effective as solid fertilizers, provided they are used correctly. The recommended placement of fertilizers for beans is 1 or 2 inches to the side and 2 inches below the seed. The seed should not be in contact with the fertilizers, because bean seed is very easily injured when it comes in direct contact with fertilizer.



BN 23786

FIGURE 10.—Zinc deficiency in beans over tile lines where calcareous subsoils have been brought to surface during tiling operations.

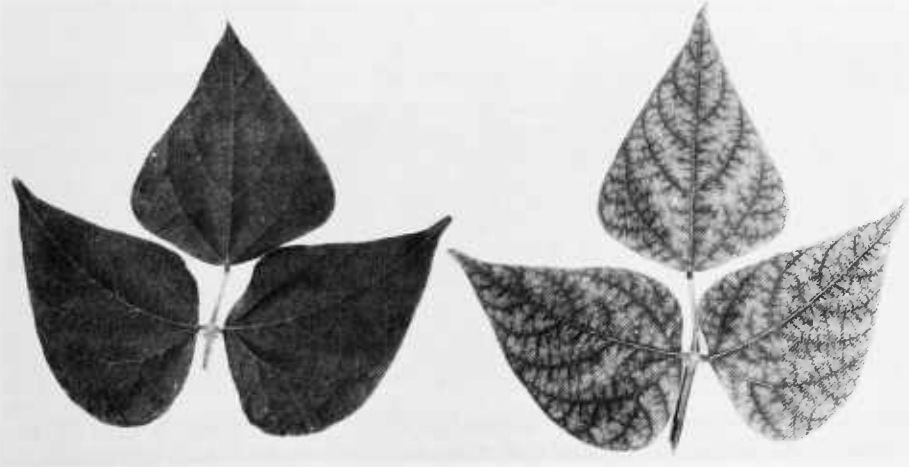
Zinc deficiency (figs. 8, 9, and 10) is becoming increasingly noticeable in beans grown on the alkaline soils of the lake bed areas in Michigan. Zinc deficient plants are stunted; have shortened internodes; show excessive branching; and have small, somewhat pointed leaves that are often distorted and necrotic along the edges. The deficiency is especially noticeable in beans grown over tile lines, on spoil banks where calcareous subsoil is mixed in with the surface soil, and in beans that follow sugarbeets. Zinc-deficient soils should be supplied with 3 to 4 pounds of zinc per acre, applied in the band fertilizer. As a preventive, 1 pound of zinc per acre is suggested. Michigan bean growers should be on the alert for new recommendations on the use of zinc in their fertilizer program—optimum rates, methods of formulation, and methods of application.

Manganese deficiency (fig. 11) frequently occurs in Michigan soils with a pH of 6.5 or higher. It may be corrected by including manganese in the fertilizer. Commercial fertilizer containing 1, 2, or 5 percent of manganese may be bought. The fertilizer should contain enough manganese to supply 5 to 10 pounds per acre.

When plant leaves show manganese or zinc deficiency, foliar sprays may be tried. Water-soluble manganese sulfate should be applied at a rate of 3 to 6 pounds per acre, and zinc sulfate at a rate of 1 to 2 pounds per acre. The nutrients may be mixed and applied in as little as 30 gallons of water per acre. Zinc foliar sprays are often ineffective.

Nitrogen deficiency may occur in some rotations. It may be prevented by applying 30 to 40 pounds of nitrogen per acre when the plants have two or three true leaves.

Detailed information on the use of fertilizers in your locality may be obtained from your county agent, from Extension Service specialists at the land-grant college or university in your State, or from your State agricultural experiment station.



BN 23787

FIGURE 11.—Normal Sanilac bean leaves (left) compared with manganese-deficient Sanilac bean leaves (right).

INOCULATION

Artificial inoculation of bean seed with nitrogen-fixing bacteria is considered of no advantage. Tests in Michigan, New York, and elsewhere on both old and new bean soil have shown no benefits from seed inoculation.

PLANTING

A corn, bean, or beet drill with removable plates is generally used to plant beans (fig. 12). Beans should be planted only deep enough to obtain good coverage and sufficient moisture to promote fast germination and growth. If the beans are planted too deep, they may be damaged by seed decay and damping-off organisms and may be injured by the seed-corn maggot as a result of delayed emergence.

Weather reports giving weekly forecasts should be helpful to the bean grower in determining how and when to plant. The temperature for the period after planting should be warm (above 65° F.), so the beans can germinate quickly. If the season is dry and there is little moisture in the surface soils and no immediate prospect of rain, the seeding rate should be increased and the beans should be planted in contact with moisture even if this is 3 to 4 inches deep. Contact with moisture will assure quick germination. On the other hand, if there is a forecast of heavy rains and the soil is fine in texture, the beans should be planted shallow (1 to 1½ inches). If the forecast is for cold and wet weather they should not be planted until the weather is favorable.

Planting dates vary in different localities. However, beans should not be planted until the soil temperature is above 65° F., a temperature that will assure immediate germination and emergence. All conditions

BN 23788

FIGURE 12.—Planting beans with a four-row drill. With a planting drill of this type, fertilizer can be banded 1 or 2 inches to the side and 2 inches below the seed. Attachments for banding systemic insecticides are easily mounted on this equipment.

that favor rapid germination and emergence will minimize the damages from fungus and insect injury. Generally, field beans are planted from May 25 to June 15 in the Lake and Northeastern States. If root rot is a problem, planting should be delayed until the soil is warm (June 5 or later). Short-season beans are available in the Pea bean types; they can be planted the latter part of June and still mature in those areas where the average frost date is September 20 to 30.

Row widths of 28, 30, and 32 inches are ordinarily recommended. The width most common in the Lake and Northeastern States is 28 inches. In experiments conducted in Michigan over a 6-year period, it was found that beans grown in 28-inch rows yielded only slightly less than those grown in 21- and 24-inch rows; the difference was not appreciable. Even increasing row width to 32 and 36 inches did not lower yield appreciably for Seaway, Sanilac, and Michelite varieties. By using wider row spacings, beans, corn, and sugarbeets can all be planted in rows of the same width and the same tractor may be used in planting and cultivating the three crops with a minimum of adjustment between crops. The time and labor saved may offset any lower yields which may occur. Figure 7 shows Seaway beans planted in 38-inch rows. The grower has been planting beans and corn in 38-inch rows.

Planting rates depend on variety, seed size, and width of row. Following are the rates recommended by New York and Michigan for rows 28 to 32 inches wide:

State and variety	*Pounds of seed per acre*
New York:	
Red Kidney, Marrow, Yellow Eye	75 to 100
Pea, Black Turtle Soup	30 to 40
Michigan:	
Red Kidney	80
Yellow Eye, Cranberry	60
Pea	30 to 40

Although these rates are considered too heavy by many growers, they increase the chances of a good stand if there is much danger from damping-off or the seed-corn maggot, or if the ground becomes crusted.

CULTIVATION

The main purpose of cultivation is weed control. Weeds are readily destroyed shortly after their emergence. At this stage, little root development has taken place. Weed control should begin during the preparation of the seedbed and should continue after the beans are planted. Special weeders or a spike-tooth harrow may be used from the second or third day after planting until the plants are 4 to 5 inches tall. These implements should not be used at the time the plants are emerging from the ground and while the stems still have the crook

in them. At this stage the plants are brittle and easily injured. Furthermore, the weeders should be used in the afternoons or when the plants are less turgid and brittle, and therefore are less easily broken.

If heavy rains pack the soil so the beans cannot emerge, the soil surface should be loosened with a spike-tooth harrow, a rotary hoe, or weeder to prevent complete loss of the beans.

Do not cultivate more frequently or deeply than is necessary to control the weeds (fig. 13). Cultivate with care late in the season, so as to avoid injuring the roots extending out between the rows just beneath the soil surface. Injury to the feeding roots at blossoming and pod-setting time may cause wilting of the plant, blossom and pod drop, and an eventual reduction in yield.

Thorough cultivation does not always remove all the weeds in a field. Weeds not removed by cultivating equipment should be removed with a sharp hoe or cut with a corn knife. Weeds not only interfere with crop growth but also hinder harvesting and curing of the beans.

Never cultivate beans while they are wet from either dew or rain, because disease organisms are more easily carried from plant to plant by farm implements when the plants are wet.

CHEMICAL WEED CONTROL

Chemical weed control is recommended where weeds are difficult to control by other methods.

BN 23789

FIGURE 13.—Cultivating Pea beans planted in 28-inch rows, using a four-row cultivator.

EPTC [5] has been used successfully by several growers in Michigan to control annual weeds on Red Kidney and Pea beans. It should be applied before planting at a rate of 3 pounds per acre. Since the material is extremely volatile, it should be worked into the soil immediately after application. The most successful users applied the material as a spray immediately ahead of the harrow or disk. New York recommends EPTC for Red Kidney beans only and in the granular form at a rate of 3 pounds of active ingredients per acre. This is equivalent to 60 pounds of 5-percent granular material per acre. They suggest using it on a trial basis on other bean varieties.

DNBP [6] amine salt can be used as a preemergence spray to control annual weeds. If applied immediately after planting, it should be used at a rate of 4½ pounds per acre (1½ gallons of liquid concentrate). But if applied just before emergence, it should be used at a rate of only 3 pounds per acre (1 gallon of liquid concentrate). To reduce costs, the material can be applied in a band spray. DNBP is not effective when the soil is dry. Before applying granular material, growers should determine how much *active chemical* they wish to apply per acre; then they should apply it at a uniform rate—the same amount of active chemical on each acre.

Sow thistle and Canada thistle have always been a menace to bean growers. Many growers have successfully controlled these perennial weeds by applying ¼ to ½ pound of actual 2,4-D [7] per acre, 6 to 10 days before planting. This practice is not recommended, however, because, under certain conditions, the compound may injure the plants and delay maturity. Furthermore, if EPTC is applied to the same field, interactions between the two chemicals may injure the plants.

The effects of chemicals on both beans and weeds depend on soil type, moisture, temperature, and type and variety of beans. For this reason, it is advisable to consult your county agricultural agent, Extension Service specialist, or State agricultural experiment station before attempting to use herbicides on beans.

HARVESTING

Harvesting is a crucial stage in bean production. To keep the period between pulling and threshing (or combining) as short as possible, harvesting should be delayed until most of the pods are dry and the beans have hardened. Although high temperature and humidity sometimes damage mature beans while they are standing in the field, these conditions generally cause greater and more frequent losses while the crop is curing in windrows or bunches. The more immature the crop is at the time of pulling, the longer the plants have to remain

[5] Chemical name: *Ethyl N,N-di-n-propylthiocarbamate.*

[6] Chemical name: *4,6-dinitro-o-sec-butylphenol.*

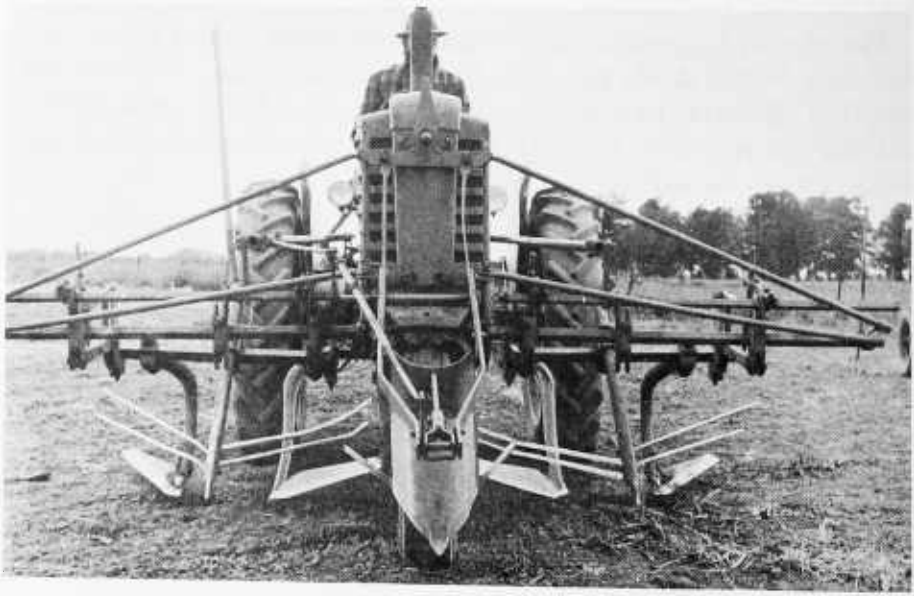
[7] Chemical name: *2,4-dichlorophenoxyacetic acid.*

on the ground to mature, and the greater are the chances that the beans may become moldy and discolored.

With modern equipment, two men can harvest 20 or 30 acres of dry beans in 1 day. The beans are cut below the surface of the ground with large steel blades mounted on a tractor (fig. 14), a process referred to as pulling beans. Pulling is followed by windrowing. Many growers use a one-man tractor-drawn puller-windrower that pulls the beans, elevates them and shakes off the stones and soil, and windrows them all in one operation (fig. 15.) After the beans have cured, a one-man self-propelled combine threshes them directly from the windrow and discharges them into a truck driven alongside (fig. 16).

The bush-type Pea bean varieties (Sanilac, Seaway, and Gratiot) were developed to shorten the time necessary to leave the beans in the windrow, or possibly to eliminate this need. If beans are left standing until all the plants are mature and the beans have dried down in the pods, then the beans can be pulled and windrowed during the morning hours while the plants are damp and the pods are tough. This will reduce shattering of the beans. Pulling is immediately followed by windrowing before the plants have a chance to dry out. Later in the morning or early afternoon the beans should be ready for threshing. Care should be taken not to pull more beans in the morning than can be readily threshed in the afternoon and evening.

The vine-type Pea beans and colored bean varieties ordinarily cannot be pulled and threshed the same day. Curing can be speeded up by turning the beans in the windrow daily, either by hand or with the windrower. In fair weather most bean varieties are cured in a day or two and are then ready for threshing.



BN 23790

FIGURE 14.—Four-row tractor-mounted cutting blades for harvesting beans. Beans are cut about 1 inch below ground.

BN 23791

FIGURE 15.—Pulling and windrowing Sanilac beans in Michigan with a harvester and an attached windrower.

BN 23792

FIGURE 16.—Threshing beans from the windrow with a self-propelled combine. Trucks can be loaded without stopping the combine, and the beans can be hauled to farm storage bins or local elevators.

The windrow method of curing works well if the weather is favorable. Occasionally wet, humid weather sets in during harvesting, and additional curing is needed. Well-made stacks built around posts in the field allow the beans to complete their curing from newly windrowed plants.

The stacking procedure is as follows: Drive a 7-foot steel fencepost or heavy stake firmly into the ground. Place a 1-foot layer of clean straw around the post, making a circle about 3 feet in diameter. Build the bean stack around the post with straight sides to a height of at least 2 feet above the top of the post. The sides may be 6 inches wider at the top than at the bottom.

A maximum of high-quality beans can be obtained by stacking, even though the beans are harvested before they are uniformly ripe.

The grower should take the utmost precautions to prevent injury to the beans during harvest. Beans with cracked seedcoats are desirable neither for canning nor for seed. In fact, commercial canning companies refuse to accept beans with a large number of cracked seedcoats. Constant vigilance is required on the part of the combine operator, who must adjust the speed of the cylinder so that all the beans are threshed but not injured. The drier the beans, the more easily they are threshed and the more easily they are injured. Since the amount of moisture in the beans can change considerably during the day, frequent adjustments may be necessary. Investigations at Michigan State University showed that spraying the beans in the windrow delays drying out during the day and reduces the damage that occurs to beans in the combine. Placing a damp, absorbent material, such as damp sawdust or damp corncobs, to dry beans in the combine hopper, truck, or bin adds sufficient moisture and weight to the beans in 2 hours to prevent further damage in handling.

DEFOLIATION

Normally, it is not necessary to use chemical defoliants in field bean production. However, natural defoliation is sometimes delayed or does not occur uniformly on plants in the field. Where this is true, chemical defoliants are desirable. They speed up ripening and assist in uniform maturing of the crop.

Commercial formulations containing magnesium chlorate or sodium chlorate and small quantities of boron or magnesium chloride should be applied at a time when the leaves are coloring and the beans in the pod are well developed. The defoliant should be applied when temperatures are above 60° F. and no rain is expected for at least 6 hours. Chemical defoliants will probably be used to a much larger extent should direct combining from the standing row become feasible.

PRODUCTION COSTS

What does it cost to produce an acre of dry beans? Researchers in Maine and New York determined the costs in 1958 and researchers in Michigan in 1962. The Maine values are for Yellow Eye production, New York for Light Red Kidney production, and Michigan for Pea bean production. The growing and harvesting costs, which include all fixed and variable costs, for Maine were $111.74 per acre. This included a cleaning (picking) cost of $14.52. Michigan's $67.90 cost per acre for dry bean production is based on estimated costs and returns from Sanilac County. New York sampled the Cayuga-Seneca Counties area, where the costs were $77.65 per acre, and the Livingston-Wyoming Counties area, where the costs were $92.77 per acre.

MARKETING, CLEANING, AND GRADING

The quality of the crop and the price at harvesttime determine for most farmers whether they market the beans promptly after threshing or store them on the farm. Many farmers, however, consistently follow one practice year after year regardless of price at harvesttime.

Limited space is available in most areas for commercial storage of beans for farmers. Most commercial space is used by elevator interests to store the beans they buy at harvesttime for processing and sale throughout the rest of the year.

Since the combine has come into general use for harvesting beans, most beans are delivered to country elevators in bulk by truck. The beans are then weighed, sampled to determined quality and price, and dumped into a pit for elevation into the elevator.

Pea beans are purchased from farmers on the basis of the price for Choice Handpicked grade. The sample from a farmer's load is "picked" to sort the good beans from the splits, discolored beans, stones, straw, and other foreign material. The amount paid to the farmer for the load is determined by multiplying the original net weight of his delivery in pounds minus the weight of the "pick" by the price per pound for Choice Handpicked grade. From this price is subtracted a picking charge per pound, which varies from year to year, and depends on relative costs of operation.

Most country elevators process the beans by putting them over a cleaner, stoner, and jigger or gravity mill, the extent of their processing depending upon their facilities and the quality of the crop.

The condition of beans on hand largely determines the degree of processing and the method of disposal of the beans by the country elevator man. Following crops of good quality, he is often able to process the beans sufficiently to meet the standard for No. 1 grade for screened beans (see below) and ship direct to merchants and large users in 100-pound bags. But when beans are of low quality and a high proportion must be picked out because of discoloration, the country elevator man may not be able economically to process his beans sufficiently to meet the higher grades. In this case he ships them in bulk carloads to major processing terminals at which electric-eye sorting machines pick the beans to a Choice Handpicked grade.

Beans are graded according to their quality by private, State, and Federal inspectors. The State bean shippers associations maintain their own inspection services for their members, but these are not official so far as the State and Federal departments are concerned. The State of New York adopted the United States Standards for inspection, whereas the State of Michigan uses two standards, one based on State regulations and the other on Federal regulations. The percentage of total defects permitted under United States Standards for beans are given below.

U.S. Grade	*Percentage of defects (splits, damaged beans, contrasting classes, and foreign material) permitted*[1]
Handpicked or specially processed beans:[2]	
U.S. Choice Handpicked	1.5
U.S. No. 1 Handpicked	2.0
U.S. No. 2 Handpicked	4.0
U.S. No. 3 Handpicked	6.0
Screened beans:[3]	
U.S. No. 1	2.0
U.S. No. 2	4.0
U.S. No. 3	6.0

[1] Data obtained from Consumer and Marketing Service, U.S. Department of Agriculture, Revised United States Standards for Beans (effective Sept. 1, 1959).

[2] Except Blackeye, Cranberry, and the various classes of lima beans.

[3] Cranberry bean standards are 4.0, 6.0, and 8.0 percent, and Pinto bean standards are 3.5, 5.0, and 8.0 percent, for U.S. Nos. 1, 2, and 3, respectively.

Two additional U.S. Standard grades of screened beans are U.S. Substandard and U.S. Sample. The U.S. Substandard grade includes those beans that do not meet the requirements of the U.S. Nos. 1, 2, and 3 or the U.S. Sample. The U.S. Sample grade includes beans of any of the classes that are musty, sour, heating, materially weathered, weevily, or are otherwise of low quality.

Michigan State standards are used in the sale of all Michigan beans except those that are sold to State agencies outside Michigan, to Federal agencies, and for export (unless inspection under Michigan standards of beans for export is requested). The percentage of total defects permitted under Michigan Standards for dry edible beans is given below.

Michigan Grade	*Percentage of defects (splits, damaged beans, contrasting classes, and foreign material) permitted*[1]
Handpicked beans:[2]	
Michigan Choice Handpicked	1.5
Michigan Prime Handpicked	3.0
Screened beans:[2]	
Michigan No. 1	2.0
Michigan No. 2	3.0

[1] Data obtained from Michigan Department of Agriculture Regulation No. 523, May 15, 1959.

[2] Cranberry and Yellow Eye beans may contain an additional 2 percent split, but otherwise sound beans of the same class in any of the established grades. Total maximum tolerance for defects in Kidney beans shall be 2 percent in the Choice Handpicked and No. 1 grades and 4 percent in Prime Handpicked and No. 2 grades.

An additional Michigan screened beans grade is Michigan Picking Stock. It includes beans that do not meet the specifications for any of the established grades.

All beans, except those shipped as "picking stock" from one bean plant to another for further processing, must be inspected before shipment by a licensed bean inspector supervised by the State department of agriculture and must carry an inspection certificate citing the grade.

In Michigan the Department of Agriculture supervises the inspection service on the basis of an agreement or contract with the Michigan Bean Shippers Association. These two agencies jointly (and solely) conduct the inspection service on the basis of official Michigan grades and standards. The same bean inspectors that are licensed by the Michigan Department of Agriculture also do the inspection work that is based on U.S. standards. This is made possible by means of a three-way agreement between the U.S. Department of Agriculture, the Michigan Department of Agriculture, and the Michigan Bean Shippers Association. The latter organization is located in Saginaw, Mich.

Three colored types—Red Kidney, Cranberry, and Yellow Eye—are handled in most respects like Pea beans, except they are bought on the basis of No. 1 grade and for the most part are processed to No. 1 grade.

Cull beans usually find a market among livestock feeders or feed manufacturers. Split beans become a sales problem, especially in dry years, when the handling and processing cause a high percentage of splits.

DISEASES

In some years, losses to bean growers from disease infestations amount to several million dollars. Some bean growers have sustained complete loss from disease.

In general, losses caused by bean diseases can be held to a minimum by following these cultural practices: (1) Plant disease-resistant varieties when available; (2) use disease-free seed (certified seed is recommended); (3) practice at least a 3- or 4-year crop rotation; (4) keep fields clean by plowing under bean refuse; (5) avoid working in beanfields while they are wet; (6) treat the seed with recommended chemicals to prevent damping-off, seed decay, and seed-corn maggot injury. Airborne diseases can be controlled by spraying the field with chemical fungicides.

Because seed infection is not easily detected in colored beans, scrutinize colored beans before planting. Obtain certified seed if it is available.

The economically important diseases of beans are described fully in Agriculture Handbook 225, "Bean Diseases—How To Control Them." A copy of this handbook can be obtained by writing to the Office of Information, U.S. Department of Agriculture, Washington, D.C., 20250.

INSECTS

For information on insects affecting the dry bean crop in the Lake and Northeastern States, and on current recommendations for insect control, call or write your county agricultural agent, your State agricultural extension service or agricultural experiment station, or the U.S. Department of Agriculture, Washington, D.C., 20250.

PRECAUTIONS

Herbicides are poisonous to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Keep herbicides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and pets cannot reach them.

Avoid repeated or prolonged contact of herbicides with the skin. Avoid inhalation of herbicide dusts or mists.

Avoid spilling herbicides on your skin, and keep them out of the eyes, nose, and mouth. If any is spilled on skin or clothing, wash it off the skin and change clothing immediately.

When handling herbicides, wear clean, dry clothing.

Wash your hands and face before eating or smoking and immediately after completing herbicide application.

To protect fish and wildlife, do not contaminate lakes, streams, or ponds with herbicide. Do not clean spraying equipment or dump excess spray material near such water.

To minimize losses of honeybees and other pollinating insects, make herbicide applications, when possible, during hours when the insects are not visiting the plants. Avoid drift of herbicides sprays to nearby crops or livestock. Avoid drift of herbicides into bee yards.

Empty containers are particularly hazardous. Burn empty bags and cardboard containers in the open or bury them. Crush and bury bottles or cans.

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